NUTRIENT ASSESSMENT REDUCTION PLAN

December 2023

CITY OF CHARLESTON, ILLINOIS

PREPARED BY: NORTHWATER CONSULTING

PREPARED FOR: CITY OF CHARLESTON, ILLINOIS

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LIST OF ACRONYMS

BNR	Biological Nutrient Removal
CFS	Cubic Feet Per Second
CWA	Clean Water Act
DAF	Design Average Flow
DMR	Discharge Monitoring Report
DO	Dissolved Oxygen
EPA	Environmental Protection Agency
FOIA	Freedom of Information Act
HUC	Hydrologic Unit Code
INLRS	Illinois Nutrient Loss Reduction Strategy
MGD	Million Gallons per Day
NARP	Nutrient Assessment Reduction Plan
NHD	National Hydrography Dataset
NLCD	National Land Cover Database
NPS	Nonpoint Source
NH_3	Ammonia
NO_3^-	Nitrate
NPDES	National Pollution Discharge Elimination System
POTW	Publicly Owned Treatment Works
SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
USGS	United States Geological Survey
WMP	Watershed Management Plan
WWTP	Wastewater Treatment Plant

City of Charleston Treatment Plant

1. INTRODUCTION & BACKGROUND

In 2018, the Illinois EPA instituted nutrient reduction permit requirements applicable to Publicly Owned Treatment Works (POTW) with effluent discharges greater than 1-million gallons per day (MGD). The nutrient reduction approach for POTWs supports a pathway to establish site-specific permit limits for phosphorus at each facility in lieu of instituting a statewide limit. The Nutrient Assessment Reduction Plan (NARP) requirement resulted from negotiations with environmental organizations, Illinois EPA, and the Illinois Association of Wastewater Agencies.

A NARP Special Permit Condition is now included in a National Pollution Discharge Elimination System (NPDES) permit if a receiving stream segment or downstream segment is on the Illinois Clean Water Act (CWA) 303(d) list as impaired with phosphorus-related causes. A NARP is also required if there is a "risk of eutrophication" as defined by meeting any of the three conditions outlined in Table 1.

Table 1 - Illinois EPA Risk of Eutrophication Criteria

Risk of Eutrophication if any of these Conditions Met:		
pH	**Median Sestonic Chlorophyll α**	**On any Two Days During Illinois EPA Monitoring Week, Daily Max**
> 9	> 26 µg/L	pH > 8.35 and DO saturation > 110%

Whether the NARP special permit condition is triggered by a CWA 303(d) impairment listing, or eutrophication risk criteria, the designation is often based on limited data. For example, the risk of eutrophication justification for some sites is based on only two non-consecutive weeks of continuous Dissolved Oxygen (DO) and pH data collection performed by the Illinois EPA. In some cases, the data is over 10 years old.

The Illinois EPA allows the NPDES permittee to undertake additional data collection and assessment, which can confirm NARP triggering conditions, or determine that the watershed does not have a phosphorus-related impairment or risk of eutrophication. If sufficient evidence indicates no impairment or risk of eutrophication, it is possible that phosphorus regulation and mitigation measures may not be necessary. The following actions have been proposed to comply with the NARP permit condition:

- Examine if sufficient data exists to fully characterize impairment or risk of eutrophication in the receiving watershed.
    - If data is insufficient, create a water quality monitoring plan and collect data.
- If existing or new data indicates a full NARP is required:
    - Undertake watershed characterization.
    - Model watershed and instream processes.
    - Establish defensible site-specific water quality criteria.
    - Define scenarios and strategies to achieve water quality targets.
    - Implement NARP recommended actions and engage stakeholders.

This report details the monitoring program implemented to support a NARP Strategy and Work Plan. Section 2 provides an overview of NARP triggers. Section 3 describes the monitoring program, methods, and results with interpretation at the end of the section. Section 4 presents a Strategy and Work Plan following a watershed characterization.

1.1 TREATMENT PLANT BACKGROUND

The City of Charleston, located in Coles County, Illinois, operates one POTW (NPDES Permit No. IL0021644) with a design average flow (DAF) of 3.3 MGD. The facility is subject to a NARP special permit condition with a deadline of December 31, 2023. The plant serves a population of 17,000 with 6,770 residential, commercial, and industrial connections. It also treats wastewater from Eastern Illinois University.

Treatment consists of screening/grinder, grit removal, a holding or detention pond, primary clarification, activated sludge, secondary clarification, anaerobic digestion, aerobic digestion/sludge holding tanks, belt filtration, sludge storage facilities, and land application. The Wastewater Treatment Plant (WWTP) discharges to Cassell Creek, a small stream that is characterized with seven-day one in ten-year low flow (7Q10) of 0 cubic feet per second (cfs). The stream is tributary to Riley Creek which then joins Kickapoo Creek prior to entering the Embarras River. The City of Mattoon's WWTP (DAF 5.3 MGD) discharges into Kickapoo Creek upstream from the confluence with Riley Creek (Figure 1). Mattoon also has a NARP requirement in its NPDES permit.

2. NARP TRIGGERS & ACTIONS

The Charleston NARP special condition was triggered by historical data indicating a risk of eutrophication in stream segment downstream of the plant's outfall. An Illinois Freedom of Information Act (FOIA) request identified the triggering segment as IL_BEN-01, a segment of Kickapoo Creek downstream from the confluence with Riley Creek. Supporting data was limited and not considered adequate to fully understand the risk of eutrophication, or conclusive that nutrient concentrations in Charleston effluent contributed to the threshold exceedances (Table 2). The upstream watershed area of the plant outfall is 56.5 mi^2 and the risk of eutrophication segment is 4.3 miles downstream with a watershed area that is nearly twice the size (100 mi^2).

Table 2 - Illinois EPA Risk of Eutrophication Designation Data

Site	Description	Continuous Monitoring Duration	Days Exceeding DO & pH Threshold	Sestonic Chlorophyll α Samples	Sestonic Chlorophyll α Exceedances
BENA-01	Riley Creek above Kickapoo	2 weeks in 2011 2 weeks in 2016	0 days	3 in 2011 3 in 2016	0
BEN-01	Kickapoo Creek after Confluence with Riley Creek	2 weeks in 2011 2 weeks in 2016	6 days, all in 2011	3 in 2011 3 in 2016	0

Additional data mining was undertaken using publicly available sources to locate any other informative and relevant nutrient, DO, pH or chlorophyll data. Several sites were identified in the study area, however, there were no more than 5 measurements per parameter since 2002. A water quality monitoring plan (Appendix A) was created to further evaluate the risk of eutrophication and guide additional components of the NARP process. Illinois EPA staff from the permit section were given the opportunity to review the plan and provide guidance on a July 7, 2022 conference call with Northwater and the City of Charleston. This consultation led to a partnership with the City of Mattoon, as the risk of eutrophication segment (BEN-

01) receives effluent from both Charleston and Mattoon. While monitoring was carried out in cooperation with Mattoon, this report focuses on Charleston and the combined segment that receives effluent from both plants.

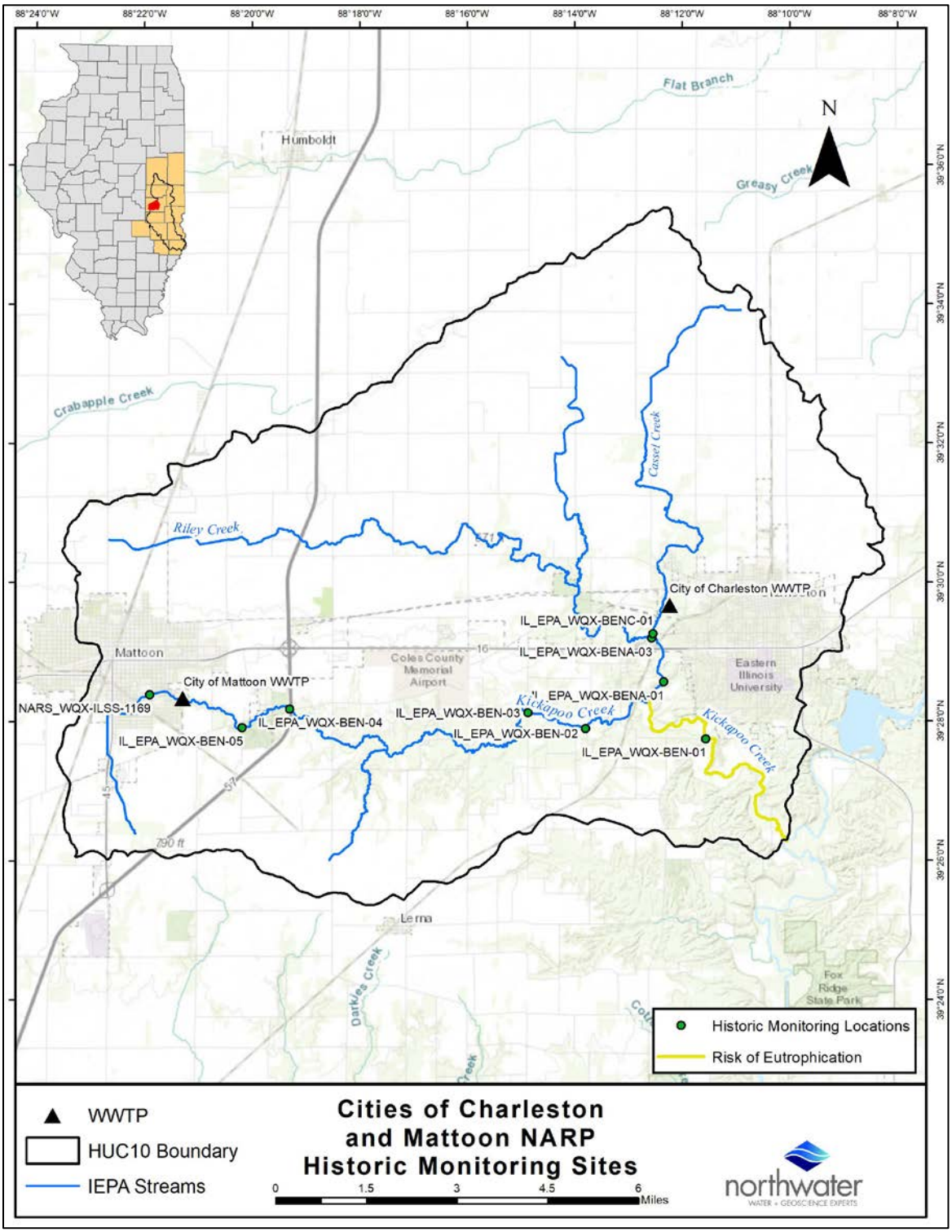

Figure 1 - Watershed Map and Historic Monitoring Sites

3. WATER QUALITY MONITORING PROGRAM & RESULTS

Based on the Illinois EPA recommendations, a combined monitoring effort between Charleston and Mattoon was carried out with three main objectives:

1. Confirm or contest the appropriateness of the NARP requirement for each plant's NPDES permit.
2. Improve understanding of nutrient dynamics to inform next steps if a NARP needs to be advanced to establish site-specific phosphorus limits.
3. Provide data to guide equitable implementation of nutrient reduction measures among contributors if such reductions are necessary.

The City of Charleston retained Northwater Consulting to develop the monitoring plan and support the City in implementing the monitoring program. The Strategy and Work Plan presented in Sections 4.2 and 4.3 are guided by the monitoring results and the foundation of next steps in the NARP process.

3.1 MONITORING STATIONS & INFRASTRUCTURE

Figure 2 and Table 3 illustrate the five stations and pertinent details about the monitoring commissioned by the City of Charleston in 2022 and 2023. Section 3.2 details methods and parameters.

The City of Charleston's WWTP discharges to Cassell Creek. Cassell Creek flows into Riley Creek which then flows into Kickapoo Creek. The monitoring program was designed as a modified upstream/downstream configuration (Figure 2 and Figure 3) to capture stream conditions (1) before and after the WWTP outfall, and (2) before and after Riley Creek flows into Kickapoo. As previously noted, the Mattoon plant contributes effluent to Kickapoo upstream of the monitoring location.

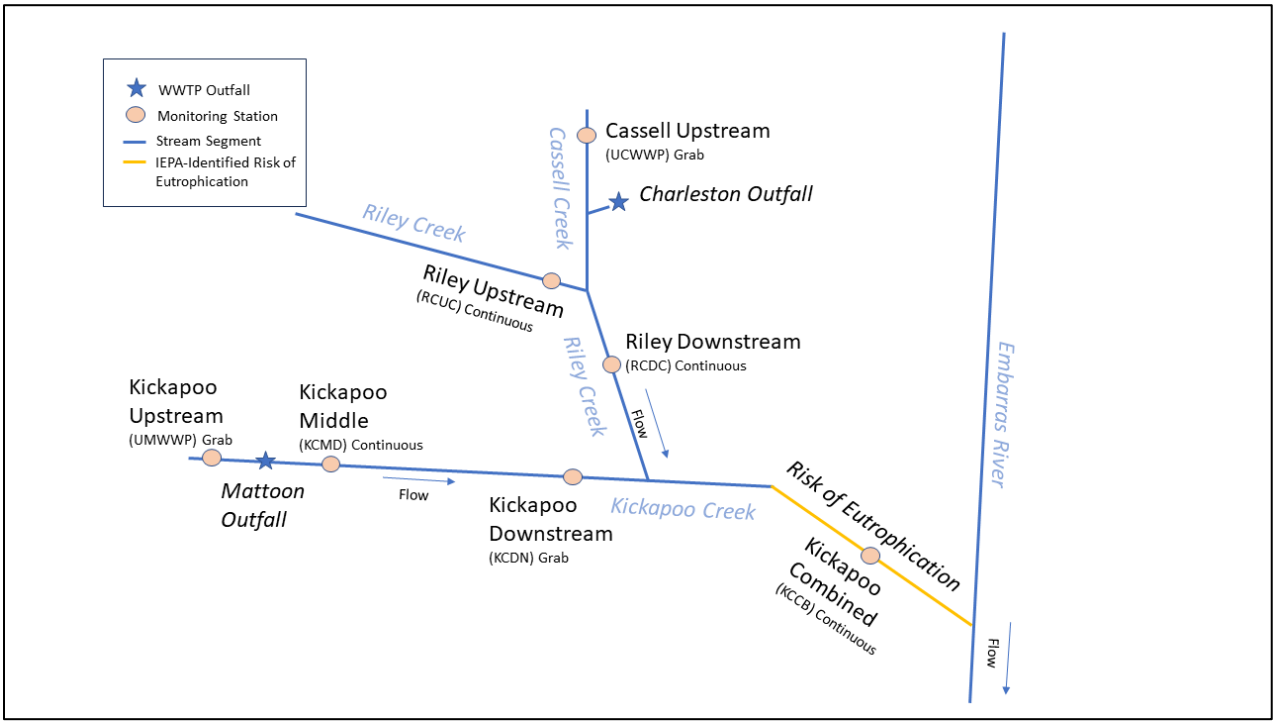

Figure 2 - Monitoring Program Schematic (not to scale)

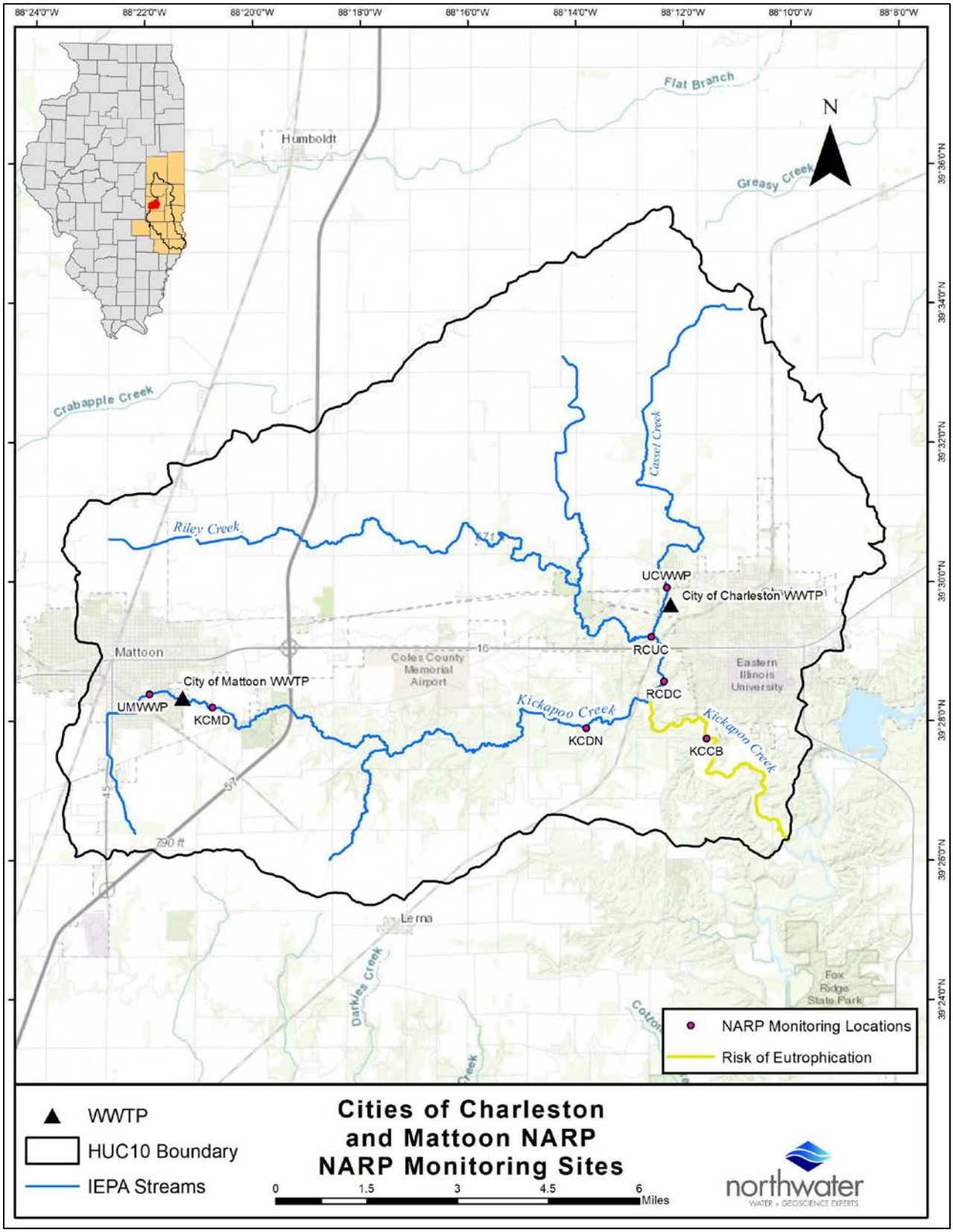

Figure 3 - NARP Monitoring Locations

Grab sample collection began at Cassell and Riley Creek in early June 2022. Due to manufacturer delays, the continuous monitoring instrumentation was deployed in late June 2022. An additional site was added on the "combined" segment of Kickapoo Creek downstream of its confluence with Riley Creek (KCCB). Grab sampling began at this site in August 2022 and continuous monitoring was initiated in October 2022. Monitoring concluded at the end of October 2022 and resumed in May 2023. For the Charleston-specific sites (UCWWP, RCUC, RCDC), 2023 monitoring concluded at the end of July 2023, while data collection at KCCB continued through the end of October 2023. Although the program spanned two years, data from the May-October period is fully represented at all sites.

Station RCDC at the Hays Ave. Bridge Showing Temporary/Passive Deployment of Monitoring Infrastructure

Table 3 - Monitoring Stations - 2022-2023 Period

Station ID	Alternate Station IDs	Name	Lat/Long (decimal degrees)	Approximate Distance from Outfall (mi)	Watershed Area (mi^2)	Type of Sampling	Monitoring Periods (2022-2023)
UCWWP	*NA*	Cassell Creek Upstream	39.498636, -88.205340	0.625 (upstream)	17.4	Grab Only Weekly	June - October 2022 & May – July 2023
RCUC	BENA-03 (Illinois EPA)	Riley Creek Upstream	39.486860, -88.210115	0.7 (upstream)	39.1	Continuous/ Biweekly Grab	June - October 2022 & May – July 2023
RCDC	BENA-01 (Illinois EPA)	Riley Creek Downstream	39.476217, -88.206194	1.5 (downstream)	66.3	Continuous/ Biweekly Grab	June - October 2022 & May – July 2023
KCCB	BEN-01 (Illinois EPA)	Kickapoo Creek Combined	39.46252, -88.19315	4.3 (downstream)	100.2	Continuous/ Biweekly Grab	October 2022 & May – October 2023

3.2 METHODS

Sampling parameters were selected to be directly responsive to the NARP triggering criteria, with a combination of continuous monitoring, spot checks with handheld meters and grab samples submitted for lab analysis. Table 4 summarizes all parameters and other details including methods and sampling frequency. Continuous data collection stations included temporarily deployed infrastructure to facilitate use of water quality sondes. Sondes were placed in 3" perforated PVC pipes that extended from the bank as close as practical to the channel thalweg. The sondes were positioned so that they were in flowing water and not influenced by stagnant or non-flowing backwater conditions.

Continuous Monitoring (3 Stations: RCUC, RCDC and KCCB)

- In-Situ Inc. AquaTroll 500 multiparameter continuous monitoring sondes with internal logging and battery deployed at three of the four stations (RCUC, RCDC, and KCCB).
    - Bi-weekly site visits to download data, calibrate and maintain the sensors and infrastructure. All instrument calibrations and maintenance followed manufacturer's recommended practices and calibration logs were saved.
- The sondes were equipped with pH, DO, temperature, conductivity, and chlorophyll α optical fluorescence sensors. The sondes also included pressure transducers to record water height/stage.
- Data collection frequency was 15-minutes to enable the capture of daily maxima and minima of parameters such as pH and DO, which is relevant to Illinois EPA eutrophication risk criteria.
- Chlorophyll α optical fluorescence data was collected to better understand its occurrence and variability through the monitoring period as it is a eutrophication risk criterion (26 µg/L is the NARP threshold). The sensor data is considered a qualitative measurement and not reliable to make conclusive determinations of NARP triggers.

Spot Checks and Field Water Quality Data

- Cassell Creek is small with lower flows compared to Riley Creek. During the sampling period there was streamflow observed during every site visit. With limited resources available, spot and grab sampling were considered adequate for securing baseline data.
- The Cassell Creek Upstream station (UCWWP) was monitored weekly for DO, pH, conductivity, temperature, and turbidity. Monitoring was performed by Northwater Consulting and Charleston WWTP staff using handheld water quality meters.
- At all other sites on Riley and Kickapoo Creeks, spot checks were performed bi-weekly for DO, pH, temperature, conductivity, and turbidity using calibrated handheld water meters (YSI ProQuatro and YSI ProDSS).
- Flow was measured bi-weekly at all sites using a measuring tape, top set wading rod and electromagnetic flowmeter. The United States Geological Survey (USGS) midsection method was applied to measure flows using a Hach FH-950 electromagnetic velocity meter, tape measure, and a top-set wading rod.

Laboratory Analysis

- Nutrient grab samples were collected on the bi-weekly schedule at all stations for the monitoring period.
- Parameters included Total Phosphorus (TP), Orthophosphate, Total Nitrogen (TN), Ammonia (NH_3) and Nitrate (NO_3^-), as well as chlorophyll α (Table 4).
- Nitrogen analysis was added for the 2023 monitoring season to support an improved understanding of in-steam chemistry processes.
- Laboratory analysis for nutrients was performed by Charleston WWTP staff in-house. Chlorophyll α was sent to an accredited contract laboratory (Pace Analytics, Peoria, IL) for analysis.

WWTP Effluent

Effluent data is collected as part of the Illinois EPA-required Discharge Monitoring Report (DMR). Parameters relevant to the NARP study include daily discharge and TP which are monitored and reported monthly.

- The average effluent flow for Charleston during the monitoring period was 1.77 MGD, or 2.7 ft^3/s.
- The average effluent TP concentration during the monitoring period was 3.1 mg/L.

Measuring Flow with Top Set Wading Rod at Site RCUC

Table 4 - Water Quality Monitoring Parameters and Methods

Parameter	Collection Type	Frequency	Method	Method Identifier	Sonde Calibration Method
Dissolved Oxygen	Continuous Probe	Continuous	Optical	InSitu: EPA Approved Method YSI: ASTM D888-09	100% Air Saturation
	Handheld Meter	Bi-weekly	Optical	ASTM D888-09	-
pH	Continuous Probe	Continuous	Potentiometric	EPA 150.2	2 Point 7 & 10 pH
	Handheld Meter	Bi-weekly	Potentiometric	EPA 150.2	-
Water Temperature	Continuous Probe	Continuous	Thermistor	EPA 170.1	Factory Calibration
	Handheld Meter	Bi-weekly	Thermistor	EPA 170.1	-
Chlorophyll-α	Continuous Probe	Continuous	In-situ Optical Fluorescence	Instrument Manufacturer Optical Method	2 Point Rhodamine 0 & 2.9 RFU
	Grab	Bi-weekly	Lab Spectrophotometric	EPA 445.0	-
Total Phosphorus	Grab	Bi-weekly	Colorimetry	EPA 365.1 / EPA 365.3	-
Orthophosphate	Grab	Bi-weekly	Colorimetry	EPA 365.1 / EPA 365.3	-
Ammonia	Grab	Bi-weekly	Colorimetry	Hach 10205	-
Nitrate	Grab	Bi-weekly	Colorimetry	Hach 10206	-
Total Kjeldahl Nitrogen	Calculated	-	Calculated	-	-
Total Nitrogen	Grab	Bi-weekly	Colorimetry	Hach 10208	-
Conductivity	Continuous Probe	Continuous	Resistor Network	EPA 120.1	1 Point 1,413 µS/cm
	Handheld Probe	Bi-weekly	Resistor Network	EPA 120.1	-

3.3 MONITORING RESULTS

This section presents results of the monitoring program and is organized into relevant sections based on the measured parameters relevant to the NARP. All grab sampling data and contract laboratory reports can be found in Appendix B.

STREAMFLOW

Table 5 and Figure 5 present a summary of the flow data collected during the monitoring period. Some data were influenced by precipitation and runoff events however, flows were generally low at all the sites through the monitoring period. Drought conditions were experienced as illustrated by nearby USGS station 03343400 on the Embarras River near Camargo, which in 2022 and 2023 respectively recorded its second and third lowest mean flows from May-October (Figure 4). The monitoring period is not considered representative of average conditions, and the hydrology and flows of the river systems were more significantly driven by WWTPs during this period than is typical.

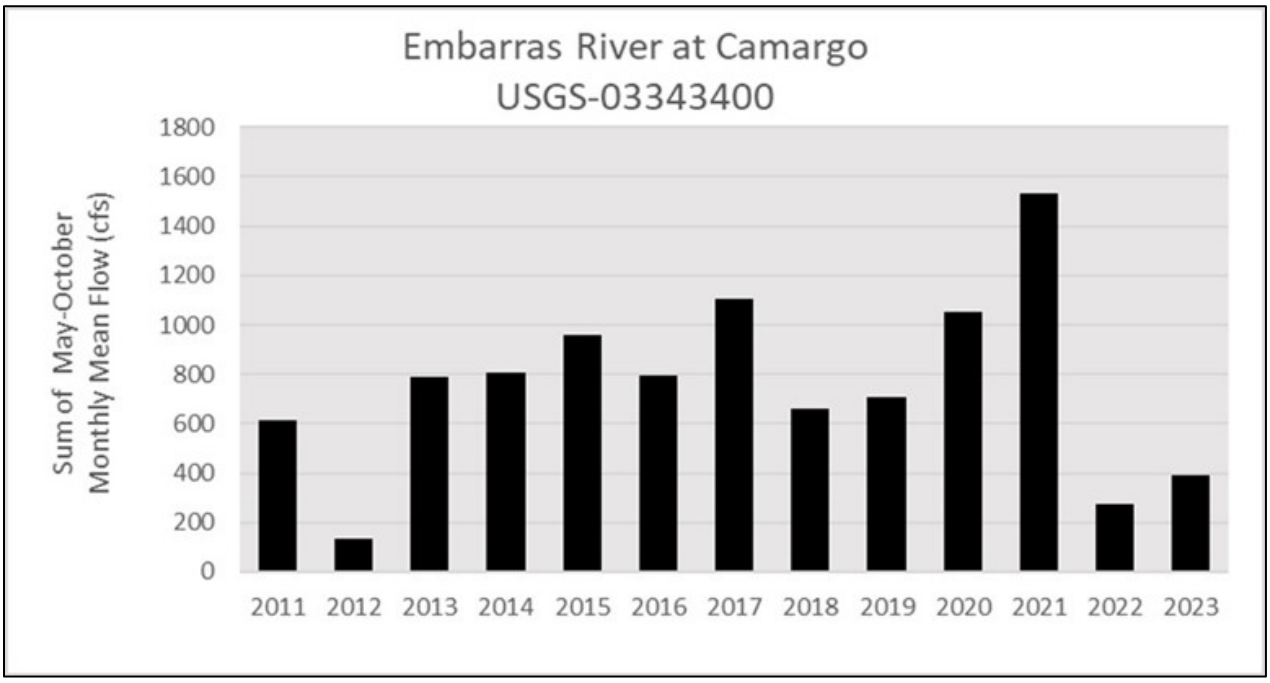

Figure 4 - Sum of Monthly Mean Flows at USGS-03343400, Embarras River

Cassell Creek Upstream (UCWWP)

- Cassell Creek upstream of the WWTP typically had low flows except for two occurrences that followed precipitation and runoff events. There were no instances of zero discharge at the site, but some measurements were ~ 0.1 cfs. The highest flow measured was 15.8 cfs on 15 May 2023, which followed a precipitation/runoff event.

Riley Creek (RCUC and RCDC)

- Based on the two monitoring stations on Riley Creek, the Charleston WWTP contributes a notable portion of baseflow after its confluence with Cassell Creek (Table 5). While there were no

instances of zero discharge above the confluence with Cassell Creek, there were several dates where it is estimated that effluent contributed over 50% of the flow at the downstream site, and one date where it was estimated to be over 90%. The lowest flow upstream was 0.12 cfs while downstream on that same date the flow was 1.26 cfs.

Kickapoo Creek (KCCB)

- The Kickapoo station is over four miles from the WWTP outfall and captures the entire Riley Creek and Kickapoo Creek watershed. The station also captures the WWTP discharges from Mattoon which is located upstream on Kickapoo Creek.
- Measured flows ranged from 3.4 to 73.8 cfs during the monitoring period, however, high flows could not be measured on several occurrences using wading methods due to safety concerns.
- At the lowest measured stage, Kickapoo Creek flows are estimated to be roughly 40-50% from the Charleston WWTP. During higher flows this proportion is significantly less.

Table 5 - Summary of Flow Data

Station	# Measurements	Range (cfs)	Median	Approximate WWTP % of Flow at Median	Notes
Cassell Creek Upstream (UCWWP)	11	0.09-15.58	2.17	Upstream	-
Riley Creek Upstream (RCUC)	11	0.12-35.12	5.77	Upstream	-
Riley Creek Downstream (RCDC)	11	1.26-69.72	10.37	26%	-
Kickapoo Creek Downstream (KCCB)	9	3.40-73.83*	12.67*	21%*	*Flow was too high to safely measure on 8/4/2022, artificially lowering the range and median flow values, while increasing the estimated proportion of WWTP effluent flow.

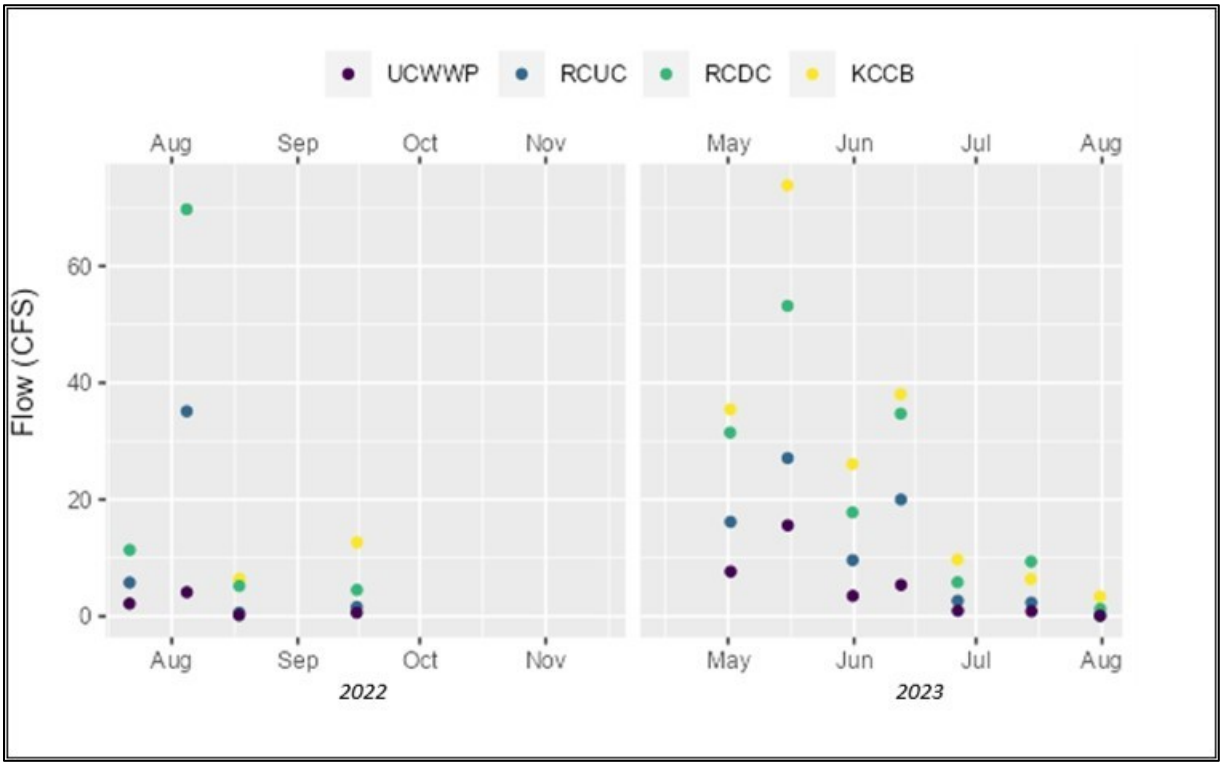

Figure 5 - Flow Measurements During Monitoring Period (note flow was not collected at KCCB on 21 July 2022 and 4 August 2022)

SESTONIC CHLOROPHYLL A

Chlorophyll α results are shown in Figure 6 and were low throughout the monitoring period at all sites (n=9), typically far below the 26 µg/L risk of eutrophication threshold.

- There was one outlier result in October 2022 with a concentration of 58 µg/L on Riley Creek Downstream of Cassell (RCDC). The elevated result coincides with the Charleston WWTP discharging treated water from their excess flow lagoon. The concentration detected is reflective of that lagoon environment and not a bloom of sestonic algae growth in Riley Creek. Treated water from the lagoon had been discharging periodically during 6 of the 10 days before the sample was collected.
- Continuous chlorophyll fluorescence results are not considered quantitative concentration measurements; however, sensor data did corroborate that there were elevated levels in the stream at that time. Sensor data also indicated elevated levels coincident with other lagoon releases. Outside of these elevated periods, the sensor-recorded levels remained near zero, indicating that chlorophyll risk of eutrophication exceedances are unlikely.
- Overall, chlorophyll laboratory results are low and below risk of eutrophication thresholds. This is expected in a small stream with perennial baseflow conditions.

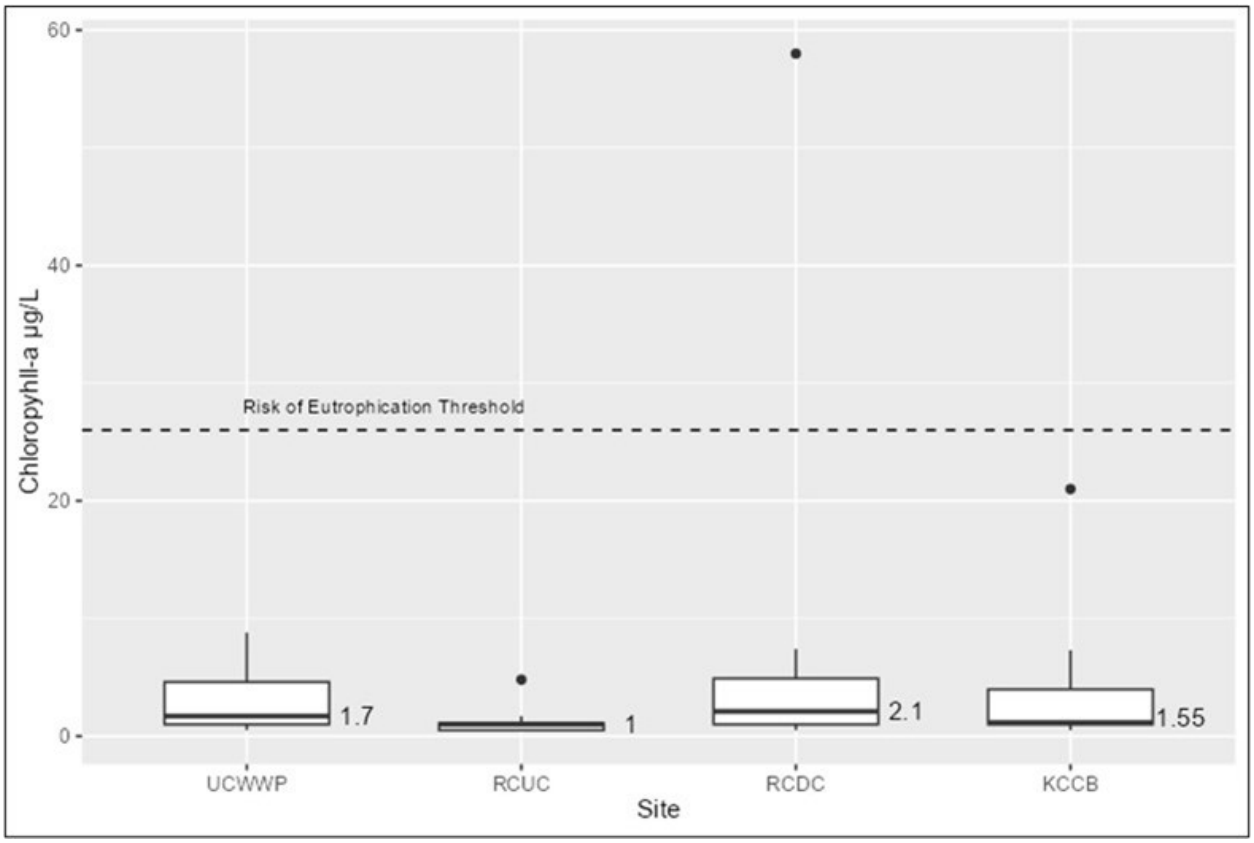

Figure 6 - Chlorophyll α Results (presented as box plots with sample medians annotated)

CASSLE CREEK UPSTREAM (UCWWP) – DO, pH, PHOSPHORUS

UCWWP Key Takeaways:

- This station is upstream and outside of influence from the Charleston WWTP outfall and was not continuously monitored.
- Eutrophication risk conditions were met based on the DO + pH criteria.
    - One day during the monitoring period (May 1, 2023).
- Eutrophication risk conditions were not met based on the pH > 9 criteria.
- Eutrophication risk conditions were not met based on the median sestonic chlorophyll α criteria.
- Data indicates nonpoint sources (NPS) are a contributor of Cassell Creek nutrient loads and canopy cover may affect algal growth and eutrophication conditions in this segment.

Cassell Creek upstream of the Charleston WWTP was monitored weekly. DO saturation and pH results collected weekly (n=42) are illustrated in Figure 7. Most measurements were made in the afternoon when DO and pH are expected to be at or near their daily peaks. Based on the DO + pH risk of eutrophication criteria, there was one exceedance in early May 2023, which corresponded with a runoff event and the second highest flow measured. This occurrence corresponded with one of the lowest phosphorus concentrations of the monitoring period.

As expected in a small stream with good canopy cover and consistent baseflow, sestonic chlorophyll α levels are low relative to the 26 µg/L threshold (Figure 6), with a mean of 3.2 µg/L and a maximum of 8.8 µg/L from 9 samples.

This station upstream of the Charleston WWTP reported a eutrophication risk occurrence. The site was not monitored continuously and data regarding the duration and magnitude of eutrophication risks are not quantifiable. There is phosphorus available in the stream (Figure 7) from NPS. The mean phosphorus concentration was 0.17 mg/L and the maximum was 0.49 mg/L (n=29). Interestingly, the one risk of eutrophication occurrence corresponded with one of the lowest concentrations of phosphorus (Figure 7).

Cassell Creek Upstream of WWTP Following a Precipitation Event

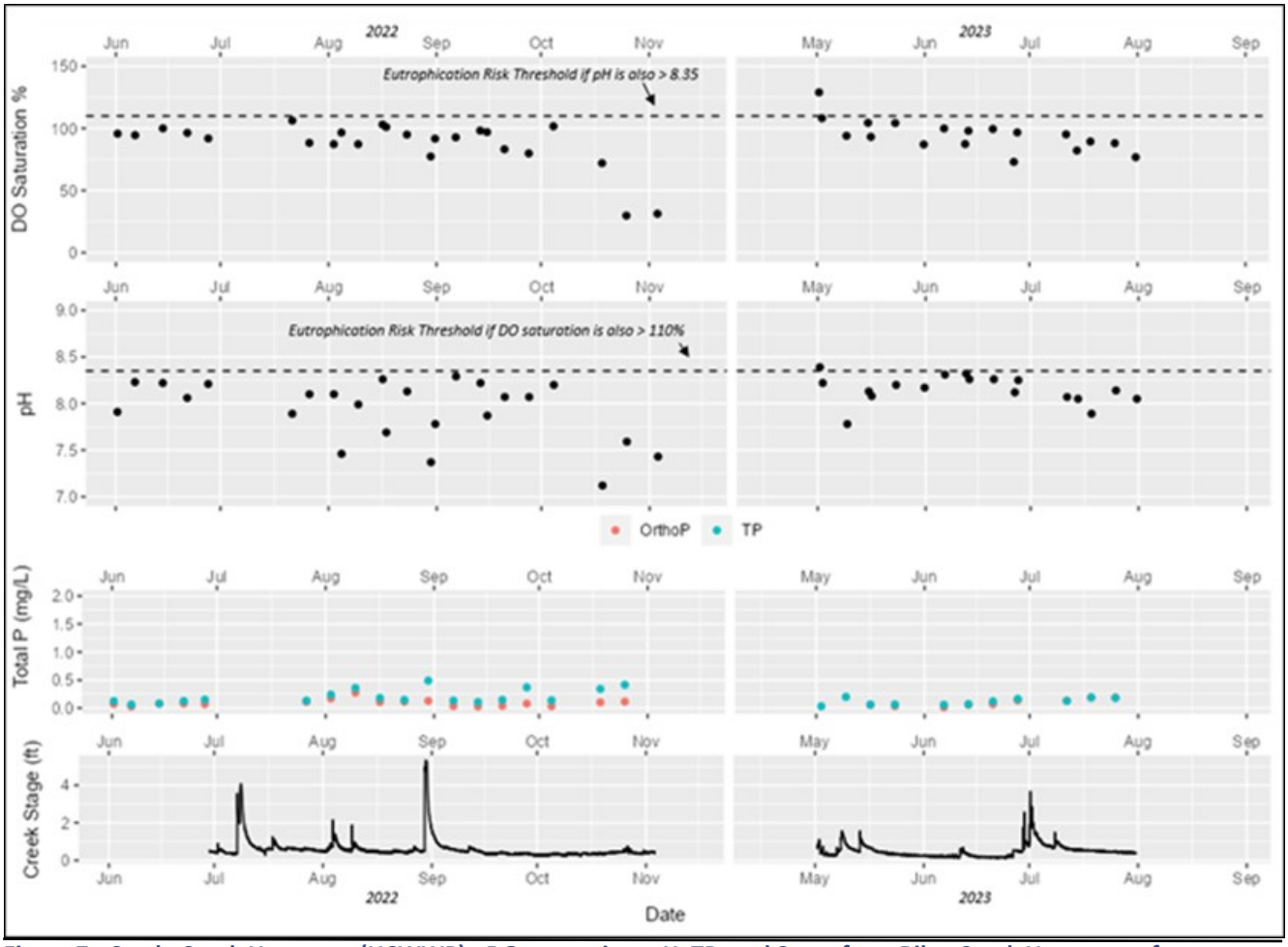

Figure 7 - Cassle Creek Upstream (UCWWP) - DO saturation, pH, TP, and Stage from Riley Creek Upstream of Cassell - 2022-2023

RILEY CREEK UPSTREAM OF CASSELL CREEK (RCUC) – DO, pH, PHOSPHORUS

RCUC Key Takeaways:

- This station is upstream of any influence from the Charleston WWTP outfall.
- Eutrophication risk conditions were met based on the DO + pH criteria.
    - The DO + pH eutrophication risk criteria was exceeded on 23% of the days monitored.
    - Almost all of the exceedances occurred in the spring.
- Eutrophication risk conditions were not met based on the pH > 9 criteria.
- Eutrophication risk conditions were not met based on the median sestonic chlorophyll α criteria.
- Data indicates that NPS and stream conditions are contributing to risk of eutrophication in Riley Creek even prior to the introduction of Charleston WWTP effluent at the confluence with Cassell Creek.

Riley Creek upstream of its confluence with Cassell was monitored with in-situ sensors. Additionally, grab samples were collected and spot checks were performed during instrument calibration visits, approximately every two weeks. There were 203 monitoring days with continuous DO and pH data. Forty-

six days, or 23%, exceeded the NARP trigger of daily maximum 110% DO saturation and 8.35 pH (Table 6). The mean chlorophyll α concentration was 1.34 µg/L and maximum was 4.8 µg/L (n=9).

Table 6 - Riley Creek Upstream of Cassell (RCUC) - Summary of Continuous Monitoring Results

Days with Continuous Monitoring	Median Daily Maximum	# of Days Exceeding the Risk of Eutrophication Criteria (8.35 pH + 110% DO)	% of Days Exceeding the Risk of Eutrophication Criteria (8.35 pH + 110% DO)
203	124% (DO Saturation) 8.0 (pH)	46 days	23%

During 2022-2023, the diel ranges of DO and pH are elevated across the spring months and decrease through the monitoring period. Rain events have a clear, short-term effect on DO and pH, moderating the diel range of each. The large daily swings gradually return over a few days period (Figure 9). In late October 2022, there was a DO anomaly where saturation and concentration were very low for a short period after a warmup event. This resulted in brief occurrence of DO falling below the state's general use enhanced water quality standard of 4.0 mg/L at any time during August through February (Title 35, Part 302, Subpart B, Section 302.206). This condition was likely due to the saturation point rapidly rising with a lag in reaeration and did not appear to be a nutrient or algae issue. This phenomenon occurred downstream at site RCDC and KCCB as well, though the magnitude of the dip was less, and DO did not fall below the standard at KCCB.

The mean TP concentration at RCUC was 0.22 mg/L with maximum values of 1.13 and 1.26 mg/L associated with storm events in August 2022 and July 2023, respectively (n=29) (Figure 8, Figure 9). Mean orthophosphate was 0.15 mg/L as phosphorus, with a maximum of 1.26 during the 17 July 2022 storm event (n=30) (Figure 8). The results indicate there to be notable phosphorus concentrations from NPS. The dense canopy cover may restrict algal growth and eutrophication conditions at this station. The risk of eutrophication occurrences corresponded with lower concentrations of phosphorus during the monitoring period (Figure 8, Figure 9).

RCUC Sensor with Debris Deposit Following High Flow Event

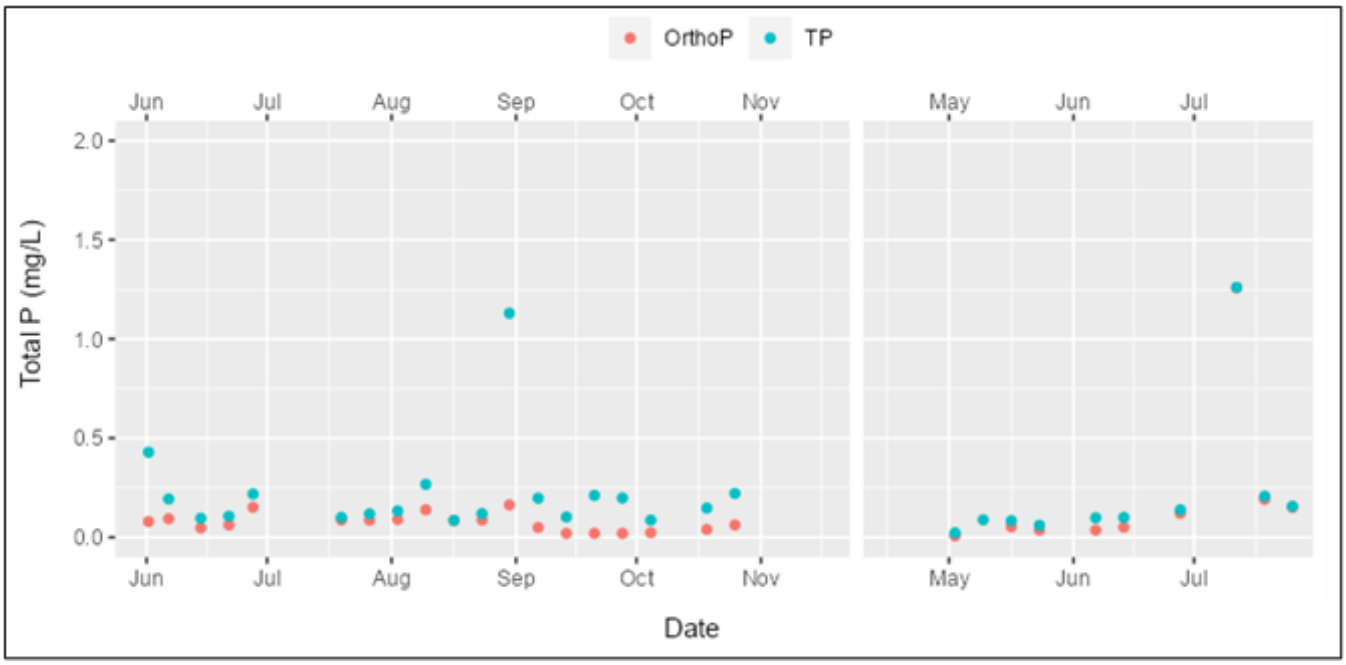

Figure 8 - Phosphorus Concentrations - Riley Creek Upstream of Cassell Creek (RCUC)

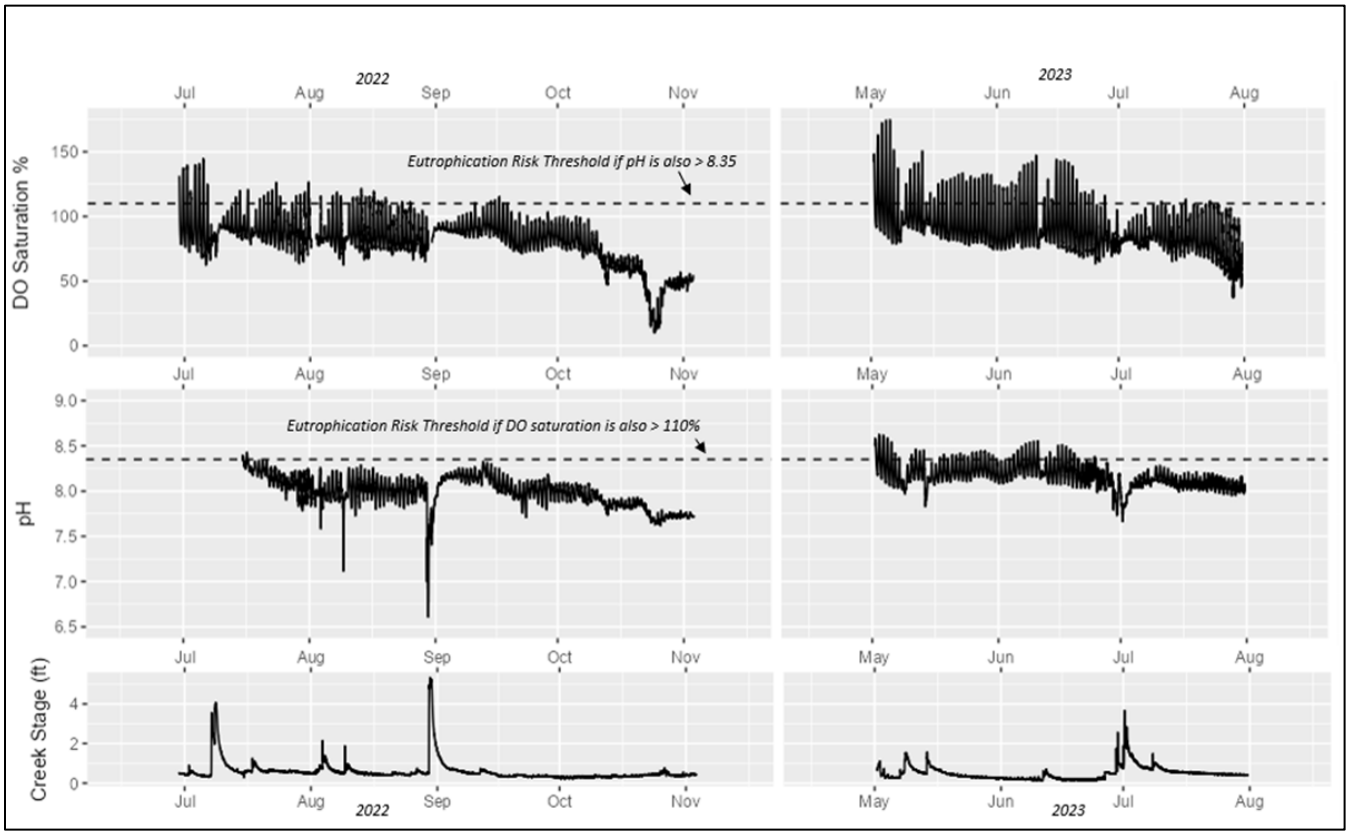

Figure 9 - Riley Creek Upstream of Cassell Creek (RCUC)- DO saturation, pH, and Stage - 2022-2023

RILEY CREEK DOWNSTREAM OF CASSELL (RCDC) – DO, pH, PHOSPHORUS

RCDC Key Takeaways:

- This station captures the watershed that includes the Charleston WWTP. The site is approximately 1.5 stream miles downstream from the outfall.
- Eutrophication risk conditions were met based on the DO + pH criteria.
    - The DO + pH eutrophication risk criteria was exceeded on 40% of the days monitored.
    - Conditions were met in the spring and summer; however, a majority were in the spring months.
- Eutrophication risk conditions were not met based on the pH > 9 criteria.
- Eutrophication risk conditions were not met based on the median sestonic chlorophyll α criteria apart from one outlier described below.
- Phosphorus concentrations are elevated compared to the two upstream stations (RCUC and UCWWP). The sources are from both treated effluent and NPS.

Riley Creek downstream of its confluence with Cassell was monitored with sensors. This allowed for characterization of the diel range of DO and pH (Figure 11). Additionally, grab samples were collected, and spot checks were performed during instrument calibration visits, approximately every two weeks. There were 187 monitoring days with both DO and pH measurements, 75 of which, or 40%, exceeded the eutrophication risk criteria of daily maximum 110% DO saturation and 8.35 pH (Table 7). Several short periods of equipment malfunction or fouling due to sediment buildup following storm events were removed from the dataset and excluded from statistical analysis. Chlorophyll was generally low, well below the 26 µg/L criteria. The median chlorophyll α concentration was 2.1 µg/L and maximum was 58 µg/L (n=9). The maximum was an outlier that occurred while the Charleston WWTP was releasing treated water from their sewage lagoon. The next highest concentration was 7.1 µg/L.

RCDC Infrastructure

Table 7 - Riley Creek Downstream of Cassell (RCDC) - Summary of Results

Days with Continuous Monitoring	Median Daily Maximum	# of Days Exceeding the Risk of Eutrophication Criteria (8.35 pH + 110% DO)	% of Days Exceeding the Risk of Eutrophication Criteria (8.35 pH + 110% DO)
187	112% (DO Saturation) 7.9 (pH)	75 days	40%

Most eutrophication risk criteria exceedances occurred during the spring and early summer months. This mirrors the pattern present in the upstream site RCUC where there are no influences from treated effluent. Storm runoff events result in a short-term positive effect on DO and pH that buffer or attenuate the diel ranges. The larger diel ranges gradually recover typically over several days.

In October 2022, a low DO saturation anomaly similar to that of RCUC was observed. Very cold air temperatures decreased DO concentrations in the stream and as temperature increased, there was a lag time for reaeration, which caused a brief violation of the state's DO water quality standard of 4.0 mg/L at any time during August through February (Title 35, Part 302, Subpart B, Section 302.206). This condition was likely due to the saturation point rapidly rising with a lag in reaeration and did not appear to be a nutrient or algae issue.

Phosphorus concentrations are higher at this station as they include both NPS and the treated effluent. The mean TP concentration at RCDC was 0.92 mg/L with two occurrences above 2.0 mg/L in October 2022 (n=29) (Figure 10). Mean orthophosphate was 0.88 mg/L as phosphorus, also with two occurrences greater than 2.0. mg/L in October 2022.

Similar to the upstream station, the risk of eutrophication occurrences are most prevalent when phosphorus concentrations are below the mean and in the lower quartile.

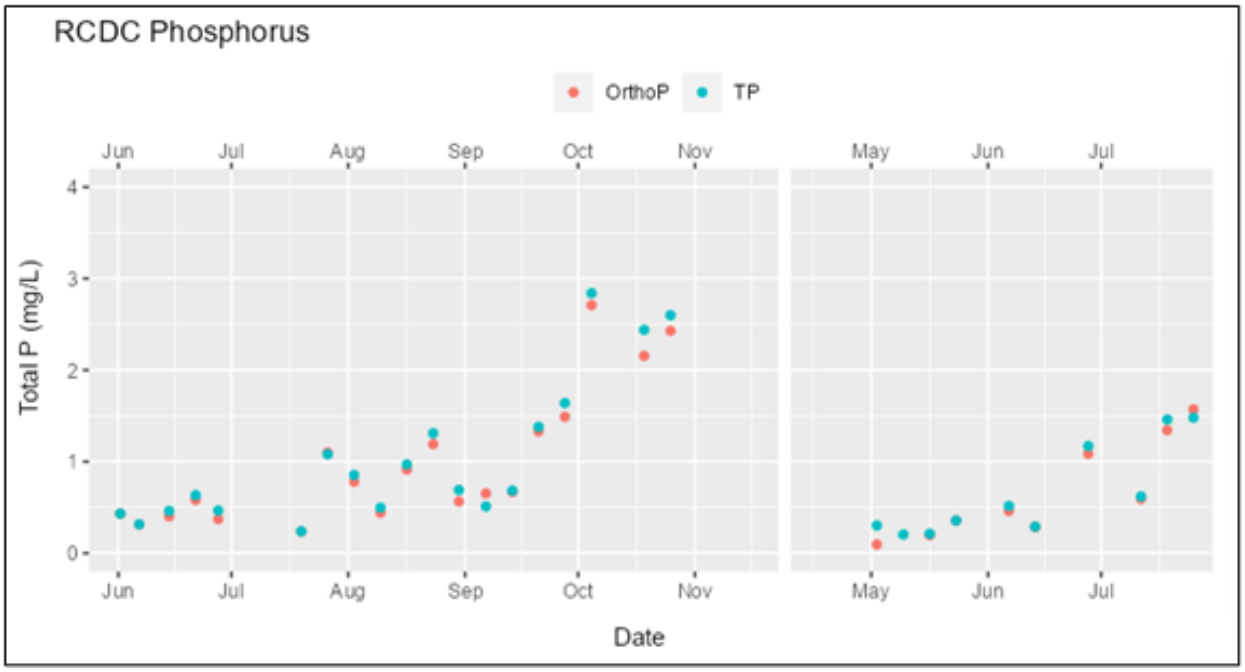

Figure 10 - Phosphorus Concentrations at RCDC

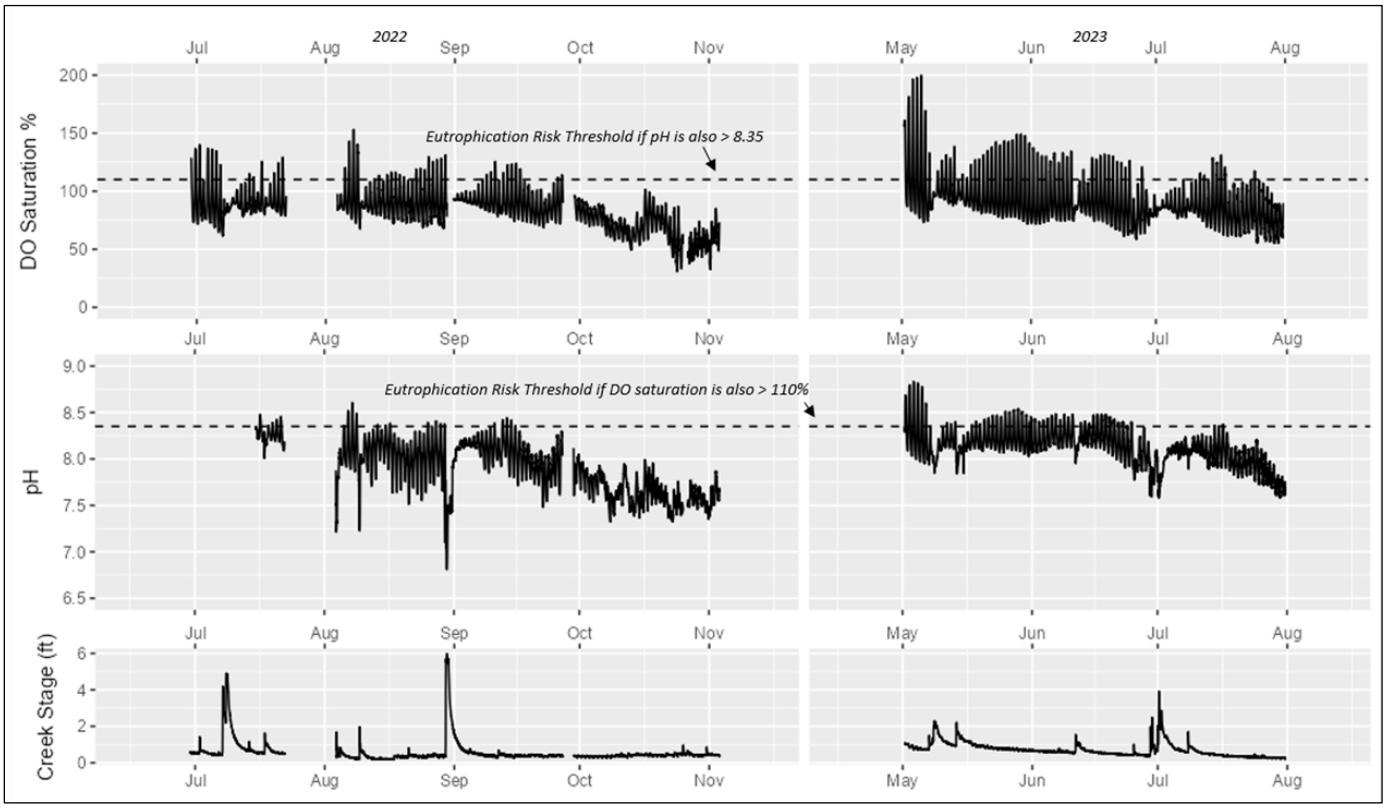

Figure 11 - Riley Creek Downstream of Cassell Creek (RCDC) - DO saturation, pH and stage - 2022-2023

KICKAPOO CREEK – UPSTREAM OF CONFLUENCE WITH RILEY CREEK (KCDN)

Kickapoo Creek upstream of the confluence with Riley Creek was monitored with grab sampling as part of the City of Mattoon's NARP from August 2022 - October 2022 and May 2023 - October 2023. It is noted as it may serve as an important reference point for development of NARP strategies and planning between Charleston and Mattoon.

KICKAPOO CREEK – BELOW CONFLUENCE WITH RILEY CREEK (KCCB) – DO, pH, PHOSPHORUS

KCCB Summary:

- This station is downstream of the influences of both the Charleston and Mattoon WWTP outfalls, approximately 4.3 stream miles downstream from Charleston and 13.5 stream miles downstream of the Mattoon.
- Eutrophication risk conditions were met based on the DO + pH criteria.
    - The DO + pH eutrophication risk criteria was exceeded on 44% of the days monitored with sensors.
    - Almost all of the exceedances occurred in the spring to early summer (mid-July).
- Eutrophication risk conditions were not met based on the pH > 9 criteria.
- Eutrophication risk conditions were not met based on the median sestonic chlorophyll α criteria.

- Phosphorus levels are elevated compared to upstream at RCDC.
- Water quality at this site is influenced by both the effluent of Charleston and Mattoon's WWTP, as well as NPS phosphorus in the watershed.
- Dense canopy cover and soft stream substrates are likely limiting periphyton growth.

Kickapoo Creek downstream of the confluence with Riley Creek (KCCB) is the stream segment that triggered the NARP special permit condition for Mattoon and Charleston. This monitoring report reflects efforts ending August 30, 2023, however, data collection continued through the end of October 2023 as part of the City of Mattoon's monitoring program.

This station was monitored with sondes and grab sampling. For the period May – August 2023, 136 days of DO and pH sensor data were collected of which 45% of monitored days exceeded the risk of eutrophication criteria (Figure 13, Table 8).

An equipment failure resulted in a data gap from late June to mid July 2023. During this period 1 of 4 grab samples exceeded the DO + pH risk of eutrophication criteria. The mean chlorophyll α concentration was 4.8 µg/L and the maximum was 21 µg/L (n=9), below the eutrophication risk criteria of 26 µg/L. It is important to note that this maximum was an outlier, influenced by Charleston's treated wastewater lagoon release described previously.

The next highest concentration was 7.3 µg/L, indicating sestonic chlorophyll α is not a eutrophication risk criteria of concern at this site. Sensor data corroborates this assertion, as the peaks in chlorophyll fluorescence coincided with treated lagoon wastewater releases.

Table 8 - Kickapoo Below Confluence with Riley (KCCB) - Summary of Continuous Monitoring Results

Days with Continuous Monitoring	Median Daily Maximum	# of Days Exceeding the Risk of Eutrophication Criteria (8.35 pH + 110% DO)	% of Days Exceeding the Risk of Eutrophication Criteria (8.35 pH + 110% DO)
136	112% (DO Saturation) 7.9 (pH)	61 days	45%

Most of the risk of eutrophication exceedances occur early in the monitoring season. In August 2023, several rainstorms over a few days increased creek stage slightly. This influx of rainwater appeared to keep the diel range of pH from rising above the 8.35 threshold, even while DO was consistently above the 110% daily maximum level.

Mean TP concentration at KCCB through September 1, 2023 was 0.96 mg/L (n=22) with several samples approaching or slightly exceeding 2 mg/L. These high concentrations occurred during some of the lowest measured flows at this site. Mean orthophosphate concentration was 0.92 mg/L as phosphorus (n=21), with maximum occurrences mirroring TP (Figure 12). There is not a correlation between phosphorus concentrations and eutrophication risk occurrences, as many of the longest durations of eutrophication risks occur when concentrations are statistically lower.

The results indicate patterns in phosphorus are similar to Riley Creek before it flows into Kickapoo. However, river flows and loads are greater at this station compared to Riley, indicating that the Kickapoo

Creek watershed is contributing nutrients likely from both point and NPS. Mattoon monitoring data was important for further assessing the eutrophication dynamics and guiding strategies.

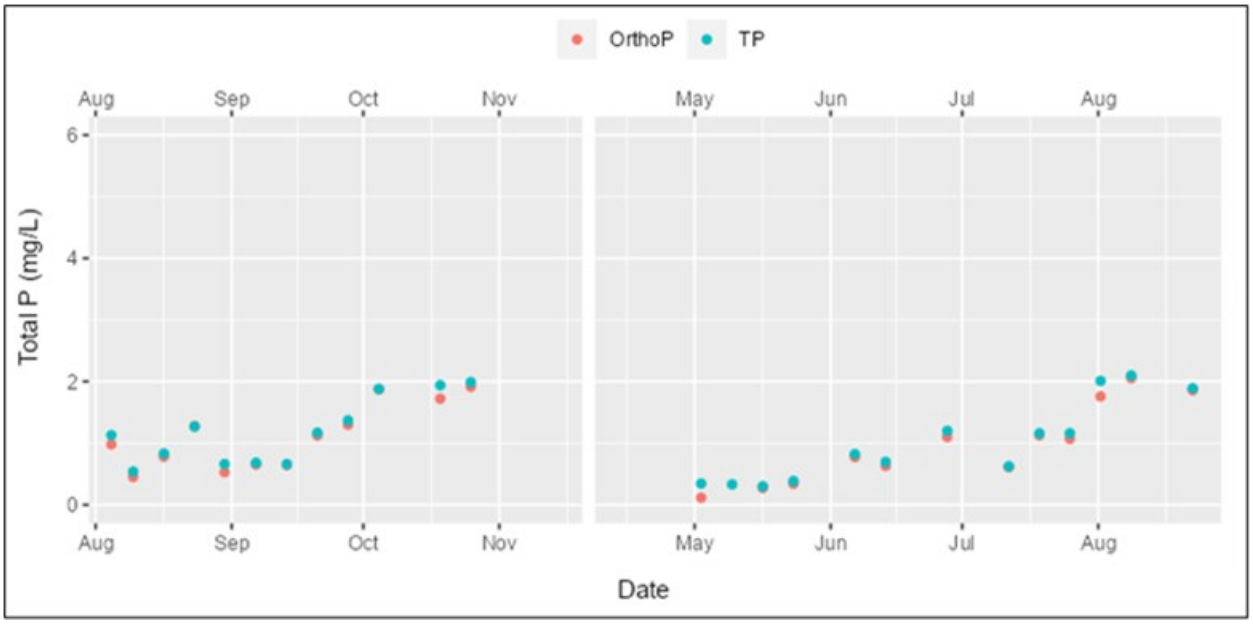

Figure 12 - Phosphorus Concentrations at KCCB - Through August 31, 2023

KCCB May 2023

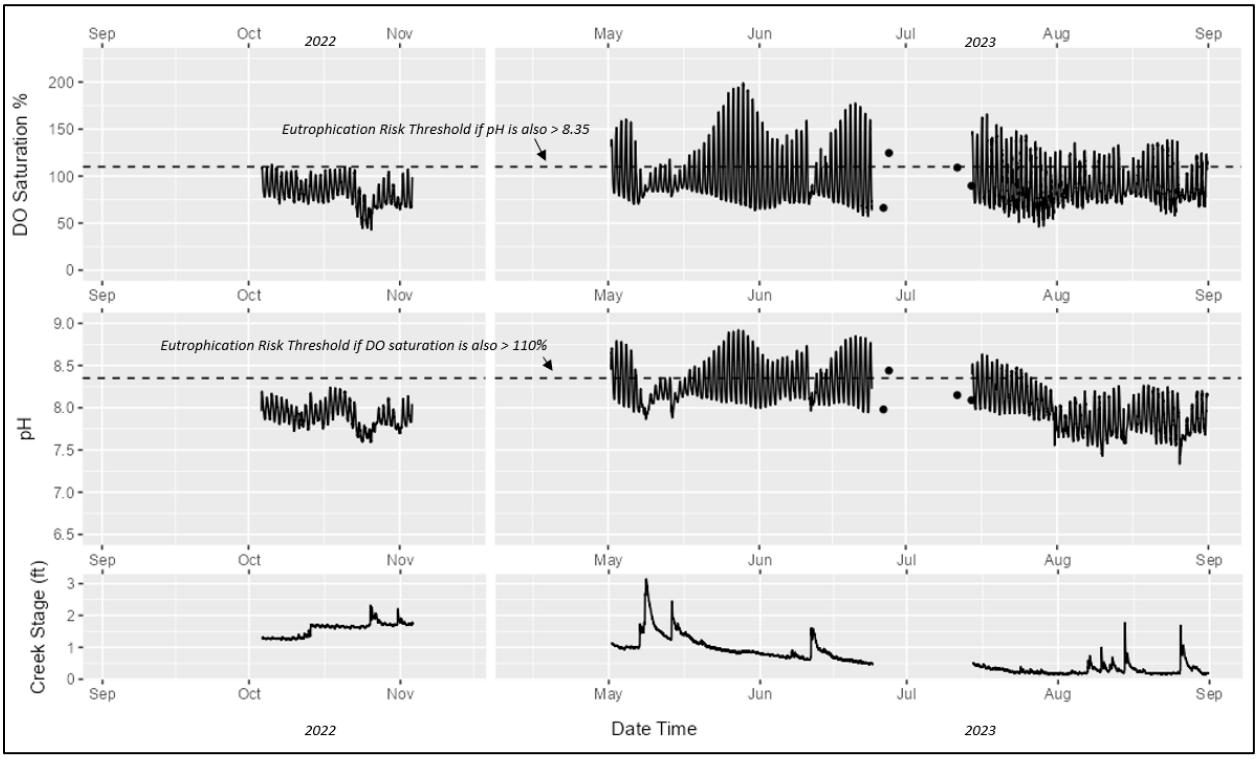

Figure 13 - KCCB DO Saturation, pH and Stage (an equipment malfunction occurred in late June - early July and no sensor data was collected during this period - dots represent grab samples collected during the outage)

3.4 INTREPRETATION & ANALYSIS

The monitoring results identified eutrophication risk based on one of the three criteria defined by the Illinois EPA (pH > 8.35 and DO saturation > 110%) at all four stations. All stations, both upstream and downstream of treated effluent influences had documented eutrophication risk associated with pH and DO saturation criteria. There were no exceedances of the chlorophyll α or pH > 9 criteria. The risk occurrences that were documented do not appear to correlate with phosphorus concentrations. Results illustrate the complex watershed and stream system processes affecting water quality and contributing to eutrophication risk. Therefore, the treated effluent from Charleston may not be the primary driver. The data demonstrates that NPS and treated wastewater effluent are both contributors of phosphorus. Nonpoint sources are likely responsible for the highest concentrations detected and comprise a larger fraction of the annual yields entering the stream systems.

The dry conditions and lower baseflows during the 2023 monitoring period likely elevated the frequency and duration of risk of eutrophication exceedances and may not be the most representative snapshot of data to inform the NARP. The segment of Kickapoo Creek (KCCB / IEPA_BEN-01) was the original stream segment that triggered the NARP permit condition for both Charleston and Mattoon. Approximately 44% of monitored days in 2022 and 2023 were above the threshold of 8.35 pH and 110% DO daily maximum which corroborates 2011 Illinois EPA monitoring results. However, the 2016 Illinois EPA data did not show any eutrophication risk occurrences. Based on the 2022-2023 monitoring period, it was this stream segment that had the most significant number of eutrophication risk conditions. Charleston intends to focus further efforts and next steps of the NARP on this segment, in coordination with the City of Mattoon. A Strategy and Work Plan is presented in subsequent sections.

4. NARP STRATEGY & WORK PLAN

Based on an understanding of the watershed dynamics and the results of the monitoring program, the NARP Strategy and Work Plan is presented focusing on the Kickapoo Creek stream segment BEN-01 and the associated 65,489-acre watershed. This watershed area is within the 2022 Embarras River Watershed Management Plan (WMP), which is an Illinois EPA approved nine-element plan and was supported by the City of Charleston. Kickapoo Creek represents 4.2% of the entire Embarras River basin.

This Kickapoo Creek watershed comprises of 67% agriculture and 13% urban/developed lands and includes the City of Mattoon WWTP in addition to the Charleston WWTP. Charleston and Mattoon intend to coordinate and synthesize NARP efforts.

4.1 WATERSHED CHARACTERIZATION

A concise watershed characterization is presented and includes relevant information related to hydrology, land cover, climate, and demographics. Current and historical water quality impairments are summarized and estimates of phosphorus loading from NPS and point sources are presented. Most of the data presented are derived and/or recalculated from the 2022 Embarrass River WMP for only the Kickapoo Creek basin. This section also details applicable linkages with the 2022 WMP, other relevant plans, efforts, and initiatives.

HYDROLOGIC UNIT CODES

Kickapoo Creek is in east-central Illinois, entirely within Coles County and within the larger Embarras River watershed. The 10-digit Hydrologic Unit Code (HUC - 0512011206) watershed is 65,489 acres and contains 3 smaller HUC12 subwatersheds (Table 9).

Table 9 - Kickapoo Creek HUC 12 subwatersheds

HUC Name	HUC12 ID	Area (acres)
Sweetwater Creek – Kickapoo Creek	05120112603	24,602
Riley Creek	05120112601	25,944
Cassell Creek	05120112601	14,944
	Total:	**65,489**

STREAMS & LAKES

According to the National Hydrography Dataset (NHD) there are 184 miles of streams and rivers, including artificial drainageways (Table 10). Kickapoo Creek is the longest named stream at 20.6 miles followed by Riley Creek (15.4 miles) and Cassell Creek (8.6 miles). Unnamed tributaries and artificial drainage ways cover 132 miles. Water quality impairments are included in a proceeding section of this watershed characterization.

Table 10 - Watershed Stream Segments and Illinois EPA Assessment ID

Stream Name	Illinois EPA Assessment ID	Length (Miles)
Unnamed Tributary/Drainage Way	N/A	132
Kickapoo Creek	BEN-01/BEN-02	20.6
Riley Creek	BENA-01/BENA-02/ BENA-03	15.4
Cassell Creek	BENC-01	8.6
Union Drainage District Number 3	N/A	4.5
Sweetwater Creek	BENB	2.7
Total:	-	**184**

The NHD also identifies 243 acres of lakes, ponds and reservoirs, the largest lake is unnamed and 21 acres in size. The largest named lake is Lake Windermere at 8 acres.

CLIMATE NORMALS

Based on climate normals published by the Illinois State Climatologist for Charleston for the period of 1991 – 2020 (UofI, 2023), Charleston experiences an average of 43.75 inches of precipitation per year (3.65 inches/month). April is typically the wettest month, with an average of 5.09 inches. Average temperature is 55 degrees Fahrenheit, and July is the warmest month.

The watershed experienced 19% less precipitation than average in 2022 and 2023. The monitoring data supporting this NARP is from a climatic and hydrological period that is not representative of average conditions.

LAND COVER

Table 11 presents the land cover of the watershed. The two predominant land cover categories are (i) 67% agriculture comprising 43,824 acres of cultivated crops, and (ii) 13% developed/urban areas comprising of 8,262 acres according to the National Land Cover Database (NLCD) (Dewitz, J., 2021). Of the fifteen HUC10 watersheds in the Embarras Basin, Kickapoo Creek contains the highest proportion of developed land area.

Table 11 – Kickapoo Creek Watershed Land Cover

Land Cover	Area (acres)	% of Watershed Area
Cultivated Crops	43,824	67%
Developed	8,262	13%
Forest	6,550	10%
Developed Open Space	3,814	5.8%
Grasslands/Hay/Pasture	2,763	4.2%
Open Water	162	0.25%
Wetlands	91	0.14%
Barren Land	23	0.04%
Total:	**65,489**	**100%**

Riley Creek (HUC12 05120112601) has the greatest proportion of agriculture/cultivated crops (78%), followed by Cassell Creek (HUC12 05120112601) at 74% and Sweetwater Creek (HUC12 05120112603) at 64%. The City of Charleston covers a land area of 6,087 acres, of which 4,783 acres are in the watershed. The City of Mattoon has 4,965 acres of its 6,598-acre municipal area within the watershed.

DEMOGRAPHICS & ECONOMY

The most significant urban area located within the watershed is Charleston, with a 2022 population of 17,119, a decline of 21.6% from 2010 according to the US Census Bureau. A large portion of the City of Mattoon is also in the watershed. Mattoon has a population of 16,666 and has experienced a 10.2% decrease since 2010.

Charleston falls within an Environmental Justice area designated by a low-income population and has a poverty rate of 26.72%. Median household income (2017 – 2021) is $44,371 compared to $72,563 for Illinois and the national average of $69,021.

WATER QUALITY IMPAIRMENTS

There are no current impairments on the 2020/2022 303(d) list for streams in the Kickapoo Creek watershed. Historic impairments from 2009, 2014, 2016, and 2018 include Aquatic Life Use listings with DO, pH and TP causes (Table 12).

Table 12 - Kickapoo Creek Watershed Historical Impairments

Stream	HUC12 Watershed	Illinois Assessment Unit	303(d) Impairments	Causes Related to P & Years on List
Cassell Creek	051201120603	IL_BENC-01	Fully Supports Designated Uses	N/A
Riley Creek	051201120802	IL_BENA-01	Aquatic Life	DO: 2018, ’16, ‘14 pH:2008
Kickapoo Creek	051201120802	IL_BEN-01, IL BEN-02	Aquatic Life	Phosphorus (total): 2008

RELATIONSHIP TO OTHER PLANS & WATERSHED EFFORTS

Two recent plans and studies are relevant to the Charleston NARP, (i) the 2022 Embarras River WMP, and (ii) the Kickapoo Creek/Riley Creek Total Maximum Daily Load (TMDL), currently in development. The Embarras WMP was developed with financial assistance from the Illinois EPA Section 319 program in partnership with the Coles County Soil and Water Conservation District (SWCD), Illinois Extension and the Illinois Farm Bureau. Charleston also contributed financially to the development of the WMP. Primary concerns addressed by the plan include erosion, sedimentation, water quality, and a lack of education.

The TMDL was triggered by the 2018 DO impairment on Riley Creek. Stage 1 (watershed characterization, data analysis, and methodology section) has been completed and Stage 3 (Model calibration, TMDL scenarios, and implementation plan) is underway with a draft expected by the Illinois EPA in January of 2024.

EMBARRAS RIVER WATERSHED MANAGEMENT PLAN

The 2022 Embarras River WMP represents an update to the 2011 plan and encompasses an area of approximately 2,435 mi^2. The Embarras River is considered a priority for phosphorus reduction as noted in the Illinois Nutrient Loss Reduction Strategy (INLRS). This was the primary driver of the plan and the focus of recommendations. Charleston contributed by providing input to the Planning Committee and in the identification of site-specific project recommendations for Riley Creek. Implementation of the plan is already underway to reduce nutrient and sediment loading. In Coles County, the SWCD intends to partner with the Illinois Farm Bureau and others to secure grant funding to implement practices in Polecat Creek, a priority HUC12 subwatershed east of Charleston. A streambank stabilization project in the Riley Creek subwatersheds is also under consideration and will receive funding support from the City of Charleston. If implemented, it is expected to reduce 60 tons/yr of sediment, 75 lbs/yr of phosphorus and 110 lbs/yr of nitrogen.

Charleston has been a partner in watershed management for decades, participating in the 2011 Embarras River WMP and more recently securing Illinois EPA Section 319 grant funding to address 2,200 feet of eroding shoreline on the north and south end of Lake Charleston. Breakwater techniques were applied and achieved annual reductions of 109 lbs of phosphorus, 218 lbs of nitrogen and 109 tons of sediment.

KICKAPOO CREEK TMDL

A TMDL, is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards and are a requirement of Section 303(d) of the CWA. Illinois EPA is leading efforts now to assess and address water quality impairments with one underway to tackle DO on the Riley Creek segment BENA-01. The TMDL covers the entire Kickapoo Creek HUC10. As previously described, a TMDL consists of 2 primary stages. Stage 1 is complete and provides a detailed watershed characterization and an analysis of water quality data relevant to the impairment being addressed. Refer to this report for more information on the HUC10.

Of relevance is Section 5 discussing potential pollution sources. Both septic systems and NPS pollution from agricultural sources are listed. Next steps in the TMDL process are to complete modeling and estimate the needed reductions to achieve the DO standard. An implementation plan will include broad recommendations to reduce NPS source pollution similar to those found in the Embarras River WMP.

POINT & NONPOINT SOURCE LOADING

Point source pollution is defined by the United States EPA as “any single identifiable source of pollution from which pollutants are discharged, such as a pipe, ditch, ship or factory smokestack” (Hill, 1997). The NPDES, a provision of the Clean Water Act, prohibits point source discharge of pollutants into waters of the U.S. unless a permit is issued by the United States EPA or a state or tribal government. Individual permits are specific to individual facilities (e.g., water or wastewater treatment facilities), and general permits are for a group of facilities in a geographical area. Permits describe the allowed discharge of pollutant concentrations (mg/L) and loads (lbs/day). The Charleston WWTP currently does not have an effluent phosphorus permit limit.

Nonpoint source pollution generally results from land runoff, precipitation, atmospheric deposition, drainage, seepage or hydrologic modification. The term "nonpoint source" is defined to mean any source of water pollution that does not meet the legal definition of "point source." Unlike pollution from point sources like industrial and sewage treatment plants, NPS pollution comes from many diffuse sources and is caused by rainfall or snowmelt moving over and through the ground. The runoff picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and ground waters (United States EPA, 2018).

Point source loading of phosphorus from the Charleston and Mattoon WWTPs is provided in Table 13. Average annual loading from 2017 through 2022 is 16,083 lbs for Charleston and 36,165 for Mattoon.

Table 13 - Annual Phosphorus Load from WWTPs in lbs - (Data Source: Illinois EPA and USEPA ECHO)

WWTP	2017	2018	2019	2020	2021	2022	Average Annual
Charleston	14,798	14,895	14,989	16,617	19,505	15,699	**16,083 lbs**
Mattoon	45,046	35,650	42,640	33,809	32,979	27,124	**36,165 lbs**

Based on the 2022 Embarras River WMP, the average annual NPS phosphorus load for the watershed is 65,390 lbs/yr. The total average annual phosphorus loading is therefore estimated at 117,638 lbs, with the Charleston WWTP accounting for 13.7%. Nonpoint sources are responsible for ~56% of average annual phosphorus loads in the watershed and are a larger contributor than both Charleston and Mattoon WWTPs combined (Figure 14).

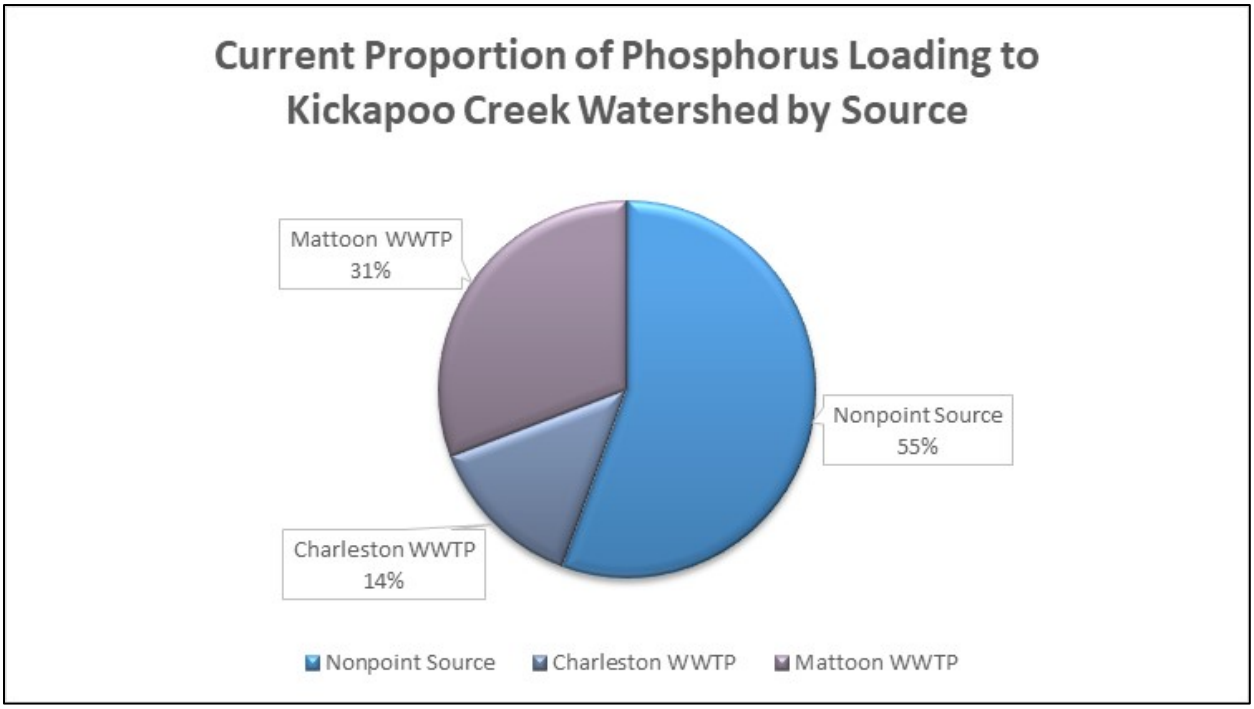

Figure 14 - Proportion of Annual Total Phosphorus Load to Kickapoo Creek Watershed by Source

4.2 NARP STRATEGY

Charleston's NARP strategy focuses on the BEN-01 segment of Kickapoo Creek and its watershed described in Section 4.1. The segment is downstream from the confluence with Riley Creek and exhibited DO + pH eutrophication risk based on Illinois EPA criteria in 2011, 2016 and more recently in 2022/2023. The monitoring program in 2022/2023 demonstrated that DO + pH eutrophication risk criteria are met at locations throughout the watershed, even upstream and outside the influence of WWTP effluent.

The Charleston WWTP contributes approximately 13.7% of the average annual phosphorus loading to the Kickapoo Creek watershed. Nonpoint sources are estimated to contribute 4X more than the Charleston WWTP and are a larger contributor to the water quality issues and eutrophication risk conditions (Figure 14). The availability of phosphorus in the stream systems is systemic due to the agricultural and urban (wastewater) land uses that dominate the watershed. Based on the monitoring program, DO + pH eutrophication risk conditions are greater where riparian and canopy cover conditions are poor, which are typically areas under agricultural production. The DO + pH eutrophication risk occurrences that were documented consistently do not correlate with phosphorus concentrations measured in the waters, and as previously mentioned, the eutrophication risks occur both upstream and downstream of wastewater influences.

The City of Charleston recognizes their contribution of phosphorus to the watershed and how this input is a part of complex and dynamic processes that may affect the frequency and/or duration of eutrophication risks under certain conditions. The city does not have jurisdiction over land management practices outside of municipal boundaries where a majority of the nutrients originate.

In this context, Charleston's NARP is focused on improving water quality in the watershed in three ways:

1. **WWTP Plant Upgrades** – Charleston will complete treatment plant upgrades to reduce phosphorus effluent to 0.5 mg/L (avg. annual geometric mean).
    a. Charleston's contribution of phosphorus will be reduced by at least 63-70% with these upgrades. The annual loading will be reduced to the 4,824 - 5,950 lbs/year range from 16,000 lbs/year.
    b. This will result in Charleston's portion of annual watershed phosphorus loading being reduced from **13.7% to 4.5 - 5.5%** without any changes at Mattoon (Figure 15).
    c. The plant upgrades and phosphorus load reductions will have a positive effect on water quality and eutrophication risk conditions.
2. **Collaborate** - on and continue to support current and future watershed planning and TMDL efforts that address NPS pollution loading. Charleston has been a consistent and active supporter of watershed planning and NPS reduction projects for well over a decade. The city contributed financially to the 2011 and 2022 Embarras River watershed management plans and has invested significantly in improvements to Lake Charleston in coordination with Illinois EPA programs.
    a. Evaluate developing an internal means to track involvement and investments in a measurable way to report on progress and improvements.
3. **Local Watershed Group** – no group currently exists for Kickapoo Creek. Charleston would strongly consider participating in a watershed group if one were to be established, recognizing that this would need to involve the agricultural community, the Coles County SWCD and the City of Mattoon.

4. **Source Water Protection** – Charleston will continue to invest in water quality improvements, planning and compliance related to the water supply lake and its watershed (Lake Charleston and Embarras River). Improving source water will help mitigate treatment costs and may also translate into effluent improvements.

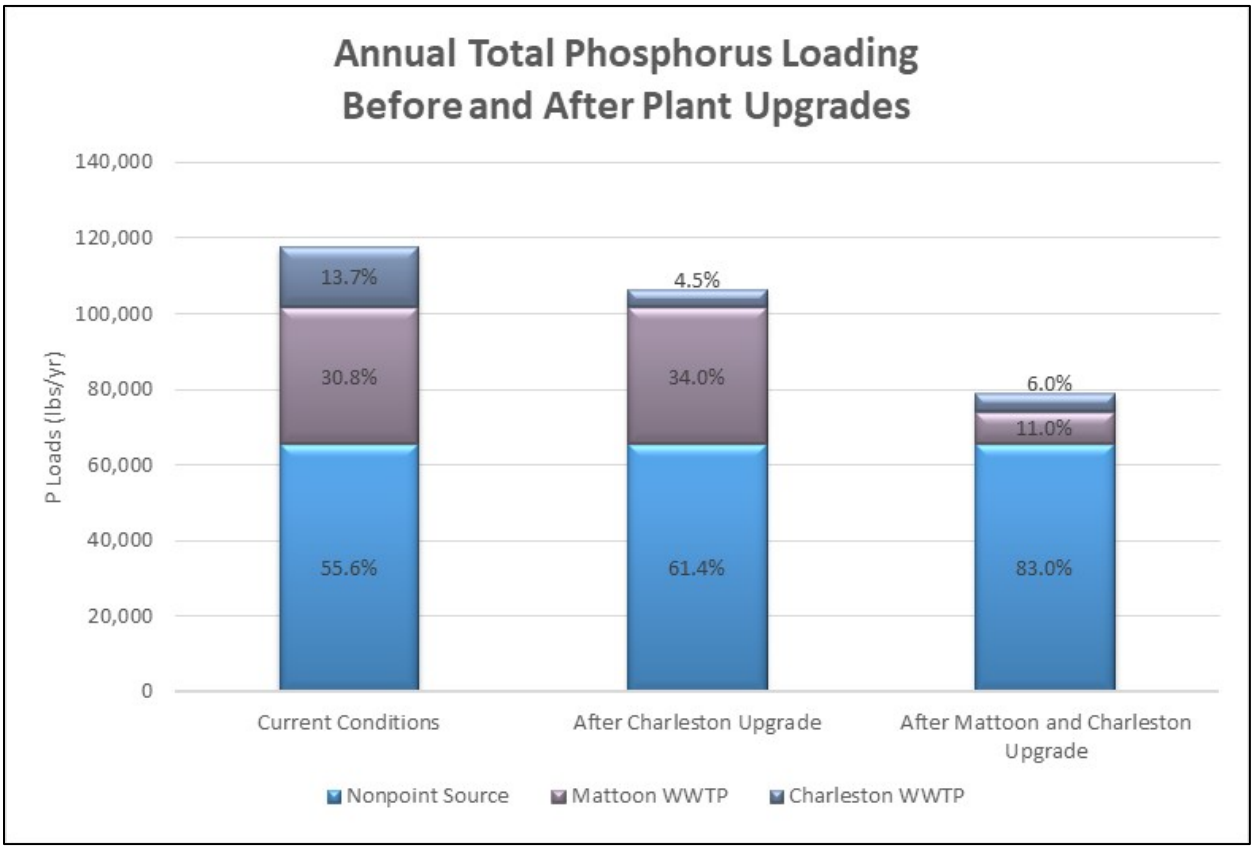

Figure 15 - Phosphorus Loads from Point and NPS and Percent of Total Load Before and After Plan Upgrades

Appendix C provides the treatment plant upgrade plans. The plans include a modified University of Cape Town configuration to achieve Biological Nutrient Removal (BNR) and meet a new phosphorus limit of 0.5 mg/L. It is estimated that by the end of 2023 to early 2024 the new system will achieve a 63 – 70% reduction in phosphorus loading. The City of Charleston is committed to removing nutrients from the discharge to the watershed and continuing the sustainable practice of beneficial reuse of stabilized sludge for land application on farm fields. Plant upgrades will also include improvements to solids handling including conversion of aerobic digester tanks to liquid sludge storage tanks, replacing belt filter press sludge dewatering equipment, and abandonment of the anaerobic digesters to pasteurize the sludge via lime. These plant upgrades and corresponding point source reductions will have a positive effect on water quality and reduce risk of eutrophication conditions.

Significant efforts and investments to reduce NPS and point source phosphorus loading in the watershed are underway including: (i) the 2022 Embarras River WMP, (ii) Kickapoo Creek TMDL, and (iii) Charleston treatment plant upgrades. These combined efforts constitute an effective and impactful nutrient assessment and reduction plan that will see immediate water quality improvements in 2024.

4.3 NARP WORK PLAN

The Work Plan includes a schedule and cost estimate for NARP activities moving forward. Charleston, alongside the City of Mattoon, is committed to a series of key activities that will significantly reduce phosphorus loading to Kickapoo Creek, the subject of a risk of eutrophication designation that triggered the NARP. Furthermore, Charleston will work with area stakeholders to further limit NPS loading through collaborative efforts outside of their jurisdiction. Actions include plant upgrades, potential involvement in a watershed group and partnerships to help secure outside funding for NPS reductions.

ACTIONS & SCHEDULE

A schedule of activities is presented in Table 14. Significant plant upgrades are already underway and will be completed in 2024. If sufficient need warrants the establishment of a watershed group for Kickapoo Creek, Charleston will consider supporting the Coles County SWCD in its establishment and participate. A fragmented but established watershed group currently exists for the Embarras River and supported the development of the 2022 WMP.

Charleston will also continue seeking partnerships with others to secure outside grant funding for NPS reduction projects recommended in the WMP and Kickapoo Creek TMDL. One example is through the Illinois EPA Section 319 program that has been used in the past to address shoreline erosion in Lake Charleston. The City has interest in pursuing grant funds to stabilize a section in the Riley Creek subwatershed.

Table 14 - NARP Actions and Schedule

NARP Action	Anticipated Start Date	Anticipated End Date	Notes
Plant upgrades	Underway	February 2024	Upgrades will achieve compliance with 0.5 mg/L effluent concentration limit and will achieve a 63-70% reduction in TP loading, more than 10 years before the 2035 permit deadline.
Watershed Group	TBD	TBD	Charleston will consider participation in a Kickapoo Creek stakeholder group if outside interest and a need dictates its formation. Charleston will support the Coles County SWCD as a coordinating entity.
NPS Reduction Grants	TBD	TBD	Charleston will look for opportunities to partner with other entities to implement NPS recommendations in the Embarras River WMP and Kickapoo Creek TMDL.

COST ESTIMATES

The Charleston WWTP capital improvements and plant upgrades are estimated at **$5,822,985**, financed at $133,355 per year for 30 years. The city does not plan to increase sewer or water rates. Participation in a watershed group is estimated at **$5,000** per year including some limited financial support to the Coles County SWCD. If implemented, the streambank stabilization project in the Riley Creek subwatershed is estimated to be **$240,000** and will improve 2,000 ft of stream channel. The cost of other NPS measures is currently unknown.

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APPENDIX A: MONITORING PLAN

City of Charleston
&
City of Mattoon
Wastewater Treatment Plants

Nutrient Assessment Reduction Plan
Data Mining & Monitoring Plan

July 2022

Prepared for: City of Charleston, Illinois
City of Mattoon, Illinois
Prepared by: Northwater Consulting

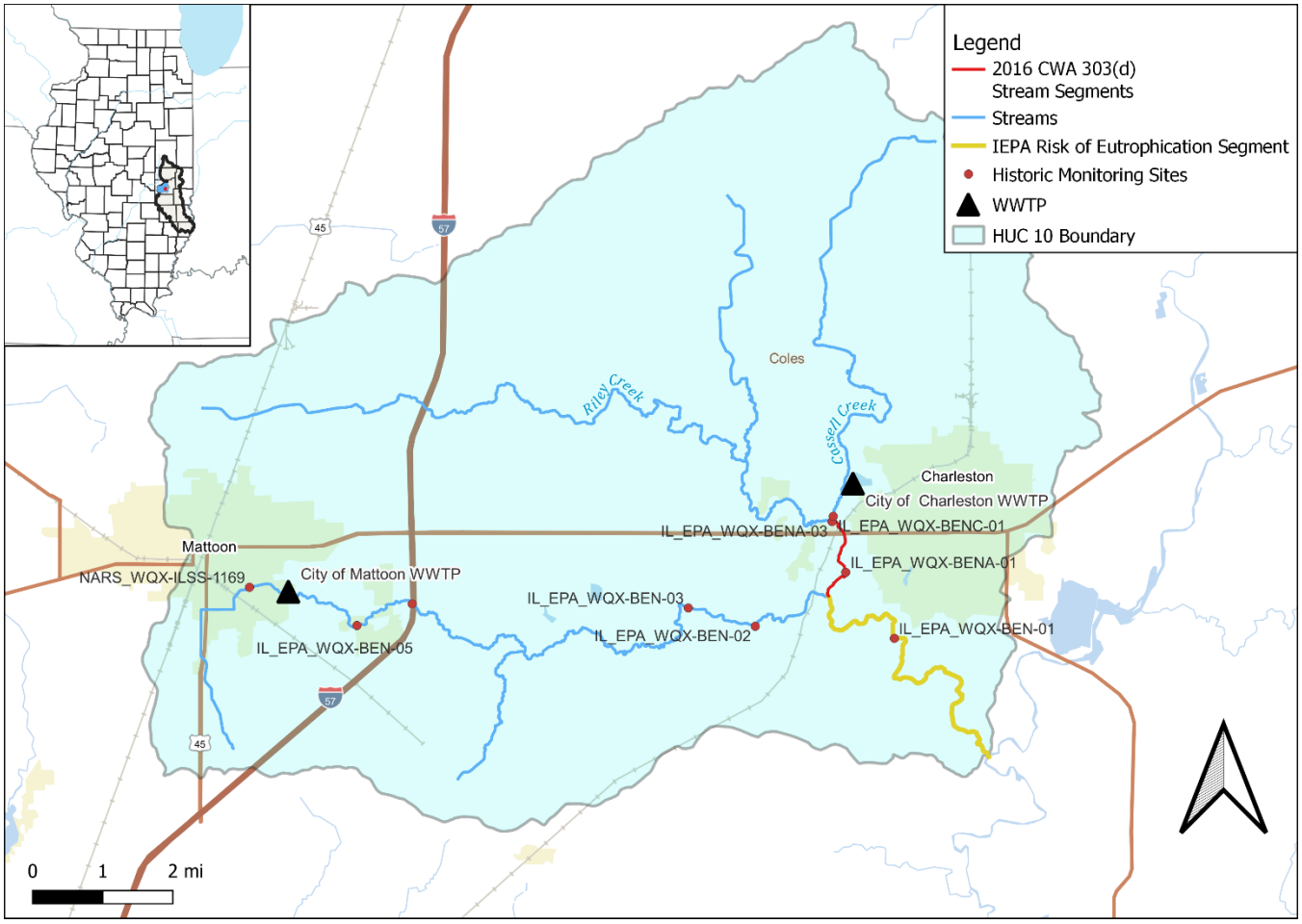

Figure 1. Project Area

Contents

1 Introduction

1.1 NARP Process & Requirements

In 2018, the Illinois EPA (IEPA) instituted a new process for permitting of Publicly Owned Treatment Works (POTW) discharges that would allow for consideration of site-specific conditions for phosphorus limits. The Nutrient Assessment Reduction Plan (NARP) process resulted from negotiations with environmental organizations, IEPA, and the Illinois Association of Wastewater Agencies. A NARP Special Permit Condition is required if a receiving stream segment or downstream segment is on the Illinois Clean Water Act 303(d) list as impaired with phosphorus-related causes. A NARP is also required if there is a "risk of eutrophication" as defined by meeting any of the conditions outlined in Table 1.

Table 1. IEPA Risk of Eutrophication Criteria

Risk of eutrophication if any of these conditions met		
pH	Median sestonic chlorophyll *a*	On any two days during IEPA monitoring week, daily max
>9	>26 u/l	pH>8.35 and DO sat >110%

The City of Charleston and the City of Mattoon each operate one treatment plant that is required to undertake the NARP process as part of their National Pollution Discharge Elimination System (NPDES) permit. However, in this process, it may be determined through collection and assessment of relevant data that the watershed does not have a phosphorus-related impairment or risk of eutrophication. In this case, phosphorus input reductions and other measures may not be necessary. Northwater Consulting was retained by Charleston and Mattoon to assess if a NARP is required for their facilities, and if so, develop a strategy for development of a full NARP. This process has several components which include:

- Examining if there is sufficient water quality data to determine if NARP requirements apply.
    - If data insufficient, create a water quality monitoring plan and collect data.
- Undertake watershed characterization and determine if additional NARP components are required.
- If a full NARP is required:
    - Engage stakeholders throughout the process.
    - Model watershed and instream processes.
    - Establish defensible site-specific water quality criteria.
    - Define scenarios and strategies to achieve water quality targets.
    - Implement the recommendations of the NARP.

1.2 Data for NARP Determination

To make a determination, sufficient dissolved oxygen (DO), pH and sestonic chlorophyll *a* data must be available between May 1 and October 31 to assess if any of the eutrophication risk criteria are met. Based

on mining and analysis of existing datasets for the outfall and associated stream segments, it was determined that additional water quality data collection is necessary to evaluate impairments and eutrophication risks according to NARP criteria.

This plan outlines the recommended monitoring and data collection actions necessary to assess requirements for the treatment plants. The data will also support focused recommendations and a strategy to develop additional NARP components for each, if required. The plan is intended to guide cities of Charleston and Mattoon through the data collection and assessment phase. More detailed results of the process and plan are presented herein.

2 Data Mining Results

The receiving streams were cross referenced with the 2016, 2018 and 2020/2022 IEPA Clean Water Act Section 303(d) list[1] of impaired waters. Details of phosphorus-related impairments are summarized for the treatment plants. The only stream segment recently impaired is Riley Creek, which is downstream of Cassell Creek, the receiving waterbody for the Charleston treatment plant effluent. Riley has been on the 303(d) list in 2008, and 2014-2018. However, IEPA determined the DO impairment on Riley Creek Segment IL_BENA-01 is not due to excess algal growth[2]. Cassell flows to Riley and Riley is tributary to Kickapoo Creek (Figure 1 and Figure 3). Kickapoo Creek, the receiving stream for Mattoon's effluent has not been listed since 2006 (fish kill) and 2008 (unknown cause). However, Kickapoo segment BEN-01, downstream of the confluence of Riley and Kickapoo qualified Charleston and Mattoon for a NARP special permit condition, as 2011 IEPA data showed 6 days monitored with pH > 8.35 and DO saturation >110%.

Table 2. Receiving Stream and Tributary Segment Summary

Mattoon and Charleston Receiving Stream Segments				
Receiving Stream	HUC12 Watershed	Illinois Assessment Unit	303(d) Impairments	Causes Related to P & Years on List
Cassell Creek	051201120603	IL_BENC-01	Fully Supports Designated Uses	N/A
Riley Creek	051201120802	IL_BENA-01	Aquatic Life	DO: 2018, '16, '14 pH:2008
Kickapoo Creek	051201120802	IL_BEN-01, IL BEN-02	Aquatic Life	Phosphorus (total): 2008

Receiving Major Watershed	POTW Design Average Flow	POTW Design Maximum Flow
Embarras River	Charleston - 3.3 MGD / Mattoon 5.3 MGD	Charleston - 6.0 MGD / Mattoon 14.0 MGD

[1] https://www2.illinois.gov/epa/topics/water-quality/watershed-management/tmdls/Pages/303d-list.aspx
[2] external.epa.illinois.gov/WebSiteApi/api/PublicNotices/GetDocument/10175

A search was completed for existing water quality data collected since January 1, 2002 from the USEPA Water Quality Portal[3] and Mattoon and Charleston provided effluent monitoring data. These data were examined to understand if eutrophication risk determinations could be made using DO, pH, chlorophyll *a* and water temperature. A summary of the data mining and analysis results for the receiving stream and stations on relevant nearby segments is presented in Table 3. Figure 1 shows site locations.

Table 3. Receiving Stream and Tributary Water Quality Summary

Site	Analyte	Mean	units	Number of Measurements	Begin Date	End Date
IL_EPA_WQX-BEN-01	Chlorophyll a, corrected for pheophytin	2.24	ug/l	5	5/31/2016	8/2/2021
IL_EPA_WQX-BEN-01	Dissolved oxygen (DO)	7.40	mg/l	3	5/31/2016	8/29/2016
IL_EPA_WQX-BEN-01	pH	7.93	None	3	5/31/2016	8/29/2016
IL_EPA_WQX-BEN-01	Temperature, water	23.50	deg C	3	5/31/2016	8/29/2016
IL_EPA_WQX-BEN-02	Chlorophyll a, corrected for pheophytin	4.14	ug/l	2	6/8/2021	8/2/2021
IL_EPA_WQX-BENA-01	Chlorophyll a, corrected for pheophytin	2.80	ug/l	5	5/31/2016	8/4/2021
IL_EPA_WQX-BENA-01	Dissolved oxygen (DO)	7.40	mg/l	3	5/31/2016	8/29/2016
IL_EPA_WQX-BENA-01	pH	7.97	None	3	5/31/2016	8/29/2016
IL_EPA_WQX-BENA-01	Temperature, water	23.07	deg C	3	5/31/2016	8/29/2016
IL_EPA_WQX-BENA-03	Chlorophyll a, corrected for pheophytin	4.38	ug/l	5	5/31/2016	8/2/2021
IL_EPA_WQX-BENA-03	Dissolved oxygen (DO)	7.73	mg/l	3	5/31/2016	8/29/2016
IL_EPA_WQX-BENA-03	pH	8.00	None	3	5/31/2016	8/29/2016
IL_EPA_WQX-BENA-03	Temperature, water	23.53	deg C	3	5/31/2016	8/29/2016
IL_EPA_WQX-BENC-01	Chlorophyll a, corrected for pheophytin	3.70	ug/l	2	6/8/2021	8/2/2021
NARS_WQX-ILSS-1169	Dissolved oxygen (DO)	1.80	mg/l	1	9/30/2014	9/30/2014
NARS_WQX-ILSS-1169	pH	7.62	None	2	9/30/2014	9/30/2014
NARS_WQX-ILSS-1169	Temperature, water	15.10	deg C	1	9/30/2014	9/30/2014

Few usable monitoring sites sourced from publicly available data were found for the receiving streams, Cassell Creek, upstream Kickapoo, and relevant downstream segments. An Illinois Freedom of Information Act request to IEPA revealed additional continuous monitoring data from 2011 and 2016 indicating the Kickapoo Creek segment BEN-01 met the risk of eutrophication threshold based on %DO + pH from 6 of 7 days monitored in July 2011. No risk was identified from 15 days of continuous monitoring in 2016 nor from 3 grab samples taken in 2011 and 3 in 2016. While this was sufficient to trigger the NARP special condition, at no site was there enough to fully understand the risk of eutrophication, nor make a defensible determination of the source of nutrients. Both receiving segments, Cassell Creek (IL_BENC) and Kickapoo Creek Upstream (IL_BEN-02) had only a single site downstream

[3] www.waterqualitydata.us

of the outfall, and only chlorophyll *a* was collected. The limited data on the impaired segment of Riley Creek (IL_BENA) exhibits appropriate DO, pH and generally low sestonic chlorophyll *a.* Other relevant sites on the receiving segments, upstream tributaries and downstream show little variation in DO and pH among sites.

Additional data collection and analysis will help to better assess the contributions of treatment plants to the receiving streams and the downstream impaired segment and allow for an informed decision on the necessity of undertaking a comprehensive NARP that includes watershed characterization, development of site-specific water quality targets, and implementation. It should be noted that a Total Maximum Daily Load (TMDL) is underway for the Kickapoo Creek watershed to address the low DO impairment for Riley Creek. Stage 1 is complete, including a watershed characterization. Additional monitoring and modeling comprise next steps in the process. In addition, a Watershed Management Plan is near completion for the entire Embarras River watershed.

3 Monitoring Plan Overview

Considering the effort and investment necessary for NARP development, and the lack of data available to make "at risk" determinations, stream monitoring is recommended. Water quality data will facilitate the assessment of the risk of eutrophication and guide additional components if required.

The proposed in-stream water quality monitoring expands upon past data collection efforts. The program will be organized by Northwater Consulting, in partnership with Charleston Public Works and the City of Mattoon. To augment existing records, data collection is prioritized to locations with previous monitoring, where possible. To maintain cost effectiveness, a combination of grab sampling and continuous monitoring is proposed. The goal is to collect adequate data during the critical period between May and October when NARP triggering conditions are most likely to occur and to provide information on the contribution of each plant's effluent to the risk of eutrophication on Kickapoo Creek. Monitoring will determine initial impacts to water quality in the receiving streams, water quality in the NARP-triggering segment of Kickapoo as well as contributions from major tributaries (Riley Creek before it combines with Cassell Creek). This will guide future stages of the NARP such as additional watershed characterization, assessing impairment causes/sources, and water quality model development. Further, the risk of eutrophication can be evaluated.

Recommended monitoring elements include:

1. Three grab sample-only sites:
    a. Cassell Creek: upstream of Charleston POTW outfall.
    b. Kickapoo Creek: upstream of Mattoon POTW outfall.
    c. Kickapoo Creek: downstream of Mattoon POTW outfall just before confluence with Riley Creek.

2. Four continuous sensor sites:
    a. Riley Creek: upstream of confluence with Cassell Creek.
    b. Riley Creek: on segment upstream of Kickapoo Creek.
    c. Kickapoo Creek: downstream of Mattoon POTW outfall (middle Kickapoo site).
    d. Kickapoo Creek combined: on downstream segment with risk of eutrophication.

3. Continuous sensor site parameters:
    a. Hydrological: stream stage.
    b. Water quality: pH, sestonic chlorophyll *a*, water temp, DO, conductivity.
4. At all sites:
    a. Grab samples and storm monitoring.
    b. Weekly at Cassell and Kickapoo upstream and downstream; biweekly at Riley upstream and downstream and Kickapoo middle and combined.
        i. Stream discharge/flow.
        ii. In-situ analysis of pH, conductivity, oxidation reduction potential, temperature, dissolved oxygen and turbidity.
        iii. Grab samples for laboratory analysis of orthophosphate, total phosphorus, chlorophyll *a.*

Recommended parameters capture data critical for making the NARP determination. While there are myriad sampling methods that could be employed and characteristics available to measure, such as periphyton (attached algae chlorophyll) and nitrogen, this sampling scheme is designed to adhere closely to Illinois EPA guidance.

4 Stream Monitoring

4.1 General Schedule

Data collection will commence as soon as possible, on or around July 1, 2022 for Charleston and on or around August 1, 2022 for Mattoon and will continue through October 31. The critical period of monitoring is May 1-October 31, when water quality issues are most likely to occur. Because of the truncated 2022 season, we propose to continue data collection starting May 1, 2023 through approximately July 31, 2023 until a sufficient dataset is gathered.

4.2 Stations

Seven monitoring stations are proposed to capture receiving stream water quality before and after the addition of treated effluent at each plant, and to determine potential tributary impacts and characterize the segment that met IEPA's risk of eutrophication criteria (Figure 3). Monitoring will provide sufficient data for NARP determination and additional stages of the process, if necessary. The stations are located at bridge crossings or preestablished access points. The upstream sites are close enough to the outfall to capture as much of the watershed upstream as possible without the influence of effluent. The downstream

sites are located at a distance to allow for sufficient mixing of effluent and streamflow and to evaluate the immediate impacts of nutrients from the treatment plants before they combine. The Kickapoo "combined" site will allow for characterization of the segment that triggered the NARP. Data collected using this approach can then be used to develop a predictive model estimating nutrient sources (if required) and the potential impacts to downstream water quality.

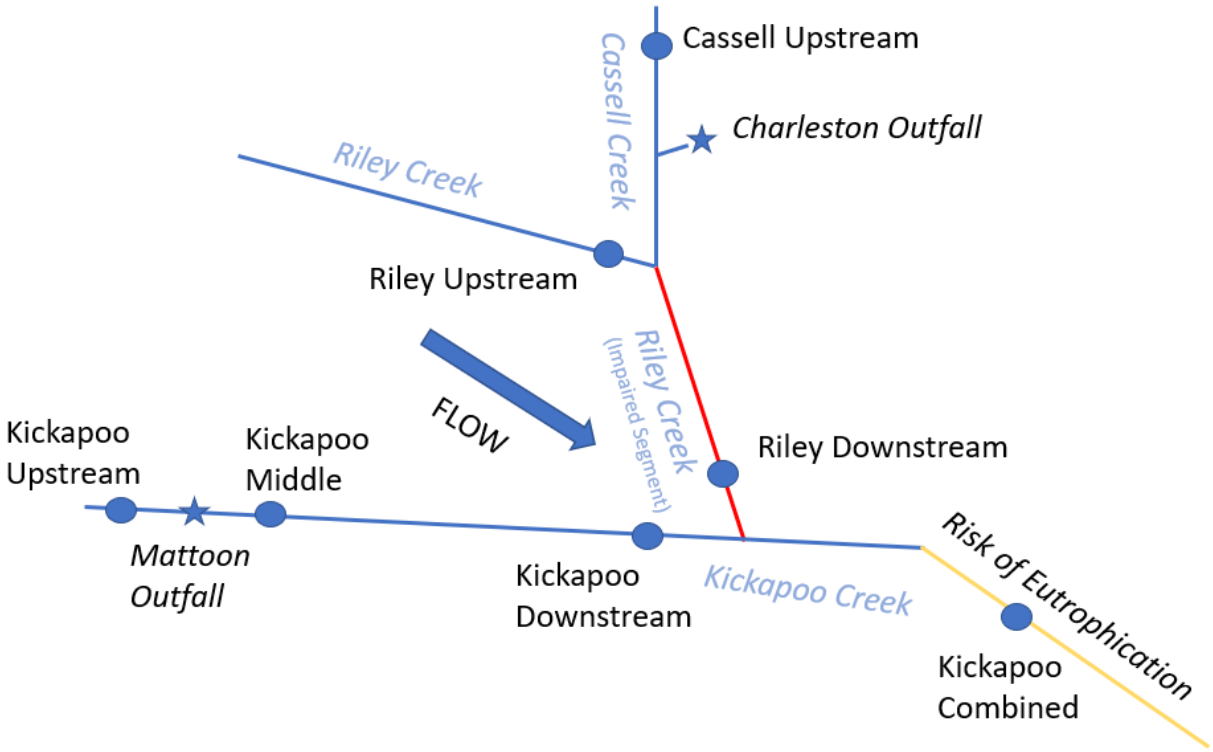

Figure 2. Line Diagram of Monitoring Creeks and Monitoring Locations

Table 4 – Proposed Water Quality Monitoring Stations

Station ID	Name	Lat/Long	Station ID and organization which previously collected data at this site	Approximate distance from outfall	Type of Sampling
U-CWWP	Cassell Creek Upstream	39.498636, -88.205340	NA	0.625 mi	Grab Only, Weekly and Storm
RC-UC	Riley Creek Upstream	39.486860, -88.210115	IEPA BENA-03	0.7 mi	Continuous, Biweekly Grab and Storm
RC-DC	Riley Creek Downstream	39.476217, -88.206194	IEPA BENA-01	1.5 mi	Continuous, Biweekly Grab and Storm

Station ID	Name	Lat/Long	Station ID and organization which previously collected data at this site	Approximate distance from outfall	Type of Sampling
U-MWWP	Kickapoo Creek Upstream	39.4731612, -88.3651197	NARS IL_SS-1169	0.25 mi	Grab Only, Weekly and Storm
KC-MD	Kickapoo Creek Middle	39.470013, -88.345709	NA	1.1 mi	Continuous, Biweekly Grab and Storm
KC-DN	Kickapoo Creek Downstream	39.465059, -88.230240	IEPA BEN-02	7.5 mi	Grab Only, Weekly and Storm
KC-CB	Kickapoo Creek Combined	39.46252, -88.19315	IEPA-BEN-01	10 mi	Continuous, Biweekly Grab and Storm

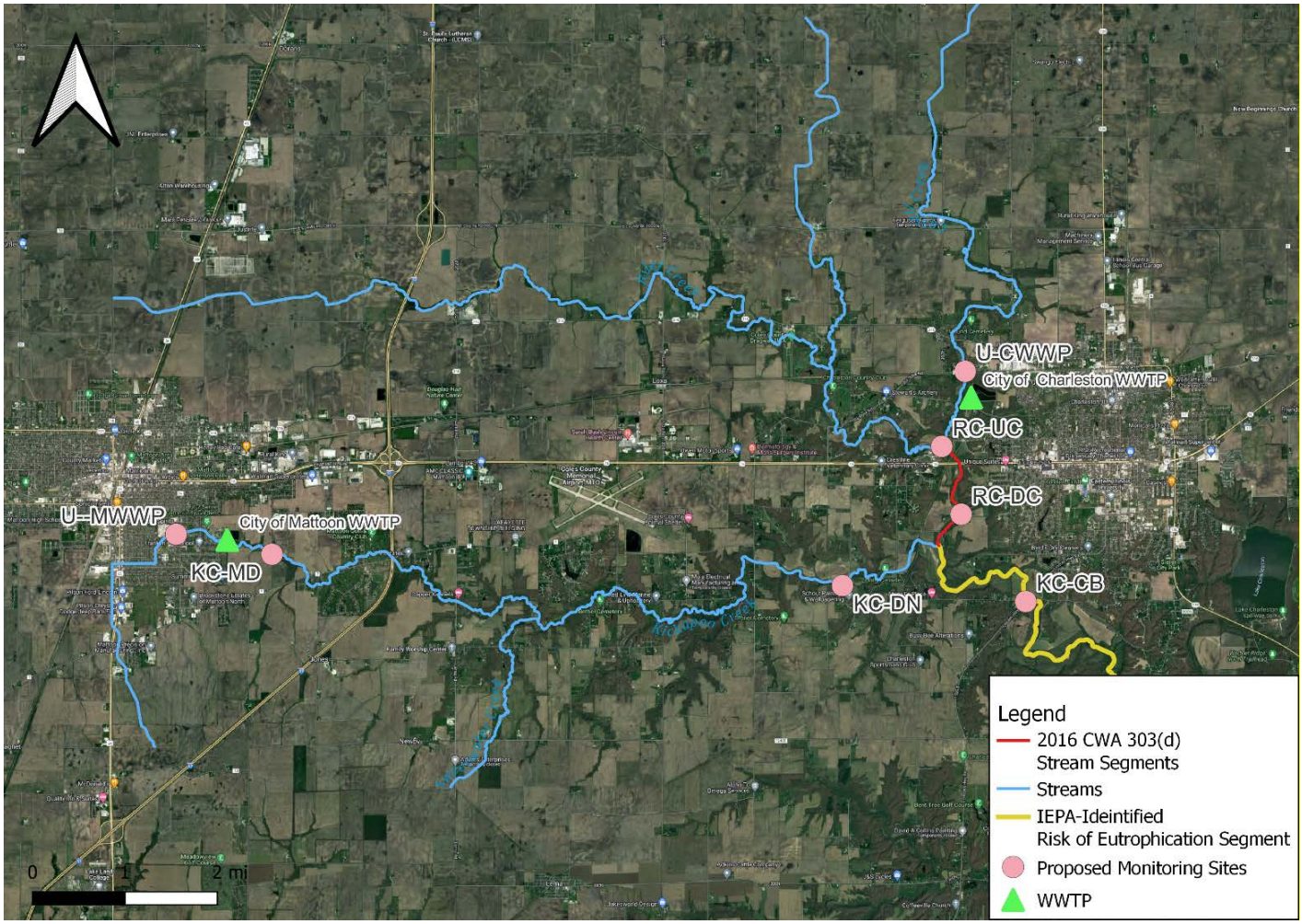

Figure 3. Proposed Monitoring Sites

4.2.1 City of Charleston Monitoring Location Information

Riley Creek Looking Downstream - RC-UC

Monitoring will begin in summer 2022. The Cassel Creek upstream site captures a 17.8 mi^2 watershed and is approximately 0.1 miles from the outfall with no significant point or nonpoint sources between. The Riley Creek upstream site is located just above its confluence with Cassell Creek, which is approximately 0.6 miles from the outfall. This site captures the influence of a major upstream tributary with 39 mi^2 watershed that contributes to the combined load downstream. Figure 3 illustrates the orientation of sites. The downstream monitoring site on Riley Creek is approximately 1.5 miles from the outfall, and 0.9 miles from where Cassell and Riley Creek combine. The Riley Creek downstream site is located on segment IL_BENA. This combination of sites site represents the best chance of capturing the initial impact of the effluent on Riley Creek, while also identifying the influence of upstream tributaries.

4.2.2 City of Mattoon Monitoring Location Information

Kickapoo Creek Looking Downstream – KC-MD

Monitoring will begin in summer 2022. The Kickapoo Creek upstream site is approximately 0.1 miles from the outfall with no significant point or nonpoint sources between and captures a 5.8 mi^2 watershed with both urban and agricultural land cover. The Kickapoo middle site is approximately 1.1 miles downstream from the Mattoon outfall and represents the best chance to capture the initial impacts of treated effluent on Kickapoo Creek. The downstream monitoring site on Kickapoo Creek is approximately 7.5 miles from the outfall, and 1.3 miles above the confluence with Riley Creek. This location captures a 30.5 mi^2 watershed and the effects of nonpoint sources to Kickapoo Creek before it combines with Riley.

4.2.3 Kickapoo Creek "Combined" Monitoring Location Information

Monitoring of the Kickapoo Creek combined site will begin in summer 2022. This site is located downstream of the confluence of Kickapoo and Riley Creek on stream segment BEN-01 which was identified by IEPA as meeting the risk of eutrophication thresholds. Monitoring at this location, combined with the others in this plan will allow for full evaluation of eutrophication risk. Further, the combination of monitoring sites will characterize stream dynamics, and, if required will inform modeling in future NARP phases including allocation of nutrient sources.

4.3 Sampling and Analyses

Sampling will use industry standards and manufacturer protocols for calibration, maintenance, and data collection, and will be documented.

4.3.1 Hydrology Data

Stream stage and discharge data will be collected at each site (Table 5). If a sufficient range of flows is captured, a rating curve can support estimates of stream loading which will inform watershed characterization and further NARP development, if necessary.

Table 5. Hydrology Parameters

Parameter	Collection Type	Frequency	Instrument/Method
Stream Stage	Continuous Probe, Staff Gauge	Continuous, Discreet	Vented Pressure Transducer, Graduated Staff Gauge
Discharge	Manual	Bi-weekly, with additional storm samples	Digital Electromagnetic Flow Meter + wading staff or ADCP

4.3.2 Water Quality Data

Multiparameter sondes with integrated sensor wipers to reduce biofouling will be installed at each continuous monitoring site and will collect data on a 15-minute interval (Table 6). Sondes will be left in place for multi-week deployments and serviced and/or calibrated bi-weekly using manufacturer protocols unless conditions allow for a longer period between service, though no less frequently than every 30 days. Multiparameter sondes manufactured by In-Situ Instruments will be deployed. Grab samples and in-situ water quality measurements will be collected to augment sonde data, support quality assurance and provide additional parameters useful for the NARP assessment.

Grab samples will be collected on a bi-weekly frequency at continuous monitoring sites, and weekly at grab sample only sites. 40 CFR Part 136 procedures will be followed and will include using laboratory-provided bottles, adherence to recommended sample preservation, holding times, and conditions for samples. Grab samples will be analyzed in-house at the City of Charleston and City of Mattoon plant laboratories respectively, with chlorophyll *a* being outsourced to an accredited environmental laboratory.

Table 6. Water Quality Parameters

Parameter	Collection Type	Frequency	Method	Method Identifier
Dissolved Oxygen	Continuous Probe	Continuous	Optical	InSitu: EPA approved method YSI: ASTM D888-09
	Handheld Meter	Bi-weekly, Storm	Optical	ASTM D888-09
pH	Continuous Probe	Continuous	Potentiometric	EPA 150.2
	Handheld Meter	Bi-weekly, Storm	Potentiometric	EPA 150.2
Water Temperature	Continuous Probe	Continuous	Thermistor	EPA 170.1
	Handheld Meter	Bi-weekly, Storm	Thermistor	EPA 170.1
Chlorophyll-a	Continuous Probe	Continuous	In-situ Optical Fluorescence	Instrument Manufacturer Optical Method
	Grab	Bi-weekly, Storm	Lab Spectrophotometric	EPA 445.0
Total Phosphorus	Grab	Bi-weekly, Storm	Colorimetry	EPA 365.1 / EPA 365.3
Orthophosphate	Grab	Bi-weekly, Storm	Colorimetry	EPA 365.1 / EPA 365.3
Conductivity	Continuous Probe	Continuous	Resistor Network	EPA 120.1
	Handheld Probe	Bi-weekly, Storm	Resistor Network	EPA 120.1

5 Data Management & Quality Control

Data will be downloaded from each logger at each site visit and will be maintained in a relational Microsoft Access database or Microsoft Excel spreadsheet. Continuous data will be corrected for drift using the statistical software R, package driftR[4] using a standard procedure based on instrument calibration. A full quality assurance and quality control procedure document will be included in a final monitoring report and implemented.

[4] https://rdocumentation.org/packages/driftR/versions/1.1.0

APPENDIX B: WATER QUALITY DATA

Appendix B Data Table 1 - Cassell Creek Upstream of Charleston WWTP outfall (UCWWP) Grab Sample Data

Date Time	Site	DO Sat	Temp	Flow	Turbidity	Stage	DO Conc.	NH3	NO3	TN	OrthoP as P	TP	Redox	ChlA	Sp. Cond.	pH
UTC		%	C	CFS	RFU	ft	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mV	µg/L	µS/cm	SU
6/1/2022 17:00	UCWWP	95.7	22.1				8.97				0.07	0.12				7.91
6/6/2022 17:00	UCWWP	94.5	21.6				8.33				0.03	0.06		3.60		8.23
6/14/2022 17:00	UCWWP	100.0	26.2				8.08				0.08	0.08				8.22
6/21/2022 17:00	UCWWP	96.4	23.6				8.18				0.08	0.13				8.06
6/27/2022 17:00	UCWWP	91.9	21.6				8.10				0.07	0.15				8.21
7/21/2022 19:20	UCWWP	106.3	25.7	2.2	7.3		8.65						107		604	7.89
7/26/2022 17:17	UCWWP	88.3	21.4				7.83				0.11	0.13				8.10
8/2/2022 17:15	UCWWP	87.3	21.7				7.68				0.17	0.24				8.10
8/4/2022 22:05	UCWWP	96.6	24.4	4.1	16.0		8.06						238		418	7.46
8/9/2022 17:32	UCWWP	87.3	22.7				7.53				0.27	0.36				7.99
8/16/2022 17:27	UCWWP	103.1	22.2				8.98				0.11	0.18				8.26
8/17/2022 18:20	UCWWP	101.1	21.8	0.2			8.88						194		608	7.69
8/23/2022 17:24	UCWWP	95.0	23.0				8.15				0.11	0.14				8.13
8/30/2022 13:11	UCWWP	77.4	20.9				6.92				0.13	0.49				7.37
8/31/2022 18:54	UCWWP	91.7	20.6		26.3	1.32	8.25						179		385	7.78
9/6/2022 17:27	UCWWP	92.8	21.8				8.15				0.04	0.13				8.29
9/13/2022 17:57	UCWWP	98.2	19.4				9.04				0.03	0.11				8.22
9/15/2022 17:04	UCWWP	97.0	19.2	0.6	2.1	0.70	8.91						179		575	7.87
9/20/2022 17:05	UCWWP	83.2	22.8				7.15				0.04	0.14		0.50		8.07
9/27/2022 16:35	UCWWP	79.9	14.6				8.12				0.08	0.37				8.07
10/4/2022 18:15	UCWWP	101.7	16.0				10.04				0.03	0.14				8.20
10/11/2022 18:05	UCWWP													4.60		
10/18/2022 17:10	UCWWP	72.0	8.6				8.38				0.10	0.34				7.12
10/25/2022 16:56	UCWWP	29.8	16.3				2.91				0.11	0.42		1.70		7.59
11/3/2022 14:56	UCWWP	31.3	11.9		1.3	0.76	3.40						118		388	7.43
5/1/2023 20:05	UCWWP	129.0	11.5	7.7	2.1	0.89	14.00						56		533	8.39
5/2/2023 16:06	UCWWP	108.2	10.3				12.14	0	5.29	6.36		0.03				8.22
5/9/2023 17:05	UCWWP	94.0	16.6			1.36	9.16	0	11.60	13.70		0.20		6.20		7.78
5/15/2023 21:24	UCWWP	104.5	16.0	15.6	5.5	1.02	10.19						186		530	8.13
5/16/2023 17:05	UCWWP	93.2	15.5			0.88	9.30	0	7.78	9.01	0.05	0.06				8.08
5/23/2023 17:02	UCWWP	104.3	19.6			0.90	9.58	0	7.14	8.24	0.03	0.06		8.80		8.20
5/31/2023 21:10	UCWWP	87.1	24.1	3.5	3.1	0.76	7.36						100		542	8.17
6/6/2023 17:09	UCWWP	99.9	19.8			0.86	9.12	0	6.02	7.87	0.01	0.06				8.31
6/12/2023 18:07	UCWWP	87.4	17.4	5.4	5.4	0.80	8.38						115		483	8.32
6/13/2023 17:02	UCWWP	98.0	19.7			0.80	9.00	0	5.04	9.76	0.06	0.07		1.00		8.26
6/20/2023 17:15	UCWWP	99.5	23.2				8.54	0	2.56	2.93	0.07	0.12				8.26
6/26/2023 17:30	UCWWP	73.0	22.4	1.0	5.9	0.76	6.31						112		515	8.12
6/27/2023 17:28	UCWWP	96.7	22.9			0.00	8.31	0	0.71	1.79	0.14	0.16				8.25
7/11/2023 17:22	UCWWP	95.2	24.1			0.50	8.01	0	2.03	6.49	0.13	0.13		1.00		8.07
7/14/2023 20:00	UCWWP	82.2	25.5	0.9	6.4	0.62	6.67						103		657	8.05
7/18/2023 17:02	UCWWP	89.4	24.4			0.26	7.51	0	0.93	8.50	0.19	0.19				7.89
7/25/2023 17:04	UCWWP	88.1	25.5				7.23	0	0.61	4.19	0.19	0.18		1.00		8.14
7/31/2023 16:58	UCWWP	76.8	23.6	0.1	11.2	0.54	6.48						110		529	8.05

Appendix B Data Table 2. Riley Creek Upstream of Cassell (RCUC) Grab Sample Data

Date Time	Site	DO Sat	Temp	Flow	Turbidity	Stage	DO Conc.	NH3-N	NO3-N	TN	OrthoP as P	TP	Redox	ChlA	Sp. Cond.	pH
UTC		%	C	CFS	RFU	ft	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mV	µg/L	µS/cm	SU
6/1/2022 17:00	RCUC	101.9	22.70				8.80				0.14	0.43				8.22
6/6/2022 17:00	RCUC	104.4	21.70				9.18				0.09	0.19		1.00		8.33
6/14/2022 17:00	RCUC	116.0	27.40				9.13				0.05	0.10				8.31
6/21/2022 17:00	RCUC	119.0	25.90				9.66				0.06	0.11				8.37
6/27/2022 17:00	RCUC	100.4	23.50				8.55				0.15	0.22				8.21
7/19/2022 17:13	RCUC	100.9	25.90				8.25				0.09	0.10				8.17
7/21/2022 20:00	RCUC	116.0	27.20	5.77	6.86	1.16	9.18						109.50		583	7.97
7/26/2022 17:32	RCUC										0.09	0.12				
8/2/2022 17:42	RCUC	79.7	22.10				6.97				0.09	0.13				
8/4/2022 21:26	RCUC	93.0	25.00	35.12	22.40	1.72	7.71						136.90		405	7.44
8/9/2022 17:51	RCUC					1.30					0.14	0.27				
8/16/2022 17:43	RCUC					1.00					0.08	0.09				
8/17/2022 18:57	RCUC	82.2	22.70	0.62	2.72		7.09						194.80		592	7.80
8/23/2022 17:45	RCUC					1.00					0.09	0.12				
8/30/2022 13:20	RCUC										0.50	1.13				
8/31/2022 19:43	RCUC	81.0	21.50		42.10	2.62	7.23						190.90		318	7.60
9/6/2022 17:35	RCUC					1.16					0.15	0.20				
9/13/2022 18:10	RCUC					1.02					0.06	0.10				
9/15/2022 17:24	RCUC	82.7	19.80	1.59	6.25	1.00	7.63						176.80		547	7.86
9/20/2022 17:20	RCUC					0.95					0.06	0.21		0.50		
9/27/2022 16:45	RCUC					0.95					0.06	0.20				
10/4/2022 18:20	RCUC										0.07	0.09				
10/11/2022 18:13	RCUC													0.50		
10/18/2022 17:20	RCUC					0.95					0.12	0.15				
10/25/2022 17:00	RCUC					1.02					0.19	0.22		0.50		
11/3/2022 15:58	RCUC	36.9	12.70		3.04	1.02	3.92						131.60		384	7.24
5/1/2023 19:28	RCUC	133.3	12.00	16.18	2.35	1.31	14.33						66.90		500	8.50
5/2/2023 16:24	RCUC							0.00	3.14	6.36	0.01	0.02				
5/9/2023 17:19	RCUC	101.6	18.20			1.94	9.58	0.13	5.54	8.67		0.09				7.92
5/9/2023 17:23	RCUC													4.80		
5/15/2023 20:41	RCUC	108.4	16.80	27.10	6.82	1.62	10.48						196.10		550	8.27
5/16/2023 17:20	RCUC					1.68		0.06	7.52	8.28	0.05	0.08				
5/23/2023 17:13	RCUC					1.28		0.04	6.10	7.31	0.04	0.06		1.00		
5/31/2023 20:23	RCUC	109.2	25.30	9.62	2.33		8.89						133.00		579	8.21
6/6/2023 17:27	RCUC					1.24		0.01	3.45	6.99	0.04	0.10				
6/12/2023 17:24	RCUC	89.4	17.90	20.00	12.10	1.37	8.46						105.40		475	8.32
6/13/2023 17:23	RCUC					1.24		0.03	4.12	5.73	0.05	0.10		1.70		
6/26/2023 16:47	RCUC	69.7	23.70	2.66	4.12	0.89	5.83						141.50		547	8.12
6/27/2023 17:39	RCUC					0.92		0.03	0.61	1.84	0.12	0.14				
7/11/2023 17:49	RCUC					1.00		0.06	9.71	11.60	1.26	1.26		1.10		
7/14/2023 19:15	RCUC	89.5	26.70	2.34	10.60	0.90	7.11						98.60		568	8.04
7/18/2023 17:13	RCUC					0.88		0.09	0.63	4.70	0.19	0.21				
7/25/2023 17:24	RCUC					0.08		0.05	0.29	3.33	0.15	0.16		1.00		
7/31/2023 17:30	RCUC	97.3	24.90	0.12	5.28	0.72	8.20						60.60		561	8.08

Appendix B Data Table 3 - Riley Creek Downstream of Cassell (RCDC) Grab Sample Data

Date Time	Site	DO Sat	Temp	Flow	Turbidity	Stage	DO Conc.	NH3-N	NO3-N	TN	OrthoP - as P	TP	Redox	ChlA	Sp. Cond.	pH
UTC		%	C	CFS	RFU	ft	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mV	µg/L	µS/cm	SU
6/1/2022 17:00	RCDC	101.2	22.5				8.77				0.43	0.43				8.25
6/6/2022 17:00	RCDC	106.9	21.5				9.42				0.31	0.32		3.40		8.33
6/14/2022 17:00	RCDC	110.7	27.2				8.80				0.40	0.46				8.14
6/21/2022 17:00	RCDC	111.5	25.5				9.13				0.58	0.63				8.32
6/27/2022 17:00	RCDC	99.6	23.7				8.44				0.37	0.47				8.22
7/19/2022 17:32	RCDC	104.0	25.7				8.47				0.24	0.24				8.22
7/21/2022 20:22	RCDC	121.6	27.8	11.4	4.8	1.22	9.50						111		616	8.07
7/26/2022 17:41	RCDC										1.10	1.08				
8/2/2022 17:50	RCDC										0.78	0.85				
8/4/2022 20:58	RCDC	96.2	24.9	69.7	21.3	1.80	7.92						131		439	7.46
8/9/2022 18:02	RCDC					1.80					0.44	0.50				
8/16/2022 17:51	RCDC					1.10					0.91	0.97				
8/17/2022 19:38	RCDC	97.1	22.6	5.2	3.4		8.42						191		689	7.87
8/23/2022 17:50	RCDC					1.00					1.19	1.31				
8/30/2022 13:30	RCDC										0.56	0.69				
8/31/2022 20:41	RCDC	91.0	21.6		38.5	2.84	8.05						192		344	7.58
9/6/2022 17:45	RCDC					1.28					0.65	0.51				
9/13/2022 18:20	RCDC					1.18					0.67	0.68				
9/15/2022 18:17	RCDC	91.2	20.2	4.5	4.2	1.12	8.25						179		600	7.94
9/20/2022 17:31	RCDC					1.10					1.33	1.38		0.50		
9/27/2022 16:55	RCDC					1.02					1.49	1.64				
10/4/2022 18:25	RCDC										2.71	2.84				
10/11/2022 18:21	RCDC													1.70		
10/18/2022 17:30	RCDC					0.98					2.16	2.44				
10/25/2022 17:15	RCDC					1.12					2.43	2.60		58.00		
11/3/2022 17:06	RCDC	50.4	14.7		1.8		5.11						134		426	7.28
5/1/2023 17:13	RCDC	125.4	11.4	31.5	1.4	1.55	13.67						71		543	8.05
5/2/2023 16:36	RCDC							0.00	6.08	7.97	0.09	0.30				
5/9/2023 17:34	RCDC	99.5	17.3			2.36	9.57	0.13	9.35	11.00		0.20				7.97
5/9/2023 17:37	RCDC													7.40		
5/15/2023 19:58	RCDC	104.0	16.8	53.2	10.4	1.90	10.05						176		541	8.23
5/16/2023 17:32	RCDC					1.84		0.07	7.89	9.17	0.20	0.21				
5/23/2023 17:26	RCDC					1.52		0.03	7.48	9.05	0.36	0.36		1.00		
5/31/2023 19:11	RCDC	116.0	24.4	17.8	2.9	1.40	9.73						143		573	8.29
6/6/2023 17:37	RCDC					1.36		0.01	5.05	11.60	0.46	0.52				
6/12/2023 16:05	RCDC	78.0	17.2	34.7	17.4	1.59	7.48						113		455	8.24
6/13/2023 17:35	RCDC					1.44		0.04	5.11	7.12	0.29	0.29				
6/13/2023 17:45	RCDC													2.10		
6/26/2023 15:52	RCDC	57.6	22.6	5.8	4.4	1.15	4.97						145		526	7.93
6/27/2023 17:49	RCDC					1.26		0.05	7.94	9.31	1.09	1.17				
7/11/2023 18:04	RCDC					1.75		0.05	5.18	6.88	0.59	0.62		1.00		
7/14/2023 17:44	RCDC	88.3	24.6	9.4	15.1	1.19	7.34						95		668	8.04
7/18/2023 17:24	RCDC					1.18		0.22	8.70	12.80	1.34	1.46				
7/25/2023 17:36	RCDC					0.98		0.08	10.80	12.00	1.57	1.48		4.90		
7/31/2023 18:21	RCDC	108.2	26.8	1.3	8.3	0.96	8.63						71		621	7.81

Appendix B Data Table 4 - Kickapoo Creek Combined (KCCB) Grab Sample Data

Date Time	Site	DO Sat	Temp	Flow	Turbidity	Stage	DO Conc.	NH3-N	NO3-N	TN	OrthoP as P	TP	Redox	ChlA	Sp. Cond.	pH
UTC		%	C	CFS	RFU	ft	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mV	µg/L	µS/cm	SU
8/4/2022 18:38	KCCB	80.2	24.50		42.30		6.66				0.98	1.13	142.90		363	7.40
8/9/2022 18:20	KCCB	88.3	23.00				7.57				0.45	0.54				7.93
8/16/2022 18:08	KCCB	115.8	24.40				9.69				0.78	0.83				8.40
8/17/2022 20:30	KCCB	109.0	24.60	6.43	4.73		9.07						182.50		661	7.93
8/23/2022 18:07	KCCB	116.2	23.80			1.50	9.81				1.28	1.27				8.31
8/30/2022 14:18	KCCB	78.7	21.40				6.97				0.53	0.66				7.43
8/31/2022 21:15	KCCB	88.5	22.30		63.30	3.15	7.70						181.60		355	7.73
9/6/2022 18:10	KCCB	100.8	22.70			1.76	8.70				0.65	0.68				8.15
9/13/2022 18:49	KCCB	123.1	21.20			1.68	10.97				0.65	0.66				8.53
9/15/2022 18:48	KCCB	112.1	21.20	12.67	3.50	1.58	10.02						167.20		582	8.01
9/20/2022 17:50	KCCB	108.9	25.40				8.96				1.13	1.17		1.80		8.38
9/27/2022 17:18	KCCB	97.3	15.20			1.38	9.79				1.30	1.37				8.27
10/4/2022 18:04	KCCB	97.9	15.20				9.84				1.87	1.88				8.04
10/11/2022 18:39	KCCB													0.50		
10/18/2022 17:46	KCCB	96.3	7.80			1.32	11.45				1.72	1.94				8.00
10/25/2022 17:32	KCCB	65.5	16.70			1.34	6.36				1.91	1.99		21.00		7.85
11/3/2022 18:15	KCCB	73.2	14.20		1.77	1.45	7.53						125.20		406	7.33
5/1/2023 18:17	KCCB	116.4	12.10	35.46	1.38	1.37	12.59						65.40		548	8.49
5/2/2023 16:50	KCCB	114.1	12.90				12.09	0.00	5.51	6.44	0.11	0.34				8.38
5/9/2023 17:49	KCCB	95.2	18.60			2.38	8.92	0.48	8.25	10.90		0.33		7.30		7.96
5/15/2023 18:42	KCCB	95.1	17.50	73.83	14.20	1.76	9.09						219.70		545	8.22
5/16/2023 17:47	KCCB	95.2	16.80			1.70	9.24	0.06	6.99	8.29	0.27	0.30				8.03
5/23/2023 17:41	KCCB	138.4	22.20			1.32	12.10	0.01	4.56	7.24	0.34	0.38		1.00		8.51
5/31/2023 18:15	KCCB	138.0	24.70	26.08	3.29	1.08	11.42						144.10		573	8.42
6/6/2023 17:47	KCCB	122.7	23.30			0.88	10.50	0.03	4.99	11.80	0.77	0.82				8.40
6/12/2023 15:21	KCCB	78.9	17.20	38.06	14.20	1.40	7.62						132.80		424	8.20
6/13/2023 17:50	KCCB	115.7	21.70			1.16	10.20	0.03	5.12	7.88	0.63	0.70		4.70		8.41
6/26/2023 15:22	KCCB	66.2	22.90	9.72	3.09	0.78	5.62						158.20		566	7.98
6/27/2023 18:05	KCCB	124.6	25.60			0.86	10.19	0.04	7.23	8.24	1.10	1.20				8.44
7/11/2023 18:22	KCCB	109.0	26.40			1.50	8.78	0.04	4.33	4.40	0.61	0.62		1.00		8.15
7/14/2023 16:15	KCCB	89.7	24.10	6.40	12.00	0.60	7.52						99.70		654	8.09
7/18/2023 17:35	KCCB	131.7	25.50			0.54	10.79	0.03	7.00	9.60	1.13	1.16				8.16
7/25/2023 17:45	KCCB	122.1	28.70				9.94	0.06	6.87	10.70	1.07	1.16		1.30		8.29
7/31/2023 16:58	KCCB	91.0	23.70	3.40	8.72	0.31	7.70						101.70		613	7.92
8/1/2023 17:36	KCCB	105.5	25.00				8.71	0.06	10.10	16.30	1.76	2.01				8.24
8/8/2023 17:32	KCCB	110.8	24.30				9.28	0.06	12.90	13.90	2.05	2.10		1.00		8.25
8/22/2023 17:45	KCCB	112.6	27.90				8.83	0.07	13.20	13.80	1.86	1.89		1.00		8.18

APPENDIX C: FACITLITY IMPROVEMENT PLAN

1200 West Madison |Charleston, Illinois, 61920

Wastewater Treatment Plant Upgrade: Solids Handling Upgrades & Biological Phosphorus Removal Improvements

PROJECT PLAN

March 13, 2020

License Expiration Date: November 30, 2021

Signature: _____

Date Signed: March 13, 2020

Prepared by:

Donohue & Associates, Inc.
1605 S State Street, Suite 1C |Champaign, IL, 61820
donohue-associates.com

Donohue Project No.: 12251.008

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ABBREVIATIONS

BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
CF	Cubic Foot
DAF	Design Average Flow
DMF	Design Maximum Flow
FEMA	Federal Emergency Management Agency
GPM	Gallons per Minute
GPD	Gallons per Day
HP	Horsepower
MGD	Million Gallons per Day
MHI	Median Household Income
NPDES	National Pollutant Discharge Elimination System
PAO	Phosphorus Accumulating Organisms
PPD	Pounds per day
RAS	Return Activated Sludge
SWD	Side Water Depth
TSS	Total Suspended Solids
UCT	University of Cape Town
USEPA	United States Environmental Protection Agency
VSS	Volatile Suspended Solids
WAS	Waste Activated Sludge
WWTP	Wastewater Treatment Plant
WWTF	Wastewater Treatment Facility

1. EXECUTIVE SUMMARY

The City of Charleston, in conjunction with Donohue & Associates, Inc., has completed a Capital Improvements Plan for the Charleston wastewater treatment plant (WWTP) that has focused on solids handling upgrades and biological nutrient removal improvements. The WWTP current treats a design average of 3.3 MGD with peak design flows of 6.0 MGD. The City authorized this study of upgrading its existing solids handling facilities in order to improve or replace its antiquated facilities, which at the same time, is planning for meeting more stringent phosphorus limits issued in its new NPDES permit. As the result of this evaluation, the City wishes to proceed with the following recommended capital improvement components:

Part A – Solids Handling Upgrades

- Convert two aerobic digester tanks to liquid sludge storage tanks
- Replace the belt filter press sludge dewatering equipment with a new Screw Press
- Abandon the anaerobic digesters and pasteurize the sludge via lime, to meet Class A quality

Part B- Biological Phosphorus Removal Improvements

- Implement a modified UCT configuration to achieve biological phosphorus removal

The proposed plant upgrades are forecasted to have a total initial capital cost of just over $5.8 million. The project is proposed to be financed by a low interest loan from the Illinois EPA Water Pollution Control Loan Program. With that assumption and assuming that nearly all of the project costs are loan eligible and funded by a 1.50% IEPA “Small Community” loan - plus a loan forgiveness award of 45% of the project cost, the project is expected to result in an annual debt retirement cost to the City of $133,355 per year over 30 years. The City is intending on retiring this debt using surplus revenues that are currently entering the City’s Water and Sewer fund. There will be no increase in water and sewer rates as the result of this project.

2. INTRODUCTION

2.1 AUTHORITY AND PURPOSE

This report has been prepared at the direction of the City of Charleston, as authorized by Task Order #9 to a Continuing Engineering Services Agreement with Donohue & Associates, Inc. The purpose of this report is to determine the best means of updating or replacing the solids handling system at the City's wastewater treatment plant and to determine the best means of achieving biological phosphorus removal at the facility.

2.2 SCOPE

This report considered the following characteristics of the solids handling processes to determine which dewatering and stabilizations processes are best suited to meet the City's needs.

From this assessment, the following considerations were taken to determine the most cost effective means of meeting the established effluent and water quality standards.

- Development and evaluation of alternative sludge handling systems.
- Selection of a recommended alternative for the sludge dewatering and stabilization systems.
- Preparation of the Project Plan report for the recommended alternative.
- Identification and discussion of implementation and financial arrangements.

3. PROJECT PLANNING AREA

3.1 FACILITY PLANNING INFORMATION

The Charleston Wastewater Treatment Facility (WWTF) is located at 1200 West Madison Avenue, just inside the corporate limits of the City of Charleston. It is situated along the east side of Cassell Creek, which is west of the City of Charleston. This facility is located inside the existing Facility Planning Area (FPA) for the City of Charleston.

The Charleston WWTF is located in Section 9 of Township 12 North, Range 9 East in the Third Principal Meridian. The facility is located in Charleston Township of Cole County. See Figure 1 for an excerpt of the USGS Charleston South Quad Map, showing the location of the plant.

The Charleston WWTF discharges treated effluent to Cassell Creek under the authority of NPDES Permit IL0021644, which currently has an effective date of March 1, 2020. Appendix A provides a copy of this permit. This permit will expire on February 28, 2025. The plant is permitted to discharge a design flow of 3.3 MGD and a design maximum flow of 6.0 MGD.

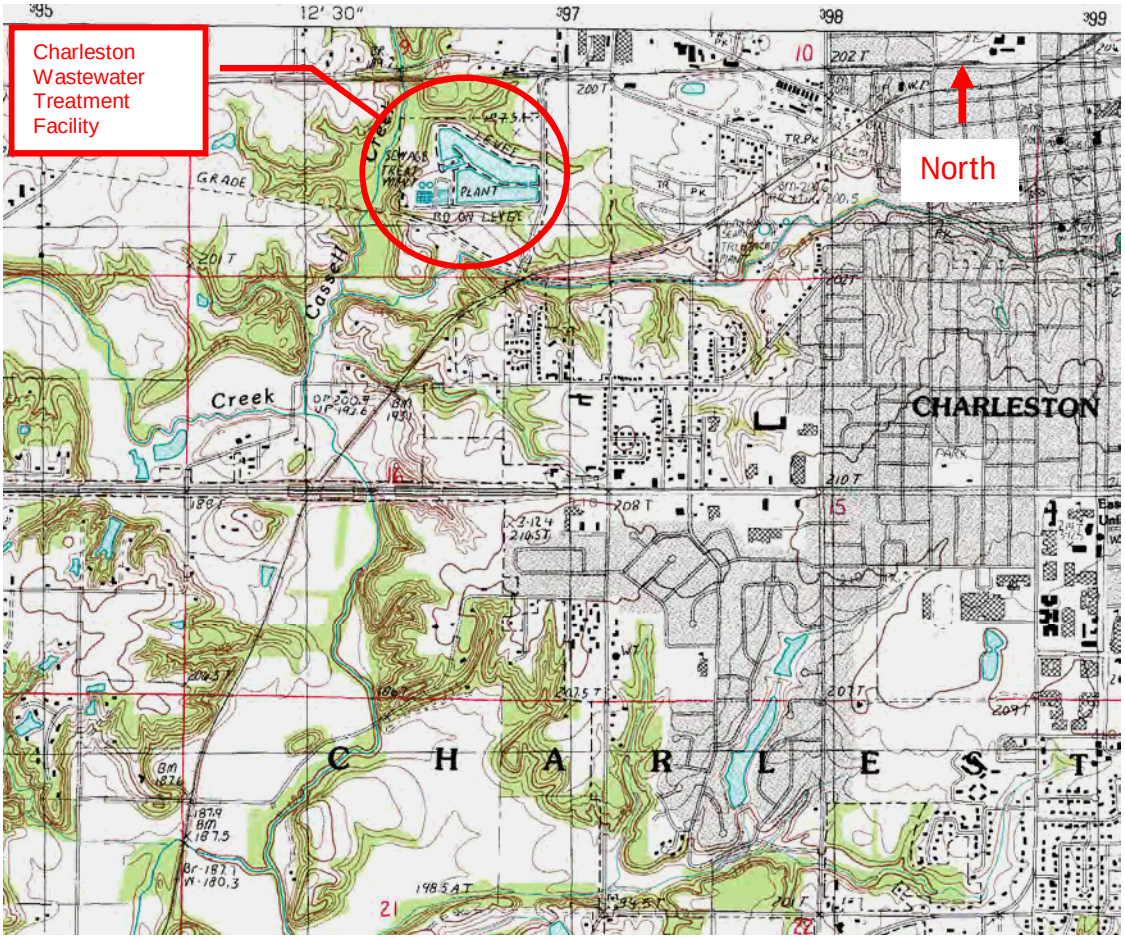


Figure 1: Project Location Map

3.2 ENVIRONMENTAL RESOURCES

As part of this study effort, Donohue & Associates, Inc. has solicited input from agencies associated with environmental issues such as wetlands; flood plains; unique plant or animal communities or other important fish and wildlife habitats; historic, archeological, and cultural features; and any other factors that would be significantly affected by the proposed improvements.

For this project, the City of Charleston has complied with the various State of Illinois and federal enactments for protecting the area's environmental resources. The agencies listed below have been notified of this project for their appropriate sign-off. Appendix B in the back of the report provides the latest correspondence and Environmental Signoffs and approvals from the following agencies about the project:

- Historic Preservation & Archeological Issues: Illinois State Historic Preservation Agency
- Endangered Species Protection & Natural Areas Preservation: Illinois Department of Natural Resources – Division of Natural Resources Review & Coordination
- Wetlands issues: Illinois Department of Natural Resources – Division of Natural Resources Review & Coordination

Figure 2 below provides an aerial map of the current conditions at the wastewater treatment facility. As Figure 2 shows, except for the far northwest end of the site, the WWTF is nearly fully developed, with lagoons, buildings and structures taking up most of the site. The work proposed in this project will take place on the east end of the site, as shown hereafter in Figure 8. For the most part, there would be no land disturbed by the recommended project.

Figure 2: Wastewater Treatment Plant Aerial Photo

Under this study effort, Donohue reviewed FEMA's website to determine whether the Project's Study Area is flood prone. Figure 3 below provides an excerpt from the FEMA flood map for the WWTF site and its surrounding areas. As one can see, the WWTF and the proposed improvements are located well beyond any flood hazard area. Based on this information, it appears that none of the recommended improvements will require flood insurance, as required by the IEPA Water Pollution Control Loan Program, for flood prone areas.

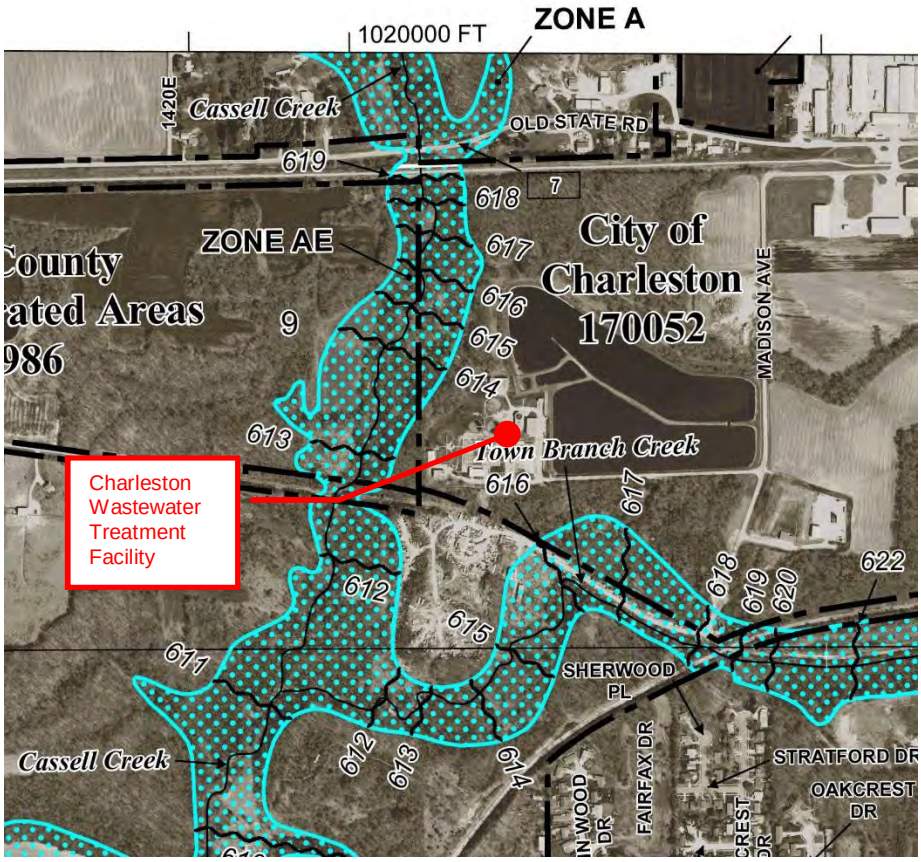


Figure 3: Wastewater Treatment Plant's Flood Map

3.3 PLANNING PERIOD

The project planning period is a 30-year period, extending from 2023 to 2053. It is intended that all equipment proposed in this report have a design life of as much as 30 years. All user charge calculations have been compiled assuming a 30-year payback of the instruments of finance, such as Illinois EPA Water Pollution Control Loan Program loans.

3.4 POPULATION INFORMATION

The U.S. Census Bureau reports that the City of Charleston had a population of 21,838 as of the 2010 census. In 2019, that same agency published population estimates for the period from 2011 to 2018 for the areas inside the City's limits. Table 1 below provides those estimates. As this data shows, the City had significant population losses in 2012-16, which was likely due to a decline in enrollment at Eastern Illinois University (EIU), whose campus is situated entirely within the City of Charleston. EIU is a public, co-educational university that was originally founded in 1895 as Eastern Illinois State Normal School. Current enrollment at EIU was 7,806 on-campus and off-campus students - as of the beginning of the Fall 2019 semester. That student count has recently been increasing. The lowest student population count of 7,030, which occurred in 2017. In comparison, the student enrollment at EIU in the Fall of 2011 was 11,178.

Table 1: Charleston Population Estimates, 2011-18

Year	Population Estimate
2011	21,830
2012	21,621
2013	21,360
2014	21,046
2015	20,770
2016	20,513
2017	20,357
2018	20,186

After reviewing this information as well as overall recent population trends for downstate Illinois, Donohue and the City believe that there will be little, if any, long-term population growth beyond the existing population. Therefore, the study assumes the 2018 population estimate of 20,186 to be viable for planning purposes.

3.5 CURRENT LAND USE

All of the Charleston Wastewater Treatment Facility and its surrounding tracts are zoned for the RE – "Residential Estates" District. Due to the limits scope of building usages under this project, no projected changes in land use are expected.

Figure 4 at right depicts an excerpt from the City's 2018 Zoning Map. As Figure 4 shows, there are no residential areas in close proximity to the plant site.

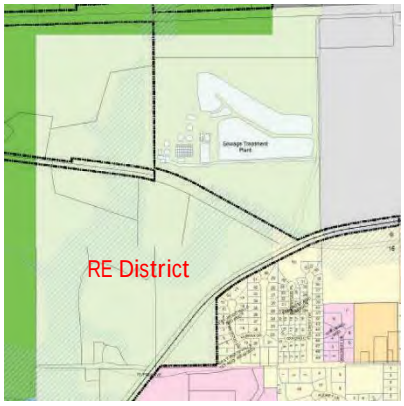


Figure 4: Excerpt from Charleston Zoning Map

4. EXISTING CONDITIONS

The City of Charleston owns and operates the Charleston WWTP. The plant is designed for an average flow of 3.3 MGD and a design maximum flow of 6.0 MGD. The current average daily flow through the plant is 3.0 MGD, slightly lower than the design average flow. The plant is regulated under NPDES Permit No. IL0021644. The full permit is found in Appendix A. There are currently three permitted outfalls; Outfall 001 to the Cassell Creek, Outfall A01 to the Cassell Creek and Outfall 002 to the Town Branch Tributary to Cassell Creek. Outfall 001 is the main plant outfall, Outfall A01 is treated lagoon CSO effluent and 002 is the Main Pump Station CSO. Current effluent limits (monthly average) for the main outfall 001 are shown in below.

$CBOD_5$	10 mg/L	
TSS	12 mg/L	
pH	6 to 9	
Fecal Coliform	400 per 100 mL	May-Oct only
Chlorine Residual	0.05 mg/L	
DO		
Mar-Jul	5.0 Daily Min	6.0 Weekly Ave
Aug-Feb	3.5 Daily Min	4.0 Weekly Ave 5.5 Monthly Ave
Ammonia Nitrogen (NH3-N)		
Apr-May/Sep-Oct	0.8 mg/L	
Jun-Aug	0.8 mg/L	
Nov-Mar	4.0 mg/L	
Total Phosphorus (TP)	Monitor Only	
Total Nitrogen (TN)	Monitor Only	

4.1 EXISTING COLLECTION SYSTEM

The City of Charleston's sewage collection system consists of a combination of separate sanitary sewers as well as some combined sewers. Figure 5 provides a map of the City sewer system. The wastewater treatment plant is on the far west end of the City and gravity sewers transport wastewater to the east where it is combined in the influent pump station, as shown in Figure 5.

4.2 EXISTING WASTEWATER TREATMENT PROCESSES

The plant's headworks consists of one JWC Auger Monster Model AMD 4020-AD fine screen, one aerated grit chamber with a grit pump, and an influent pump station. The fine screen was installed in 2006. It is of the inclined-cylinder type that is equipped with a grinder unit. It has ¼-inch openings and is equipped with a washer-compactor section. A portion of the City's wastewater collection system has combined sewers.

When excess flows are encountered, the plant also contains one excess flow lagoon with lagoon drain pumps. Excess flow is diverted to the excess flow lagoon, from there flow can either be pumped to the primary clarifier diversion structure or exit the plant via an excess flow outfall via gravity. The existing headworks unit processes are shown in Table 1 on page 9. This project proposes no changes to the plant's headworks system.

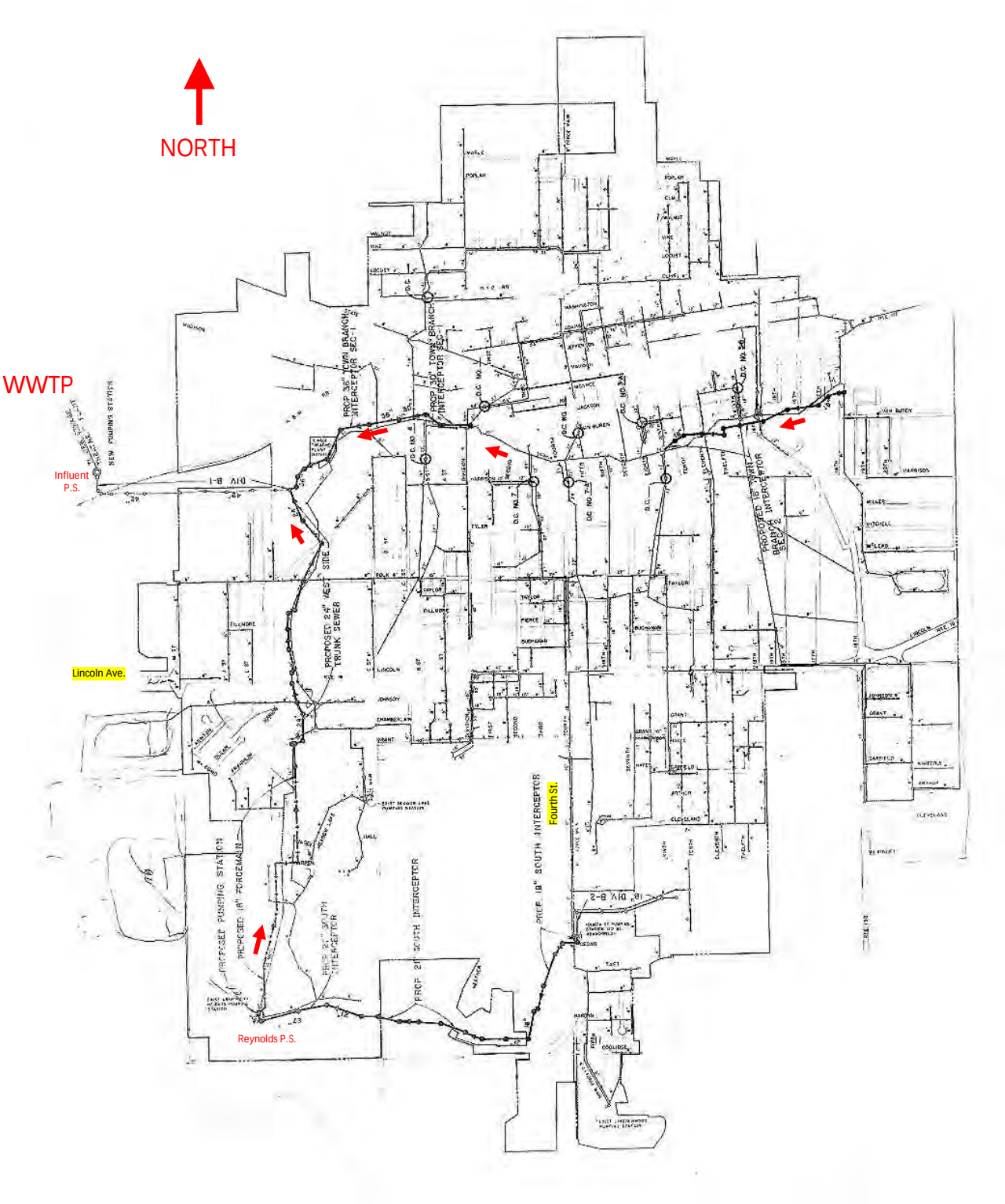


Figure 5: Charleston Sewer Map

Table 1 Headworks Unit Processes

	Unit Process	Number	Capacity	Sizing
Headworks	Influent Screen	1	12 MGD	
	Aerated Grit Chamber	1	16 MGD @ 3 min detention	22' x 17' x 12' SWD
	Grit Pumps	1	150 GPM	
	Influent Pumps	6	1 – 9,000 GPM, 200 HP 2 – 6,000 GPM, 100 HP 2 – 3,500 GPM, 75 HP 1 – 417 GPM, 25 HP	
	Excess Flow Lagoon	1	Volume = 40 Million Gallons	
	Lagoon Drain Pumps	2	300-800 GPM, 7.5 HP each	

Primary and secondary treatment consists of two primary clarifiers, six aeration basins, four secondary clarifiers, an abandoned chlorine contact tank, an abandoned travelling bridge type tertiary filter system, and a new UV disinfection system. The existing primary and secondary treatment unit processes are shown in Table 2.

Table 2 Primary and Secondary Unit Processes

	Unit Process	Number	Capacity	Sizing
Primary and Secondary Treatment	Primary Clarifiers	2	SOR: 6 MGD @ 904 gal//sf/d WLR: 6 MGD @ 14,691 gal/ft./d	65' diameter 12' SWD
	Aeration Tanks	6	233,508 cf./1.75 MG	Plug Flow 122' x 22' x 14.5' SWD Per Pass
	Secondary Clarifiers	4	SOR: 6 MGD @ 452 gal/sf/day WLR: 6 MGD @ 7,346 gal/ft./day	3 – 65' Diameter 10' SWD 1 – 65' Diameter 12' SWD
	Chlorine Contact Tank (not in use)	1	6 MGD – 13.6 minutes of detention time	146' x 6' x 8.45' SWD Total
	Tertiary Filters (not in use)			
	UV disinfection			

The existing solids handling facilities consist of one primary and one secondary anaerobic digesters, two aerobic digesters used for scum treatment, covered sludge storage pad, a gravity belt thickener (WAS thickening), a belt filter press (dewatering), a filtrate pump station and one heat exchanger. Existing solids handling processes are shown in Table 3. Most of the existing solids handling processes were last updated in 1987 and although the structures are in a reasonably good condition, the process equipment is close to

or past their useful life and in need of upgrading. Process flow diagrams for the liquid treatment and solids treatment train for the existing plant are shown in Appendix C.

Table 3 Existing Solids Handling Existing Unit Processes

	Unit Process	Number	Capacity	Sizing
Solids Handling Processes	Gravity Belt Thickener	1	15,000 – 20,000 GPD @ 0.75% - 1.0 % solids	
	Belt Filter Press	1	85 GPM @ 2.5% - 3.5% solids	
	Anaerobic Digestion Primary	1	25,014 cf. 17 day detention	35' diameter 26' SWD
	Anaerobic Digestion Secondary	1	25,014 cf. 17 day detention	35' diameter 26' SWD
	Sludge holding tanks (Aerobic Digesters)	2	77,836 cf. total	122' x 22' x 14.5 SWD each
	Filtrate (GBT and BFP) Lift Station Pumps	4	5 HP	
	Covered sludge storage beds	6	20,000 sf total	5 – 20' x 100' each 1 – 100' x 100'
	Heat exchanger	1		

4.3 EXISTING FLOWS AND LOADINGS

The WWTP's current average daily flow is 3.0 MGD. The following section details the existing flows and loadings through the treatment facility. BOD, TSS and ammonia raw influent percentiles for concentrations and loadings are shown in Table 4. Average BOD, TSS and ammonia levels are 157 mg/L, 156 mg/L and 16 mg/L, respectively.

Table 4 Influent Percentiles

	Flow	BOD		TSS		Ammonia	
	MGD	mg/L	ppd	mg/L	ppd	mg/L	ppd
25th	2.00	93	2417	102	2573	10	288
50th	2.67	143	3147	148	3265	16	341
75th	3.85	202	4124	196	4150	21	426
95th	5.52	310	6843	292	6476	30	540
99th	6.00	444	9401	400	8385	34	641
Averages	3.02	157	4735	156	3834	16	377

Primary effluent concentrations and loadings for DAF, DMF and current daily average are shown in Table 5 below. For the purposes of conservative design, the concentrations are held the same at DAF, DMF and current average. More realistically, design maximum flows will occur during storm events, leading to lower concentrations and loadings of BOD, TSS, ammonia and total phosphorus. Primary treatment removes approximately 30% of BOD, 45% of TSS and no ammonia. These removal rates are in the range of a typical treatment plant.

Table 5 Primary Effluent Concentrations and Loadings

		Design Average Flow	Design Maximum Flow	Current Average Flow
Flow	MGD	3.30	6.00	3.00
Concentrations				
$CBOD_5$	mg/l	110	110	110
TSS	mg/l	86	86	86
TKN	mg/l	30	30	30
Ammonia	mg/l	17	17	17
TP	mg/L	2	2	2
Mass Loadings				
$CBOD_5$	ppd	3,025	5,499	2,750
TSS	ppd	2,361	4,293	2,147
TKN	ppd	826	1,501	751
Ammonia	ppd	468	851	425
TP	ppd	55	100	50

Final effluent percentile are shown in Table 6 below. BOD, TSS and ammonia average concentrations are 2.1 mg/L, 3.5 mg/L and 0.02 mg/L respectively. The 99% percentiles for BOD, TSS and ammonia are 5.0 mg/L 10.6 mg/L and 0.06 mg/L, respectively. All of the 99th percentiles are under the NDPES permit limits.

Table 6 Effluent Percentiles

Parameter	BOD (mg/L)	TSS (mg/L)	Ammonia (mg/L)
0.25	1.0	2.0	0.01
0.50	2.0	3.0	0.02
0.75	3.0	5.0	0.03
0.95	4.0	7.0	0.04
0.99	5.0	10.6	0.06
Average	2.1	3.5	0.02
Permit Limit (Monthly Average)	10	12	0.8 - 1.5

Solids handling flows and concentrations are shown in Table 7 below. This table includes RAS and WAS flows, RAS return rates, and primary sludge. Under typical operating conditions, the plant wastes solids three to four times per week. The solids wasting rate was also calculated as an average daily wasted at 7 times per week. RAS return rates are typically 300 to 400% of influent flows, which is well beyond the recommended Ten States Standards design rate of 100% of design average flow. RAS return flow is conveyed via airlift pumps.

Table 7 Existing Solids Percentiles

Parameter	RAS Flow	WAS	Sludge Wasted	RAS % of Influent	Primary Sludge
Unit >>	MGD	MGD	PPD		gpd
25th	6.23	0.037	1,512	260%	4,754
50th	6.94	0.044	2,120	347%	5,750
75th	7.39	0.049	2,411	379%	7,248
95th	7.52	0.066	4,501	431%	10,807
99th	N/A	N/A	N/A	N/A	19,792
Averages >>	6.81	0.044	2,194	321%	6,599
Avg. (based on 7 days/week wasting		0.025	1,284		

Anaerobic digester flows and loadings at DAF, DMF and current average flows are presented in Table 8 below. Donohue recommends keeping anaerobic digester loadings under 80 lb. VSS/kcf day, which is consistent with the provisions of 35 Ill. Adm. Code 370.830-c-2-A. The current anaerobic digesters are undersized, with the DAF, DMF and average daily loadings all being over 80 lb. VSS/kcf/d. Anecdotally, in the past, the City has experienced digester foaming issues during times of high flows.

Table 8 Existing Anaerobic Digesters' Flows and Loadings

		Design Average Flow	Design Maximum Flow	Current Average Flow
Flow	MGD	3.30	6.00	3.00
Total VSS Loading to Digesters	ppd	2,620	5,480	2,381
Flow to Digesters	gpd	11,357	20,649	10,325
Digester loading	lbs. VSS/kcf/d	105	219	95
Hydraulic Retention Time	Days	16.5	9.1	18.1

4.4 CURRENT SOLIDS HANDLING PROCESSES

Sheet 009-N-2 in Appendix B provides a copy of the Existing Sludge Flow Schematic.

4.5 CURRENT SOLIDS HANDLING DEFICIENCIES

In general, most of the solids handling equipment is past its useful life and needs to be replaced, repaired or updated. Some of the current issues with the existing solids handling equipment are:

- The existing gas cannon boxes in the digesters have been removed. There is little-to-no sludge mixing for the anaerobic digesters.
- The anaerobic digesters' covers need to be painted and repaired in some places.
- The digesters' gas flare does not light.
- The digesters' gas safety equipment needs to be replaced.
- Many sludge handling valves and piping segments need replacement/repairing.
- Digester foaming is common during high loadings.
- The anaerobic digesters' sludge heat exchanger needs to be replaced.
- The belt filter press (BFP) is only dewatering sludge to 12-13%, but was designed for 20%.

5. PART A - SOLIDS HANDLING UPGRADES

5.1 INTRODUCTION

At the early stages of the project, Donohue reviewed numerous solids handling options with the City, in order to sort out which is the optimum upgrade for implementation. Under this project, the City and Donohue considered the following options:

- Thickening Upgrades + Dewatering Upgrades + Anaerobic Digestion Upgrade
- Convert Anaerobic Digesters to Aerobic Digesters
- Sludge Drying with Aerobic Digestion
- Sludge Drying without Digestion
- Lime Stabilization to Class B quality
- Lime Pasteurization to Class A quality
- Split Digestion (combination of aerobic and anaerobic digestion)
- Auto-thermal Aerobic Digesters (ATAD)

5.2 RECOMMENDED OPTION – LIME PASTEURIZATION TO CLASS A QUALITY

5.2.1 DESCRIPTION

After considerable deliberation and investigations, Donohue and the City selected the lime pasteurization process for implementation. This sludge stabilization process will replace the existing anaerobic digestion and dewatering processes. Figure 6 below provides a conceptual diagram of this process. The existing anaerobic digestion process produces Class B biosolids; however, the recommended process will produce the higher quality Class A biosolids, as defined by the 503 regulations. Figure 7 on the following page provides a flow schematic of the new Lime Pasteurization sludge handling system.

Under the recommended solids handling upgrade, all primary sludge and waste activated sludge will be routed to two Liquid Sludge Storage Tanks. These tanks will be existing Aerobic Digester Tanks #7 and #8, which will be converted to completely mixed and aerated holding tanks. Figure 8 on page 16 provides the plant site plan, showing the locations of these tanks. Sludge from the Storage Tanks will then be pumped into one Screw Press that will dewater the sludge to an average of 20% total solids. The feed to the Screw Press will be achieved via one rotary lobe type Sludge Feed Pump that will be located in the existing Sludge Treatment Building. See Figure 9 on page 17. The new Screw Press and feed pump will be rated to handle 95 gpm or 1,200 dry pounds/hour of sludge. The Screw Press will be housed in the west end of the existing Sludge Treatment Building, in the locations where the existing Belt Filter Presses exist. The existing Belt Filter Presses, which are over 30 years old, will be cut up and removed from this building.

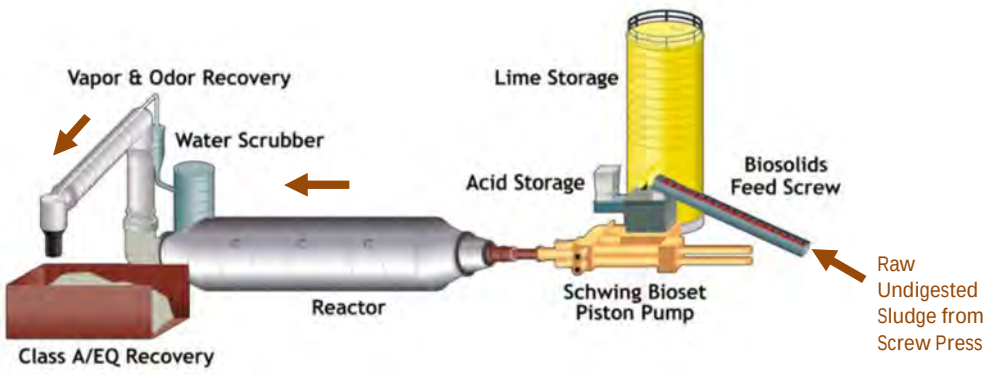


Figure 6: Lime Pasteurization Conceptual Diagram

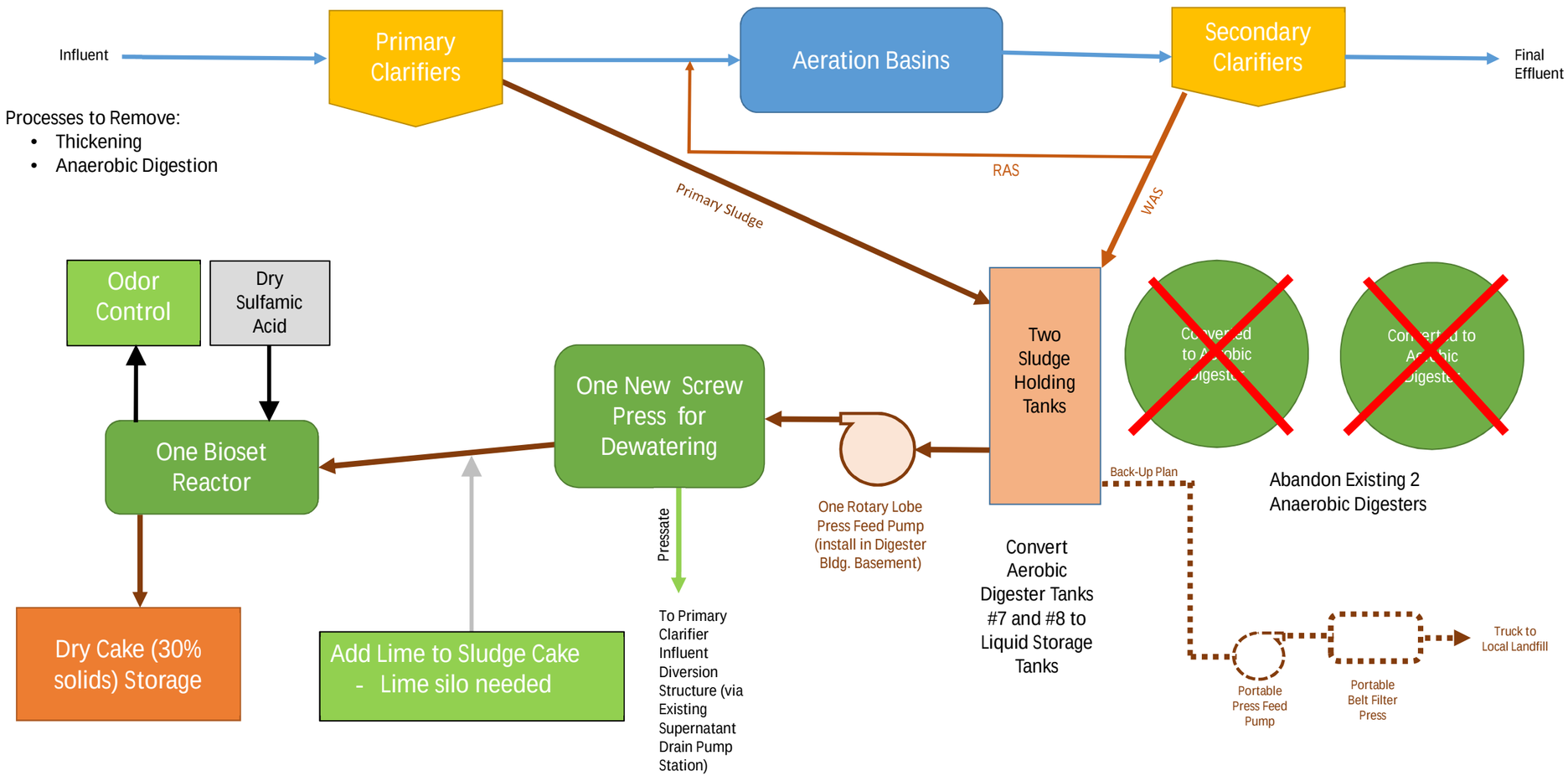


Figure 7

Flow Schematic – Solids Handling Upgrades
Lime Stabilization to Class A via Schwing System

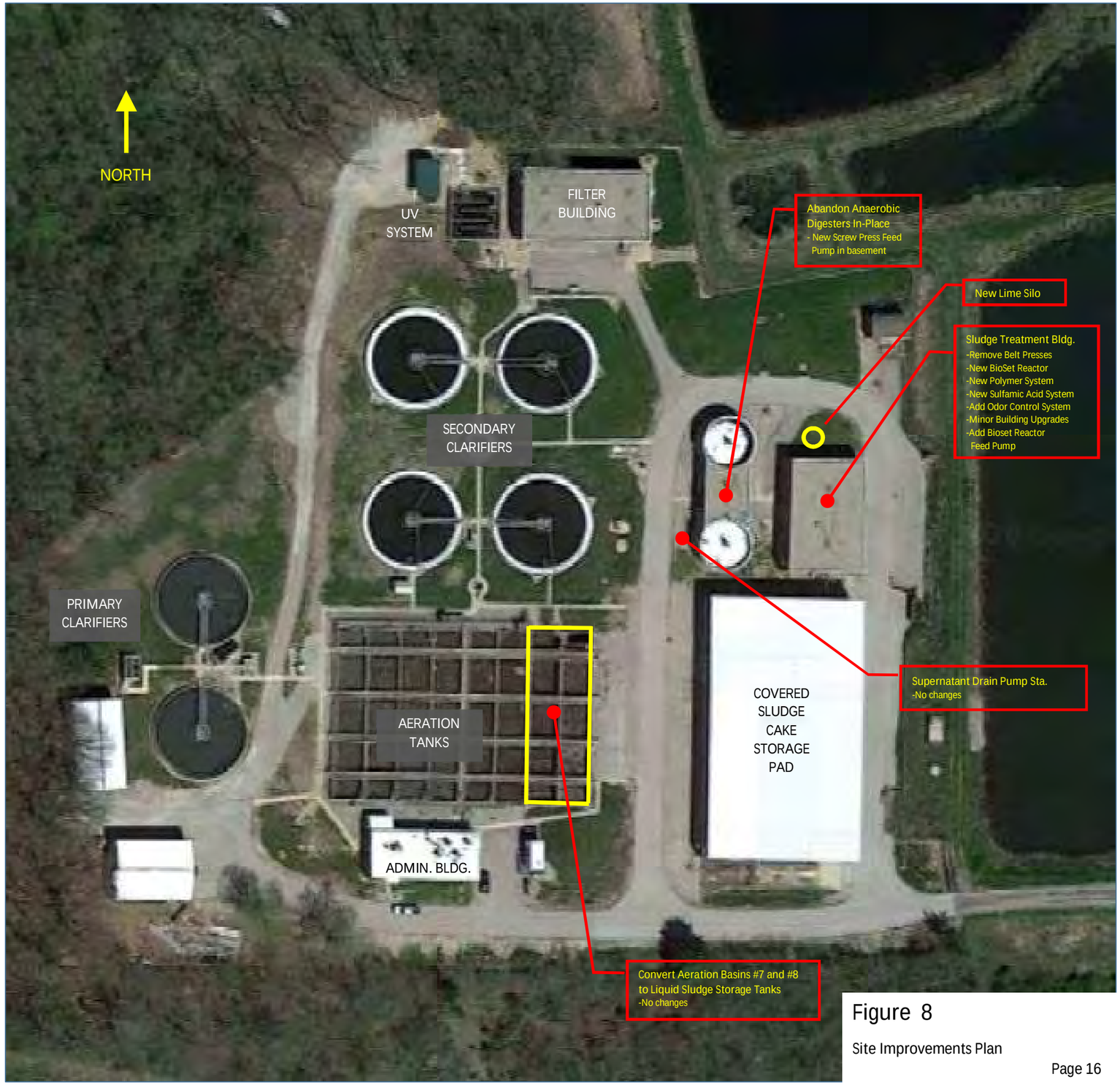


Figure 8

Site Improvements Plan

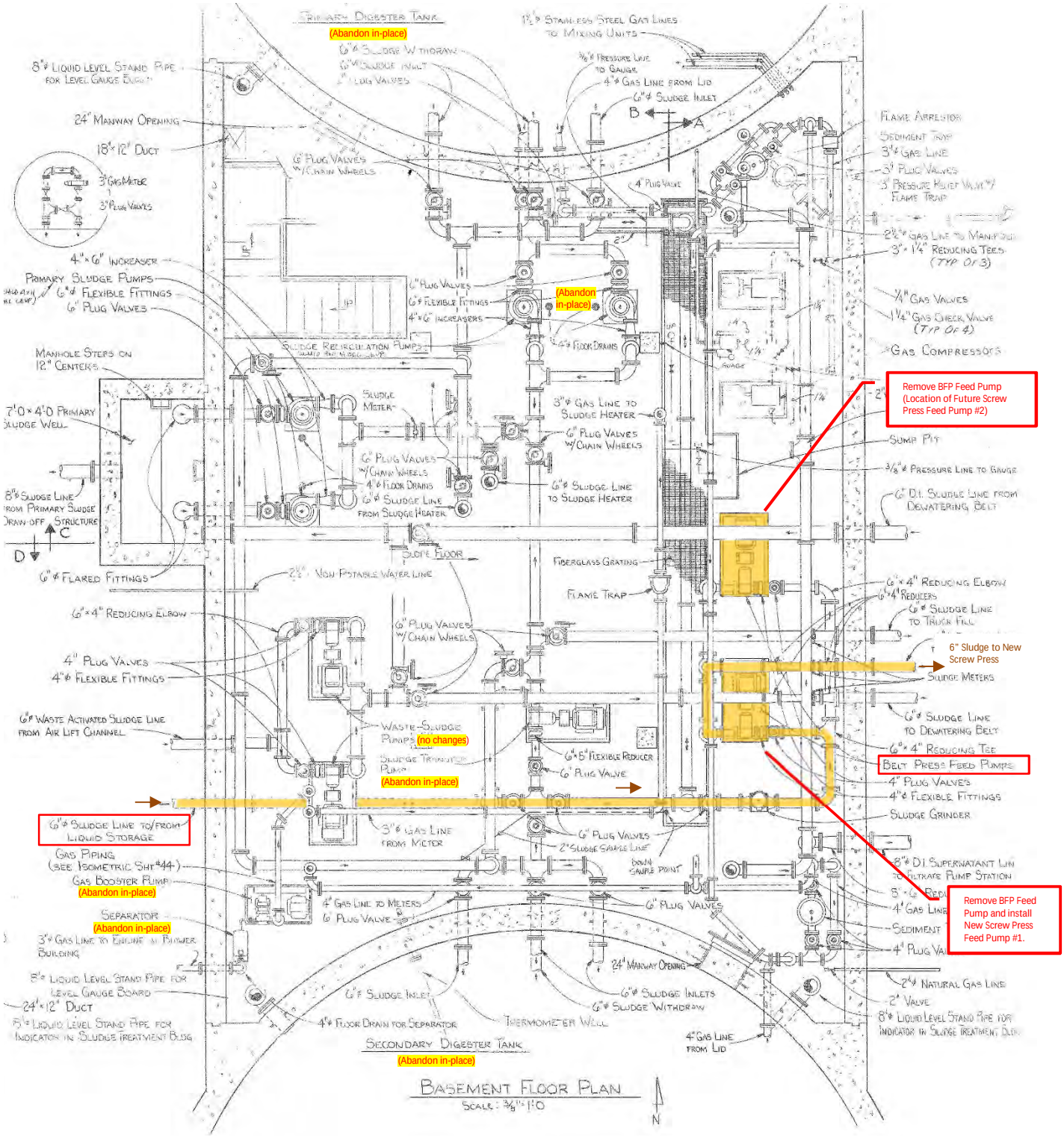


Figure 9: Digester Building Basement Modifications Plan

The clear pressate flow from the Screw Press dewatering operation will be conveyed by existing gravity piping that flows to the existing Supernatant Drain Pump Station. This station is located just west of the Sludge Treatment Building. That pump station is about 8 years old. That station will remain unchanged.

The dewatered sludge produced by the Screw Presses will be conveyed within the existing Sludge Treatment Building via shaftless screw conveyor. That dewatered sludge will be conveyed into the mixing chamber of a new "Bioset Reactor", which is a proprietary sludge pasteurization device manufactured by Schwing Bioset, Inc. of Somerset, WI. Figure 10 on page 19 provides a conceptual layout of the Bioset reactor installation inside the existing Sludge Treatment Building.

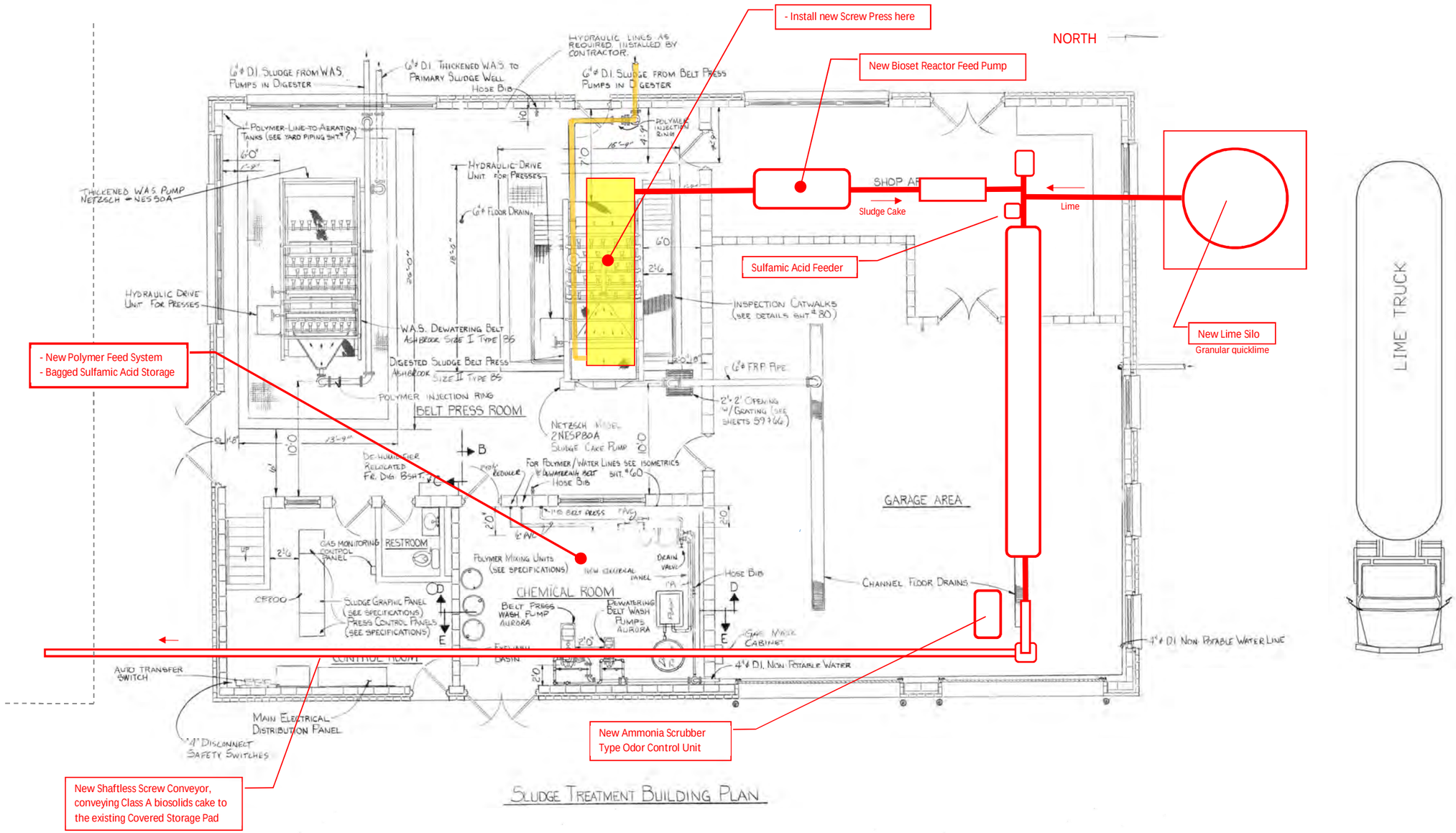
As Figure 10 shows, lime will be injected into the Bioset reactor along with dewatered sludge cake and the two components will be thoroughly mixed inside the unit. Inside the Bioset Reactor, the dewatered sludge's pH will be raised to 12 or greater and the sludge will be held at this pH for 60 minutes, for proper pasteurization.

The 503 regulations stipulate that for biosolids intended to meet Class A standards for vector attraction reduction, the sludge must be kept at a pH of 12 for two hours and remains at pH of at least 11.5 after 24 hours. The Schwing Bioset System meets that criteria.

It should be noted that sulfamic acid, in the form of bagged dry crystals, will also be fed into the Bioset Reactor's twin-screw inlet hopper. The sulfamic acid is added to the system as a sludge conditioning agent as it passes inside the reactor. The sulfamic acid will be shipped to the plant site in bags and will be stored in the existing Chemical Room. The Bioset Reactor unit will have a Sulfamic Acid Feeder Hopper mounted on it, as shown in Figure 8.

The pasteurized Class A biosolids cake produced by the Bioset Reactor will drop down into a hopper from which it will be conveyed southward, out of the Sludge Treatment Building and into the northeast corner of the existing Covered Sludge Storage Pad. See Figure 8 for this configuration. Existing end loader vehicles will move the Class A biosolids around inside the Covered Storage Pad.

During times that any of the proposed equipment (including the single Rotary Lobe Sludge Feed pump, Screw Press and the Bioset Reactor) is out of operation for any reason, the City will resort to bringing in a temporary portable belt filter press unit and/or a portable feed pump and/or polymer fee system, in order to continue processing sludge. During this time, raw, un-stabilized sludge produced by the plant will be dewatered to at least 20% solids and all dewatered sludge cake will be trucked to a local landfill for final disposal.



SLUDGE TREATMENT BUILDING PLAN

Figure 10

Sludge Treatment Building Modifications Plan

5.2.2 BASIS OF DESIGN

The Basis of Design criteria for the recommended Solids Handling Improvements are listed in Table 10.

Table 10 Solids Handling System Basis of Design

	Unit	Design Avg. Q	Design Max. Q	Current Average Q
Plant Flows	MGD	3.30	6.00	3.00
WAS Solids to Holding Tanks	ppd	1,191	2,166	1,083
Primary Sludge to Holding Tanks	ppd	2,576	4,984	2,342
Total Solids to Holding Tanks	ppd	3,767	6,850	3,425
Sludge Flows to Lime Pasteurization	gpd	11,357	20,649	10,325
	Gal/week	79,499	144,543	72,275
Liquid Sludge Storage Tanks				
Volume =	gallons	582,213		
Available Storage =	Days	51	28	56
Screw Press Feed Pump				
Pumping Capacity =	gpm	95		
Screw Press				
Hydraulic Capacity =	gpm	95		
Solids Loading Rate =	Lb. /hr.	1,200		
Operating Time based on hyd. load =	Hr./week	14	25	13
Operating Time based on solids load =	Hr./week	3	6	3
Lime Pasteurization "Bioset Reactor"				
Reactor Feed Pump Type & Capacity =		22 gpm, piston pump		
Design Processing Rate =	Lb./Hr.	2,400		
Design Sludge Residence Time =	Minutes	60		
Design Lime Feed Rate =	Lb./Hr.	1,404		
Design Sulfamic Acid Feed Rate =	Lb./Hr.	9.6		
Lime Silo				
Material Type =	Granular quicklime (Calcium oxide)			
Design Storage Capacity =	Tons	38		
Capacity in equivalent truckloads of lime =	Loads	1.5		
Diameter =	Ft.	8.5		
Cylinder Height =	Ft.	24		

5.2.3 COST OPINION – SOLIDS HANDLING ONLY

Appendix D provides the Cost Opinion for the recommended Solids Handling Improvements "Part A" portion of the project. As Appendix D shows, the total project cost for the Solids Handling Improvements portion of the project is forecasted to be just under $4.1 million.

6. PART B - BIOLOGICAL PHOSPHORUS REMOVAL

6.1 INTRODUCTION

As Appendix A shows, the City recently received from IEPA renewed NPDES permit for its effluent discharge. Special Condition #19 on page 17 of the permit contains an effluent phosphorus limit of 0.5 mg/L under several stipulations. In preparation for this limit, the City in conjunction with Donohue & Associates has investigated both chemical phosphorus precipitation and biological phosphorus removal.

Biological phosphorus removal is achieved by creating anaerobic zones and anoxic (i.e., unaerated) zones in the activated sludge process, in order to encourage the growth of phosphorus-accumulating organisms (PAOs), which biologically uptake the phosphorus. Those PAOs (and therefore the phosphorus within them) are then removed from the wastewater via sludge wasting. As Special Condition #19 states, the target effluent is 0.5 mg/L of total phosphorus (TP) at an annual geometric mean; however, in its investigations, Donohue also analyzed the efforts needed to TP meet limits or 1.0 mg/L monthly.

6.2 SPECIAL SAMPLING

In preparation for its nutrient removal evaluation, the City of Charleston completed two six-day special sampling programs over two weeks in March 2018 and August 2018. This special sampling was used to better characterize the wastewater and to calibrate an accurate BioWin model to complete evaluations for future BOD treatment, biological phosphorus removal and total nitrogen removal. The special sampling focused on phosphorus, COD and BOD/CBOD components at each stage, from raw influent to final effluent. This sampling served as a platform for estimating potential biological nutrient removal performance with modifications such as selectors and recycle streams.

When modeling activated sludge systems, it is necessary to characterize the composition of the wastewater in terms of physical-chemical fractions of COD, phosphorus, and nitrogen. Characterizing the wastewater in this manner makes it possible for a model to account for the various forms in which these constituents (e.g., carbon, nutrients) are present and the expected behavior of those forms throughout the treatment process. For example, a significant portion of particulate COD, particulate phosphorus, and particulate TKN is removed during primary clarification, while soluble, readily biodegradable COD is quickly consumed in selectors or at the front of aerobic zones, affecting denitrification, biological phosphorus uptake, and oxygen utilization rates. Ultimately, site-specific wastewater characteristics determine the performance that can be expected with biological nutrient removal processes.

Average special sampling results for cold weather and warm weather are shown in Tables 11 through Table 14. Aeration basin profiles were also completed and determined that fully treatment is likely achieved at the end of the third pass. Therefore, the last three passes of aeration basins could be taken offline or become un-aerated, with no decline in nitrification.

The special sampling effort also indicated that primary effluent dissolved oxygen (DO) concentrations in the tanks is extremely high due to over aerating and that the RAS airlift pumps introduce approximately 2.0 mg/L more D.O. into RAS stream. The WAS rates are not shown in the solids sampling tables as it was determined that the measured flow rates during special sampling are inaccurate. Aeration basin profiles were also completed.

Table 11 Cold Weather Special Sampling

		Influent	Primary Effluent	Final Effluent
Flow	(mgd)	2.33		2.9
Temp.	C	11.3	9.4	10.4
pH	S.U.	7.8	5.8	7.3
CBOD5	(mg/l)	88	56	3.0
BOD5	(mg/l)	109	62	-
BOD5	(mg/l)	16.6	16	-
COD	(mg/l)	288	155	23
COD	(mg/l)	94	76	19
ffCOD	(mg/l)	98	50	13
Ammonia	(mg/l)	10.8	11	0.01
TKN	(mg/l)	16.5	16	2.2
+NO3-N	(mg/l)	1.3	1.3	11.9
Total P	(mg/l)	2.17	2.08	1.36
Ortho-P	(mg/l)	-	-	-
TSS	(mg/l)	147	51	7.2
VSS	(mg/l)	82	38	5.6
Alkalinity	(mg/l)	257	253	156

Table 12 Cold Weather Special Sampling Solids

		Aeration Basins	RAS
Flow	(mgd)	-	6.4
TSS	(mg/l)	5,210	7,850
VSS	(mg/l)	4,001	6,118

Table 13 Warm Weather Special Sampling

		Influent	Primary Effluent	Final Effluent
Flow	(mgd)	1.7	0.0	1.7
Temp.	C	23	23	24
pH	S.U.	7.4	0.7	7.3
CBOD5	(mg/l)	151	91	1.8
BOD5	(mg/l)	186	95	0.0
BOD5	(mg/l)	41	55	0.0
COD	(mg/l)	532	239	15
COD	(mg/l)	142	151	19
ffCOD	(mg/l)	97	125	17
Ammonia	(mg/l)	20	25	0.01
TKN	(mg/l)	33	27	-
+NO3-N	(mg/l)	0.7	0.3	23
Total P	(mg/l)	3.95	2.45	1.69
Ortho-P	(mg/l)	2.51	2.25	0.82
TSS	(mg/l)	198	51	4.3
VSS	(mg/l)	-	38	-
Alkalinity	(mg/l)	233	237	89

Table 14 Warm Weather Special Sampling Solids

		Aeration Basins	RAS
Flow	(mgd)	-	7.0
TSS	(mg/l)	3,796	4,635
VSS	(mg/l)	2,505	3,105

6.3 BIOLOGICAL PHOSPHORUS REMOVAL DESCRIPTION

Enhanced biological phosphorus removal (EBPR) uses phosphorus-accumulating organisms (PAOs) to uptake phosphorus from the wastewater, and is most commonly used when phosphorus effluent limits are below 1 mg/L or when there is a significant amount of phosphorus in the influent flow. The organisms and cellular phosphorus is then removed from the system via sludge wasting. PAOs are organisms that uptake and store excess phosphorus beyond what is required for normal cell growth. An activated sludge system must be set up to select for these particular organisms.

Selecting for PAOs involves alternating mixed liquor exposure to anaerobic (i.e. no common electron acceptors i.e., oxygen or nitrates) and aerobic conditions. To achieve this selection an anaerobic zone (also referred to as a selector) is placed in front of the typical aerobic zone. Because typical electron acceptors are not available in the selector zone PAOs cannot complete typical cellular respiration. Therefore, the PAOs use readily biodegradable chemical oxygen demand (rbCOD) to produce polyhydroxybuturate (PHB), a product that can be stored and metabolized under aerobic conditions. Transforming rbCOD into PHB requires the breakdown of poly-phosphates stored within the cells. The breakdown of poly-phosphates leads to a release of soluble phosphorus. Once the PAOs reach the aerobic zone the process will essentially reverse with the organisms creating and storing large amounts of poly-phosphates through soluble phosphate uptake to ensure the ability to produce energy during anaerobic conditions. In a properly functioning EBPR system, soluble phosphorus will increase above influent levels in the selector zone and then drop well below influent levels in the aerobic zone. The PAOs are then recycled back to the selector zone or removed from the system via sludge wasting. This is demonstrated in Figure 11 below.

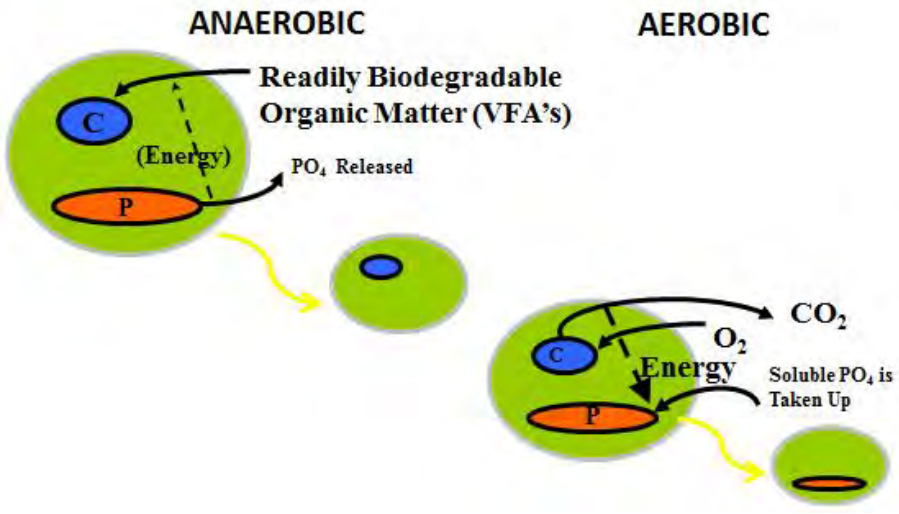


Figure 11 Enhanced Biological Phosphorus Removal Using Phosphorus Accumulating Organisms

EBPR functions most efficiently when nitrate and/or oxygen entering the anaerobic zone is minimized since PAOs, which are facultative aerobes, will preferentially use these energy sources and release less soluble phosphorus. Decreases in the production of PHB (and therefore lower rates of phosphorus release in the anaerobic zone) ultimately lead to a decrease in phosphorus uptake in the aerobic zone. As well, if rbCOD is consumed with oxygen or nitrate, then less will be available for PHB production.

When evaluating EBPR systems, influent selector concentrations of oxygen and nitrate (as well as the ratio of rbCOD-to-total phosphorus), both play a critical role in system performance. BNR has little impact on the solids concentration of the generated sludge when compared to chemical phosphorus removal. BNR often has a negative effect on sludge dewatering. However, this may be of concern for this plant, since the current dewatering method by the antiquated belt filter press is only achieving approximately 12 to 13% total solids.

6.4 BIOWIN CALIBRATION

Flow, primary influent, primary effluent and final effluent characteristics data for the Charleston WWTP from 2013 through 2017 were used for process modeling. It should be noted that average annual values were used for this modeling effort. This is the same data set used to characterize the process flows. The 2013 to 2017 average values, along with analytical data from the special sampling program conducted for influent characterization in 2018, was used for calibration and modeling using BioWin® (5.3) software developed by Envirosim Associates Ltd. (Hamilton, Ontario, Canada). The Charleston WWTP was modeled using basic reactors available in BioWin® (i.e. influent, aerobic reactor, ideal clarifier, and sludge wastage effluent). An initial overall process flow schematic used for process modeling for the City is shown in Figure 12 below.

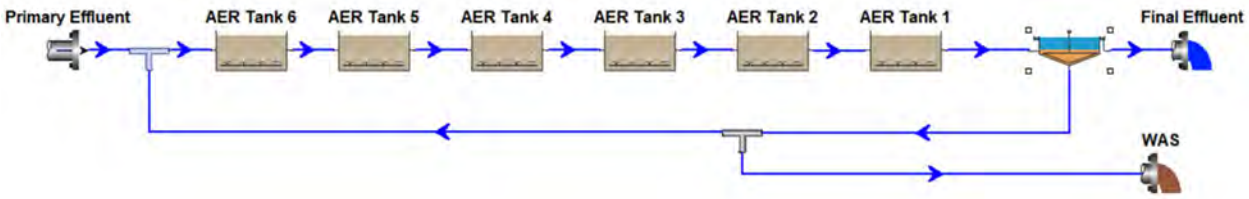


Figure 12 BioWin Existing Configuration

After special sampling calibration, the modeling fractions, shown in Table 15 on the following page, and the calibration input, shown in Table 16, were determined for the BioWin model. Note that the BioWin input is based on primary effluent special sampling, which includes recycle flows and loadings. As the winter and summer sampling discovered very different modeling fractions, the BioWin modeling was completed using the warm weather sampling data, however the cold weather Fbs fraction of 0.21 was used – so as to not over-predict achievable phosphorus removal. The original Fbs fraction for summer special sampling was 0.46, higher than the average predicted BioWin range. If only the first week of the summer sampling is used, then the fraction drops to 0.36, which is still higher than the average BioWin prediction but more realistic for a warm weather average day.

When creating influent specifiers all special sampling specifiers had the same problem. The special-sampling measured fcBOD was lower than the BioWin predicted value. BioWin designates fcBOD as CBOD filtered through a 1.2 micron filter. In error, the special sampling protocol called for a 0.45 micron filter. This likely caused the discrepancy, as more CBOD would be filtered out leading to an artificially low fcBOD. Since the plant is not having current treatment issues, it is unlikely that the fcBOD is as low as measured. Therefore, the BioWin-predicted fcBOD was used in the model.

Table 15 BioWin Input Modeling Fractions Warm Weather Sampling

Name	Default	Value	Typical Ranges
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.27	0.21	0.20 - 0.35
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.15	0.129	0.0 - 0.3
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degrad. COD]	0.5	0.35	0.0 - 1.0
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.08	0.078	0.05 -.10
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.08	0.30	0.0 - 1.0
Fna - Ammonia [gNH3-N/gTKN]	0.75	0.853	0.60 - 0.85
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.25	0.25	-
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.02	0.020	-
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.035	0.035	-
Fpo4 - Phosphate [gPO4-P/gTP]	0.75	0.75	0.5 - 0.8
FupP - P:COD ratio for unbiodegradable part. COD [gP/gCOD]	0.011	0.011	-
Substrate COD:VSS Ratio	1.6	2.78	1.5 - 1.7
Inert COD:VSS Ratio	1.6	2.78	1.5 - 1.7

Table 16 BioWin Special Sampling Calibration Input

Name	Value
Flow	1.65
Total COD (mgCOD/L)	211
Total Kjeldahl Nitrogen (mgN/L)	29.5
Total P (mgP/L)	3.75
Nitrate N (mgN/L)	0.3
pH	7.38
Alkalinity (mmol/L)	4.855
ISS Influent (mgISS/L)	14.6
Calcium (mg/L)	80
Magnesium (mg/L)	15
Dissolved O2 (mg/L)	0.7

The model was calibrated against historic 2013-2017 averages. The only exception is that the RAS/WAS rates were estimated from September to November 2018, due to error in certain previous data. Even though wasting at the plant does not occur every day, BioWin models the wasting efforts as an average daily flow. The actual-measured weekly wasting volume was calculated and then divided over seven days to produce an estimated daily average for the model. The influent parameters were adjusted to match the average primary effluent parameters, the historical calibration input parameters are shown in Table 17. As the special sampling influent parameters did not deviate largely from the historical data, the special sampling influent fractions were not altered from the special sampling fractions shown in Table 15.

Table 17 BioWin Historic Data Calibration Input

Name	Value
Flow (2013 – 2017)	3.0
Total COD (mgCOD/L)	220
Total Kjeldahl Nitrogen (mgN/L)	29.5
Total P (mgP/L)	4.0
Nitrate N (mgN/L)	0.3
pH	7.38
Alkalinity (mmol/L)	4.855
ISS Influent (mgISS/L)	14.6
Calcium (mg/L)	80
Magnesium (mg/L)	15
Dissolved O2 (mg/L)	0.7

Both the special sampling and historical model calibrations accurately modeled the total pounds wasted from the system, the MLSS and RAS concentrations and the final effluent constituent concentrations, with the exception of effluent BOD in which the historical model slightly over-predicted the BOD removal. The final calibration results to the five-year data are shown in Table 18 through Table 21. This final calibration was used to model all of the investigated basin configurations.

Table 18 Final Calibration Aeration Basins

Aeration Basins				
Parameter	Units	Model	Observed	Ratio
MLSS	mg/L	4,089	4,056	1.01
MLVSS	mg/L	2,499	2,677	0.93
SRT	days	43.0	42.6	1.01

Table 19 Final Calibration RAS

RAS				
Parameter	Units	Model	Observed	Ratio
Flow	MGD	6.14	6.14	1.00
TSS	mg/L	6,067	6,159	0.99
Total P	mg/L	138	-	
TKN	mg/L	432	-	

Table 20 Final Calibration WAS

WAS				
Parameter	Units	Model	Observed	Ratio
Flow	MGD	0.027	0.027	1.00
TSS	mg/L	6,067	6,159	0.99
TSS	ppd	1,366	1,387	0.99

Table 21 Final Calibration Effluent

Effluent				
Parameter	Model	Observed	Units	Ratio
Flow	2.97	3.00	MGD	0.99
BOD	1.02	2.25	mg/L	0.45
BOD	25	56	ppd	0.45
TSS	3.76	3.50	mg/L	1.07
TSS	93	88	ppd	1.06
Ammonia	0.04	0.02	mg/L	2.00
Ammonia	1	1	ppd	2.00
TKN	1.17	1.12	mg/L	1.04
TKN	29	28	ppd	1.04
Sol P	2.7	2.7	mg/L	0.98
Sol P	68	69	ppd	0.98
Total P	2.78	2.98	mg/L	0.93
Total P	70	75	ppd	0.93
Nitrate	23.9	-	mg/L	
Nitrate	598	-	ppd	

6.5 BIOWIN RESULTS

This first round of BioWin modeling compared three classic Process Flow Schemes, those being A/O, A2O and UCT. See Figure 13 below. The A/O and A2O configurations are typically the easiest to implement and simplest configuration to operate. The UCT (acronym for "University of Cape Town) option is more complex to operate, but typically leads to lower and more stable effluent phosphorus. All configuration require a new RAS pump station, as the most effective RAS rates will be 25%-75% of the influent flow, a rate that is not achievable with the current RAS airlift pumps. From the special sampling evaluation effort, it was determined that full nitrification occurs within the first three basins. Therefore it is assumed that up to half of the basins could be converted to unaerated anoxic tanks - with no negative impacts to treatment.

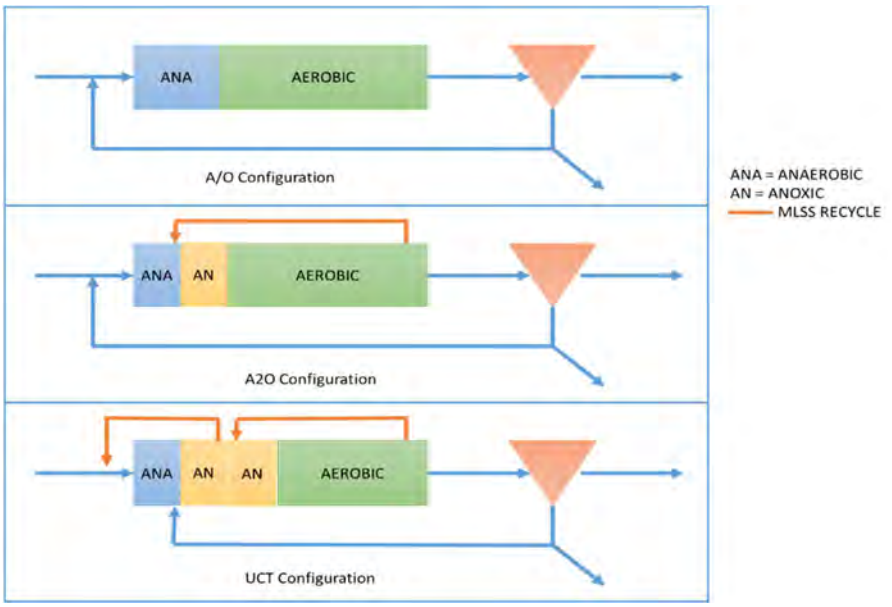


Figure 13

Three Initial Candidate Flow Schemes for Enhanced Biological Phosphorus Removal (Using Phosphorus Accumulating Organisms)

The initial modeling efforts found that none of the original three configurations were able to achieve effluent phosphorus concentration below 1.0 mg/L. Likely contributing factors were:

- High influent ammonia concentrations, leading to higher nitrate recycle
- Lower influent COD, leading to COD limited phosphorus removal

After a review and discussions with the City staff, two new modeling configurations were chosen for testing, both of which focused on reducing the recycled nitrate. The low influent COD effects cannot be solved with a different configuration, but COD can be increased by dosing a source of COD (such acetic acid) to the primary effluent stream. In addition, there was concern that the Winter weather Fbs fraction was giving overly conservative results. Therefore, the new configurations were run under four separate scenarios - to help determine which of the factors were most strongly inhibiting biological phosphorus removal. Those scenarios were:

- Existing calibrated conditions
- Existing calibrated conditions with Fbs fraction of 0.36
- Existing calibrated conditions with lower ammonia
- Existing calibrated conditions with 25% high COD

In addition, two new flow configurations were developed, those being: "RAS Denitrification" configuration and the "Modified University of Cape Town (UCT)" configuration, shown in Figure 14 below:

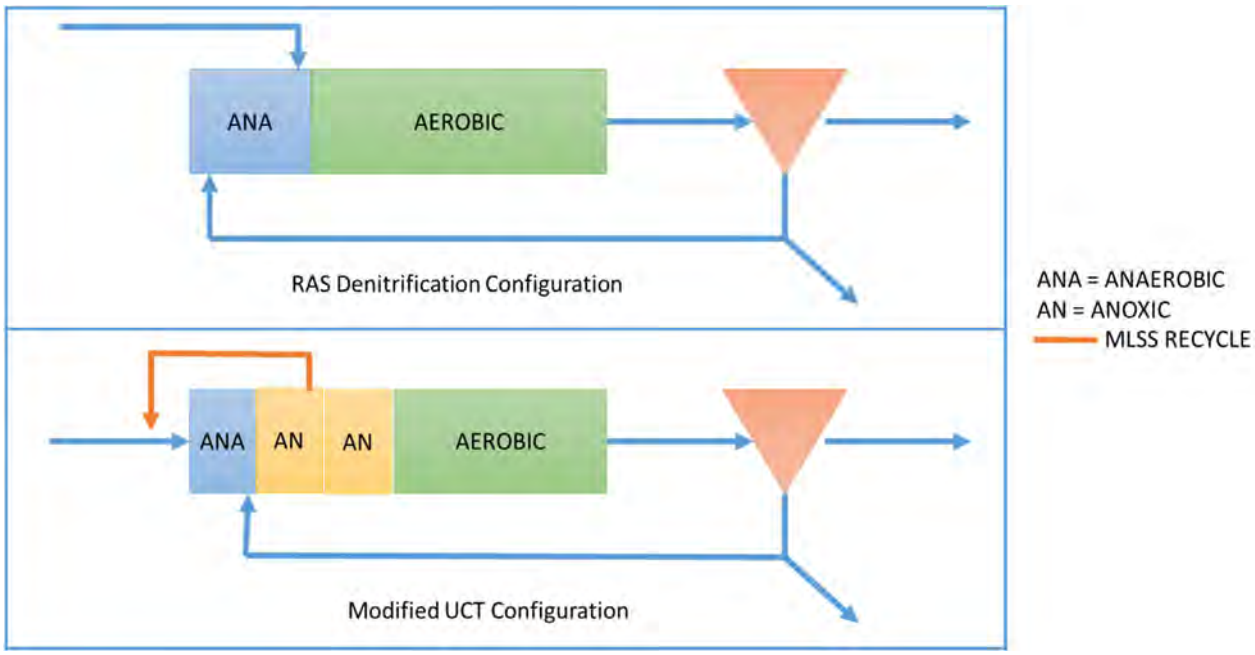


Figure 14

Second Round of Flow Schemes – Enhanced Biological Phosphorus Removal – Using Phosphorus Accumulating Organisms

The configuration entitled "RAS denitrification Configuration" as shown in Figure 14 would feed RAS into an unaerated Existing Basin 6 first, then the denitrified RAS and the rerouted primary effluent will meet before entering the unaerated Existing Basin 5. The BioWin model is shown in Figure 15 below.

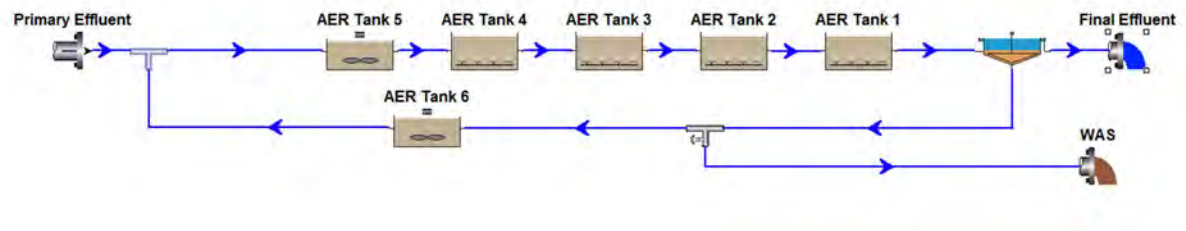


Figure 15 BioWin RAS Denitrification Configuration

The RAS Denitrification Model was able to achieve effluent total phosphorus below 1.0 mg/L without ammonia bleed-thru and its results are shown in Table 22 below. At the existing calibration, the model was not able to achieve effluent total phosphorus concentrations below 0.5 mg/L, therefore, it would require chemical polishing for TP limits 0.5 mg/L and below. This configuration was able to achieve effluent phosphorus below 0.5 mg/L for the three other scenarios. The most effective options were the addition of 25% more COD, and the summer Fbs fraction, both of which achieved approximately 0.3 mg/L effluent phosphorus. The lowered ammonia did affect effluent phosphorus, lowering it to 0.45 mg/L. In general, this configuration would likely require either chemical polishing to the influent of the secondary clarifier or an addition to acetic acid in the winter months.

Table 22 BioWin RAS Denitrification Results

A/O with RAS Denitrification												
	Unaerated Volume	Aerated Volume	RAS	WAS	RAS/WAS	MLSS	TSS	CBOD	Nitrate	Ammonia	Total P	Sol P
	MG		MGD		mg/L							
fbs 0.22	0.291	1.164	1.05	0.032	6521	1708	4.62	1.65	17.09	0.05	0.72	0.5
fbs 0.36	0.291	1.164	1.05	0.031	6645	1740	4.71	1.59	17.18	0.04	0.32	0.07
lower influent ammonia	0.291	1.164	1.05	0.031	6638	1740	4.71	1.64	10.11	0.06	0.45	0.21
25% higher COD	0.291	1.164	1.05	0.032	7728	2023	5.48	1.87	16.04	0.05	0.3	0.06

The second configuration, entitled "Modified UCT" would feed primary effluent and a recycle line of approximately 200% of the influent flow from the end of Aeration Basin #5, back to the beginning of Basin #6. RAS recycle would be re-routed to the beginning of Aeration Basin #5. As the end of Basin #5 and the beginning of Basin #6 share a common wall, a low-horsepower, wall-mounted pump could be used for conveying the recycle flow. Aeration Basins 4, 5 and 6 would all become fully-mixed, unaerated anoxic zones. Basins 1 thru 3 would be unchanged. The BioWin model is shown in Figure 16.

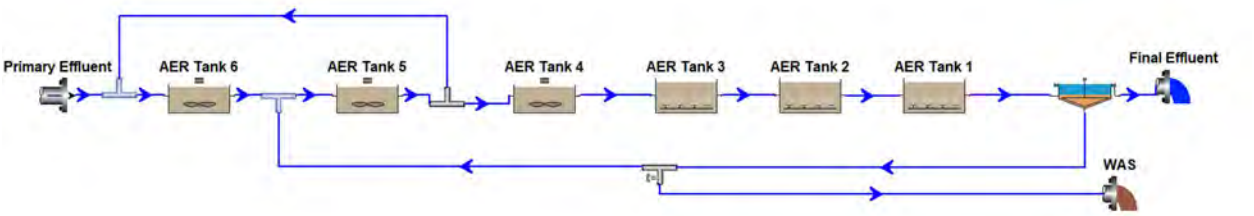


Figure 16 BioWin Modified UCT Configuration

The Modified UCT configuration was able to achieve effluent phosphorus below 1.0 mg/L, without significant impacts to effluent ammonia. Results are shown in Table 23 below. At the existing calibration, the model was not able to achieve effluent total phosphorus under 0.5 mg/L, therefore requiring chemical polishing for limits 0.5 mg/L and below. This configuration was able to achieve effluent phosphorus below 0.5 mg/L for the three other scenarios. In addition, the Modified UCT Configuration effluent total phosphorus got down to 0.64 mg/L and when compared to the RAS Denitrification Configuration's performance of no better than 0.72 mg/L, it was approximately 10% better in performance.

The results from the other scenarios were approximately the same, with the higher Fbs fraction and the higher COD scenarios leading to effluent phosphorus around 0.34 mg/L, and the lower ammonia scenario resulting an effluent phosphorus of 0.4 mg/L. In general, the Modified UCT Configuration could require either chemical polishing to the influent of the secondary clarifier or an addition to acetic acid in the Winter months. Compared to the RAS Denitrification Configuration, this alternative would require less chemical polishing.

Table 23 BioWin Modified UCT Results

Modified UCT												
	Unaerated Volume	Aerated Volume	RAS	WAS	RAS/WAS	MLSS	TSS	CBOD	Nitrate	Ammonia	Total P	Sol P
	MG		MGD		mg/L							
fbs 0.22	0.873	0.873	1.05	0.029	7472	1955	5.29	2.04	17.1	0.05	0.64	0.39
fbs 0.36	0.873	0.873	1.05	0.028	7601	1990	5.38	1.98	17.18	0.05	0.34	0.07
lower influent ammonia	0.873	0.873	1.05	0.029	7577	1983	5.37	2.02	10.14	0.07	0.40	0.13
25% higher COD	0.873	0.873	1.05	0.029	8817	2307	6.24	2.32	16.05	0.06	0.33	0.06

It should be noted that the new NPDES permit has an option for a system that can achieve a yearly geometric mean of 0.5 mg/L without a chemical backup system. The term "chemical backup" refers to both dosing a coagulant to remove phosphorus or dosing acetic acid to the primary effluent.

The RAS Denitrification Configuration and the Modified UCT Configuration were both evaluated to determine if a weighted yearly average for TP below 0.5 mg/L could be achieved using the BioWin effluent results from the summer and winter Fbs fractions. Two weighted averages were considered: 1) One assuming 6 months of cold weather Fbs fraction; and 2) One assuming 3 months of cold weather Fbs fraction. A three-month period of a low Fbs fraction observed during cold weather sampling is more likely, but a six-month term was also used to investigate the worst-case scenario. A geometric mean is less affected by outlier days than a standard average; however, a standard-weighted average was used - to be conservative. Average results are shown in Table 24 below. *This evaluation determined that the Modified UCT Configuration is the only configuration likely to achieve < 0.5 mg/L on a yearly average for effluent total phosphorus concentrations for both scenarios - with no chemical polishing* Therefore, since the City, like most dischargers, wishes to minimize the use a chemical backup, the recommended option of going to the "Modified UCT Configuration" does not include any chemical backup facilities.

Table 24 Estimated Effluent Phosphorus Yearly Averages (mg/L)

Effluent Total Phosphorus	Results with Winter Fbs	Results with Summer Fbs	Weighted (6 month Fbs 0.22)	Weighted (3 month Fbs 0.22)
RAS Denitrification	0.72	0.32	0.52	0.42
Modified UCT	0.64	0.34	0.49	0.41

6.6 MODIFIED UCT PROCESS BASIS OF DESIGN

The recommended MUCT process for biological removal of TP does not includes a chemical back-up system. It is important to note that a chemical feed skid and an alum storage tank will be needed in the distant future to meet a 0.1 mg/L TP limit. Chemical dosing may also require tertiary filtration for the lowest level limit of 0.1 mg/L; however, since that limit is not in the current NPDES permit, it has not been included in the cost opinion for this Project.

Figure 17 – Site Plan for Chemical Phosphorus Removal

A recommended location of the long-term future chemical skid and possible filters is shown in Figure 17. The Basis of Design criteria for the Modified UCT Configuration is as follows:

- A new 3,437 gpm RAS/WAS pump station, which will provide a 150% return rate.
- Re-routing of the primary effluent (See Figure 17).
- Six (6) new mixers (two per tank) for the anoxic zones in Basins #4, #5, and #6.
- One wall-mounted internal 4,583 gpm Internal Recycle Pump to provide a recycle equal to 200% of design average flow, with one un-installed back-up pump kept in inventory.

The site plan for the recommended Modified UCT Configuration is shown in Figure 18 below, with the non-aerated anoxic basins being shown in blue.

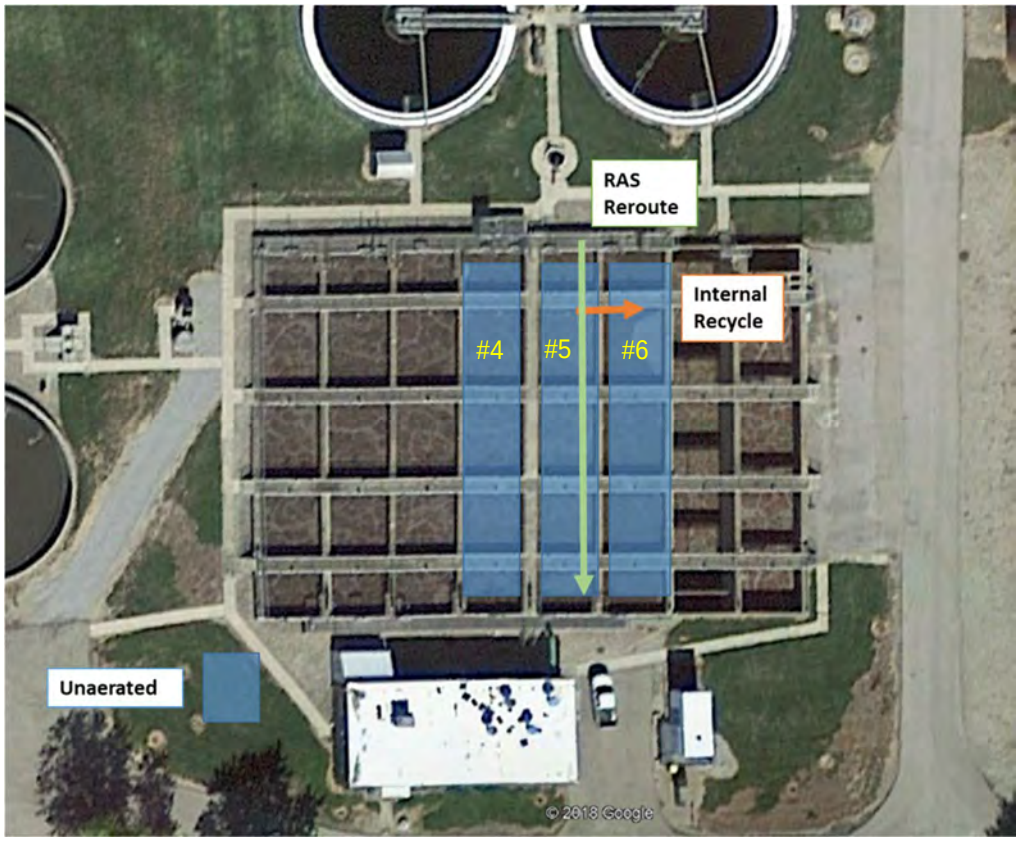


Figure 18 – Site Plan for recommended Modified UCT Process for Bio P removal

6.7 COST OPINION – BIO-P REMOVAL ONLY

All capital costs are planning level based costs and they assume a 10% contingency (the maximum permitted by the IEPA loan program during planning), a 20% factor for contractor overhead and profit, plus and engineering fees. Appendix E provides a detailed cost opinion for the Bio-P Removal part of the project. As Appendix E indicates, the total initial cost for the Bio-P Removal part of the project is forecasted to be slightly over $1.3 million.

The chemical dosing and chemical polishing estimates are shown in Table 25 and Table 26 respectively. Both chemical dosing and polishing is based on the DAF of 3.3 MGD. Chemical dosing is based on an effluent total phosphorus of 2.5 mg/L, which the chemical polishing, to be paired with biological treatment is based on the very conservative effluent phosphorus of 1.0 mg/L.

Note that the ratio of alum dosing-to-phosphorus to be removed increases dramatically with the low level limit. This is because it becomes increasingly difficult for the phosphorus to come in contact with and bind to the alum when phosphorus is in very low concentrations. If chemical phosphorus is selected, it is recommended to run tests to determine the most cost-effective chemical dosing agent, as it can vary from plant to plant.

Table 25 Chemical Dosing Estimations

Design Flows – Chemical Dosing				
Conditions	Units	Goal 1	Goal 2	Goal 3
Average Flow	mgd	3.3	3.3	3.3
Average Effluent TP	mgP/L	2.50	2.50	2.50
Effluent TP Limit	mgP/L	1.00	0.50	0.10
Dosing Target TP	mgP/L	0.80	0.40	0.1
P to be Removed	ppd	46.8	57.8	66.1
Standard Al:P Molar Ratio	mol/mol	1.0	1.4	3.7
Assumed Al:P Molar Ratio	mol/mol	2.0	2.9	7.5
Alum Required	gpd	171.1	301.4	892.7
Alum Required	gph	7.13	12.56	37.20
Alum Required	gpy	62,460	109,993	325,843
Alum Cost	$/gal	$1.75	$1.75	$1.75
Annual Cost	$/yr	$109,305	$192,488	$570,225
Alum Required	mgAl/L	3.0	5.3	15.6
TSS production	ppd	238.7	420.3	1245.2
TSS production	ppy	87,124	153,427	454,511
Sludge production	gpy	417,860	735,860	2,179,910
Sludge handling cost	$/gal	$0.035	$0.035	$0.035
Annual chemical solids cost	$/yr	$14,625	$25,755	$76,297
Total Annual Cost		$123,930	$218,243	$646,522

Table 26 Chemical Polishing Estimations

Design Flows – Chemical Polishing				
Conditions	Units	Goal 1	Goal 2	Goal 3
Average Flow	mgd	3.3	3.3	3.3
Average Effluent TP	mgP/L	1.00	1.00	1.00
Effluent TP Limit	mgP/L	1.00	0.50	0.1
Dosing Target TP	mgP/L	0.80	0.40	0.1
P to be Removed	ppd	5.5	16.5	24.8
Standard Al:P Molar Ratio	mol/mol	1.0	1.4	3.7
Assumed Al:P Molar Ratio	mol/mol	2.0	2.9	7.5
Alum Required	gpd	20.1	86.1	334.8
Alum Required	gph	0.84	3.59	13.95
Alum Required	gpy	7,348	31,427	122,191
Alum Cost	$/gal	$1.75	$1.75	$1.75
Annual Cost	$/yr	$12,859	$54,996	$213,834
Alum Required	mgAl/L	0.4	1.5	5.9
TSS production	ppd	28.1	120.1	467.0
TSS production	ppy	10,250	43,836	170,442
Sludge production	gpy	49,160	210,246	817,466
Sludge handling cost	$/gal	$0.035	$0.035	$0.035
Annual chemical solids cost	$/yr	$1,721	$7,359	$28,611
Total		$14,580	$62,355	$242,446

7. RECOMMENDED IMPROVEMENTS

7.1 SUMMARY OF RECOMMENDED PROJECT COSTS

As noted previously, Part A of the project (the Solids Handling Upgrades) consists of replacing the plant's belt filter press system and anaerobic digestion system with a new Screw Press and a Class A Lime Pasteurization System. Part B of the project is to convert the plant's activated sludge system to a Modified University of Cape Town (MUCT) configuration, in order to achieve biological phosphorus removal down to 0.5 mg/l. The MUCT system conversion under Part B includes chemical back-up facilities. Table 27 on page 38 shows that the total project cost to be funded adds up to just over $5.8 million.

7.2 GREEN PROJECT RESERVE ELIGIBILITY

IEPA's rules for its Water Pollution Control Loan Program are defined in 35 Ill. Adm. Code 365. Under this code, IEPA has created the Green Project Reserve, which provides certain incentives for "Green Infrastructure" related projects. Beginning in October 2019, the loan rules under 35 Ill. Adm. Code 365.110 and 365.210, and 365.345 provided these incentives for Green Infrastructure projects. These projects are defined as those that result in or contains any of the following:

- Reduce water or energy usage.
- Resiliency components, including facilities built for redundancy, or if the project assists a loan applicant with planning for potential service disruptions, natural or manmade.
- Constructs green roofs, pervious pavement, rainwater harvesting or cisterns, sustainable landscaping, storm water control, constructed wetlands, LEED-certified buildings, and/or riparian buffers.
- Implements agricultural Best Management Practices (BMPs).
- Nutrient removal or nutrient loss reduction projects.
- Providing treatment to un-sewered areas.

Donohue has reviewed the project components and all of Part B – Biological Phosphorus Removal should be considered for Green Project Reserve funding. As Table 27 shows, the Biological Phosphorus Removal portion of the project constitutes 29% of the overall project cost. However, under 35 Ill. Adm. Code 365.210-d-2, the 0.2% discount in the loan interest rate available under the "Environmental Impact Discount" part of the loan rules does not apply, since Biological Phosphorus Removal portion is less than 50% of the total project cost. *Therefore, no Green Infrastructure Project loan incentives are expected for this project.*

7.3 APPLICABILITY OF ANTI-DEGRADATION RULE

This section of the Project Plan addresses the anti-degradation aspects and requirements of the project, which are regulated by 35 Ill. Adm. Code 302.105 under Title 35 Part 302 – Water Quality Standards. This section of the code was added to Title 35 in December 2002 in order to " … protect the existing uses of all waters of the State of Illinois and to maintain the quality of waters with quality that is better than water quality standards, and to prevent unnecessary deterioration of waters of the State."

It should be noted that the project, as proposed, does not propose any increases flows or pollutant loadings into the receiving stream. In part, the project is being implemented in order to comply with the nutrient reduction requirements of a NPDES permit that is already in place. Furthermore, once the project is implemented, it is expected that the phosphorus loadings into Cassell Creek will measurably decrease, due to the biological phosphorus removal aspects of the project. For these reasons, the Anti-Degradation requirements of 35 Ill. Adm. Code 302.105 do not apply to this project.

Client: City of Charleston, Illinois
Project: WWTP Upgrades
Task: Project Budget for Loan Proceeds
IEPA Loan No. L17-XXXX
Date: March 13, 2020

TABLE 27

Line Item		Part A - Solids Handling Upgrades	Part B - Bio-P Removal Improvements	Total Project Loan Eligible Costs Totals	Non- Eligible Costs Totals	OVERALL TOTALS
Construction Amounts =		$3,150,000	$1,356,000	$4,506,000	$5,000 spare parts	$4,511,000
Contingency =	10%	$315,000	$136,000	$451,000	$0	$451,000
Construction + Contingency =		$3,465,000	$1,492,000	$4,957,000	$5,000	$4,962,000
Legal =		$0	$0	$0	$0	$0
Design Engineering, incl. Bid Phase Assist. =		$303,989	$95,996	$399,985	$0	$399,985
Construction Engineering =		$334,000	$110,000	$444,000	$0	$444,000
Other - Loan Administration =		$16,700	$5,300	$22,000	$0	$22,000
TOTAL BUDGET =		**$4,119,689** 71%	**$1,703,296** 29%	**$5,822,985** Loan Amount	**$5,000** Non-eligible	**$5,827,985** Total Project Budget

7.4 PROJECT FINANCING

As Table 27 indicates, the total project cost for this option is $5,827,985. This cost includes construction costs as well as loan administration costs, design engineering with bidding assistance, and construction engineering costs. Table 28 on page 39 provides the simple-interest loan financing calculations for the project. It is expected that some of the project costs (such as specified spare parts, currently assigned a preliminary value at $5,000) will be declared as non-eligible for loan funding. Furthermore, as Table 28 shows, the project will be financed by an IEPA low interest loan (at thr "Small Community" rate) with the 2019-20 interest rate of 1.50% being utilized. Loan forgiveness from IEPA is estimated to be 45%. Table 28 assumes that the City's up-front funding input will be limited to only the non-loan-eligible costs.

The City of Charleston intends fund the loan using monies derived from its sanitary sewer fees charged to existing customers served by the City. Currently, the City has approximately 7,000 sewer customers within its service area. The computed principal and interest for the loan, as computed in Table 28 totals $133,355 per year. That cost, when spread out uniformly amongst those customers, results in an average debt retirement cost per customer of about $19.05 per year or $1.59 per month. It should be noted that this cost impact calculation is not applicable to large users (such as Eastern Illinois University), since those customers have bulk service agreements with special user rates.

The City has reviewed its current water and sewer budgetary situation and for this project, it commits to funding the debt retirement cost of $133,355 via existing revenues, with no actual proposed increases in water and sewer rates.

7.5 AFFORDABILITY ANALYSIS

In order to determine the financial impact of the proposed project on the City's sewer customers, the annual cost for sewer service is often compared as a percentage when compared to the Median Household Income (MHI) in the service area. According to the current U.S. Census Bureau information, the MHI for the City of Charleston, Illinois is $29,968, which is that Bureau's American Community Survey 5-year estimate for 2013-2017. It is important to note that using that data source is consistent with the requirements of 35 Ill. Adm. Code 365.110. The statewide MHI for all of Illinois is currently $61,229. Charleston's MHI is currently only 48.9% of the statewide MHI. This parameter is a positive aspect toward the City's chances of receiving some degree of Loan Forgiveness from IEPA, if such funding exists at the time that the loan is executed.

Article 8-3-2 of the City of Charleston's Municipal Code states that the City's combined water and sanitary sewer rate for most customers is $15.33/month for the first 1,000 gallons of water passing through the customer's water meter, plus $15.33 per 1,000 gallons after the first 1,000 gallons, up to 10,000 gallons/month of total usage. For all usage above 10,000 gallons/month, the combined water and sewer rate is $14.75 per 1,000 gallons of water used. This rate structure was put into place on April 16, 2019. The City operates a combined water and sewer system and it does not separate out the cost allocations between the water system and the sanitary sewer system.

The City reports that its average customer uses 5,250 gallons per month. Using the aforementioned rate system, the average Charleston customers combined water and sewer bill is computed as follows:

$15.33/mo. For the first 1,000 gal. + $15.33/1,000 gallons x 4,250 gallons/month = $80.48 per month

City of Charleston - Wastewater System Financing Considerations
Revised 03/18/2020

IEPA WPCLP Loan Requirements to Qualify for Principal Forgiveness				Comments
Charleston's MHI	$29,968			Charleston median household income - must be less than IL MHI
IL MHI	$61,229			Illinois median household income
			Points	
Charleston % ÷ State %	48.9%		55	Percent MHI of IL MHI - results in 55 points
Population	20,186		5	Population less than 25,000 - results in 5 points
IL Unemployment	4.30%			
Gen. Unemployment	4.50%	Charleston	1	Unemployment is higher than IL unemployment rate
Pop shrank from 2010 to 2018			0	Population did not shrink 5% over the last 5 years - results in 0 points
Points Awarded			**61**	Need a minimum of 21 points to qualify for loan forgiveness
Principal Forgiveness			45%	Up to 45% forgiveness allowed - may be less than 45%
Loan Amount		**$5,822,985**		Example loan amount
Principal Forgiveness		$2,620,343		Principal forgiveness - basically a grant
Re-payment		$3,202,642		Resulting principal to be paid back
Term, years		30		
Interest		1.50%		Current interest rate for SRF funds: 2.0% Small community rate - 1.50% (75% of the regular rate)
Annual Payment		**$133,355**		

The following calculation computes what percentage the current average water and sewer bill is when compared to the Median Household Income (MHI) in Charleston:

$80.48 per month x 12 months/year ÷ MHI of $29,968 x 100 = 3.22%

The above calculation demonstrates that Charleston's current average water and sewer bill constitutes 3.22% of the MHI. USEPA's stated view on the cost of drinking water is that it is affordable if it costs less than 2.5% of the MHI. For system with combined water and wastewater bills, it is commonly inferred that USEPA considers a combined annual water and wastewater bill of less than 4.5% of MHI to be affordable (2.5% for drinking water plus an additional 2% for wastewater services and CSO controls when applicable). *Based on this criteria, the current Charleston average water and sewer bill is considered affordable.* As noted previously, the City intends to repay the loan's principal and interest using existing revenues, with no further increases in water and sewer bills. With that, the affordability analysis for existing rates remains unchanged.

7.6 PROJECT BENEFITS

Currently, the City's WWTF anaerobically digests and dewaters its sludge solids and the City applies these biosolids to local farmland. The digestion equipment is antiquated and has outlived its useful life. In addition, as Table 9 on page 12 demonstrates, the digesters are overloaded with excessive amounts of volatile solids, which has caused periodic foaming. In addition, the belt filter press dewatering system is performing poorly, dewatering the sludge to only 12 to 13%. The result is that excessive volumes of sludge has to be trucked to the land application sites.

The Solids Handling Upgrades, as proposed, will replace the poorly-performing belt filter press dewatering system with a new Screw Press unit, which will dewater the sludge to a 20% total solids concentration. This represents an 8.6% reduction in the water content of the sludge. In addition, the antiquated anaerobic digestion system, which marginally produces Class B biosolids, will be replaced with a modern lime pasteurization system that will produce high quality Class A biosolids that are suitable for public distribution, if so desired.

As Tables 11 and 13 on page 23 showed, the plant routinely discharges between 1.36 and 1.69 mg/L of total phosphorus. The Biological Phosphorus Removal Improvements part of the project, once put into operation, will reduce effluent total phosphorus to 0.5 mg/L or less. That improvement should increase the receiving stream's water quality since it will reduce the phosphorus load on the receiving stream by 63% to 70% on average.

7.7 PROJECT SCHEDULE

It is the City's intent to design the project in the 2020 calendar year with construction occurring in 2021-2022. Table 29 below outlines the projected schedule for the project, which assumes that Illinois EPA loan funds will be available for the project in the 2021 calendar year. It is important to note that this schedule should put the Charleston in compliance well within the compliance deadline of January 1, 2030 for meeting a total phosphorus limit of 0.5 mg/L with Special Condition #19.

Table 29 Project Schedule

Task	Start Date	Completion Date
Complete Facility Plan and send to IEPA	01/01/2020	04/01/2020
IEPA approves Facility Plan	04/01/2020	06/01/2020
Equipment Vendor Reference Check & Site Visits	01/01/2020	04/01/2020
Complete Loan Application & User Charge Analysis	03/01/2020	04/01/2020
Complete Preliminary Design	05/01/2020	09/01/2020
Complete Final Design and send plans/specs to IEPA	09/01/2020	01/01/2021
IEPA permit review and approval	01/01/2021	04/01/2021
IEPA grants loan approval	06/01/2021	07/01/2021
Advertise for and open bids	04/01/2021	05/15/2021
Issue Notice of Intent to Award	05/15/2021	06/01/2021
Issue Notice of Award	07/01/2021	08/01/2021
Issue Notice to Proceed	08/01/2021	09/01/2021
Construction Substantially Complete	09/01/2021	10/01/2022
Construction to Final Completion	10/01/2022	11/01/2022
Initial Loan Payment	05/01/2023	05/01/2023

Appendix A

Current NPDES Permit

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 · (217) 782-3397

JB PRITZKER, GOVERNOR JOHN J. KIM, DIRECTOR

217/782-0610

February 19, 2020

City of Charleston
520 Jackson Avenue
Charleston, Illinois 61920

Re: City of Charleston
City of Charleston STP
NPDES Permit No. IL0021644
Bureau ID W0290100001
Final Permit

Gentlemen:

Attached is the final NPDES Permit for your discharge. The Permit as issued covers discharge limitations, monitoring, and reporting requirements. Failure to meet any portion of the Permit could result in civil and/or criminal penalties. The Illinois Environmental Protection Agency is ready and willing to assist you in interpreting any of the conditions of the Permit as they relate specifically to your discharge.

Please note that Special Condition 10 on page 8 has been updated since the public notice period to include the correct language.

Pursuant to the Final NPDES Electronic Reporting Rule, all permittees must report DMRs electronically unless a waiver has been granted by the Agency. The Agency utilizes NetDMR, a web based application, which allows the submittal of electronic Discharge Monitoring Reports instead of paper Discharge Monitoring Reports (DMRs). More information regarding NetDMR can be found on the Agency website, https:www2.illinois.gov/epa/topics/water-quality/surface-water/netdmr/pages/quick-answer-guide.aspx. If your facility has received a waiver from the NetDMR program, a supply of preprinted paper DMR Forms will be sent to your facility. Additional information and instructions will accompany the preprinted DMRs. Please see the attachment regarding the electronic reporting rule.

The attached Permit is effective as of the date indicated on the first page of the Permit. Until the effective date of any re-issued Permit, the limitations and conditions of the previously-issued Permit remain in full effect. You have the right to appeal any condition of the Permit to the Illinois Pollution Control Board within a 35 day period following the issuance date.

Should you have questions concerning the Permit, please contact Keith Runge at 217/782-0610.

Sincerely,

Amy L. Dragovich, P.E.
Manager, Permit Section
Division of Water Pollution Control

ALD:kar11012018

Attachment: Final Permit

cc: Records
Compliance Assurance Section
Champaign Region
Billing
USEPA(email)

NPDES Permit No. IL0021644

Illinois Environmental Protection Agency

Division of Water Pollution Control

1021 North Grand Avenue East

Post Office Box 19276

Springfield, Illinois 62794-9276

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

Reissued (NPDES) Permit

Expiration Date: February 28, 2025

Issue Date: February 19, 2020
Effective Date: March 1, 2020

Name and Address of Permittee:

City of Charleston
520 Jackson Avenue
Charleston, Illinois 61920

Facility Name and Address:

City of Charleston STP
1200 West Madison Avenue
Charleston, Illinois
(Coles County)

Receiving Waters: Cassell Creek

In compliance with the provisions of the Illinois Environmental Protection Act, Title 35 of the Ill. Adm. Code, Subtitle C, Chapter I, and the Clean Water Act (CWA), the above-named Permittee is hereby authorized to discharge at the above location to the above-named receiving stream in accordance with the Effluent Limitations, Monitoring, and Reporting requirements; Special Conditions and Attachment H Standard Conditions attached herein.

Permittee is not authorized to discharge after the above expiration date. In order to receive authorization to discharge beyond the expiration date, the Permittee shall submit the proper application as required by the Illinois Environmental Protection Agency (IEPA) not later than 180 days prior to the expiration date.

Amy L. Dragovich, P.E.
Manager, Permit Section
Division of Water Pollution Control

ALD:kar11012018

NPDES Permit No. IL0021644

Effluent Limitations, Monitoring, and Reporting

FINAL

Discharge Number(s) and Name(s): B01 STP Outfall

Load limits computed based on a design average flow (DAF) of 3.3 MGD (design maximum flow (DMF) of 6.0 MGD).

From the effective date of this Permit until the expiration date, the effluent of the above discharge(s) shall be monitored and limited at all times as follows:

	LOAD LIMITS lbs/day DAF (DMF)*			CONCENTRATION LIMITS mg/L				
Parameter	Monthly Average	Weekly Average	Daily Maximum	Monthly Average	Weekly Average	Daily Maximum	Sample Frequency	Sample Type
Flow (MGD)							Continuous	
$CBOD_5$**, ***	275 (500)		550 (1001)	10		24	2 Days/Week	Composite
Suspended Solids***	330 (600)		661 (1201)	12		24	2 Days/Week	Composite
pH	Shall be in the range of 6 to 9 Standard Units						2 Days/Week	Grab
Fecal Coliform	Daily Maximum shall not exceed 400 per 100mL (May through October)						2 Days/Week	Grab
Chlorine Residual						0.05	****	Grab
Ammonia Nitrogen: As (N)								
March-May/Sept.-Oct.	22 (40)	----	83 (150)	0.8	----	3.0	2 Days/Week	Composite
June-August	22 (40)	55 (100)	83 (150)	0.8	2.0	3.0	2 Days/Week	Composite
Nov.-Feb.	41 (75)	----	94 (170)	1.5	----	3.4	2 Days/Week	Composite
Total Nitrogen as N	Monitor Only						1 Day/Month	Composite
Total Phosphorus as P	Monitor Only						1 Day/Month	Composite
				Monthly Average not less than	Weekly Average not less than	Daily Minimum		
Dissolved Oxygen								
March-July				----	6.25	5.0	1 Day/Month	Grab
August-February				6.0	4.5	4.0	1 Day/Month	Grab

*Load limits based on design maximum flow shall apply only when flow exceeds design average flow.
**Carbonaceous BOD_5 ($CBOD_5$) testing shall be in accordance with 40 CFR 136.
***BOD_5 and Suspended Solids (85% removal required) For Discharge No. 001 and B01: In accordance with 40 CFR 133, the 30-day average percent removal shall not be less than 85 percent. The percent removal need not be reported to the IEPA on DMRs but influent and effluent data must be available, as required elsewhere in this Permit, for IEPA inspection and review. For measuring compliance with this requirement, 5 mg/L shall be added to the effluent $CBOD_5$ concentration to determine the effluent BOD_5 concentration.
Percent removal is a percentage expression of the removal efficiency across a treatment plant for a given pollutant parameter, as determined from the 30-day average values of the raw wastewater influent concentrations to the facility and the 30-day average values of the effluent pollutant concentrations for a given time period.
****See Special Condition 10.

NPDES Permit No. IL0021644

Effluent Limitations, Monitoring, and Reporting

FINAL

Flow shall be reported on the Discharge Monitoring Report (DMR) as monthly average and daily maximum.

pH shall be reported on the DMR as minimum and maximum value.

Chlorine Residual shall be reported on the DMR as daily maximum value.

Dissolved oxygen shall be reported on the DMR as a minimum value.

Fecal Coliform shall be reported on the DMR as a daily maximum value.

Total Phosphorus shall be reported on the DMR as monthly average and daily maximum value.

NPDES Permit No. IL0021644

Effluent, Limitations, Monitoring, and Reporting

Discharge Number(s) and Name(s): A01 Treated CSO Lagoon Outfall

Shall not be utilized until the main treatment facility is receiving a design maximum flow (DMF)* of 4,167gpm.

From the effective date of this Permit until the expiration date, the effluent of the above discharge(s) shall be monitored and limited at all times as follows:

Parameter	CONCENTRATION LIMITS (mg/L) Monthly Average	Sample Frequency	Sample Type
Total Flow (MG)	See Below	Daily When Discharging	Continuous
BOD_5	Report	Daily When Discharging	Grab
Suspended Solids	Report	Daily When Discharging	Grab
Fecal Coliform	Daily Maximum Shall not Exceed 400 per 100 mL	Daily When Discharging	Grab
pH	Shall be in the range of 6 to 9 Standard Units	Daily When Discharging	Grab
Chlorine Residual	0.75	Daily When Discharging	Grab
Ammonia Nitrogen (as N)	Monitor Only	Daily When Discharging	Grab
Total Phosphorus (as P)	Monitor Only	Daily When Discharging	Grab

Total flow in million gallons shall be reported on the Discharge Monitoring Report (DMR) in the quantity maximum column. The main treatment facility flows at the time that Outfall A01 is first utilized shall be reported in the comment section of the DMR in gallons per minute (gpm).

Report the number of days of discharge in the comments section of the DMR.

Fecal Coliform shall be reported on the DMR as daily maximum.

Chlorine Residual shall be reported on the DMR as monthly average.

pH shall be reported on the DMR as a minimum and a maximum.

Total Phosphorus shall be reported on the DMR as monthly average and daily maximum value.

BOD_5 and Suspended Solids shall be reported on the DMR as a monthly average concentration.

*An explanation shall be provided in the comment section of the DMR should these facilities be used when the main treatment facility is not receiving Design Maximum Flow (DMF). The explanation shall identify the reasons the main facility is at a diminished treatment capacity. Additionally, the Permittee shall comply with the provisions of Special Condition 7.

NPDES Permit No. IL0021644

Effluent Limitations, Monitoring, and Reporting

FINAL

Discharge Number(s) and Names(s): 001 Combined Discharge from A01 and B01 Outfall*

From the effective date of this Permit until the expiration date, the effluent of the above discharge(s) shall be monitored and limited at all time as follows:

Parameter	CONCENTRATION LIMITS (mg/L) Monthly Average	Weekly Average	Sample Frequency	Sample Type
Total Flow (MG)			Daily When A01 is Discharging	Continuous
BOD_5**	30	45	Daily When A01 is Discharging	Grab
Suspended Solids**	30	45	Daily When A01 is Discharging	Grab
pH	Shall be in the range of 6 to 9 Standard Units		Daily When A01 is Discharging	Grab
Chlorine Residual	0.75		Daily When A01 is Discharging	Grab
Ammonia Nitrogen (as N)	Monitor only		Daily When A01 is Discharging	Grab
Total Phosphorus (as P)	Monitor only		Daily When A01 is Discharging	Grab
Dissolved Oxygen	Monitor only		Daily When A01 is Discharging	Grab

*An explanation shall be provided in the comment section of the DMR should these facilities be used when the main treatment facility is not receiving Design Maximum Flow (DMF). The explanation shall identify the reasons the main facility is at a diminished treatment capacity. Additionally, the Permittee shall comply with the provisions of Special Condition 7.
**BOD_5 and Suspended Solids (85% removal required): In accordance with 40 CFR 133, the 30-day average percent removal shall not be less than 85 percent. The percent removal need not be reported to the IEPA on DMRs but influent and effluent data must be available, as required elsewhere in this Permit, for IEPA inspection and review. For measuring compliance with this requirement, 5 mg/L shall be added to the effluent $CBOD_5$ concentration to determine the effluent BOD_5 concentration. Percent removal is a percentage expression of the removal efficiency across a treatment plant for a given pollutant parameter, as determined from the 30-day average values of the raw wastewater influent concentrations to the facility and the 30-day average values of the effluent pollutant concentrations for a given time period.

Total flow in million gallons shall be reported on the Discharge Monitoring Report (DMR) in the quantity maximum column.

Report the number of days of discharge in the comments section of the DMR.

Chlorine Residual shall be reported on the DMR as monthly average value.

pH shall be reported on the DMR as a minimum and a maximum value.

Total Phosphorus shall be reported on the DMR as monthly average and daily maximum value.

BOD_5 and Suspended Solids shall be reported on the DMR as a monthly and weekly average concentration.

A monthly average value for ammonia shall be computed for each month that A01 discharges beginning one month after the effective date of the permit. A monthly average concentration shall be determined by combining data collected from A01 and B01 (only B01 data from days when A01 is not discharging) for the reporting period. These monitoring results shall be submitted to the Agency on the DMR. Ammonia Nitrogen shall also be reported on the DMR as a maximum value.

A monthly and weekly average value for Dissolved Oxygen (DO) shall be computed for each month that A01 discharges beginning one month after the effective date of the permit. The monthly and weekly average concentrations for 001 shall be determined by combining data collected from A01 and B01 (only B01 data from days when A01 is not discharging) for the reporting period. These monitoring results shall be submitted to the Agency on the DMR. DO shall also be reported on the DMR as a minimum value.

NPDES Permit No. IL0021644

Influent Monitoring, and Reporting

The influent to the plant shall be monitored as follows:

Parameter	Sample Frequency	Sample Type
Flow (MGD)	Continuous	
BOD_5	2 Days/Week	Composite
Suspended Solids	2 Days/Week	Composite

Influent samples shall be taken at a point representative of the influent.

Flow (MGD) shall be reported on the Discharge Monitoring Report (DMR) as monthly average and daily maximum.

BOD_5 and Suspended Solids shall be reported on the DMR as a monthly average concentration.

Special Conditions

SPECIAL CONDITION 1. This Permit may be modified to include different final effluent limitations or requirements which are consistent with applicable laws and regulations. The IEPA will public notice the permit modification.

SPECIAL CONDITION 2. The use or operation of this facility shall be by or under the supervision of a Certified Class 1 operator.

SPECIAL CONDITION 3. The IEPA may request in writing submittal of operational information in a specified form and at a required frequency at any time during the effective period of this Permit.

SPECIAL CONDITION 4. The IEPA may request more frequent monitoring by permit modification pursuant to 40 CFR § 122.63 and Without Public Notice.

SPECIAL CONDITION 5. The effluent, alone or in combination with other sources, shall not cause a violation of any applicable water quality standard outlined in 35 Ill. Adm. Code 302 and 303.

SPECIAL CONDITION 6. The Permittee shall record monitoring results on Discharge Monitoring Report (DMR) electronic forms using one such form for each outfall each month.

In the event that an outfall does not discharge during a monthly reporting period, the DMR Form shall be submitted with no discharge indicated.

The Permittee is required to submit electronic DMRs (NetDMRs) instead of mailing paper DMRs to the IEPA unless a waiver has been granted by the Agency. More information, including registration information for the NetDMR program, can be obtained on the IEPA website, https:www2.illinois.gov/epa/topics/water-quality/surface-water/netdmr/pages/quick-answer-guide.aspx.

The completed Discharge Monitoring Report forms shall be submitted to IEPA no later than the 25th day of the following month, unless otherwise specified by the permitting authority.

Permittees that have been granted a waiver shall mail Discharge Monitoring Reports with an original signature to the IEPA at the following address:

Illinois Environmental Protection Agency
Division of Water Pollution Control
Attention: Compliance Assurance Section, Mail Code # 19
1021 North Grand Avenue East
Post Office Box 19276
Springfield, Illinois 62794-9276

SPECIAL CONDITION 7. The provisions of 40 CFR Section 122.41(m) & (n) are incorporated herein by reference.

SPECIAL CONDITION 8. Samples taken in compliance with the effluent monitoring requirements shall be taken:

A. For Outfall Number B01 shall be taken at a point:
   1. Representative of the discharge of fully treated wastewater effluent, and
   2. When discharges are occurring from Outfall Number A01, prior to admixture with discharges from Outfall Number A01.
B. For Outfall Number A01 shall be taken at a point:
   1. Representative of the discharge from the excess flow treatment unit(s) to Outfall Number 001, and
   2. Prior to admixture with discharges from Outfall Number B01.
C. For Outfall Number 001 shall be taken at a point:
   1. Representative of the discharge from Outfall Number 001 but prior to entry into the receiving water, and
   2. Representative of the admixture of all flow from Outfall Numbers A01 and B01.
      a. On days when there are no discharges through Outfall Number A01 samples for all effluent limitations and monitoring parameters applicable to Outfall Number 001 can be taken at the location of sampling for Outfall Number B01. When this occurs, sample results for Outfall Number B01 must be reported on the DMRs for Outfall Number B01 and Outfall Number 001.
      b. On days when there are discharges through Outfall A01, samples for all effluent limitations and monitoring parameters applicable to Outfall 001 shall be representative of the discharge through Outfall 001 to the receiving water; and shall be taken at a point representative of the admixture of flows from Outfall Numbers A01 and B01.

SPECIAL CONDITION 9. This Permit may be modified to include requirements for the Permittee on a continuing basis to evaluate and detail its efforts to effectively control sources of infiltration and inflow into the sewer system and to submit reports to the IEPA if necessary.

Special Conditions

SPECIAL CONDITION 10. Any use of chlorine to control slime growths, odors or as an operational control, etc. shall not exceed the limit of 0.05 mg/L (daily maximum) total residual chlorine in the effluent. Sampling is required on a daily grab basis during the chlorination process. Reporting shall be submitted on the DMR's on a monthly basis.

SPECIAL CONDITION 11. The Permittee shall conduct semi-annual monitoring of the effluent and report concentrations (in mg/L) of the following listed parameters. Monitoring shall begin three (3) months from the effective date of this permit. The sample shall be a 24-hour effluent composite except as otherwise specifically provided below and the results shall be submitted on Discharge Monitoring Report Forms to IEPA unless otherwise specified by the IEPA. The parameters to be sampled and the minimum reporting limits to be attained are as follows:

STORET CODE	PARAMETER	Minimum reporting limit
01002	Arsenic	0.05 mg/L
01007	Barium	0.5 mg/L
01027	Cadmium	0.001 mg/L
01032	Chromium (hexavalent) (grab)	0.01 mg/L
01034	Chromium (total)	0.05 mg/L
01042	Copper	0.005 mg/L
00720	Cyanide (total) (grab)***	5.0 µg/L
00722	Cyanide (grab) (available**** or amenable to chlorination)***	5.0 µg/L
00951	Fluoride	0.1 mg/L
01045	Iron (total)	0.5 mg/L
01046	Iron (Dissolved)	0.5 mg/L
01051	Lead	0.05 mg/L
01055	Manganese	0.5 mg/L
71900	Mercury (grab)**	1.0 ng/L*
01067	Nickel	0.005 mg/L
00556	Oil (hexane soluble or equivalent) (Grab Sample only)	5.0 mg/L
32730	Phenols (grab)	0.005 mg/L
01147	Selenium	0.005 mg/L
01077	Silver (total)	0.003 mg/L
01092	Zinc	0.025 mg/L

Minimum Reporting Limits are defined as – (1) The minimum value below which data are documented as non-detects. (2) Three to ten times the method detection limit. (3) The minimum value of the calibration range.

All sample containers, preservative, holding times, analyses, method detection limit determinations and quality assurance/quality control requirements shall be in accordance with 40 CFR 136.

Unless otherwise indicated, concentrations refer to the total amount of the constituent present in all phases, whether solid, suspended or dissolved, elemental or combined, including all oxidation states.

*1.0 ng/L = 1 part per trillion.
**Utilize USEPA Method 1631E and the digestion procedure described in Section 11.1.1.2 of 1631E.
***Analysis for cyanide (available or amenable to chlorination) is only required if cyanide (total) is detected at or above the minimum reporting limit.
****USEPA Method OIA-1677.

The Permittee shall provide a report briefly describing the permittee's pretreatment activities and an updated listing of the Permittee's significant industrial users. The list should specify which categorical pretreatment standards, if any, are applicable to each Industrial User. Permittees who operate multiple plants may provide a single report. Such report shall be submitted within six (6) months of the effective date of this Permit to the following addresses:

U.S. Environmental Protection Agency
Region 5
77 West Jackson Blvd.
Chicago, Illinois 60604
Attention: Water Assurance Branch Enforcement and Compliance

Illinois Environmental Protection Agency
Division of Water Pollution Control
Attention: Compliance assurance Section, Mail Code #19
1021 North Grand Avenue East
Post Office Box 19276
Springfield, Illinois 62794-9276
Springfield, Illinois 62794-9276

SPECIAL CONDITION 12. The Permittee has undergone a Monitoring Reduction review and the influent and effluent sample frequency has been reduced for parameters due to sustained compliance. The IEPA may require that the influent and effluent sampling frequency for these parameters be increased without Public Notice. This provision does not limit EPA's authority to require additional monitoring, information or studies pursuant to Section 308 of the CWA.

SPECIAL CONDITION 13. During January of each year the Permittee shall submit annual fiscal data regarding sewerage system operations to the Illinois Environmental Protection Agency/Division of Water Pollution Control/Compliance Assurance Section. The Permittee may use any fiscal year period provided the period ends within twelve (12) months of the submission date.

Submission shall be on forms provided by IEPA titled "Fiscal Report Form For NPDES Permittees".

SPECIAL CONDITION 14. The Permittee shall conduct biomonitoring of the effluent from Discharge Number(s) B01.

Biomonitoring

A. Acute Toxicity - Standard definitive acute toxicity tests shall be run on at least two trophic levels of aquatic species (fish, invertebrate) representative of the aquatic community of the receiving stream. Testing must be consistent with Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (Fifth Ed.) EPA/821-R-02-012. Unless substitute tests are pre-approved; the following tests are required:

   1. Fish 96-hour static LC_{50} Bioassay using fathead minnows (*Pimephales promelas*).

   2. Invertebrate 48-hour static LC_{50} Bioassay using *Ceriodaphnia*.

B. Testing Frequency - The above tests shall be conducted using 24-hour composite samples unless otherwise authorized by the IEPA. Sample collection and testing must be conducted in the 18th, 15th, 12th, and 9th month prior to the expiration date of this Permit. When possible, bioassay sample collection should coincide with sample collection for metals analysis or other parameters that may contribute to effluent toxicity.

C. Reporting - Results shall be reported according to EPA/821-R-02-012, Section 12, Report Preparation, and shall be mailed to IEPA, Bureau of Water, Compliance Assurance Section or emailed to EPA.PrmtSpecCondtns@Illinois.gov within one week of receipt from the laboratory. Reports are due to the IEPA no later than the 16th, 13th, 10th, and 7th month prior to the expiration date of this Permit.

D. Toxicity – Should a bioassay result in toxicity to >20% of organisms tested in the 100% effluent treatment, the IEPA may require, upon notification, six (6) additional rounds of monthly testing on the affected organism(s) to be initiated within 30 days of the toxic bioassay. Results shall be submitted to IEPA within one (1) week of becoming available to the Permittee. Should any of the additional bioassays result in toxicity to ≥50% of organisms tested in the 100% effluent treatments, the Permittee must contact the IEPA within one (1) day of the results becoming available to the Permittee and begin the toxicity identification and reduction evaluation process as outlined below.

E. Toxicity Identification and Reduction Evaluation - Should any of the additional bioassays result in toxicity to ≥50% of organisms tested in the 100% effluent treatment, the Permittee must contact the IEPA within one (1) day of the results becoming available to the Permittee and begin the toxicity identification evaluation process in accordance with Methods for Aquatic Toxicity Identification Evaluations, EPA/600/6-91/003. The IEPA may also require, upon notification, that the Permittee prepare a plan for toxicity reduction evaluation to be developed in accordance with Toxicity Reduction Evaluation Guidance for Municipal Wastewater Treatment Plants, EPA/833B-99/002, which shall include an evaluation to determine which chemicals have a potential for being discharged in the plant wastewater, a monitoring program to determine their presence or absence and to identify other compounds which are not being removed by treatment, and other measures as appropriate. The Permittee shall submit to the IEPA its plan for toxicity reduction evaluation within ninety (90) days following notification by the IEPA. The Permittee shall implement the plan within ninety (90) days or other such date as contained in a notification letter received from the IEPA.

Special Conditions

The IEPA may modify this Permit during its term to incorporate additional requirements or limitations based on the results of the biomonitoring. In addition, after review of the monitoring results, the IEPA may modify this Permit to include numerical limitations for specific toxic pollutants. Modifications under this condition shall follow public notice and opportunity for hearing.

SPECIAL CONDITION 15. . For the duration of this Permit, the Permittee shall determine the quantity of sludge produced by the treatment facility in dry tons or gallons with average percent total solids analysis. The Permittee shall maintain adequate records of the quantities of sludge produced and have said records available for U.S. EPA and IEPA inspection. The Permittee shall submit to the IEPA, at a minimum, a semi-annual summary report of the quantities of sludge generated and disposed of, in units of dry tons or gallons (average total percent solids) by different disposal methods including but not limited to application on farmland, application on reclamation land, landfilling, public distribution, dedicated land disposal, sod farms, storage lagoons or any other specified disposal method. Said reports shall be submitted to the IEPA by January 31 and July 31 of each year reporting the preceding January thru June and July thru December interval of sludge disposal operations.
Duty to Mitigate. The Permittee shall take all reasonable steps to minimize any sludge use or disposal in violation of this Permit.

Sludge monitoring must be conducted according to test procedures approved under 40 CFR 136 unless otherwise specified in 40 CFR 503, unless other test procedures have been specified in this Permit.

Planned Changes. The Permittee shall give notice to the IEPA on the semi-annual report of any changes in sludge use and disposal.

The Permittee shall retain records of all sludge monitoring, and reports required by the Sludge Permit as referenced in Standard Condition 25 for a period of at least five (5) years from the date of this Permit.

If the Permittee monitors any pollutant more frequently than required by this permit or the Sludge Permit, the results of this monitoring shall be included in the reporting of data submitted to the IEPA.

The Permittee shall comply with existing federal regulations governing sewage sludge use or disposal and shall comply with all existing applicable regulations in any jurisdiction in which the sewage sludge is actually used or disposed.

The Permittee shall comply with standards for sewage sludge use or disposal established under section 405(d) of the CWA within the time provided in the regulations that establish the standards for sewage sludge use or disposal even if the permit has not been modified to incorporate the requirement.

The Permittee shall ensure that the applicable requirements in 40 CFR Part 503 are met when the sewage sludge is applied to the land, placed on a surface disposal site, or fired in a sewage sludge incinerator.

Monitoring reports for sludge shall be reported on the form titled "Sludge Management Reports" to the following address:

Illinois Environmental Protection Agency
Bureau of Water
Compliance Assurance Section
Mail Code #19
1021 North Grand Avenue East
Post Office Box 19276
Springfield, Illinois 62794-9276

SPECIAL CONDITION 16.

AUTHORIZATION OF
COMBINED SEWER AND TREATMENT PLANT DISCHARGES

The IEPA has determined that at least a portion of the collection system consists of combined sewers. References to the collection system and the sewer system refer only to those parts of the system which are owned and operated by the Permittee unless otherwise indicated. The Permittee is authorized to discharge from the overflow(s)/bypass(es) listed below provided the diversion structure is located on a combined sewer and the following terms and conditions are met:

Discharge Number	Location	Receiving Water
002	Main Pump Station CSO	Creek Town Branch tributary to Cassell Creek

Special Conditions

A. CSO Monitoring, Reporting and Notification Requirements

1. The Permittee shall monitor the frequency of discharge (number of discharges per month) and estimate the duration (in hours) of each discharge from each outfall listed in this Special Condition. Estimates of storm duration and total rainfall shall be provided for each storm event.

Start Date	Rainfall Duration (hrs.)	Rainfall Amount (in.)	CSO Outfall #	Outfall Description	Estimated Duration of CSO Discharge (hrs.)	Estimated Volume of CSO Discharge (MG)

For frequency reporting, all discharges from the same storm, or occurring within 24 hours, shall be reported as one. The date that a discharge commences shall be recorded for each outfall. Reports shall be in the form specified by the IEPA and on forms provided by the IEPA (e.g., Form IL 532-2471, or updated form of same). These forms shall be submitted to the IEPA monthly with the DMRs and covering the same reporting period as the DMRs. Parameters (other than flow frequency and volume), if required in this Permit, shall be sampled and reported as indicated in the transmittal letter for such report forms.

2. All Submittals listed in this Special Condition can be submitted electronically to EPA.PrmtSpecCondtns@illinois.gov with IL0021644 Special Condition 16 as the subject of the email.

B. CSO Treatment Requirements

1. All combined sewer overflows and treatment plant bypasses shall be given sufficient treatment to prevent pollution and the violation of applicable water quality standards. Sufficient treatment consists of the following:

   All dry weather flows and the first flush of storm flows shall meet all applicable effluent standards and the effluent limitations as required for the main STP outfall;
   a. Additional flows, but not less than ten times the average dry weather flow for the design year, shall receive a minimum of primary treatment and disinfection with adequate retention time; and
   b. Any additional treatment, necessary to comply with all applicable water quality based requirements of this Permit including, but not limited to, the requirement that discharges from CSOs not cause or contribute to violations of applicable water quality standards or cause use impairment in the receiving waters.

2. All CSO discharges authorized by this Permit shall be treated, in whole or in part, to the extent necessary to prevent accumulations of sludge deposits, floating debris and solids in accordance with 35 Ill. Adm. Code 302.203 and to prevent depression of oxygen levels below the applicable water quality standards.

3. Overflows during dry weather are prohibited. Dry weather overflows shall be reported to the IEPA pursuant to Standard Condition 12(f) of this Permit (24 hour notice).

4. The collection system shall be operated to optimize transport of wastewater flows and to minimize CSO discharges and the treatment system shall be operated to maximize treatment of wastewater flows.

C. CSO Nine Minimum Controls

1. The Permittee shall comply with the nine minimum controls contained in the National CSO Control Policy published in the Federal Register on April 19, 1994. The nine minimum controls are:

   a. Proper operation and maintenance programs for the sewer system and the CSOs;

   b. Maximum use of the collection system for storage;

   c. Review and modification of pretreatment requirements to assure CSO impacts are minimized;

   d. Maximization of flow to the POTW for treatment;

   e. Prohibition of CSOs during dry weather;

   f. Control of solids and floatable materials in CSOs;

g. Pollution prevention programs which focus on source control activities;

h. Public notification to ensure that citizens receive adequate information regarding CSO occurrences and CSO impacts; and,

i. Monitoring to characterize impacts and efficiency of CSO controls.

A CSO pollution prevention plan (PPP) shall be developed by the Permittee unless one has already been prepared for this collection system. Any previously-prepared PPP shall be reviewed, and revised if necessary, by the Permittee to address the items contained in Chapter 8 of the U.S. EPA guidance document, Combined Sewer Overflows, Guidance For Nine Minimum Controls, and any items contained in previously-sent review documents from the IEPA concerning the PPP. Combined Sewer Overflows, Guidance For Nine Minimum Controls is available on line at http://www.epa.gov/npdes/pubs/owm0030.pdf. The PPP (or revised PPP) shall be presented to the general public at a public information meeting conducted by the Permittee annually during the term of this Permit. The Permittee shall submit documentation that the pollution prevention plan complies with the requirements of this Permit and that the public information meeting was held. Such documentation shall be submitted to the IEPA within twelve (12) months of the effective date of this Permit and shall include a summary of all significant issues raised by the public, the Permittee's response to each issue, and two (2) copies of the "CSO Pollution Prevention Plan Certification" one (1) with original signatures. This certification form is available online at http://www.epa.state.il.us/water/permits/waste-water/forms/cso-pol-prev.pdf. Following the public meeting, the Permittee shall implement the pollution prevention plan and shall maintain a current pollution prevention plan, updated to reflect system modifications, on file at the sewage treatment works or other acceptable location and made available to the public. The pollution prevention plan revisions shall be submitted to the IEPA one (1) month from the revision date.

D. Sensitive Area Considerations

1. Pursuant to Section II.C.3 of the federal CSO Control Policy of 1994, sensitive areas are any water likely to be impacted by a CSO discharge which meet one or more of the following criteria: (1) designated as an Outstanding National Resource Water; (2) found to contain shellfish beds; (3) found to contain threatened or endangered aquatic species or their habitat; (4) used for primary contact recreation; (5) National Marine Sanctuaries; or, (6) within the protection area for a drinking water intake structure.

   The IEPA has tentatively determined that none of the outfalls listed in this Special Condition discharge to sensitive areas. However, if information becomes available that causes the IEPA to reverse this determination, the IEPA will notify the Permittee in writing. Upon the date contained in the notification letter, the Permittee shall revise the LTCP and schedule to eliminate or relocate these outfalls. If elimination or relocation is not economically feasible or technically achievable the Permittee shall submit a revised plan and schedule for treating the discharge. Such justification shall be in accordance with Section II.C.3 of the National CSO Control Policy.

E. CSO Operational and Maintenance Plans

1. The Permittee shall implement measures to reduce, to the greatest extent practicable, the total loading of pollutants and floatables entering the receiving stream to ensure that the Permittee ultimately achieves compliance with water quality standards. These measures shall include, but not be limited to developing and implementing a CSO O & M plan, tailored to the permittee's collection and waste treatment systems, which shall include mechanisms and specific procedures where applicable to ensure:

   a. Collection system inspection on a scheduled basis;

   b. Sewer, catch basin, and regulator cleaning and maintenance on a scheduled basis;

   c. Inspections are made and preventive maintenance is performed on all pump/lift stations;

   d. Collection system replacement, where necessary;

   e. Detection and elimination of illegal connections;

   f. Detection, prevention, and elimination of dry weather overflows;

   g. The collection system is operated to maximize storage capacity and the combined sewer portions of the collection system are operated to delay storm entry into the system; and,

h. The treatment and collection systems are operated to maximize treatment.

The IEPA reviewed and accepted a CSO operational and maintenance plan "CSO O&M plan" on October 28, 2007 prepared for this sewerage system. The Permittee shall fully implement the approved plan and review and revise, if needed, the CSO O&M plan to reflect system changes.

The CSO O&M plan shall be presented to the general public at a public information meeting conducted by the Permittee within nine (9) months of the effective date of this Permit or within nine (9) months of the CSO system being modified. The Permittee shall submit documentation that the CSO O&M plan complies with the requirements of this Permit and that the public information meeting was held. Such documentation shall be submitted to the IEPA within twelve (12) months of the effective date of this Permit or within three (3) months of the public meeting and shall include a summary of all significant issues raised by the public, the Permittee's response to each issue, and two (2) copies of the "CSO Operational Plan Checklist and Certification", one (1) with original signatures. Copies of the "CSO Operational Plan Checklist and Certification" are available online at http://www.epa.state.il.us/water/permits/waste-water/forms/cso-checklist.pdf. Following the public meeting, the Permittee shall maintain a current CSO O&M plan, updated to reflect system modifications, on file at the sewage treatment works and made available to the public. The CSO O&M plan revisions shall be submitted to the IEPA one (1) month from the revision date.

F. Sewer Use Ordinances

1. The Permittee, within six (6) months of the effective date of this Permit, shall review and where necessary, modify its existing sewer use ordinance to ensure it contains provisions addressing the conditions below. If no ordinance exists, such ordinance shall be developed and implemented within six (6) months from the effective date of this Permit. Upon completion of the review of the sewer use ordinance(s), the Permittee shall submit two (2) copies of a completed "Certification of Sewer Use Ordinance Review", one (1) with original signatures. Copies of the certification form can be obtained on line at http://www.epa.state.il.us/water/permits/waste-water/forms/sewer-use.pdf. The Permittee shall submit copies of the sewer use ordinance(s) to the IEPA one (1) month from the revision date. Sewer use ordinances are to contain specific provisions to:

   a. Prohibit introduction of new inflow sources to the sanitary sewer system;

   b. Require that new construction tributary to the combined sewer system be designed to minimize and/or delay inflow contribution to the combined sewer system;

   c. Require that inflow sources on the combined sewer system be connected to a storm sewer, within a reasonable period of time, if a storm sewer becomes available;

   d. Provide that any new building domestic waste connection shall be distinct from the building inflow connection, to facilitate disconnection if a storm sewer becomes available;

   e. Assure that CSO impacts from non-domestic sources are minimized by determining which non-domestic discharges, if any, are tributary to CSOs and reviewing, and, if necessary, modifying the sewer use ordinance to control pollutants in these discharges; and,

   f. Assure that the owners of all publicly owned systems with combined sewers tributary to the Permittee's collection system have procedures in place adequate to ensure that the objectives, mechanisms, and specific procedures given in Paragraph 9 of this Special Condition are achieved.

   The Permittee shall enforce the applicable sewer use ordinances.

G. Long-Term Control Planning and Compliance with Water Quality Standards

1.

   a. Pursuant to Section 301 of the federal Clean Water Act, 33 U.S.C. § 1311 and 40 CFR § 122.4, discharges from the CSOs, including the outfalls listed in this Special Condition and any other outfall listed as a "Treated Combined Sewage Outfall", shall not cause or contribute to violations of applicable water quality standards or cause use impairment in the receiving waters. In addition, discharges from CSOs shall comply with all applicable parts of 35 Ill. Adm. Code 306.305(a), (b), (c), and (d).

   b. The Permittee shall develop and implement a water quality monitoring program adequate to verify compliance with water quality standards and to verify protection of designated uses in the receiving water(s) and to ascertain the effectiveness

of CSO controls. Guidance on monitoring plans is available at: http://www.epa.gov/npdes/pubs/final_cso_pccm guidance.pdf. This program shall contain a plan that details the monitoring protocols to be followed, including any necessary effluent and ambient monitoring, and if appropriate, other monitoring protocols such as biological assessments, whole effluent toxicity testing, and sediment sampling. This plan shall be submitted to the IEPA and be presented to the public at an informational meeting within nine (9) months of the effective date of this Permit. Within twelve (12) months of the effective date of this Permit, the Permittee shall submit to IEPA a summary of all significant issues raised by the public, the Permittee's response to each issue, and three (3) copies of the proposed plan (revised following the public meeting, if necessary). The Permittee shall respond to an IEPA review letter in writing within ninety (90) days of the date of such an initial review letter and within thirty (30) days of any subsequent review letter(s), if any. The monitoring plan shall be implemented within six (6) months of the date of IEPA approval. Within thirty (30) months of the approval of the plan, the results shall be submitted to the IEPA along with recommendations and conclusions as to whether or not the discharges from any of the CSOs (treated or untreated) authorized by this Permit are causing or contributing to violations of applicable water quality standards or causing use impairment in the receiving water(s).

c. Should the results of the water quality monitoring plan or if information becomes available that causes IEPA to conclude that the discharges from any of the CSOs (treated or untreated) authorized to discharge under this Permit are causing or contributing to violations of water quality standards or are causing use impairment in the receiving water(s) (and so do not comply with the provisions of Paragraph G.1.a, above), the Permittee shall develop and submit to IEPA three copies of a CSO Long-Term Control Plan (LTCP) that includes measures for assuring that the discharges from the CSOs (treated or untreated) authorized in this Permit comply with the provisions of Paragraph G.1.a above. The LTCP shall include a schedule for implementation and provisions for re-evaluating compliance with applicable standards and regulations after complete implementation.

   If IEPA notifies the Permittee in writing that it has concluded that discharges from any of the CSOs are causing or contributing to violations of water quality standards or are causing use impairment in the receiving waters, then the Permittee shall develop and submit to IEPA three copies of a LTCP within twelve (12) months of receiving the IEPA written notice. The LTCP shall include measures necessary for assuring that the discharges from the CSOs (treated or untreated) authorized in this Permit comply with the provisions of Paragraph G.1.a above.

   Following submittal of the LTCP, the Permittee shall respond to any initial IEPA review letter in writing within ninety (90) days of the date of such a review letter, and within thirty (30) days of any subsequent review letter(s), if any. The Permittee may be required to implement the LTCP, or another remedy for addressing CSOs, through an enforcement action, permit modification or other enforceable mechanism.

2. A public notification program in accordance with Section II.B.8 of the federal CSO Control Policy of 1994 shall be developed employing a process that actively informs the affected public. The program shall include at a minimum public notification of CSO occurrences and CSO impacts, with consideration given to including mass media and/or Internet notification. The Permittee shall post and maintain signs in waters likely to be impacted by CSO discharges at the point of discharge and at points where these waters are used for primary contact recreation. The sign's message should be visible from both shoreline and water vessel approach (if appropriate), respectively. Provisions shall be made to include modifications of the program when necessary and notification to any additional member of the affected public. The program shall be presented to the general public at a public information meeting conducted by the Permittee. The Permittee shall conduct the public information meeting providing a summary and status of the CSO control program annually during the term of this Permit. The Permittee shall submit documentation that the public information meeting was held, shall submit a summary of all significant issues raised by the public and the Permittee's response to each issue and shall identify any modifications to the program as a result of the public information meeting within 60 days of holding the public meeting. The Permittee shall submit copies of the public notification program to the IEPA upon written request.

3. If any of the CSO discharge points listed in this Special Condition are eliminated, or if additional CSO discharge points, not listed in this Special Condition, are discovered, the Permittee shall notify the IEPA in writing within one (1) month of the respective outfall elimination or discovery. Such notification shall be in the form of a request for the appropriate modification of this NPDES Permit.

H. Summary of Compliance Dates in this CSO Special Condition

1.

a. The following summarizes the dates that submittals contained in this Special Condition are due at the IEPA (unless otherwise indicated):

Submission of CSO Monitoring Data (Paragraph A.1)	25th of every month

Submission of Revised CSO O&M Plan (Paragraph E.1)	1 month from revision date
Elimination of a CSO or Discovery of Additional CSO Locations (Paragraph G.3)	1 month from discovery or elimination
Control (or Justification for No Control) of CSOs to Sensitive Areas (Paragraph D.1)	Upon date contained in IEPA notification letter
Certification of Sewer Use Ordinance Review (Paragraph F.1)	6 months from the effective date of this Permit
Conduct Pollution Prevention, and PN Public Information meeting (Paragraphs C.1 and G.2) **No Submittal Due with this Milestone**	Annually
Submit Pollution Prevention Certification and OMP Certification (Paragraphs C.1 and E.1)	12 months from the effective date of this Permit
Conduct OMP Public Information Meeting (Paragraph E.1) **No Submittal Due with this Milestone**	9 months from the effective date of this Permit
Submit PN Information Meeting Summary (Paragraph G.2)	60 days after the public meeting
Submit CSO Long-Term Control Plan (Paragraph G.1)	12 months from the date of IEPA notification

b. Additional Action Items and Required Reporting

Submit Results of Monitoring Plan (Paragraph G.1)	30 months from the date of IEPA plan approval

All Submittals listed in this Special Condition can be submitted electronically to EPA.PrmtSpecCondtns@illinois.gov with "IL0021644 Special Condition 16" as the subject of the email.

I. Reopening and Modifying this Permit

1. The IEPA may initiate a modification for this Permit at any time to include requirements and compliance dates which have been submitted in writing by the Permittee and approved by the IEPA, or other requirements and dates which are necessary to carry out the provisions of the Illinois Environmental Protection Act, the Clean Water Act, or regulations promulgated under those Acts. Public Notice of such modifications and opportunity for public hearing shall be provided.

SPECIAL CONDITION 17. This Permit may be modified to include alternative or additional final effluent limitations pursuant to an approved Total Maximum Daily Load (TMDL) Study or upon completion of an alternate Water Quality Study.

SPECIAL CONDITION 18. The Permittee shall work towards the goals of achieving no discharges from sanitary sewer overflows or basement back-ups and ensuring that overflows or back-ups, when they do occur do not cause or contribute to violations of applicable standards or cause impairment in any adjacent receiving water. Overflows from sanitary sewers are expressly prohibited by this permit and by Ill. Adm. Code 306.304. As part of the process to ultimately achieve compliance through the elimination of and mitigating the adverse impacts of any such overflows if they do occur, the Permittee shall (A) identify and report to IEPA all SSOs that do occur, and (B) update the existing Capacity, Management, Operations, and Maintenance (CMOM) plan at least annually and maintain it at the facility for review during Agency Field Operations Section inspections. The Permittee shall submit copies of the CMOM to the IEPA upon written request. The Permittee shall modify the Plan to incorporate any comments that it receives from IEPA and shall implement the modified plan as soon as possible. The Permittee should work as appropriate, in consultation with affected authorities at the local, county, and/or state level to develop the plan components involving third party notification of overflow events. The Permittee may be required to construct additional sewage transport and/or treatment facilities in future permits or other enforceable documents should the implemented CMOM plan indicate that the Permittee's facilities are not capable of conveying and treating the flow for which they are designed.

The CMOM plan shall include the following elements:

A. Measures and Activities:

1. A complete map and system inventory for the collection system owned and operated by the Permittee;
2. Organizational structure; budgeting; training of personnel; legal authorities; schedules for maintenance, sewer system cleaning, and preventative rehabilitation; checklists, and mechanisms to ensure that preventative maintenance is performed on equipment owned and operated by the Permittee;
3. Documentation of unplanned maintenance;
4. An assessment of the capacity of the collection and treatment system owned and operated by the Permittee at critical junctions and immediately upstream of locations where overflows and backups occur or are likely to occur; use flow monitoring and/or sewer hydraulic modeling, as necessary;
5. Identification and prioritization of structural deficiencies in the system owned and operated by the Permittee. Include preventative maintenance programs to prevent and/or eliminate collection system blockages from roots or grease, and prevent corrosion or negative effects of hydrogen sulfide which may be generated within collection system;
6. Operational control, including documented system control procedures, scheduled inspections and testing, list of scheduled frequency of cleaning (and televising as necessary) of sewers;
7. The Permittee shall develop and implement an Asset Management strategy to ensure the long-term sustainability of the collection system. Asset Management shall be used to assist the Permittee in making decisions on when it is most appropriate to repair, replace or rehabilitate particular assets and develop long-term funding strategies; and

8. Asset Management shall include but is not limited to the following elements:
   a. Asset Inventory and State of the Asset;
   b. Level of Service;
   c. Critical Asset Identification;
   d. Life Cycle Cost; and
   e. Long-Term Funding Strategy.

B. Design and Performance Provisions:

1. Monitor the effectiveness of CMOM;
2. Upgrade the elements of the CMOM plan as necessary; and
3. Maintain a summary of CMOM activities.

C. Overflow Response Plan:

1. Know where overflows and back-ups within the facilities owned and operated by the Permittee occur;
2. Respond to each overflow or back-up to determine additional actions such as clean up; and
3. Locations where basement back-ups and/or sanitary sewer overflows occur shall be evaluated as soon as practicable for excessive inflow/infiltration, obstructions or other causes of overflows or back-ups as set forth in the System Evaluation Plan.
4. Identify the root cause of the overflow or basement backup, and document to files;
5. Identify actions or remediation efforts to reduce risk of reoccurrence of these overflows or basement backups in the future, and document to files.

D. System Evaluation Plan:

1. Summary of existing SSO and Excessive I/I areas in the system and sources of contribution;
2. Evaluate plans to reduce I/I and eliminate SSOs;
3. Evaluate the effectiveness and performance in efforts to reduce excessive I/I in the collection system;
4. Special provisions for Pump Stations and force mains and other unique system components; and
5. Construction plans and schedules for correction.

E. Reporting and Monitoring Requirements:

1. Program for SSO detection and reporting; and
2. Program for tracking and reporting basement back-ups, including general public complaints.

F. Third Party Notice Plan:

1. Describes how, under various overflow scenarios, the public, as well as other entities, would be notified of overflows within the Permittee's system that may endanger public health, safety or welfare;

2. Identifies overflows within the Permittee's system that would be reported, giving consideration to various types of events including events with potential widespread impacts;
3. Identifies who shall receive the notification;
4. Identifies the specific information that would be reported including actions that will be taken to respond to the overflow;
5. Includes a description of the lines of communication; and
6. Includes the identities and contact information of responsible POTW officials and local, county, and/or state level officials.

For additional information concerning USEPA CMOM guidance and Asset Management please refer to the following web site addresses. http://www.epa.gov/npdes/pubs/cmom_guide_for_collection_systems.pdf and http://water.epa.gov/type/watersheds/wastewater/upload/guide_smallsystems_assetmanagement_bestpratices.pdf

SPECIAL CONDITION 19.

A. Subject to paragraph B below, an effluent limit of 0.5 mg/L Total Phosphorus 12 month rolling geometric mean (calculated monthly) basis (hereinafter "Limit"), shall be met by the Permittee by January 1, 2030, unless the Permittee demonstrates that meeting such Limit is not technologically or economically feasible in one of the following manners:
   1. the Limit is not technologically feasible through the use of biological phosphorus removal (BPR) process(es) at the treatment facility; or
   2. the Limit would result in substantial and widespread economic or social impact. Substantial and widespread economic impacts must be demonstrated using applicable USEPA guidance, including but not limited to any of the following documents:
      a. Interim Economic Guidance for Water Quality Standards, March 1995, EPA-823-95-002;
      b. Combined Sewer Overflows – Guidance for Financial Capability Assessment and Schedule Development, February 1997, EPA-832—97-004;
      c. Financial Capability Assessment Framework for Municipal Clean Water Act Requirements, November 24, 2014; and
      d. any additional USEPA guidance on affordability issues that revises, supplements or replaces those USEPA guidance documents; or
   3. the Limit can only be met by chemical addition for phosphorus removal at the treatment facility in addition to those processes currently contemplated; or
   4. the Limit is demonstrated not to be feasible by January 1, 2030, but is feasible within a longer timeline, then the Limit shall be met as soon feasible and approved by the Agency; or
   5. the Limit is demonstrated not to be achievable, then an effluent limit that is achievable by the Permittee (along with associated timeline) will apply instead, except that the effluent limit shall not exceed 0.6 mg/L Total Phosphorus 12 month rolling geometric mean (calculated monthly).

B. The Limit shall be met by the Permittee by January 1, 2030, except in the following circumstances:
   1. If the Permittee develops a written plan, preliminary engineering report or facility plan no later than January 1, 2025, to rebuild or replace the secondary treatment process(es) of the treatment facility, the Limit shall be met by December 31, 2035; or
   2. If the Permittee decides to construct/operate biological nutrient removal (BNR) process(es), incorporating nitrogen reduction, the Limit shall be met by December 31, 2035; or
   3. If the Permittee decides to use chemical addition for phosphorus removal instead of BPR, the Limit and the effluent limit of 1.0 mg/L Total Phosphorus monthly average shall be met by December 31, 2025; or
   4. If the Permittee has already installed chemical addition for phosphorus removal instead of BPR, and has a 1.0 mg/L Total Phosphorus monthly average effluent limit in its permit, or the Permittee is planning to install chemical addition with an IEPA construction permit that is issued on or before July 31, 2018, the 1.0 mg/L Total Phosphorus monthly average effluent limit (and associated compliance schedule) shall apply, and the Limit shall not be applicable.
   5. The NARP determines that a limit lower than the Limit is necessary and attainable. The lower limit and timeline identified in the NARP shall apply to the Permittee.
   6. If the Permittee participates in a watershed group that is developing a NARP for an impairment related to phosphorus or a risk of eutrophication, and IEPA determines that the group has the financial and structural capability to develop the NARP by the deadline specified in the NARP provisions below

C. The Permittee shall identify and provide adequate justification of any exception identified in paragraph A or circumstance identified in paragraph B, regarding meeting the Limit. The justification shall be submitted to the Agency at the time of renewal of this permit or by December 31, 2023, whichever date is first. Any justification or demonstration performed by the Permittee pursuant to paragraph A or circumstance pursuant to paragraph B must be reviewed and approved by the Agency. The Agency will renew or modify the NPDES permit as necessary. No date deadline modification or effluent limitation modification for any of the exceptions or circumstances specified in paragraphs A or B will be effective until it is included in a modified or reissued NPDES Permit.

D. For purposes of this permit, the following definitions are used:

1. BPR (Biological Phosphorus Removal) is defined herein as treatment processes which do not require use of supplemental treatment processes at the treatment facilities before or after the biological system, such as but not limited to, chemical addition, carbon supplementation, fermentation, or filtration. The use of filtration or additional equipment to meet other effluent limits is not prohibited, but those processes will not be considered part of the BPR process for purposes of this permit; and
2. BNR (Biological Nutrient Removal) is defined herein as treatment processes used for nitrogen and phosphorus removal from wastewater before it is discharged. BNR treatment processes, as defined herein, do not require use of supplemental treatment processes at the treatment facilities before or after the biological system, such as but not limited to, chemical addition, carbon supplementation, fermentation or filtration. The use of filtration or additional equipment to meet other effluent limits is not prohibited, but those processes will not be considered part of the BNR process for purposes of this permit.

E. The 0.5 mg/L Total Phosphorus 12 month rolling geometric mean (calculated monthly) effluent limit applies to the effluent from the treatment plant.

SPECIAL CONDITION 20.

The Agency has determined that the Permittee's treatment plant effluent is located upstream of a waterbody or stream segment that has been determined to be at risk of eutrophication. This determination was made upon reviewing available information concerning the characteristics of the relevant waterbody/segment and the relevant facility (such as quantity of discharge flow and nutrient load relative to the stream flow).

A waterbody or segment is at risk of eutrophication if there is available information that plant, algal or cyanobacterial growth is causing or will cause violation of a water quality standard.

The Permittee shall develop, or be a part of a watershed group that develops, a Nutrient Assessment Reduction Plan (NARP) that will meet the following requirements:

A. The NARP shall be developed and submitted to the Agency by December 31, 2023. This requirement can be accomplished by the Permittee, by participation in an existing watershed group or by creating a new group. The NARP shall be supported by data and sound scientific rationale.
B. The Permittee shall cooperate with and work with other stakeholders in the watershed to determine the most cost-effective means to address the risk of eutrophication. If other stakeholders in the watershed will not cooperate in developing the NARP, the Permittee shall develop its own NARP for submittal to the Agency to comply with this condition.
C. In determining the target levels of various parameters necessary to address the risk of eutrophication, the NARP shall either utilize the recommendations by the Nutrient Science Advisory Committee or develop its own watershed-specific target levels.
D. The NARP shall identify phosphorus input reductions from point sources and non-point sources in addition to other measures necessary to remove the risk of eutrophication characteristics that will cause or may cause violation of a water quality standard. The NARP may determine, based on an assessment of relevant data, that the watershed does not have a risk of eutrophication related to phosphorus, in which case phosphorus input reductions or other measures would not be necessary. Alternatively, the NARP could determine that phosphorus input reductions from point sources are not necessary, or that phosphorus input reductions from both point and nonpoint sources are necessary, or that phosphorus input reductions are not necessary and that other measures, besides phosphorus input reductions, are necessary.
E. The NARP shall include a schedule for the implementation of the phosphorus input reductions and other measures. The NARP schedule shall be implemented as soon as possible and shall identify specific timelines applicable to the permittee.
F. The NARP can include provisions for water quality trading to address the phosphorus related risk of eutrophication characteristics in the watershed. Phosphorus/Nutrient trading cannot result in violations of water quality standards or applicable antidegradation requirements.
G. The Permittee shall request modification of the permit within 90 days after the NARP has been completed to include necessary phosphorus input reductions identified within the NARP. The Agency will modify the permit if necessary.
H. If the Permittee does not develop or assist in developing the NARP and such a NARP is developed for the watershed, the Permittee will become subject to effluent limitations necessary to address the risk of eutrophication. The Agency shall calculate these effluent limits by using the NARP and any applicable data. If no NARP has been developed, the effluent limits shall be determined for the Permittee on a case-by-case basis, so as to ensure that the Permittee's discharge will not cause or contribute to violations of the dissolved oxygen or narrative offensive condition water quality standards.

Attachment H

Standard Conditions

Definitions

Act means the Illinois Environmental Protection Act, 415 ILCS 5 as Amended.

Agency means the Illinois Environmental Protection Agency.

Board means the Illinois Pollution Control Board.

Clean Water Act (formerly referred to as the Federal Water Pollution Control Act) means Pub. L 92-500, as amended. 33 U.S.C. 1251 et seq.

NPDES (National Pollutant Discharge Elimination System) means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under Sections 307, 402, 318 and 405 of the Clean Water Act.

USEPA means the United States Environmental Protection Agency.

Daily Discharge means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurements, the "daily discharge" is calculated as the average measurement of the pollutant over the day.

Maximum Daily Discharge Limitation (daily maximum) means the highest allowable daily discharge.

Average Monthly Discharge Limitation (30 day average) means the highest allowable average of daily discharges over a calendar month, calculated as the sum of all daily discharges measured during a calendar month divided by the number of daily discharges measured during that month.

Average Weekly Discharge Limitation (7 day average) means the highest allowable average of daily discharges over a calendar week, calculated as the sum of all daily discharges measured during a calendar week divided by the number of daily discharges measured during that week.

Best Management Practices (BMPs) means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the State. BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

Aliquot means a sample of specified volume used to make up a total composite sample.

Grab Sample means an individual sample of at least 100 milliliters collected at a randomly-selected time over a period not exceeding 15 minutes.

24-Hour Composite Sample means a combination of at least 8 sample aliquots of at least 100 milliliters, collected at periodic intervals during the operating hours of a facility over a 24-hour period.

8-Hour Composite Sample means a combination of at least 3 sample aliquots of at least 100 milliliters, collected at periodic intervals during the operating hours of a facility over an 8-hour period.

Flow Proportional Composite Sample means a combination of sample aliquots of at least 100 milliliters collected at periodic intervals such that either the time interval between each aliquot or the volume of each aliquot is proportional to either the stream flow at the time of sampling or the total stream flow since the collection of the previous aliquot.

(1) **Duty to comply**. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action, permit termination, revocation and reissuance, modification, or for denial of a permit renewal application. The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish these standards or prohibitions, even if the permit has not yet been modified to incorporate the requirements.

(2) **Duty to reapply**. If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. If the permittee submits a proper application as required by the Agency no later than 180 days prior to the expiration date, this permit shall continue in full force and effect until the final Agency decision on the application has been made.

(3) **Need to halt or reduce activity not a defense**. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

(4) **Duty to mitigate**. The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

(5) **Proper operation and maintenance**. The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with conditions of this permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up, or auxiliary facilities, or similar systems only when necessary to achieve compliance with the conditions of the permit.

(6) **Permit actions**. This permit may be modified, revoked and reissued, or terminated for cause by the Agency pursuant to 40 CFR 122.62 and 40 CFR 122.63. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

(7) **Property rights**. This permit does not convey any property rights of any sort, or any exclusive privilege.

(8) **Duty to provide information**. The permittee shall furnish to the Agency within a reasonable time, any information which the Agency may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with the permit. The permittee shall also furnish to the Agency upon request, copies of records required to be kept by this permit.

(9) **Inspection and entry**. The permittee shall allow an authorized representative of the Agency or USEPA (including an authorized contractor acting as a representative of the Agency or USEPA), upon the presentation of credentials and other documents as may be required by law, to:
  (a) Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;
  (b) Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;
  (c) Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and
  (d) Sample or monitor at reasonable times, for the purpose of assuring permit compliance, or as otherwise authorized by the Act, any substances or parameters at any location.

(10) **Monitoring and records**.
  (a) Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.
  (b) The permittee shall retain records of all monitoring information, including all calibration and maintenance records, and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of this permit, measurement, report or application. Records related to the permittee's sewage sludge use and disposal activities shall be retained for a period of at least five years (or longer as required by 40 CFR Part 503). This period may be extended by request of the Agency or USEPA at any time.
  (c) Records of monitoring information shall include:
    (1) The date, exact place, and time of sampling or measurements;
    (2) The individual(s) who performed the sampling or measurements;
    (3) The date(s) analyses were performed;
    (4) The individual(s) who performed the analyses;
    (5) The analytical techniques or methods used; and
    (6) The results of such analyses.
  (d) Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit. Where no test procedure under 40 CFR Part 136 has been approved, the permittee must submit to the Agency a test method for approval. The permittee shall calibrate and perform maintenance procedures on all monitoring and analytical instrumentation at intervals to ensure accuracy of measurements.

(11) **Signatory requirement**. All applications, reports or information submitted to the Agency shall be signed and certified.
  (a) **Application**. All permit applications shall be signed as follows:
    (1) For a corporation: by a principal executive officer of at least the level of vice president or a person or position having overall responsibility for environmental matters for the corporation:
    (2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or
    (3) For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official.
  (b) **Reports**. All reports required by permits, or other information requested by the Agency shall be signed by a person described in paragraph (a) or by a duly authorized representative of that person. A person is a duly authorized representative only if:
    (1) The authorization is made in writing by a person described in paragraph (a); and
    (2) The authorization specifies either an individual or a position responsible for the overall operation of the facility, from which the discharge originates, such as a plant manager, superintendent or person of equivalent responsibility; and
    (3) The written authorization is submitted to the Agency.
  (c) **Changes of Authorization**. If an authorization under (b) is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of (b) must be submitted to the Agency prior to or together with any reports, information, or applications to be signed by an authorized representative.
  (d) **Certification**. Any person signing a document under paragraph (a) or (b) of this section shall make the following certification:

  I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

(12) **Reporting requirements**.
  (a) **Planned changes**. The permittee shall give notice to the Agency as soon as possible of any planned physical alterations or additions to the permitted facility.
  Notice is required when:
    (1) The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source pursuant to 40 CFR 122.29 (b); or
    (2) The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements pursuant to 40 CFR 122.42 (a)(1).
    (3) The alteration or addition results in a significant change in the permittee's sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan.
  (b) **Anticipated noncompliance**. The permittee shall give advance notice to the Agency of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.
  (c) **Transfers**. This permit is not transferable to any person except after notice to the Agency.
  (d) **Compliance schedules**. Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date.
  (e) **Monitoring reports**. Monitoring results shall be reported at the intervals specified elsewhere in this permit.
    (1) Monitoring results must be reported on a Discharge Monitoring Report (DMR).

(2) If the permittee monitors any pollutant more frequently than required by the permit, using test procedures approved under 40 CFR 136 or as specified in the permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR.

(3) Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Agency in the permit.

(f) **Twenty-four hour reporting**. The permittee shall report any noncompliance which may endanger health or the environment. Any information shall be provided orally within 24-hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and time; and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance. The following shall be included as information which must be reported within 24-hours:

(1) Any unanticipated bypass which exceeds any effluent limitation in the permit.

(2) Any upset which exceeds any effluent limitation in the permit.

(3) Violation of a maximum daily discharge limitation for any of the pollutants listed by the Agency in the permit or any pollutant which may endanger health or the environment.

The Agency may waive the written report on a case-by-case basis if the oral report has been received within 24-hours.

(g) **Other noncompliance**. The permittee shall report all instances of noncompliance not reported under paragraphs (12) (d), (e), or (f), at the time monitoring reports are submitted. The reports shall contain the information listed in paragraph (12) (f).

(h) **Other information**. Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application, or in any report to the Agency, it shall promptly submit such facts or information.

(13) **Bypass**.

(a) Definitions.

(1) Bypass means the intentional diversion of waste streams from any portion of a treatment facility.

(2) Severe property damage means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

(b) Bypass not exceeding limitations. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of paragraphs (13)(c) and (13)(d).

(c) Notice.

(1) Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least ten days before the date of the bypass.

(2) Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required in paragraph (12)(f) (24-hour notice).

(d) Prohibition of bypass.

(1) Bypass is prohibited, and the Agency may take enforcement action against a permittee for bypass, unless:

(i) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(ii) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and

(iii) The permittee submitted notices as required under paragraph (13)(c).

(2) The Agency may approve an anticipated bypass, after considering its adverse effects, if the Agency determines that it will meet the three conditions listed above in paragraph (13)(d)(1).

(14) **Upset**.

(a) Definition. Upset means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

(b) Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology based permit effluent limitations if the requirements of paragraph (14)(c) are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

(c) Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

(1) An upset occurred and that the permittee can identify the cause(s) of the upset;

(2) The permitted facility was at the time being properly operated; and

(3) The permittee submitted notice of the upset as required in paragraph (12)(f)(2) (24-hour notice).

(4) The permittee complied with any remedial measures required under paragraph (4).

(d) Burden of proof. In any enforcement proceeding the permittee seeking to establish the occurrence of an upset has the burden of proof.

(15) **Transfer of permits**. Permits may be transferred by modification or automatic transfer as described below:

(a) Transfers by modification. Except as provided in paragraph (b), a permit may be transferred by the permittee to a new owner or operator only if the permit has been modified or revoked and reissued pursuant to 40 CFR 122.62 (b) (2), or a minor modification made pursuant to 40 CFR 122.63 (d), to identify the new permittee and incorporate such other requirements as may be necessary under the Clean Water Act.

(b) Automatic transfers. As an alternative to transfers under paragraph (a), any NPDES permit may be automatically

transferred to a new permittee if:

(1) The current permittee notifies the Agency at least 30 days in advance of the proposed transfer date;

(2) The notice includes a written agreement between the existing and new permittees containing a specified date for transfer of permit responsibility, coverage and liability between the existing and new permittees; and

(3) The Agency does not notify the existing permittee and the proposed new permittee of its intent to modify or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement.

(16) All manufacturing, commercial, mining, and silvicultural dischargers must notify the Agency as soon as they know or have reason to believe:

(a) That any activity has occurred or will occur which would result in the discharge of any toxic pollutant identified under Section 307 of the Clean Water Act which is not limited in the permit, if that discharge will exceed the highest of the following notification levels:

(1) One hundred micrograms per liter (100 ug/l);

(2) Two hundred micrograms per liter (200 ug/l) for acrolein and acrylonitrile; five hundred micrograms per liter (500 ug/l) for 2,4-dinitrophenol and for 2-methyl-4,6 dinitrophenol; and one milligram per liter (1 mg/l) for antimony.

(3) Five (5) times the maximum concentration value reported for that pollutant in the NPDES permit application; or

(4) The level established by the Agency in this permit.

(b) That they have begun or expect to begin to use or manufacture as an intermediate or final product or byproduct any toxic pollutant which was not reported in the NPDES permit application.

(17) All Publicly Owned Treatment Works (POTWs) must provide adequate notice to the Agency of the following:

(a) Any new introduction of pollutants into that POTW from an indirect discharge which would be subject to Sections 301 or 306 of the Clean Water Act if it were directly discharging those pollutants; and

(b) Any substantial change in the volume or character of pollutants being introduced into that POTW by a source introducing pollutants into the POTW at the time of issuance of the permit.

(c) For purposes of this paragraph, adequate notice shall include information on (i) the quality and quantity of effluent introduced into the POTW, and (ii) any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.

(18) If the permit is issued to a publicly owned or publicly regulated treatment works, the permittee shall require any industrial user of such treatment works to comply with federal requirements concerning:

(a) User charges pursuant to Section 204 (b) of the Clean Water Act, and applicable regulations appearing in 40 CFR 35;

(b) Toxic pollutant effluent standards and pretreatment standards pursuant to Section 307 of the Clean Water Act; and

(c) Inspection, monitoring and entry pursuant to Section 308 of the Clean Water Act.

(Rev. 7-9-2010 bah)

(19) If an applicable standard or limitation is promulgated under Section 301(b)(2)(C) and (D), 304(b)(2), or 307(a)(2) and that effluent standard or limitation is more stringent than any effluent limitation in the permit, or controls a pollutant not limited in the permit, the permit shall be promptly modified or revoked, and reissued to conform to that effluent standard or limitation.

(20) Any authorization to construct issued to the permittee pursuant to 35 Ill. Adm. Code 309.154 is hereby incorporated by reference as a condition of this permit.

(21) The permittee shall not make any false statement, representation or certification in any application, record, report, plan or other document submitted to the Agency or the USEPA, or required to be maintained under this permit.

(22) The Clean Water Act provides that any person who violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Clean Water Act is subject to a civil penalty not to exceed $25,000 per day of such violation. Any person who willfully or negligently violates permit conditions implementing Sections 301, 302, 306, 307, 308, 318 or 405 of the Clean Water Act is subject to a fine of not less than $2,500 nor more than $25,000 per day of violation, or by imprisonment for not more than one year, or both. Additional penalties for violating these sections of the Clean Water Act are identified in 40 CFR 122.41 (a)(2) and (3).

(23) The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000, or by imprisonment for not more than 2 years, or both. If a conviction of a person is for a violation committed after a first conviction of such person under this paragraph, punishment is a fine of not more than $20,000 per day of violation, or by imprisonment of not more than 4 years, or both.

(24) The Clean Water Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or non-compliance shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

(25) Collected screening, slurries, sludges, and other solids shall be disposed of in such a manner as to prevent entry of those wastes (or runoff from the wastes) into waters of the State. The proper authorization for such disposal shall be obtained from the Agency and is incorporated as part hereof by reference.

(26) In case of conflict between these standard conditions and any other condition(s) included in this permit, the other condition(s) shall govern.

(27) The permittee shall comply with, in addition to the requirements of the permit, all applicable provisions of 35 Ill. Adm. Code, Subtitle C, Subtitle D, Subtitle E, and all applicable orders of the Board or any court with jurisdiction.

(28) The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit is held invalid, the remaining provisions of this permit shall continue in full force and effect.

Appendix B

Environmental Sign-off Documentation

IDNR Correspondence

Wetlands and Endangered Species Issues

EcoCAT
Ecological Compliance Assessment Tool

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Applicant: Donohue & Associates
Contact: Joseph V. Pisula
Address: 1605 S. State Street
Suite 1C
Champaign, IL 61820

IDNR Project Number: 2007715
Date: 03/18/2020

Project: Charleston WWTF Upgrades
Address: 1200 West Madison Street, Chareston

Description: Part A: Solids Handling Upgrades including new dewatering and sludge stabilization equipment. Part B: Biological Phosphorus Removal Improvements, which is mostly aeration tankage modifications.

Natural Resource Review Results

Consultation for Endangered Species Protection and Natural Areas Preservation (Part 1075)

The Illinois Natural Heritage Database shows the following protected resources may be in the vicinity of the project location:

Riley Creek INAI Site
Eastern Sand Darter *(Ammocrypta pellucidum)*

Wetland Review (Part 1090)

The Illinois Wetlands Inventory shows wetlands within 250 feet of the project location.

An IDNR staff member will evaluate this information and contact you to request additional information or to terminate consultation if adverse effects are unlikely.

Location

The applicant is responsible for the accuracy of the location submitted for the project.

County: Coles

Township, Range, Section:
12N, 9E, 9

IL Department of Natural Resources Contact
Brian Willard
217-785-5500
Division of Ecosystems & Environment

Government Jurisdiction
IL Environmental Protection Agency
Gary Bingenheimer
1023 North Grand Avenue East
Springfield, Illinois 62794

Disclaimer

The Illinois Natural Heritage Database cannot provide a conclusive statement on the presence, absence, or condition of natural resources in Illinois. This review reflects the information existing in the Database at the time of this inquiry, and should not be regarded as a final statement on the site being considered, nor should it be a substitute for detailed site surveys or field surveys required for environmental assessments. If additional protected resources are encountered during the project's implementation, compliance with applicable statutes and regulations is required.

Terms of Use

By using this website, you acknowledge that you have read and agree to these terms. These terms may be revised by IDNR as necessary. If you continue to use the EcoCAT application after we post changes to these terms, it will mean that you accept such changes. If at any time you do not accept the Terms of Use, you may not continue to use the website.

1. The IDNR EcoCAT website was developed so that units of local government, state agencies and the public could request information or begin natural resource consultations on-line for the Illinois Endangered Species Protection Act, Illinois Natural Areas Preservation Act, and Illinois Interagency Wetland Policy Act. EcoCAT uses databases, Geographic Information System mapping, and a set of programmed decision rules to determine if proposed actions are in the vicinity of protected natural resources. By indicating your agreement to the Terms of Use for this application, you warrant that you will not use this web site for any other purpose.

2. Unauthorized attempts to upload, download, or change information on this website are strictly prohibited and may be punishable under the Computer Fraud and Abuse Act of 1986 and/or the National Information Infrastructure Protection Act.

3. IDNR reserves the right to enhance, modify, alter, or suspend the website at any time without notice, or to terminate or restrict access.

Security

EcoCAT operates on a state of Illinois computer system. We may use software to monitor traffic and to identify unauthorized attempts to upload, download, or change information, to cause harm or otherwise to damage this site. Unauthorized attempts to upload, download, or change information on this server is strictly prohibited by law.

Unauthorized use, tampering with or modification of this system, including supporting hardware or software, may subject the violator to criminal and civil penalties. In the event of unauthorized intrusion, all relevant information regarding possible violation of law may be provided to law enforcement officials.

Privacy

EcoCAT generates a public record subject to disclosure under the Freedom of Information Act. Otherwise, IDNR uses the information submitted to EcoCAT solely for internal tracking purposes.

Illinois Department of
Natural Resources

One Natural Resources Way Springfield, Illinois 62702-1271
http://dnr.state.il.us

JB Pritzker, Governor
Colleen Callahan, Director

March 18, 2020

Joseph V. Pisula
Donohue & Associates
1605 S. State Street
Suite 1C
Champaign, IL 61820

RE: Charleston WWTF Upgrades
Project Number(s): 2007715
County: Coles

Dear Applicant:

This letter is in reference to the project you recently submitted for consultation. The natural resource review provided by EcoCAT identified protected resources that may be in the vicinity of the proposed action. The Department has evaluated this information and concluded that adverse effects are unlikely. Therefore, consultation under 17 Ill. Adm. Code Part 1075 and 1090 is terminated.

Consultation for Part 1075 is valid for two years unless new information becomes available that was not previously considered; the proposed action is modified; or additional species, essential habitat, or Natural Areas are identified in the vicinity. If the project has not been implemented within two years of the date of this letter, or any of the above listed conditions develop, a new consultation is necessary. Consultation for Part 1090 (Interagency Wetland Policy Act) is valid for three years.

The natural resource review reflects the information existing in the Illinois Natural Heritage Database and the Illinois Wetlands Inventory at the time of the project submittal, and should not be regarded as a final statement on the site being considered, nor should it be a substitute for detailed site surveys or field surveys required for environmental assessments. If additional protected resources are encountered during the project's implementation, you must comply with the applicable statutes and regulations. Also, note that termination does not imply IDNR's authorization or endorsement of the proposed action.

Please contact me if you have questions regarding this review.

Brian Willard
Division of Ecosystems and Environment
217-785-5500

Illinois State Historic Preservation Office Correspondence

Pisula, Joe

From:	Pisula, Joe
Sent:	Thursday, March 19, 2020 3:35 PM
To:	'jeffery.kruchten@illinois.gov'
Subject:	Charleston, IL Wastewater Plant Upgrade
Attachments:	2020-03-19 IHPA Letter+Attachs 12251.008.pdf

Jeff:

The City of Charleston, IL is intending on upgrading its wastewater plant next year, using IEPA loan money. We are seeking SHPO approval of this work, so that the City can qualify for the loan. Attached is our solicitation letter. Because of the coronavirus issue, I am submitting by email for now, with a hard copy to follow in the coming days.

Donohue's understanding is that the State Historic Preservation Office (SHPO) is working with reduced capacity as part of a statewide effort to help slow the spread of the coronavirus. We believe this is a non-structural review, so as per Carol Wallace's recent email, we are sending this to your attention. Please forward if this should go elsewhere within SHPO.

Please call me at 217-621-4747 if you have any questions on this submittal.

Joseph V. Pisula, P.E. | Donohue & Associates, Inc.
1605 South State Street, Suite 1C - Champaign, IL 61820
Cell: 217.621.4747

Donohue & Associates, Inc.
1605 South State Street, Suite 1C | Champaign, IL 61820
217.621-4747 | donohue-associates.com

March 19, 2020

State Historic Preservation Office (Preservation Services)
Illinois Department of Natural Resources
One Natural Resources Way
Springfield, Illinois 62702-1271

Re: City of Charleston
Wastewater Treatment Plant Upgrade

Attention: Jeff Kruchten

Dear Mr. Kruchten:

In the near future, the City of Charleston, Illinois intends to construct certain upgrades to its existing wastewater treatment plant that is located at 1200 West Madison avenue on the west end of the City. The project is expected to be funded in part by the IEPA's Water Pollution Control Loan Program's low interest loan system. By this letter and its attachments, the City of Charleston is notifying the State Historic Preservation Office of this project. Enclosed please find the following documents for the referenced project:

Project Location Drawing (Attachment "A")	2 copies
Project Description Sheet (Attachment "B")	2 copies

We believe that no cultural or archeological resources will be disturbed by the project. However, on behalf of the City of Charleston, Donohue & Associates, Inc. is requesting that the City be provided with the applicable State Historic Preservation Office sign-off on the project, so that the project can qualify for an Illinois Revolving Fund Loan. If you should have any questions about this submittal, please contact me at 217-621-4747 or email me at jpisula@donohue-associates.com at your earliest convenience.

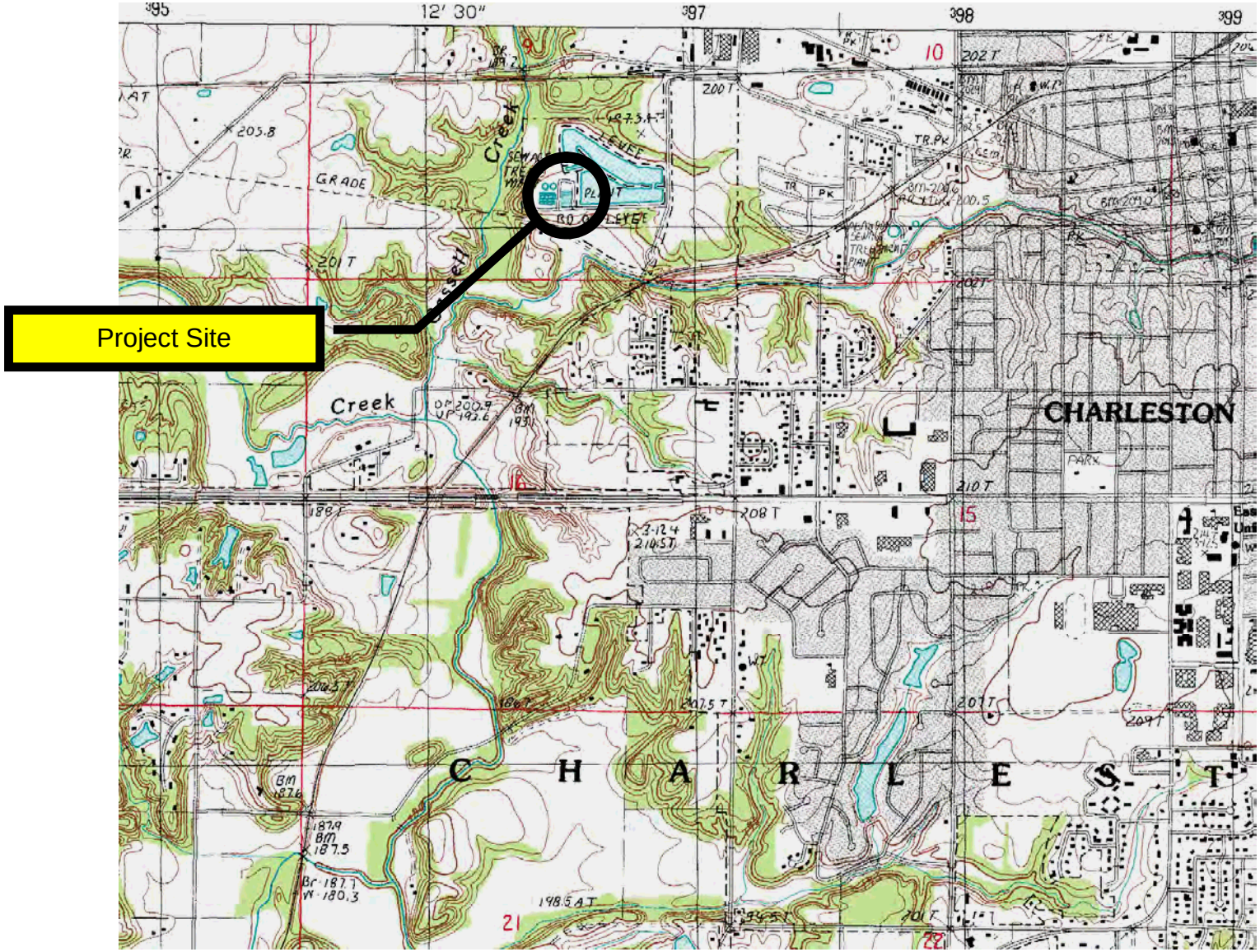
Very truly yours,

DONOHUE & ASSOCIATES, INC.

Joseph V. Pisula, P. E.

The project site is located in Sections 9 in Township 12 North, Range 9 East in the Third Principal Meridian.

North



Attachment "A"

Project Location Map

Project: Wastewater Treatment Plant Upgrade
Owner: City of Charleston, Illinois
Date: March 19, 2020

PROJECT DESCRIPTION

A. BACKGROUND

The City of Charleston owns and operates a public wastewater system that serves the customers with the City's corporate limits. The City's public wastewater infrastructure includes a wastewater treatment facility that is rated to treat an average of 3.3 million gallons per day (MGD). That facility was last upgraded in 2013 and its sludge handling facilities were last updated in 1987. The sludge handling equipment is in poor condition and in need of total replacement, due to their age. Those facilities struggle to meet USEPA rules for biosolids quality. In addition, the plant is unable to biologically remove phosphorus to the extent required under its new NDPES discharge permit. Under this project, the existing plant would be upgraded with new process equipment housed in the existing buildings. No buildings will be altered or demolished. The only addition to the site will be a new lime silo which will be added as shown herein.

B. NAMES OF ALL FUNDING, LICENSING AND PERMITTING AGENCIES

The City intends to fully fund the project with an Illinois EPA Water Pollution Control Loan Program (WPCLP) low interest loan. Permitting has been received from the Illinois Department of Natural Resources with respect to wetlands issues and the possible presence of endangered species. No floodplain issues are anticipated since the facility is well above the local flood plain.

C. COMPLETE DESCRIPTION OF ALL ELEMENTS OF THE PROPOSED UNDERTAKING

The project will consist of two parts:

Part A is the solids handling facilities upgrade. That part of the project will consist of a new rotary lobe sludge pump to be placed in the basement of the existing Digester Building – with no exterior changes to the building. See Figure 8 from the Project Plan report that shows the site improvements plan for Part A. In addition, Part A includes removal of a belt filter press from inside the existing Sludge Treatment Building and replacing it with a Screw Press unit inside the building. The Screw Press then discharges the sludge to a "Bioset" unit which will be housed inside the existing Sludge Treatment Building. A new lime silo will be added to the site, just north of the existing Sludge Treatment Building, as shown in Figure 8. The photo on page B-5 shows an example (from another plant), showing what the lime silo will look like.

Part B is the biological phosphorus removal improvements. That part of the project will consist of a new RAS/WAS pump station, whose structured will consist of a pair of circular manhole type structures that will extend not more than 18-inches above grade. The remainder of Part B are piping changes and a pump addition inside existing aeration tanks (with no building changes).

D. ANY RELEVANT PERMIT, PROJECT OR PREVIOUS IHPA LOG NUMBERS

This is a new project submittal. Therefore, there are no previous IHPA log numbers.

E. MAP CLEARLY INDICATING THE PROJECT LOCATION

Attachment "A" provides a USGS map excerpt. Photos on page B-3 provide images of the areas of concern, showing the existing Digester and Sludge Treatment Buildings and structures, which will be the only affected structures. All changes to these two buildings will be interior changes, with no external changes. The new lime silo will look similar to the photo on page B-5.

F. PROJECT SITE PLANS AND SPECIFICATIONS

These items are not applicable yet, since the project is still in the planning stages. Detailed final plans and specifications will be submitted, if needed, by December 2020.

G. PROJECT ADDRESS

- The wastewater treatment plant site is located at the following street address:
  1200 West Madison Avenue
  Charleston, IL 61920

H. PRESENCE OF STRUCTURES IN THE PROJECT AREA

A reconnaissance of the site shows several existing structures in the project area. Those structures are the existing Digester Building and the existing Sludge Treatment Building. Those facilities will remain unchanged during and after the project is being constructed.

I. EXISTING SOIL CONDITIONS

Soil borings have not yet been taken at the station site. The upper soils likely consist mainly of alluvial soils.

J. TOTAL ACREAGE INVOLVED IN THE PROJECT

The project is likely to disturb approximately less than 1.0 acres of land.

K. DOCUMENTATION OF PRIOR NON-AGRICULTURAL SITE DISTURBANCES

See the photos of the site, which were taken in March 2020. The east end of the site (where the work will take place) appears to have been previously disturbed when the wastewater treatment facility was updated in 1987. The facility was also upgraded in 2013.

Sludge Treatment Building – Looking Northwest (no exterior changes)

**Sludge Treatment Building –
Looking Southwest
(no exterior changes)**

**Covered Biosolids Storage Pad –
Looking Northwest
(no exterior changes)**


Example of Lime Silo to be added to the plant

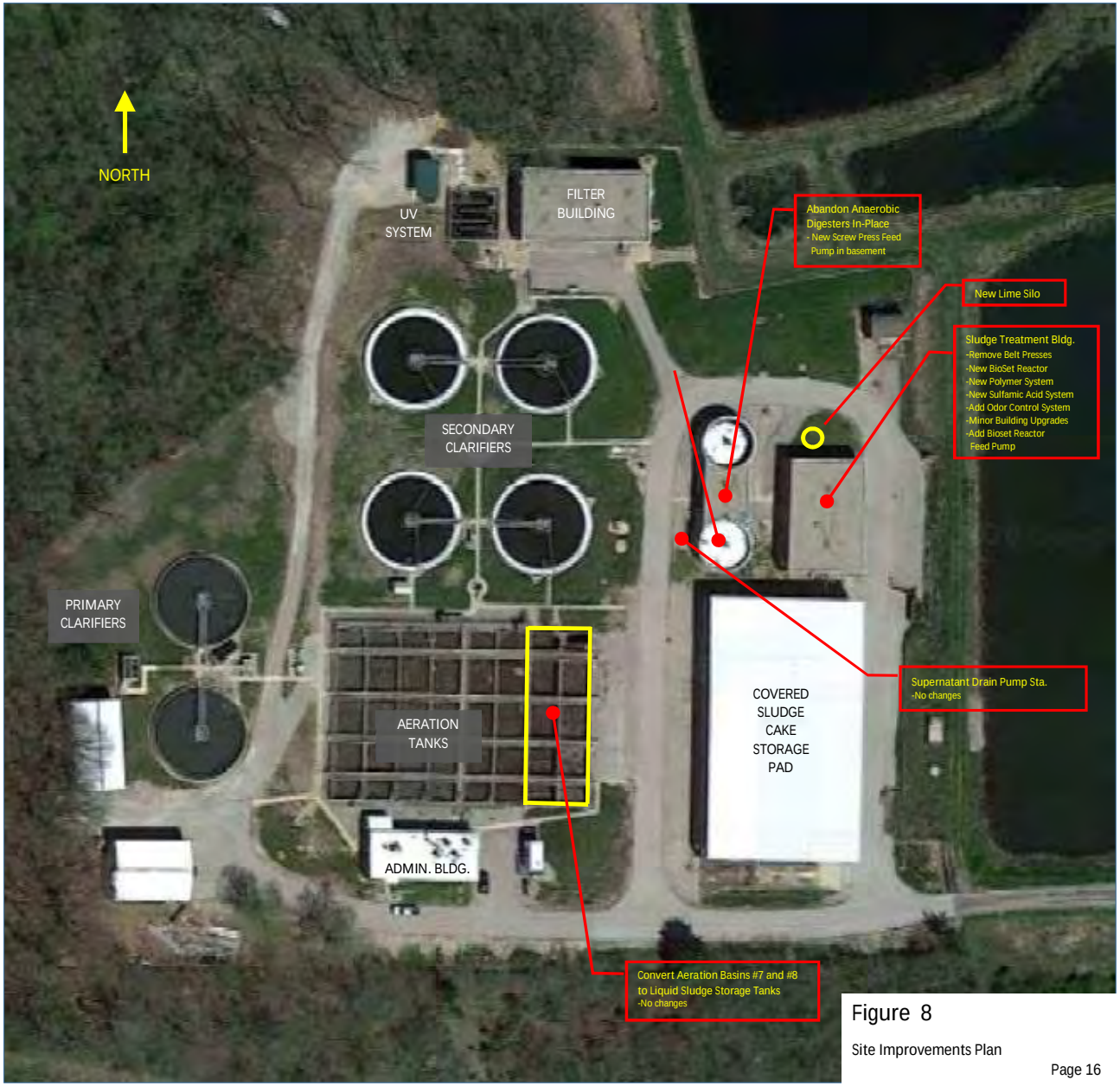
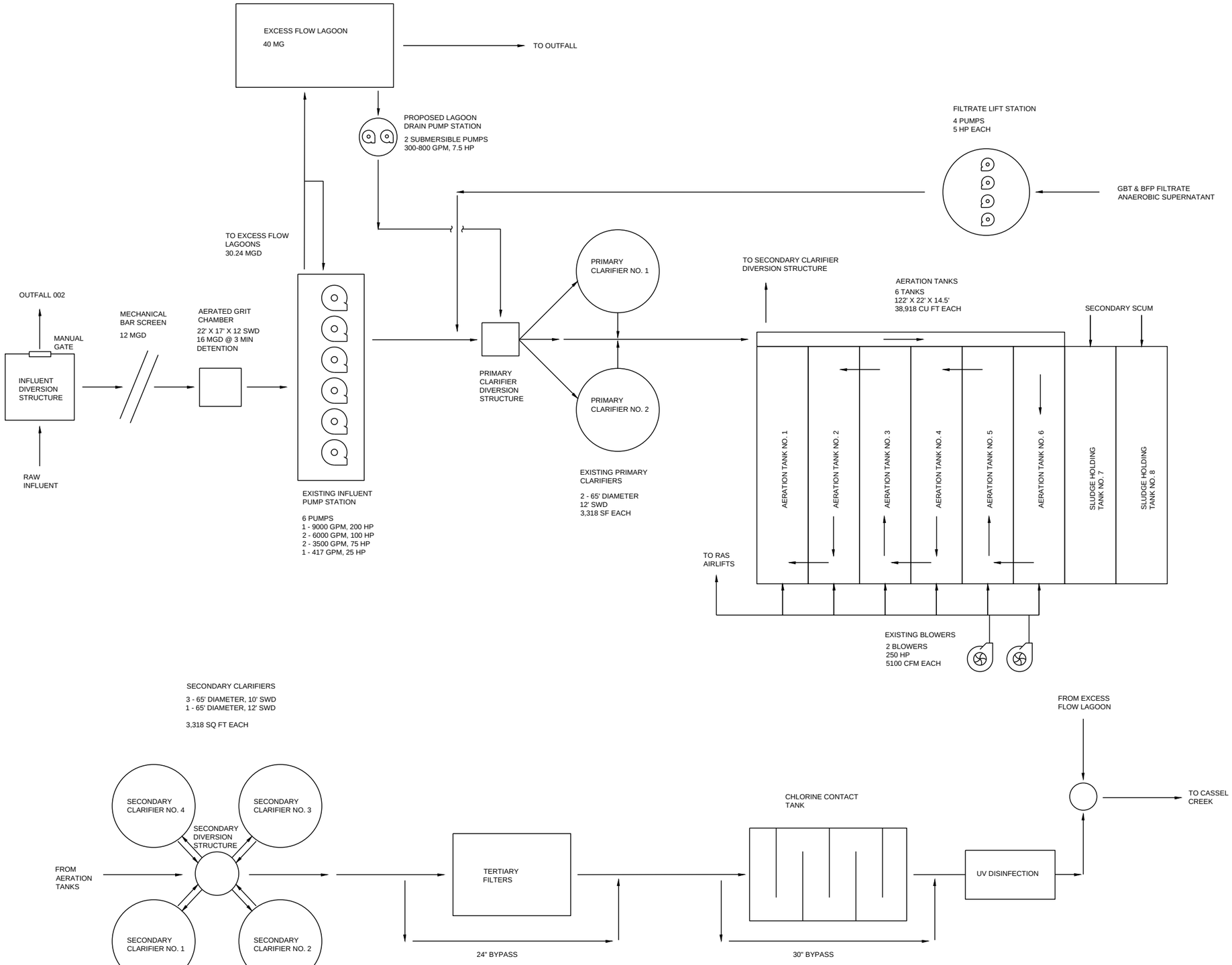


Figure 8

Site Improvements Plan

Appendix C

Existing Plant Flow Diagrams



Existing Wastewater Treatment Processes

Revision Number	Revision Description	Drawn By	Checked By	Date

Designed By	
Drawn By	AJS
Checked By	
Approved By	
Filename	009M1.DWG
Project No.	12251
Project Date	11/30/18

CITY OF CHARLESTON
BIOWIN MODELING AND
CAPITAL IMPROVEMENT PLAN
CHARLESTON, IL

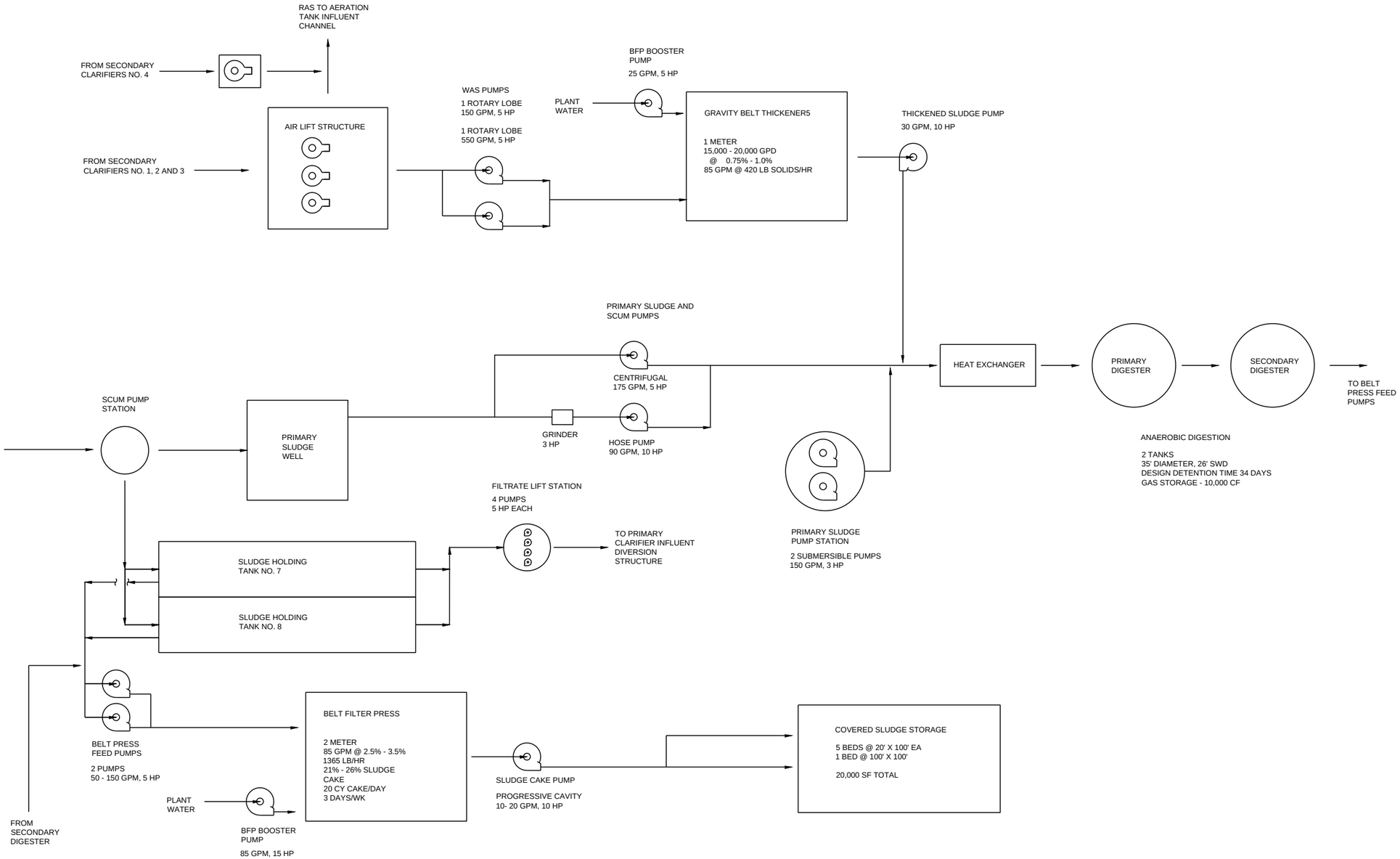
PROCESS FLOW DIAGRAM

DONOHUE

Sheet No.

Drawing No.

009-N-1



Existing Solids Handling Processes

Date	
Checked By	
Drawn By	
Revision Description	
Revision Number	
Designed By	
Drawn By	AJS
Checked By	
Approved By	
Filename	009M1.DWG
Project No.	12251
Project Date	11/30/18

CITY OF CHARLESTON
BIOWIN MODELING AND
CAPITAL IMPROVEMENT PLAN
CHARLESTON, IL

PROCESS FLOW DIAGRAM

DONOHUE

Sheet No.

Drawing No.

009-N-2

Appendix D

Project Cost Opinion -

Part A - Solids Handling Upgrades

City of Charleston
Charleston Wastewater Treatment Plant
Charleston, IL

Part A - Solids Handling System Improvements

Lime Pasteurization, Class A Biosolids - Schwing System

INITIAL COST OPINION

General Description

This portion of the project involves replacing the existing sludge stabilization and dewatering systems with a new Screw Press dewatering device plus a Schwing Bioset Reactor unit that will lime pasteurize the sludge to produce a Class A biosolids.

ITEM	Units	Quantity	Unit Cost ($)	Initial Cost ($)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			$0
Concrete	See Worksheet for Detailed Cost Breakdown			$2,200
Metals	See Worksheet for Detailed Cost Breakdown			$0
Buildings	See Worksheet for Detailed Cost Breakdown			$10,000
Demolition	See Worksheet for Detailed Cost Breakdown			$3,000
				$0
				$0
Schwing Press Class A Equipment	ea	**1**	**$600,000**	$600,000
Schwing Press Class A Equipment - Installation	ea	**1**	**$72,000**	$72,000
Schwing Bioset Class A Equipment	ea	**1**	**$900,000**	$900,000
Schwing Bioset Class A Equipment - Installation	ea	**1**	**$90,000**	$90,000
Shaftless Screw Conveyor	LS	**1**	**$50,000**	50,000
Civil % Not Listed Above	%		**2.0%**	$34,544
Process-Mechanical Piping % Not Listed Above	%		**27%**	$466,344
Electrical % Not Listed Above	%		**12%**	$207,264
Instrumentation and Control % Not Listed Above	%		**8.0%**	$138,176
Plumbing % Not Listed Above	%		**1.0%**	$17,272
HVAC % Not Listed Above	%		**2%**	$34,544
Construction Subtotal w/o OHP, rounded to the nearest $1,000 =				$2,625,000
Contractor Overhead & Profit			**20%**	$525,000
Total Construction Cost before contingency				$3,150,000
Contingency, rounded to the nearest $1,000 =			**10%**	$315,000
Design Engineering, incl. geotech. =				$303,989
Construction Engineering =				$334,000
Total Initial Cost - Biosolids Handling Portion Only =				**$4,102,989**

City of Charleston
Charleston Wastewater Treatment Plant
Charleston, IL

Lime Pasteurization, Class A Biosolids - Schwing System

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost ($)	Initial Cost ($)
Earthwork: Dewatering	lump sum	**1**	**0**	
Earthwork: Excavation	cu yds	**0**	**10**	0
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				**0**
Concrete: Footings	cu yds		**350**	0
Concrete: Base Slab for lime silo	cu yds	**4**	**500**	2,000
Concrete: Walls	cu yds	**0**	**1,000**	0
Concrete: Floor Slabs	cu yds		**350**	0
Concrete: Structural Slabs	cu yds		**800**	0
Concrete: Columns	cu yds			
Concrete: Channels	cu yds		**1,009**	0
Concrete: Class B Fill	cu yds		**305**	0
Concrete				**2,000**
Metals: Aluminum Grating	sq ft		**28**	0
Metals: Aluminum Handrail	ft		**53**	0
Metals: Aluminum Stairway	risers		**414**	0
Metals: Baffles and Weirs	sq ft		**70**	0
Metals: Steel Joists	lb		**2**	0
Metals				**0**
Building: One Story Brick and Block	sq ft	**0**	**150**	0
Building: Two Story Brick and Block	sq ft		**300**	0
Building:	sq ft			
Building: misc. modifications	LS	**1**	**10,000**	10,000
Building:	sq ft			
Building:	sq ft			
Buildings				**10,000**
Demolition: Selective Concrete	cu ft	**100**	**30**	3,000
Demolition: Structure	lump sum			
Demolition: Mechanical	lump sum			
Demolition:	lump sum			
Demolition				**3,000**

City of Charleston
Charleston Wastewater Treatment Plant
Charleston, IL

Lime Pasteurization, Class A Biosolids - Schwing System

INITIAL ANNUAL O&M COST ESTIMATE

O&M Labor

ITEM	Units	Annual Quantity	Unit Cost ($)	Annual Cost ($)

Electricity

ITEM	Units	Annual Quantity	Unit Cost ($)	Annual Cost ($)
Annual operating costs - electricity	total	**1**	**1,578**	1,578

Natural Gas

ITEM	Units	Annual Quantity	Unit Cost ($)	Annual Cost ($)

Chemicals

ITEM	Units	Annual Quantity	Unit Cost ($)	Annual Cost ($)
Polymer	lb/ dry ton	**3,066**	**1.76**	5,396
Lime Annual	total	**1**	**72,800.00**	72,800
Acid Annual	lbs	**2,624**	**0.65**	1,706

Appendix E

Project Cost Opinion -

Part B - Biological Phosphorus Removal Improvements

City of Charleston
Charleston Wastewater Treatment Plant
Charleston, IL

Part B - Biological Phosphorus Removal Improvements

INITIAL COST OPINION

General Description

This portion of the project consists of converting the WWTP's conventional activated sludge into a Modified University of Cape Town (MUCT) system. This includes adding mixers to three Aeration Basins and converting them to non-aerated, anoxic basins. Also included is piping for ML recycle and primary effluent diversions, plus a wall mounted Internal Recycle Pump. A new RAS/WAS pump station would also be provided.

ITEM	Units	Quantity	Unit Cost ($)	Initial Cost ($)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			8,800
Concrete	See Worksheet for Detailed Cost Breakdown			165,000
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			40,000
Demolition	See Worksheet for Detailed Cost Breakdown			0
Mixers	ea	**6**	**15,000**	$90,000
mixer installation	ea	**6**	**4,100**	$24,600
Wall mounted Recycle Pumps	ea	**2**	**33,000**	$66,000
Recycle Pump Installation (one)	ea	**1**	**15,000**	$15,000
Chemical Feed Skid	ea	**0**	**21,000**	$0
Chemcial feed skid installation	ea	**0**	**4,200**	$0
Chemical storage tank	ea	**0**	**16,000**	$0
RAS Pumps	LS	**1**	**52,000**	$52,000
WAS Pumps	LS	**1**	**30,000**	$30,000
RAS rerouting	LS	**1**	**71,000**	$71,000
Civil % Not Listed Above	%		**18%**	$101,232
Process-Mechanical Piping % Not Listed Above	%		**30%**	$168,720
Electrical % Not Listed Above	%		**22%**	$123,728
Instrumentation and Control % Not Listed Above	%		**25%**	$140,600
Plumbing % Not Listed Above	%		**4%**	$22,496
HVAC % Not Listed Above	%		**2%**	$11,248
Construction Subtotal w/o OHP, rounded to the nearest $1,000 =				$1,130,000
Contractor Overhead & Profit			**20%**	$226,000
Total Construction Cost before contingency				$1,356,000
Contingency, rounded to the nearest $1,000 =			**10%**	$136,000
Design Engineering, incl. geotech. =				$95,996
Construction Engineering =				$110,000
Total Initial Cost - Part B - Bio-P Removal Only =				**$1,697,996**

City of Charleston
Charleston Wastewater Treatment Plant
Charleston, IL

Part B - Biological Phosphorus Removal Improvements

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost ($)	Initial Cost ($)
Earthwork: Dewatering	lump sum	**1**	**5,000**	5,000
Earthwork: Excavation	cu yds	**300**	**10**	3,000
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				**8,000**
Concrete: Footings	cu yds		**350**	0
Concrete: RAS/WAS PS structure	LS	**1**	**150,000**	150,000
Concrete: Walls	cu yds	**0**	**1,000**	0
Concrete: Floor Slabs	cu yds		**350**	0
Concrete: Structural Slabs	cu yds		**800**	0
Concrete: Columns	cu yds			
Concrete: Channels	cu yds		**1,009**	0
Concrete: Class B Fill	cu yds		**305**	0
Concrete				**150,000**
Metals: Aluminum Grating	sq ft		**28**	0
Metals: Aluminum Handrail	ft		**53**	0
Metals: Aluminum Stairway	risers		**414**	0
Metals: Baffles and Weirs	sq ft		**70**	0
Metals: Steel Joists	lb		**2**	0
Metals				**0**
Building: Alum Storage Bldg.	sq ft	**400**	**100**	40,000
Building: Two Story Brick and Block	sq ft		**300**	0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				**40,000**
Demolition: Selective Concrete	cu ft		**30**	0
Demolition: Structure	lump sum			
Demolition: Mechanical	lump sum			
Demolition:	lump sum			
Demolition				**0**

City of Charleston
Charleston Wastewater Treatment Plant
Charleston, IL

Part B - Biological Phosphorus Removal Improvements

INITIAL ANNUAL O&M COST ESTIMATE

O&M Labor

ITEM	Units	Annual Quantity	Unit Cost ($)	Annual Cost ($)

Electricity

ITEM	Units	Annual Quantity	Unit Cost ($)	Annual Cost ($)
Mixer	6	**13,070**	**0.045**	588
Internal recycle	kwh	**49,012**	**0.045**	2,206

Natural Gas

ITEM	Units	Annual Quantity	Unit Cost ($)	Annual Cost ($)

Chemicals

ITEM	Units	Annual Quantity	Unit Cost ($)	Annual Cost ($)
Hauled Sludge (additional biological solids)	gal	**1,460,000**	**0.035**	51,100
			0.00	