AECOM

Intact Cellular Algae Harvesting with Simultaneous Nutrient Export in Lake Jesup to Mitigate Harmful Algae Blooms (HABs) and Reduce Nutrients

Lake Jesup HFT HAB Project

St. Johns River Water Management District

August 31, 2022

525 Community College Parkway, S.E.
Palm Bay, FL 32909

Delivering a better world

Quality information

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St. Johns River Water Management District
525 Community College Parkway, S.E.
Palm Bay, FL 32909

Executive Summary

In 2020, the St. Johns River Water Management District (SJRWMD) was awarded a $1.6 million Innovative Technology Grant from the Florida Department of Environmental Protection (FDEP) for the research project, **Intact Cellular Algae Harvesting with Simultaneous Nutrient Export in Lake Jesup to Mitigate Harmful Algae Blooms (HABs) and Reduce Nutrients** [Lake Jesup Hydronucleation Flotation Technology (HFT) HAB Project, formerly known as the Hypernucleation Flotation System (HFS) HAB Project]. The SJRWMD contracted with AECOM Technical Services, Inc. (AECOM) to design and implement the project.

The purpose of the research project was to demonstrate an innovative, mobile algae harvesting system using AECOM's HFT as a sustainable and environmentally safe lake management solution to address HABs in Lake Jesup, Seminole County, Florida. The research aimed to a) generate representative operational and treatment efficiency data for a barge-mounted HFT system operating over an approximate nine month period spanning a range of water quality conditions; b) document environmental safety of the operations with respect to water and air quality, and c) evaluate the cost-effectiveness of a full-scale system that can help achieve Total Maximum Daily Load (TMDL) and Basin Management Action Plan goals for nutrient reduction in Lake Jesup.

An algae harvester with HFT with a rated process flow of 100 gallons per minute (gpm) was fabricated for the project. Algae harvesting in Lake Jesup was conducted from a barge in Lake Jesup on select days during each month of project operations (September 2021 through May 2022) with scheduling based on available staff and lake and weather conditions. The barge was repositioned on four occasions to locations within a FDEP-permitted area to evaluate operations under different lake conditions that can vary spatially and to field-test the practicality of moving the barge. The barge-mounted algae harvester was successfully operated with little variation from the target flow rate of 100 gpm, treating water for between 16.00 and 82.25 hours in each month for a total of 388.75 hours and producing 2,416,618 gallons (gal) of treated water over the project duration. A total of 6,595 gal of slurry were produced; 76% of the slurry was disposed of at the Yankee Lake Wastewater Treatment Plant and the remainder was used for research by others.

SJRWMD staff and AECOM co-hosted a media day event on December 17, 2021 at the Black Hammock located at 2316 Black Hammock Fish Camp Road, Oviedo, FL. The event was well attended with representatives from SJRWMD, FDEP, Seminole County, and other local and state government agencies, as well as interested members of the public.

Monitoring was conducted to provide reliable and representative data on operational and treatment efficiencies, and safety, over a range of water quality conditions for Lake Jesup. Key optimal operating parameters that were established included:

- Optimal water conditioning for standard treatment using aluminum chlorohydrate (ACH) for coagulation and the polyacrylamide flocculant, PolyTech 2160 (PT-2160), at dosages of 40 milligrams per liter (mg/L) of ACH and 2 mg/L, respectively
- Optimal water conditioning for organic treatment using only PT-2160 at a dosage of 2 mg/L
- Mixing speeds of 40% and 20% in the coagulant and flocculant chambers, respectively for the standard treatment
- A mixing speed of 50% in the flocculant chamber for the organic treatment
- A recycle flow rate between 27% and 30% of the influent flow rate for optimal nanobubble formation to assist algae floc flotation.
- A float blanket skimming cycle of 1.6 and 2 skims per hour for the standard and organic treatments, respectively, to maximize algae removal while reducing the water content of the recovered algae slurry.

Monitoring of influent (raw water from Lake Jesup entering the HFT unit) and effluent (water discharged back to Lake Jesup after treatment) during the project across a range of seasonal water quality conditions in Lake Jesup supported previous studies demonstrating highly effective removal of algae and other suspended solids along with associated nutrients. Both the standard and organic treatments substantially reduced the concentrations of key indicators that are relevant to HAB mitigation and nutrient reduction including total suspended solids TSS, algae (as Chlorophyll-a [Chl-a]), and the key nutrients, total phosphorus (TP) and total nitrogen (TN), that promote algae production, as

shown in the table below. The standard treatment, however, was approximately twice as efficient in removing key parameters than the organic treatment.

Summary of HFT Performance Metrics for Key Indicators

Treatment Type	Parameter	Influent Concentration		Performance Metric Effluent Concentration		% Reduction
		Mean	SD	Mean	SD	
Standard	Chl-a (mg/m^3)	132	48.1	22.0	15.6	85%
	TSS (mg/L)	39	8	7	2	83%
	TP (mg/L)	0.071	0.017	0.010	0.002	85%
	TN	1.61	0.65	0.83	0.18	43%
Organic	Chl-a (mg/m^3)	210	49.0	132.5	21.7	36%
	TSS (mg/L)	42	5	24	2	42%
	TP (mg/L)	0.051	0.015	0.028	0.017	43%
	TN (mg/L)	2.73	0.39	2.17	0.31	20%

Environmental safety monitoring including air monitoring for algal toxins and toxicity testing of the treated influent demonstrated that there was no risk to worker and public safety due to airborne toxins during operations and that the treatment did not cause acute toxicity to the tested organisms (*Ceriodaphnia dubia* and *Pimephales promelas*). The effluent failed several chronic toxicity tests for *C. dubia* (Oct., Nov., Dec., Jan., Feb.) and one test for *P. promelas* (March). Additional testing revealed chronic toxicity of the influent for *C. dubia* (Dec., Feb., March; no tests were preformed in Oct., Nov., and Jan.) and for *P. promelas* (Feb.), indicating that raw water from Lake Jesup was also chronically toxic to the test organisms and may have been the cause of toxicity in the effluent.

Based on the performance metrics established from this project, algae harvesting using HFT and the standard treatment (with ACH as a coagulant) can be upscaled to remove sufficient nutrients to achieve the TMDL load reductions from in-lake sources. Using a land-based system that can process water at a flow rate of one million gallons per day (mgd), the system can remove 387 pounds per year (lb/yr) of TP and 5,297 lb/yr of TN.

TMDLs for TP (41,888 lb/yr) and TN (545,203 lb/yr) were adopted to achieve a Trophic State Index of 65.5 for the lake, which corresponds to long-term annual average concentrations of 31.2 µg/L for Chl-a, 96 µg/L for TP, and 1,270 µg/L for TN (Gao, 2006). The BMAP provides nutrient load allocations to reduce TP and TP loads from watershed sources, but additional reduction is required to address loads from in-lake sources (groundwater and sediment flux). The TMDL calls for a 45.5% and 16.7% reduction in TP and TN loads from in-lake sources, respectively. This requires a reduction of 15,883 lb/yr for TP and 31,178 lb/yr for TN.

Algae harvesting upscaled to treat 40 mgd of water would achieve the TP target load reduction for in-lake sources. The TN target load reduction for in-lake sources would be met with treatment of 6 mgd. These estimates assume that the system would be operated 24 hours per day, 365 days per year. This approach is aggressive, however, and the TMDL targets could also be achieved by treating a smaller volume of water over a longer period, at a lower cost for the overall restoration of the lake. A valued engineering study and implementation of a smaller system (1-5 mgd) is recommended to quantify the cost/benefit of expanding the cleanup duration and treating a smaller volume of water, while making progress toward meeting TMDL targets for the lake.

The cost of an HFT algae harvesting system to meet TMDL targets for in-lake nutrients will depend on the system size, design, and implementation strategy, with significant economies of scale. Amortized over 25 years, the cost of the treatment for a 1-mgd land-based system would be $739 per pound of TP removed, $54 per pound of TN removed, and $4 per pound of TSS removed. The cost per pound of nutrients removed is reduced by approximately 39% for a 5-mgd system and by 57% for a 40 mgd system. Valorization of the biomass into biofertilizer or biofuel would further reduce this cost. Additionally, progress towards implementing Intelligent Process Automation System (IPAS) into operations will reduce onsite labor requirements and further optimize efficiencies which will provide additional cost savings. Preliminary estimates suggest that the use of IPAS could drop the operational costs by as much as 50%.

The results of this research demonstrated that while a mobile system is feasible, it would be limited to a small HFT unit like the one used in this project due to the shallow water in Lake Jesup. The seasonal lowering of water levels would also limit mobility of even a small unit. An onshore system with inlet piping to draw water from offshore areas would be more cost effective considering additional costs associated with a mobile unit, potential issues with water levels, and the large-scale treatment required to meet TMDL nutrient reduction targets. A mobile unit would be more advantageous in lakes where there are significant accumulations (i.e., surface scums or mats) that develop in different areas in the lake for emergency response use.

In conclusion, Lake Jesup HFT HAB Project successfully demonstrated that the innovative HFT algae harvesting system can be an effective and environmentally safe management solution to address eutrophication and HABs in Lake Jesup, Seminole County, Florida. Information gained from the study can support the development of an optimal HFT treatment plan to help mitigate HABs and associated water quality concerns in Lake Jesup and other impacted lakes in Florida and the nation.

Abbreviations

Abbreviation/Acronym	Definition
µg/L	microgram per liter
ACH	aluminum chlorohydrate
BMAP	Basin Management Action Plan
Chl-a	chlorophyll-a, corrected for pheophytin
DO	dissolved oxygen
EU/m^3	endotoxin units per cubic meter of air
FDEP	Florida Department of Environmental Protection
ft	foot/feet
gal	gallon(s)
HAB	Harmful Algal Bloom
HFS	Hypernucleation Flotation System (now known as HFT)
HFT	Hydronucleation Flotation Technology
kW	kilowatt
lb	pound(s)
M	meter
MC	microcystin
mgd	million gallons per day
mL	milliliter
mg/L	milligrams per liter
ng/m3	nanograms per cubic meter of air
NOD	nodularin
PT-2160	Polytec 2160
QAPP	Quality Assurance Project Plan
SD	standard deviation
SJRWMD	St. Johns River Water Management District
SPCOND	specific conducivity
TEMP	temperature
TMDL	Total Maximum Daily Load
TN	total nitrogen
TP	total phosphorus
TSS	total suspended solids
TURB	turbidity
WET	Whole Effluent Toxicity
WWTP	Wastewater Treatment Plant
Yr	year

Calendar months longer than five letters are abbreviated to three letters (Jan., Feb., etc.). Additional water quality parameter abbreviations are provided in ***Table 2****.*

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1. Introduction

In 2020, the St. Johns River Water Management District (SJRWMD) was awarded a $1.6 million Innovative Technology Grant from the Florida Department of Environmental Protection (FDEP) for the research project, **Intact Cellular Algae Harvesting with Simultaneous Nutrient Export in Lake Jesup to Mitigate Harmful Algae Blooms (HABs) and Reduce Nutrients** [Lake Jesup Hydronucleation Flotation Technology (HFT) HAB Project, formerly known as the Hypernucleation Flotation System (HFS) HAB Project]. The SJRWMD contracted with AECOM Technical Services, Inc. (AECOM) to design and implement the project.

Lake Jesup is one of the most nutrient-enriched lakes within the SJRWMD and has a long history of large-scale, toxic cyanobacteria HABs that pose significant environmental and health concerns. As such, Lake Jesup is a long-time management priority for the Florida Department of Environmental Protection (FDEP), the SJRWMD, and other stakeholders. The lake flows to the St. Johns River, the longest river in Florida, which was named one of the 14 American Heritage Rivers in 1998. In 2008, the St. Johns River was ranked Number 6 on a list of America's Ten Most Endangered Rivers. Nutrient loads from Lake Jesup contribute to nutrient enrichment and water quality impairments of the river. A total maximum daily load (TMDL) was adopted for Lake Jesup in 2006 for total phosphorus (TP) and total nitrogen (TN) implemented in a Basin Management Action Plan (BMAP) in 2010 which was amended in 2018. These efforts have led local stakeholders to make significant progress in reducing the external nutrient load to Lake Jesup. In-lake water quality has been slow to respond to the external nutrient load reductions due in part to continued nutrient enrichment from legacy nutrient stores in sediments and groundwater.

Controlling the source of nutrients to water bodies is well regarded as the most sustainable way to mitigate HABs, but this approach alone can take decades to be effective. Even with significant reduction in external nutrient supplies, HABs and associated water quality issues can continue due to the release of legacy nutrients from lake sediments. For shallow lakes, this contributes to a resistance to changing from a turbid, algae dominated state to a clear water state with low algae abundance following nutrient reduction. In-lake intervention is often desirable, therefore, to reduce sediment nutrient loads and/or directly suppress algae growth so that the present social, economic and environmental damages caused by HABs can be mitigated in the short term.

Over the years, several in-lake intervention techniques have been developed to manage cyanobacteria HABs in water bodies. These include, but are not limited to, the application of algicides, in-situ oxidation, and ultrasound management techniques. However, these techniques are not always effective or only provide short-term relief as they do not reduce nutrients from the water body that can fuel a subsequent HAB. Conventional methods such as aeration, sediment inactivation, dredging and hydrological manipulation can reduce sediment nutrient flux, but methods often have limited or short-term success in shallow lakes and can be cost-prohibitive for large lakes like Lake Jesup. Algae harvesting with HFT, which removes algae and suspended matter and the nutrients they contain, offers a promising alternative.

The HFT is an advanced and highly optimized form of dissolved air flotation used to capture and separate intact algae cells and other suspended particles from water. Algae-laden water withdrawn from the source waterbody is conditioned by adding a small amount of commonly used potable water treatment amendments, which coagulate the algae into larger particles to create a ‘floc’ as the water flows through a series of treatment and mixing tanks. Microscopic air bubbles (nanobubbles) generated in the process attach to the algae floc, which imparts buoyancy. The algae floc then floats to the surface of the water in a flotation tank, where it forms a dense ‘skimmate’ layer (the float blanket). The skimmate layer is efficiently separated from the underlying water by a skimmer that moves across the top of the flotation tank to a slurry holding tank. The recovered algae biomass has potential to be further processed for beneficial use as bioplastics, biocrude, and fertilizer that can provide additional benefits including offsetting of restoration costs and carbon sequestration.

Several pilot projects have been completed documenting the effectiveness of the HFT to remove algae and associated nutrients and toxins from HAB impaired water. Recent studies conducted at Lake Okeechobee, Florida and Lake Agawam, New York achieved over 90% reduction for chlorophyll-a (Chl-a), total microcystins and nodularins (MCs/NODs), and TP, and greater than 80% reduction was achieved for total suspended solids (TSS) and TN (AECOM, 2019; Page et al., 2020, 2021). While extremely effective in these demonstration projects, up-scaling of the algae harvester for broad application requires further study to determine the effectiveness of the treatment over a wider range of source water conditions.

A key step in the treatment process involves effective coagulation and flocculation of algae, so that it can be separated from water. The selection of coagulants and flocculants, and their dosage to optimize the performance are ultimately dependent on the physical and chemical characteristics of the source water. These characteristics can vary tremendously within and between lakes. It is, therefore, necessary to understand how the selection and use of these chemicals may need to be adjusted over the course of a full-scale treatment to optimize performance.

The purpose of this research project was to demonstrate the use of a mobile algae harvesting system with HFT as a sustainable and environmentally safe management solution to address eutrophication and HABs in Lake Jesup, Seminole County, Florida. The research was intended to generate representative operational and treatment efficiency data under varying environmental conditions over an approximate 9-month operational period from Sep. 2021 through May 2022.

The anticipated benefits expected from this research included:

- An improved understanding of the effectiveness of algae harvesting to remove algal biomass and other suspended particles, nutrients, and algal toxins from water sourced from Lake Jesup
- An improved understanding of treatment optimization (e.g., coagulant/flocculant usage) for successful application of the technology over variable physical, chemical, and biological conditions in Lake Jesup
- Documentation of environmental safety of the treatment including effects on water quality due to use of coagulants and/or flocculants, and air quality in relation to algal toxins
- Documentation of energy usage and biomass recovery rates to evaluate treatment sustainability
- A conceptual algae harvesting treatment plan for Lake Jesup in support of meeting TMDL objectives for the lake using treatment effectiveness data generated by the study and supporting lake water quality and quantity data collected by Seminole County and the SJRWMD.

Ultimately, it is hoped that this information will support the development of an optimal algae harvesting treatment plan to help mitigate HABs and associated water quality concerns in Lake Jesup and other impacted lakes in Florida and the nation.

2. Financial Summary

The actual cost of the project was $1,696,600 versus the original budget of $1,646,630. The additional cost was for new scope of work to extend the algae harvesting operations by one month. FDEP provided funding in the amount of $49,970 for this added scope. No other project work was performed outside of the project agreement.

3. Project Schedule

The project timeline, per AECOM's original contract with SJRWMD, was from July 14, 2020 to Dec. 31, 2021. The contract was extended to Jan. 31, 2023. Installation and start-up were originally scheduled for Dec. 2020 but was delayed until Aug. 2021 due to supply chain issues and the COVID-19 pandemic. System operations began Sep. 2021. There were also changes to scheduling during operations including delays for the originally planned air monitoring activities and barge repositioning due to site conditions. Air monitoring for algal toxins was to occur during system start up, however, no significant algae bloom activity was observed at that time such that the presence of airborne toxins was likely to be low. The air monitoring was therefore postponed until spring when more significant bloom activity and toxin production was anticipated to occur. Repositioning of the barge to areas of higher algae concentrations was also delayed until spring due to relatively uniform algae levels in the lake.

System operations were scheduled to be completed in April 2022 but were extended by an additional month (May) as discussed and agreed upon by AECOM, SJRWMD and FDEP. In May 2022, water levels in Lake Jesup declined and were too low to safely remove the barge at the conclusion of the May operations. Water levels did not rise to a level that would allow for removal of the barge until Sep. 2022, but demobilization was delayed due to Hurricane Ian. Following the hurricane, Lake Jesup water level rose by approximately four feet in one day causing severe flooding in the area and severely damaging the marina where the barge was to be removed. The demobilization of the barge was completed on Nov. 7, 2022 when water levels subsided and the barge was able to be towed safely to a different marina, the Downtown Sandford Marina, via the St. Johns River. Due to the decommissioning delays, the project contract end date was extended to Jan. 31, 2022.

The project was completed by the final revised contract end date.

4. Activities

4.1 Permitting and Planning

The permits, plans and approvals developed for the project and dates obtained include:

- Seminole County Environmental Services authorization to transfer algae biosolids to the Yankee Lake Wastewater Treatment Plant (WWTP) (Sep. 29, 2020)
- General Permit pursuant to rule 62-330.485, Florida Administrative Code, Nov. 9, 2020 (File No. 0393808-001-EG, Seminole County)
- SAJ-2008-00233 "No Permit Required" determination for the Lake Jesup algae harvesting project from the United States Army Corps of Engineers (letter to SJRWMD dated Dec. 17, 2020)
- FDEP Quality Assurance Project Plan (QAPP) (approved Dec. 22, 2020, revised March 16, 2022)
- FDEP Industrial Wastewater Facility Permit No. FL0A00015-001-IW7B (issued Feb. 5, 2021)
- Conceptual Plan for launching of the barge and loading the harvester and support equipment onto the barge at Sanford Boat Works and Marina (March 18, 2021)
- Site access approval, Black Hammock Marina (April 1, 2021)
- Site access approval, Lake Jesup Park and Camron Wright Park (Seminole County, Sep.14, 2021)

4.2 Mobilization, System Installation and Start-Up

An algae harvester with HFT and a rated process flow of 100 gallons per minute (gpm) designed by AECOM in conjunction with Ecosa Process Technologies was fabricated for the project. Diagrams showing the process flow and general arrangement of the treatment system are provided in **Appendix A**.

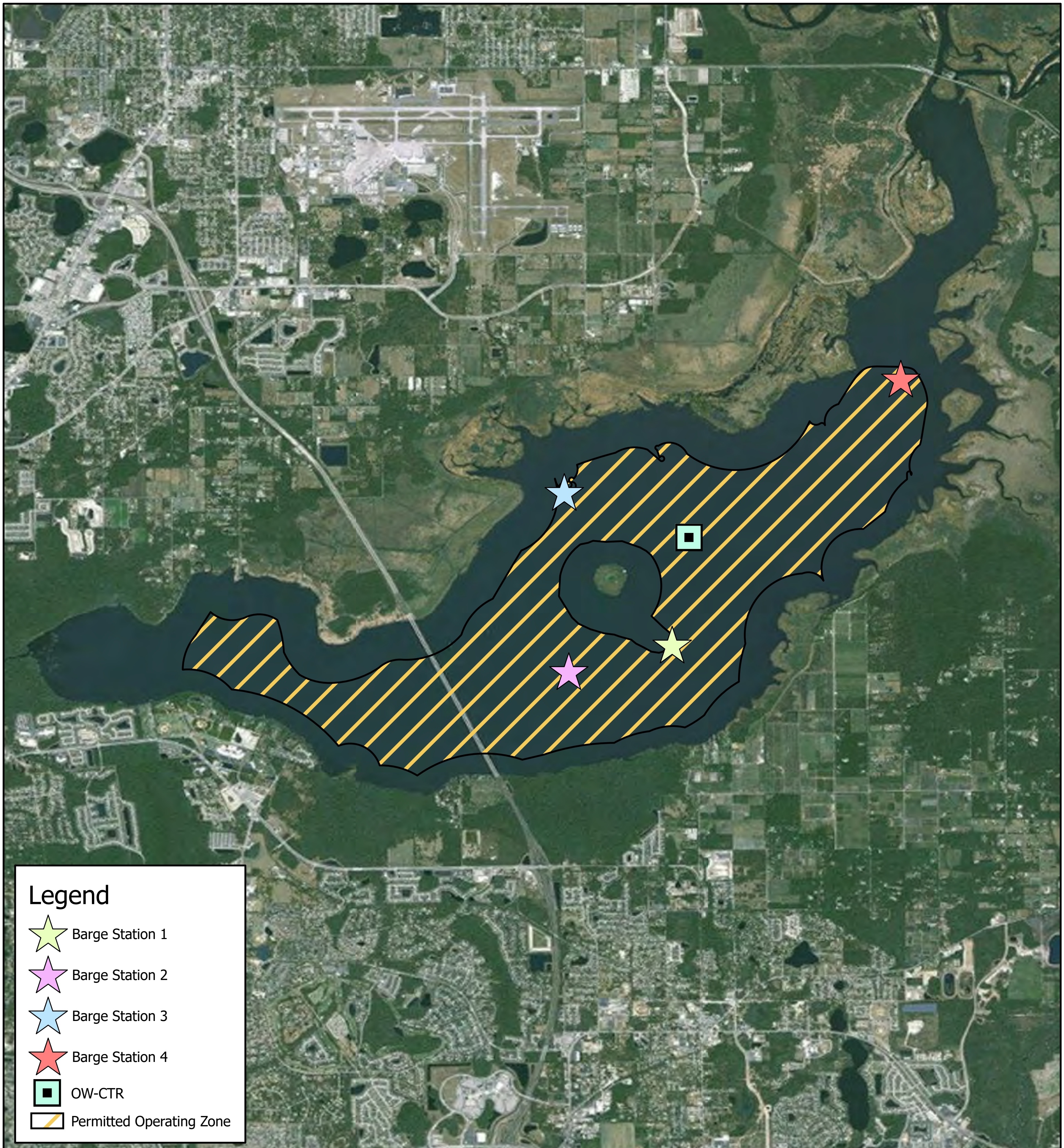
Barge assembly and loading of the treatment system components at Sanford Boat Works and Marina, transport, and deployment/positioning in Lake Jesup and system shakedown took place the first three weeks of August 2021. A barge was assembled at the Sanford Boat Works and Marina from three 10 feet (ft) x 40 ft sectional barge components and the treatment system was placed on the barge, towed nine miles up the St. Johns River, and positioned at Barge Station 1 located south of Bird Island within the approved operational area in Lake Jesup (**Figure 1**). Spuds attached to the barge were lowered into the lakebed to hold the barge stationary. Construction was completed in accordance with the approved design drawings. Algae concentrations in the lake as well as water depth were taken into consideration when choosing a location for the barge. Algae concentrations were measured with a handheld AlgaeTorch™ at various locations throughout the lake. Barge Station 1 has a water depth of approximately 7 ft and the intake water assembly was placed approximately 12 inches below the water surface to capture algae in the photic zone.

Once the Barge Station 1 was established, bench testing was performed on the lake water near the intake assembly of the algae harvester. Water samples from Lake Jesup were screened for their response to coagulation using aluminum chlorohydrate (ACH) and their further response to flocculation with Polytec 2160 (PT-2160), an organic, cationic, polyacrylamide flocculant. ACH and PT-2160 were selected based on their previous good performance at similar freshwater pilot study sites in Florida. The selected doses for ACH of 40 parts per million (ppm) and PT-2160 of 2 ppm are consistent with the dosages used in previous freshwater pilot studies and were used as the standard treatment during operations. Operations were also tested using an organic treatment (without the use of ACH) (see **Section 4.3**)

A detailed System Installation and Startup Report (Jan. 24, 2022) was prepared for the SJRWMD and provides additional information and photos of the mobilization, installation, and start-up.

Loading of the algae harvester onto the barge (left) and moving the barge to Barge Station 1 using a push boat partially visible behind the yellow frame of the spud winch (right).

Barge positioned at Barge Station 1 south of Bird Island. HFT algae harvester (silver) and 56 kW generator with secondary containment (green) are secured to the deck with chain and ratchet strap binders. Spuds are lowered into the lakebed to hold the barge in place.



Geographic Coordinate System: GCS WGS 1984

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0 3,500 7,000 14,000
Feet

Scale: 1:70,000

AECOM

Designed	TC
Drawn	JRL
Checked	TKR
Peer Review	TC
Project Manager	WC
Project Number	60640336

Figure 1

Barge Stations and Permitted Operational Area in Lake Jesup

6/3/2022

4.3 Operations

Algae harvesting in Lake Jesup was conducted from a barge in Lake Jesup on select days during each month of project operations (September 2021 through May 2022) with scheduling based on available staff and lake and weather conditions. The barge was repositioned on four occasions to locations within the FDEP-permitted area to evaluate operations under different lake conditions that can vary spatially and to field-test the practicality of moving the barge (**Figure 1**, **Table 1**). To reposition the barge, all equipment was secured on the barge, the spuds were raised, and the barge towed to the selected location. The spuds were then lowered into the lakebed to hold the barge stationary and the intake water assembly installed in the lake at a depth of approximately 12 inches below the water surface to capture algae in the photic zone.

Table 1. Barge Station Locations and Operations Summary

Barge Station	Latitude (°N)	Longitude (°W)	Dates at Location	Days at Location	Miles between OW-CTR and Barge Station
1	28.71706	81.21204	9/7/21 - 2/8/22	154	0.90
2	28.71385	81.22451	2/8/22 - 2/22/22	14	1.42
3	28.73550	81.22506	2/22/22- 3/9/22	15	0.99
4	28.74890	81.18438	3/9/22 – 5/31/22	83	2.03

Notes: OW-CTR is the SJRWMD water quality monitoring location near the center of Lake Jesup positioned at approximately 28.73 °N and 81.21 °W.

The algae harvester was operated at a flow rate of 100 gpm ± 1% and various system process controls were varied during operations to optimize algae separation from water including:

- Mixing speeds in the coagulant and flocculant chambers
- Recycle flow rates (recycle water used to create nanobubbles for flotation of the algae floc)
- Skimming cycles

Coagulant chamber showing mixer.

Flotation chamber showing float blanket skim bar.

Operations were performed to test the standard treatment using ACH at 40 milligrams per liter (mg/L) and PT-2160 at 2.0 mg/L that was determined through bench testing (see **Section 4.2**) as well as organic treatments without the use of ACH. Organic treatments were field-tested during the January operations (over four days from Jan. 24 to 26), which included the use of the organic coagulant, Green Floc™, and varying dosages of PT-2160. PT-2160 at a dosage of 2.0 mg/L without the use of a coagulant provided the optimal algae/water separation, and this treatment was tested further during field operations. Operations using the standard (40 mg/L ACH, 2 mg/L PT-2160) and organic (2.0 mg/L PT-2160) treatments were performed on a total of 60 and 15 days, respectively, as follows:

- Standard treatment days (59 days, 264 hours)
  - Sep. 7, 8, 14-16, 21, 22 (7 days)
  - Oct. 4-6, 8, 26, 27 (6 days)
  - Nov. 8, 10, 12, 30 (4 days)
  - Dec. 1, 3, 13, 15-17 (6 days)
  - Jan. 4-6, 17-21, 2022 (8 days)
  - March 14-18, 21, 22, 24, 25, 28-31 (13 days)
  - April 1, 4-8, 11-15 (11 days)
  - May 25-27, 31 (4 days)
- Organic treatment days (15 days, 97.50 hours)
  - Jan. 28 (1 day)
  - Feb. 9, 14-18, 21, 23-25, 28 (11 days)
  - March 1-3 (3 days)

The harvested algae biomass was held in a hopper on the barge and transferred using a pneumatic diaphragm pump into a 325-gallon (gal) poly-tank on the crew workboat. A two-inch centrifugal pump was used to transfer the biomass from the workboat poly-tank into a 500-gal shoreside poly-tank. The biomass was then transferred from the shoreside poly-tank and transported off-site in a vacuum truck via a licensed waste hauler to the Yankee Lake Wastewater Treatment Plant (WWTP) for disposal.

Algae slurry recovered by the HFT treatment.

Poly-tank on work boat to transfer slurry from the barge to the shoreside storage tank.

The clarified water treated by the algae harvester was returned to Lake Jesup via a six-inch pipe.

Raw water from Lake Jesup (left bottle) and HFT treated water (right bottle).

Discharge of clarified water to Lake Jesup.

Monthly Operating Reports were prepared over the course of the project and provide additional details on monthly operations.

4.4 Monitoring

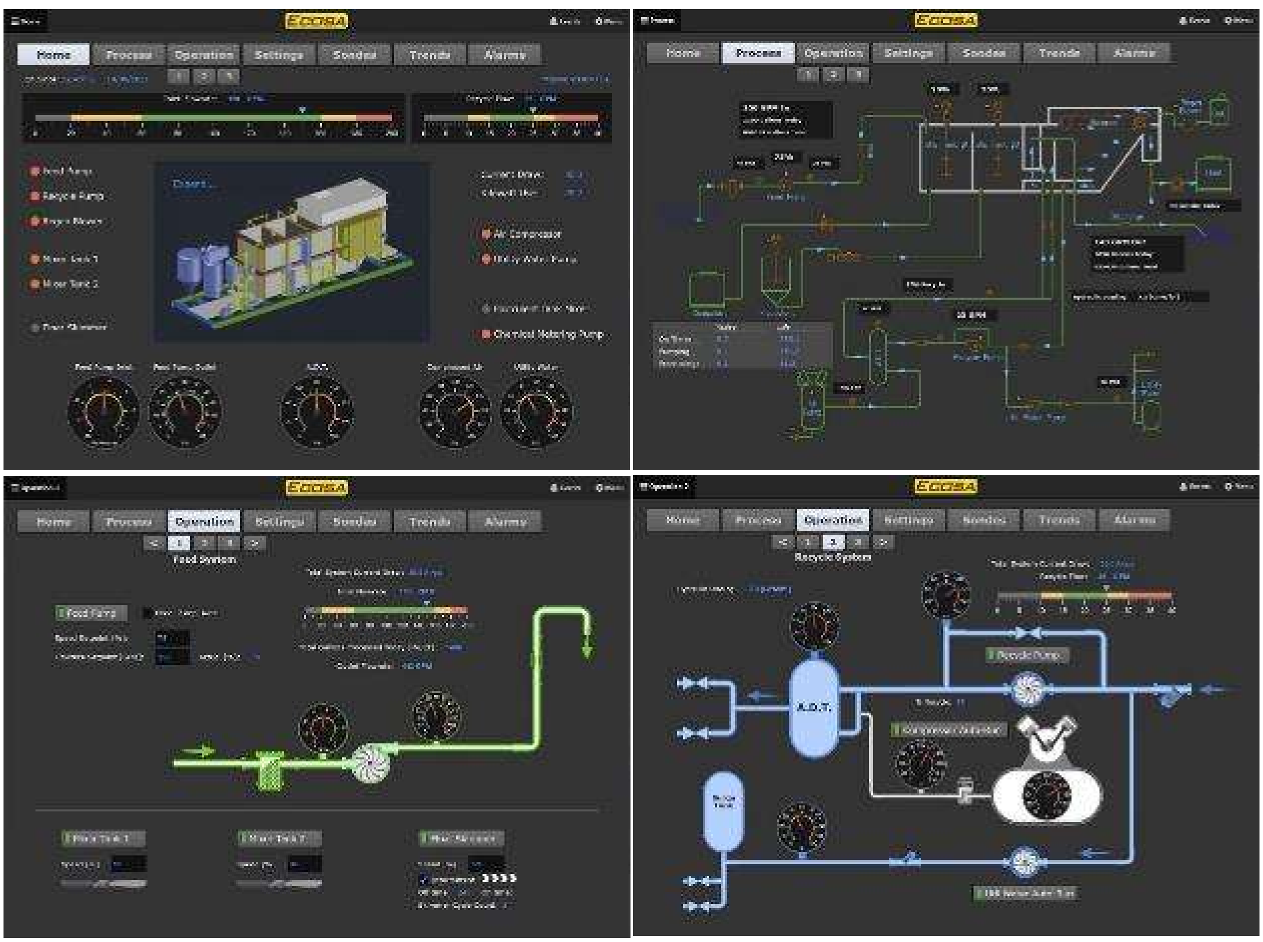
Monitoring activities were conducted in accordance with the approved QAPP for the project. Detailed MORs were prepared for the project that document details of the monitoring including quality procedures and field data verification. The following provides an overview of monitoring activities for treatment operations, water quality, and air quality. These monitoring activities aimed to provide reliable and representative data on operational and treatment efficiencies, and safety, over a range of water quality conditions for Lake Jesup.

4.4.1 Treatment Operations

System control parameters for the algae harvester were monitored during operations including:

- Current draw
- Power usage
- Processing hours
- Influent flow rate
- Influent volume
- Recycle flow rate and percentage
- Float blanket skim cycle counts

Data for each system control parameter were acquired and stored by a Supervisory Control and Data Acquisition (SCADA) system integral to the algae harvester with updates every 10 minutes. The data were monitored during operations and downloaded at least monthly.



SCADA process control and operations panel screens.

4.4.2 Water Quality

4.4.2.1 Field Parameters

Water quality sondes (EXO2, YSI Inc.) were installed in an influent port and effluent port to collect continuous measurements of temperature, conductivity, pH, DO, turbidity, Chl-a, and phycocyanin. The sondes were programmed to log data at regularly scheduled intervals (i.e., every 15 minutes) during the operation of the algae harvester.

EXO2 water quality sonde in the influent port chamber

The sondes were designed for long-term, unattended deployment and the manufacturer recommends monthly calibration with more frequent spot calibrations performed if field values do not seem ordinary. Calibration of the sondes followed the manufacturer's calibration protocols for each parameter. During calibration, a SmartQC score is generated by the EXO software that assesses the state of sensor performance relative to factory-defined performance parameters. Verification of the field measurements was performed by comparison between pre- and post-calibration values to assess stability between calibrations. Calibration and field verification results were evaluated against Acceptance Criteria in Table FT 1000-1 of the FDEP Standard Operating Procedures (SOPs) for field testing (FT series) for all parameter standards. Data were qualified as 'estimated' if the criteria were not met.

Turbidity, Chl-a, and phycocyanin results from the sondes were rejected due to issues with significant drift, evidence of interference likely due to a combination of factors including high concentrations of colored organic matter in the water, nanobubbles produced by the recycle water, and sensor fouling. Efforts to resolve the issues included recalibration of the sondes, replacement of the calibration standards, cleaning, and inspection of the sensors, increasing automatic sensor wiping, and repositioning of the sondes within the sample ports. Despite these efforts, results continued to be suspect returning large numbers of negative values, and results that did not reflect field observations of water clarity and algae levels.

Due to the issues with turbidity measured by the sondes, a manual portable turbidimeter (HACH 2100P) was used to measure turbidity of grab samples collected approximately hourly from the influent and effluent ports. The turbidimeter was calibrated and field verified daily during operations and results were assessed and qualified as for the sondes.

Descriptive statistics were computed from mean daily data for each month of operation by treatment type (standard and organic). Differences between the mean daily influent and effluent data were tested for each parameter using a paired-sample Mann-Whitney Test at a 95% significance level ($p < .05$).

4.4.2.2 Laboratory Parameters

Grab water samples were collected from the influent and effluent sample ports on the algae harvesting system for analysis of water quality parameters (**Table 2**). Samples were collected once per week in each operational week for a total of 20 sampling events and trip and field blanks were collected on two events (March, April) (**Table 3**). Fifteen events were sampled during the standard treatment weeks and five events were sampled during the organic treatment weeks.

Whole Effluent Toxicity (WET) testing (acute, chronic) was conducted seven times (once per month from Nov. to April) for the effluent and four times (Dec., Feb., Mar., April) for the influent. Only three WET tests were planned for the effluent, but additional testing of the effluent and the influent was performed to further investigate potential toxicity of raw water from Lake Jesup on the test organisms. In compliance with the National Pollutant Discharge Elimination System FDEP Industrial Wastewater Facility Permit No. FL0A00015-001-IW7B, grab samples were collected over a series of 2-3 days from the influent and effluent sampling ports on the algae harvester. The WET testing was performed by Marinco Bioassay Laboratory under a subcontract from Eurofins TestAmerica on a water flea species (*Ceriodaphnia dubia*) and the Fathead Minnow (*Pimephales promelas*).

Table 2. Water Quality Parameters, Test Methods, and Commercial Laboratories

Analyte	Test Method Code	Method Detection Limit (mg/L)
Aluminum (Al)	EPA 200.7 Rev 4.4	0.024 - 0.054
Al, Dissolved	EPA 200.7 Rev 4.4	0.024 - 0.054
Total Volatile Suspended Solids (VSS)	SM 2540E	6.7-51
Total Suspended Solids (TSS)	SM 2540D	3.3-25
Alkalinity, Total (ALK)	SM 2320B	5.0
Organic Carbon, Total (TOC)	SM 5310B_TOC	0.50
Organic Carbon, Dissolved (DOC)	SM 5310B_DOC	0.50
Carbonaceous Biochemical (cBOD5)	SM5210B	2.0
Chlorophyll-a, corrected for phaeophytin (Chl-a)	SM 10200 H-2011	0.0010
Nitrogen, Kjeldahl, Total (TKN)	MCAWW 351.2	0.10
TKN, Dissolved	MCAWW 351.2	0.10
Nitrate as N (NO3-N)	EPA 353.2	0.010
Nitrate+Nitrite as N (NO3NO2-N)	MCAWW 353.2-1993 R2.0	0.010
NO3NO2-N, Dissolved	MCAWW 353.2-1993 R2.0	0.010
Nitrite as N (NO2-N)	MCAWW 353.2-1993 R2.0	0.010
Ammonia (NH3)	EPA 350.1	0.10
Nitrogen, Total (TN)	MCAWW 351.2 + 353.2	0.11
TN, Dissolved	MCAWW 351.2+ 353.2	0.11
Phosphorus as P, Total (TP)	EPA 365.1	0.0096
Phosphorus as P, Total Dissolved (DP)	EPA 365.1	0.0096
Orthophosphate as P (PO4-P)	EPA 365.1	0.0050
ADDA Microcystins/Nodularins (MCs/NODs)	ELISA	0.0003
Potentially Toxigenic (PTOX) Cyanobacteria Screen (with cell photo)	(see Note 1)	

Notes: MCs/NODs and PTOX cyanobacteria screens were analyzed by GreenWater Laboratory, Palatka, FL. Chl-a was analyzed by Environmental Conservation Laboratories, Orlando, FL under contract by Eurofins Test America, Savannah, GA. All other parameters were analyzed by Eurofins TestAmerica, location. 1-One mL aliquots of sample are prepared using Sedgewick Rafter cells and scanned at 100 times magnification for the presence of PTOX cyanobacteria using a Nikon Eclipse TE200 Inverted Microscope equipped with phase contrast optics. Higher magnification is used as necessary. SM=Standard Methods for the Examination of Water and Wastewater, ELISA = Enzyme-Linked ImmunoSorbent Assay, EPA = US Environmental Protection Agency, MCAWW = Methods for Chemical Analysis of Water And Wastes, EPA-600/4-79-020, March 1983 and subsequent revisions.

Table 3. Water Quality Monitoring Event Dates

Influent / Effluent	PTOX and Toxins	Field Duplicates	Field Blanks	WET Tests
9/15/2021	9/15/2021	3/2/2022	3/2/2022	10/4/2021
9/22/2021	9/22/2021	3/16/2021	4/7/2022	11/8/2021
10/6/2021	10/6/2021	3/16/2022		12/13/2021
11/10/2021	10/28/2021	4/7/2022		12/15/2021
12/1/2021	11/10/2021			12/17/2021
12/15/2021	12/1/2021			1/17/2022
1/5/2022	12/15/2021			1/19/2022
1/19/2022	1/5/2022			1/21/2022
1/26/2022	1/19/2022			2/14/2022
2/9/2022	1/26/2022			3/28/2022
2/16/2022	2/9/2022			3/30/2022
2/23/2022	2/16/2022			4/1/2022
3/2/2022	2/23/2022			4/11/2022
3/16/2022	3/2/2022			4/13/2022
3/24/2022	3/16/2022			4/15/2022
3/30/2022	3/24/2022			
4/7/2022	3/30/2022			
4/13/2022	4/7/2022			
5/26/2022	4/13/2022			
5/31/2022	5/26/2022			
	5/31/2022			

Notes: PTOX= Potentially Toxigenic (PTOX) Cyanobacteria Screen; WET=Whole Effluent Toxicity; toxins tested included Total Microcystins and Nodularins on all events and anatoxin, saxitoxin, and cylindrospermopsin on Sep. 15. 2021.

Sample collection, handling and quality control measures were conducted in accordance with the approved QAPP and following applicable FDEP Standard Operating Procedures including *FS 1000 – General Sampling and FS 2000 – General Aqueous Sampling* described therein, and with the FDEP Industrial Wastewater Facility Permit No. FL0A00015-001-IW7B.

Quality verification of the laboratory data was completed by AECOM chemists. Data verification reports prepared for each month of operations including summaries of data qualifications and rejected or incomplete data are provided in **Appendix B**. Initial review of data quality in the MORs identified instances of dissolved concentrations exceeding their total concentration in a sample. The data were therefore further evaluated for usability based on parts versus whole comparisons (i.e., reversals) following FDEP (2008). Where applicable, sample results were evaluated and rejected if the sum of reported parts or fractions for the associated sample analyte results exceeded 120% of the corresponding reported or calculated whole (e.g., if dissolved TN concentration was greater than the total TN concentration by more than 120%, then total and dissolved TN concentrations were rejected for that sample). Calculations for the evaluation of reversals are provided in **Appendix C**. The results of the laboratory analyses for water quality with the revised qualifiers following data verification are provided in **Appendix D**.

Descriptive statistics were computed for each parameter by treatment type (standard and organic). Differences between parameters in the influent and effluent were tested for each parameter using a paired-sample Mann-Whitney Test at a 95% significance level ($p < .05$) for each treatment type.

4.4.3 Air Monitoring

Air monitoring program included collection of area and personal air samples during non-operational (background) and operational conditions. Non-operational sampling was performed on March 13, 2022, after seven days without operations. The operational sampling was performed on March 14 and April 5, 2022. Area samples were collected in four fixed locations on the barge (north, south, east, and west sides). Personal samples were collected from the breathing zone of each of two workers and were intended to measure actual exposure of the worker for comparison with occupational exposure limits. The samples were analyzed for endotoxins and cyanotoxins (MCs/NODs, anatoxin-a, and cylindrospermopsin).

Endotoxin samples were shipped to Eurofins EMLab P&K in Marlton, NJ for analysis. Sample analysis was performed using the *Limulus* amebocyte lysate assay in accordance with the laboratory's internal analytical method SOP EM-BC-S-2583. Sample results were reported in endotoxin units (EU) per cubic meter of air (EU/m^3). The laboratory has reported that one EU converts to 0.125 nanograms of endotoxin.

Microcystin samples were shipped to GreenWater Laboratories in Palatka, FL for analysis. Sample analysis was performed using the enzyme-linked immunosorbent assay (ELISA) method using US EPA method 546 & Ohio EPA DES 701.0 (for MCs/NODs) and liquid chromatography mass spectrometry (anatoxin-a and cylindrospermopsin). Sample results were reported in nanograms per cubic meter of air (ng/m^3).

4.5 Public Events

SJRWMD staff and AECOM co-hosted a media day event on Dec. 17, 2021 at the Black Hammock located at 2316 Black Hammock Fish Camp Road, Oviedo, FL. The event was well attended with representatives from SJRWMD, FDEP, Seminole County, and other local and state government entities as well as interested members of the public. Twenty-six guests signed the roster. Ten AECOM staff directly involved in the project were in attendance, providing information to guests on various aspects of the project at information stations set up at the site. Guests were also taken on an air boat tour of the lake and to the barge to view the algae harvester in operation.

A video presentation of the medial event can be accessed at the link: https://www.youtube.com/watch?v=K6B-o-cEbp0&list=PLuMz7fdvlAtGfH2MI_iFAE8X7G97QZmiX&index=3

AECOM staff giving a tour of the Lake Jesup algae harvester to media and guests on Dec. 17, 2021.

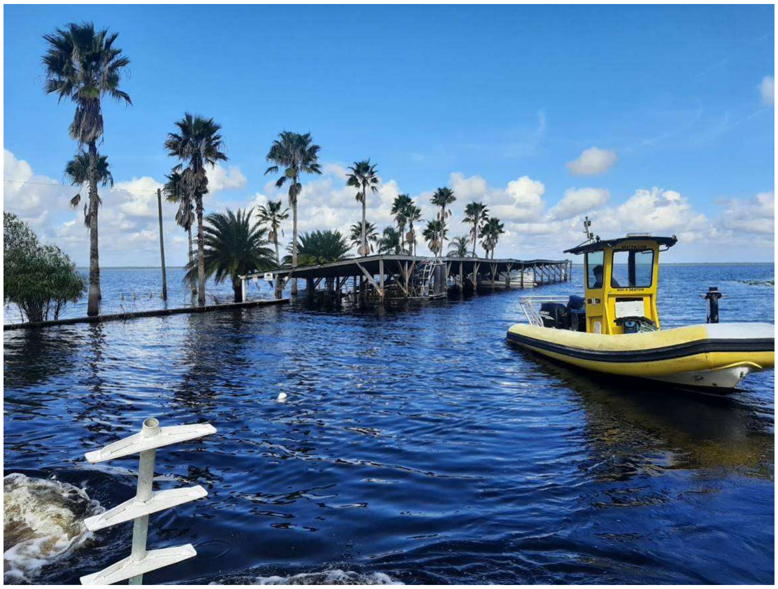
4.6 Decommissioning and Site Restoration

Land-based operations were staged at the Black Hammock Adventures marina located at 2316 Black Hammock Fish Camp Rd, Oviedo, FL 32765. Site restoration at the Black Hammock was completed May 31, 2022 following the end of operations and included the removal of two 500-gallon poly-tanks used for temporary storage of recovered algae biomass that were located near the marina fueling dock. No other site improvements or equipment were staged at the site. The AECOM work boat was retained at the Black Hammock marina berth to be used in the final demobilization effort (i.e., removal of the barge from Lake Jesup).

Decommissioning of the barge was completed Nov. 7, 2022 following several delays due to "acts of nature" that prevented safe removal of the barge. At the end of operations in May 2022, water levels in Lake Jesup declined and were too low to safely remove the barge. A “Wait and Watch” approach was adopted with plans to resume decommissioning once water levels in Lake Jesup increased to a gage height of approximately 3 ft at USGS Station 02234435 located at the Lake Jesup outlet (28°47'02" N, 81°10'53" W; North American Datum 1927 [NAD27]). Water levels reached 3 ft on Sep. 8, 2022 and plans for decommissioning resumed but were halted on Sep. 22, 2022 in advance of Hurricane Ian. AECOM conducted a site visit on Sep. 23, 2022 and secured the barge for the pending storm. Hurricane Ian landed Sep. 28, 2022 and caused water levels in Lake Jesup to rise by approximately four feet in one day with significant flooding in the area. The Sanford Boat Works and Marina, where the barge was to be removed, sustained hurricane-related damage, was under water, and out-of-service following the hurricane.

View of the Sanford Boat Works and Marina on Nov. 2, 2022, where the barge was initially deployed. The entire land area is under water, a result of flooding from Hurricane Ian.

The Downtown Sanford Marina was selected as an alternate site for decommissioning of the barge. On Nov. 2, 2022 AECOM and SeaTow met at the Black Hammock Adventures marina to launch two work boats for use in towing/pushing the algae harvester barge. The marina was flooded, and the business was still closed from flooding and damage caused by Hurricane Ian. The two work boats were safely launched and barge transit from Lake Jesup began. The barge was towed from barge station 4 in Lake Jesup to a side slough out of the main channel of the St. Johns River near the State Road 46 bridge and the Cameron Wright Park and Boat Ramp and the spuds were lowered to anchor the barge for the evening.



Submerged covered boat slips at the Black Hammock Adventures marina on Nov. 2, 2022, due to elevated water level in Lake Jesup following Hurricane Ian.

Towing of the barge to the Downtown Sanford Marina resumed the morning of November 3, 2022. The barge was moved to near the entrance of the Downtown Sanford Marina and the spuds were lowered to anchor the barge in place. The crew then shuttled into the marina to visit the debarkation point, review site conditions and then finalized the course the barge would follow to its mooring point at the debarkation station. The barge transit was safely completed into the marina, and it was moored for the evening.

SeaTow work Boat and barge entering the Downtown Sanford Marina (left) and the barge moored at the debarkation station of the marina (right).

All equipment was removed from the deck of the barge (algae harvester, generator, and spud winch) using a crane and transported off-site on Nov. 4, 2022. The barge was then broken down into its constituent three 10 ft x 40 ft sectional barge pontoons. One pontoon was transported off-site and the remaining two pontoons were staged on land at the marina for the weekend due to mechanical problems with the moving truck. The remaining two sectional barge pontoons were lifted by a crane onto a truck and transported off-site on Nov. 7, 2022. With this accomplishment, barge demobilization was complete.

Crane lifting the algae harvester off the barge (left) and the spud wench and sectional barge leaving the site on a transport truck (right).

Downtown Sanford Marina barge debarkation station on Nov. 4, 2022 after all equipment had been removed from the water.

Details of the site restoration and barge demobilization activities were documented in a letter from William H. Colona III (AECOM) to Gretchen Kelley (SJRWMD) dated Dec. 2, 2022, which included a signed statement verifying completion. .

5. Lake Jesup Algae and Nutrients

5.1 TMDLs for TP and TN

Lake Jesup is a productive lake with high concentrations of algae and nutrients (TP and TN) that persist throughout the year with common occurrences of toxic cyanobacterial HABs that impair water quality. TMDLs for TP (41,888 pound (lb)/yr) and TN (545,203 lb/yr) were adopted to achieve a Trophic State Index of 65.5 for the lake, which corresponds to long-term annual average concentrations of 31.2 µg/L for Chl-a, 96 µg/L for TP, and 1,270 µg/L for TN (Gao, 2006). The TMDLs represent the TP and TN loads that the lake could receive and still maintain designated uses for Class III waters. The load allocations to meet the TMDLs are summarized in **Table 4**.

Table 4. Nutrient TMDL Allocations and Required Reductions by Source

Source	TN Existing Load (lb/yr)	TN Allowable Load (lb/yr)	TN % Reduction	TP Existing Load (lb/yr)	TP Allowable Load (lb/yr)	TP % Reduction
Watershed	329,421	274,407	16.7	24,217	13,197	45.5
Anthropogenic	272,540	217,526	20.2	19,870	8,850	55.5
Natural	56,881	56,881	0.0	4,347	4,347	0.0
In-Lake	186,975	155,797	16.7	34,907	19,024	45.5
Groundwater Seepage to Lake	103,175	85,945	16.7	10,907	5,944	45.5
Sediment Flux	83,800	69,852	16.7	24,000	13,080	45.5
Atmospheric Deposition	84,000	84,000	0.0	9,600	9,600	0.0
Nitrogen Fixation	633,894	31,695	95.0	0	0	0.0
Total	1,234,290	545,899	55.8	68,724	41,821	39.1

Source: 2018 BMAP Amendment (FDEP, 2019). Notes: Allowable TN and TP loads differ from those adopted in the TMDL due to updates in the 2018 BMAP Amendment

Progress has been made to reduce nutrient loads from the watershed since the Lake Jesup TMDLs were implemented with the adoption of a BMAP in 2010 (as amended in 2018). The 2021 Status and Trends Report by the FDEP (2022) indicates that concentrations of TP and TN have declined over the 15-year interval from 2006 to 2020, potentially in response to the reduced watershed loads. While Chl-a and nutrient concentrations continue to exceed in-lake water quality targets (**Table 5**), the targets are anticipated to be achieved once the nutrient TMDLs are met. The timeline to achieve the TMDLs is 2030.

Table 5. TMDL Water Quality Targets and Average Annual Chl-a, TN, and TP Concentrations in Lake Jesup (2017-2022)

Year	Chl-a (µg/L)	TN (µg/L)	TP (µg/L)
TMDL Target:	31.2	1,270	96.0
2017	81.9	2,664	145.7
2018	72.2	2,152	143.3
2019	71.3	2,059	129.0
2020	65.9	2,438	139.5
2021	125.4	3,122	127.6
2022 (Jan 1 to May 31)	98.9	2,979	137.6
2017-2021 Average	85.9	2,569	137.1

Source: Seminole County Water Atlas. Notes: The 2017-2022 period was selected for comparison against the TMDL to reflect recent conditions given the evidence for declining concentrations since 2010 as per the 2021 Status and Trends Report (FDEP, 2022).

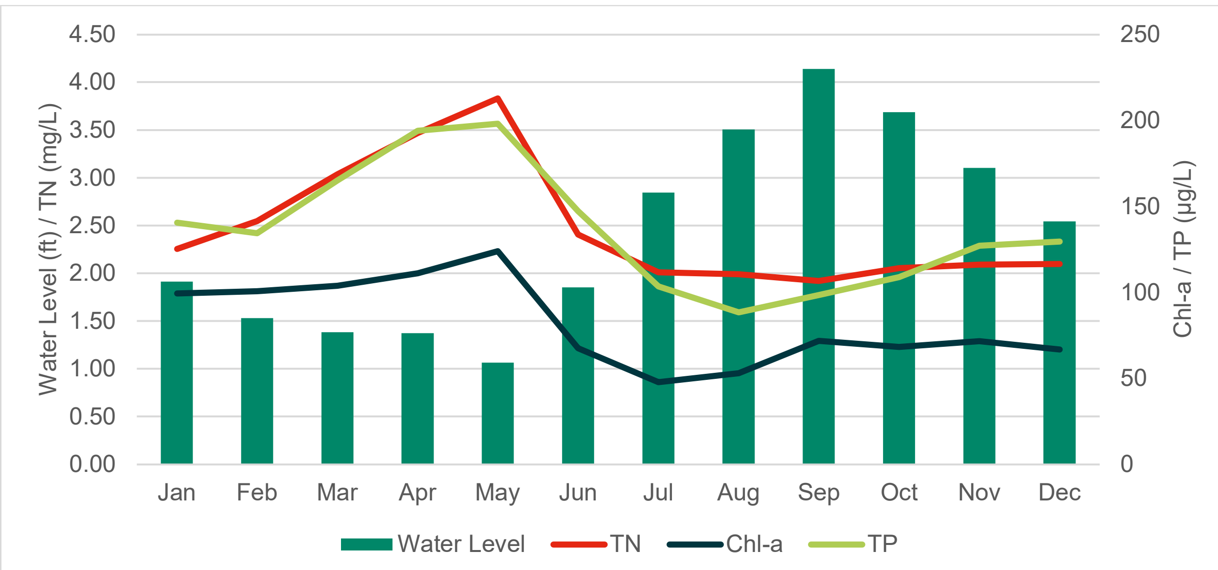
The 2018 BMAP Amendment concluded that nutrient reductions from watershed sources will also reduce loads from in-lake sources (groundwater and sediment flux) and nitrogen fixation, but innovative in-lake management techniques will be needed to further reduce these loads to meet the TMDLs by 2030. In-lake algae harvesting using HFT presents such innovation and could provide a tool to reduce nutrients and help achieve the TMDLs and water quality targets for the lake.

5.2 Temporal and Spatial Variability

The amounts of algae and nutrients that can be removed by the algae harvesting system largely depend on their concentrations in the lake water, which vary over time and space in Lake Jesup. The timing of operations and the positioning of the algae harvester therefore must be considered to determine the treatment potential of the technology and to optimize treatment plans to maximize removal efficiencies.

Seasonal patterns in algae (as Chl-a) and nutrients (TP and TN) in Lake Jesup generally follow changes in water levels (**Figure 2**). Peak concentrations typically occur in late winter and spring (March, April and May) when water levels are lowest and decline to minimum concentrations in summer (July and Aug.) as water levels rise (**Figure 2**). Concentrations increase in fall to moderate levels and continue to increase through winter with occasional blooms as water levels continue to decline to spring lows.

Figure 2. Patterns in Mean Monthly Water Levels and Concentrations of Chl-a, TP, and TN in Lake Jesup (2017-2022)



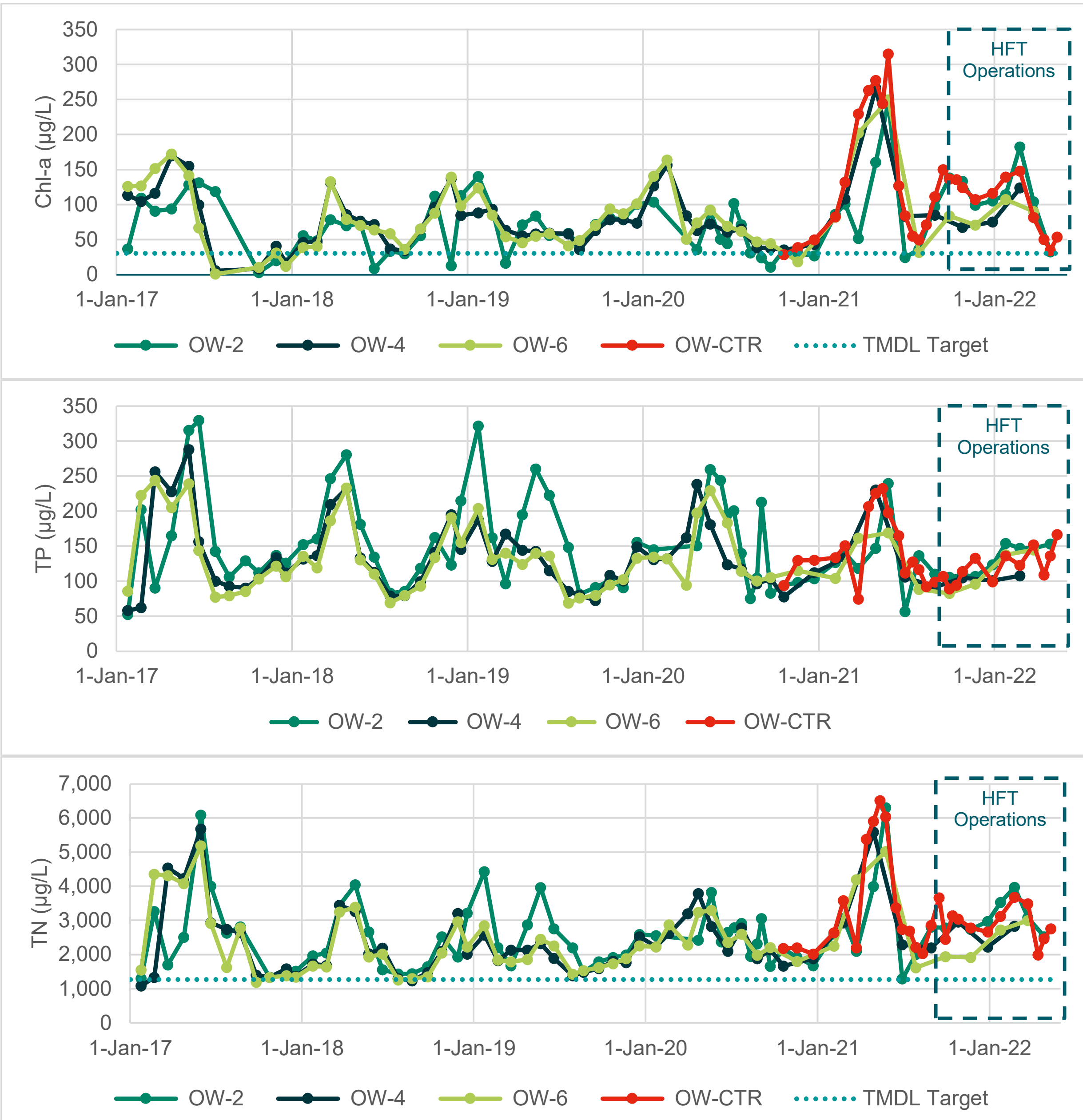
Data Source: SJRWMD data downloaded from the Seminole County Water Atlas, URL: https://seminole.wateratlas.usf.edu/DataDownload/SelectStations.aspx, retrieved July 25, 2022 (TN, TP and Chl-a data); USGS National Water Information System: Web Interface, URL: https://waterdata.usgs.gov/usa/nwis/uv?site_no=02234435, retrieved July 26, 2022 (water level data).

Large-scale spatial patterns in algae and nutrients also occur in Lake Jesup. In general, concentrations in the east of the lake near the outlet to the St. Johns River (SJWMD monitoring site OW-2) are often lower than those at monitoring sites in the west end of the lake (SJWMD monitoring sites OW-4 and OW-6) (**Figure 3**), potentially due to dilution from the St. Johns River and higher nutrient loads from external sources in the east.

During the algae harvesting operational period from Sep. 2021 through May 2022, algae and nutrient concentrations in Lake Jesup deviated from typical temporal and spatial patterns (**Figure 3**, **Figure 4**). In September and October, concentrations of algae and TN were higher than those observed in the previous five years, and no prominent peak in algae and nutrients occurred in late winter or spring. Spring concentrations of Chl-a were the lowest observed in the previous five years. The deviations in seasonal algae and nutrient concentrations were coincident with lower-than-average water levels in September, and higher-than-average water levels in late winter and spring (March – May) (**Figure 5**). Differences were also apparent in spatial patterns where algae and nutrient concentrations were higher at the east end of the lake near the outlet than at the west end of the lake through the fall and winter months (**Figure**

3). Concentrations near the center of Lake Jesup (SJRWMD monitoring site OW-CTR) were similar to those at the outlet over the entire monitoring period. These spatial patterns support field observations of algae levels in Lake Jesup that were used to inform the timing and selection of locations for the repositioning of the barge (see **Section 4.3**) to areas of higher algae levels to maximize removal efficiencies.

Figure 3. Patterns in Lake Jesup Algae (as Chl-a) and Nutrient (TP and TN) Concentrations (2017-2022)

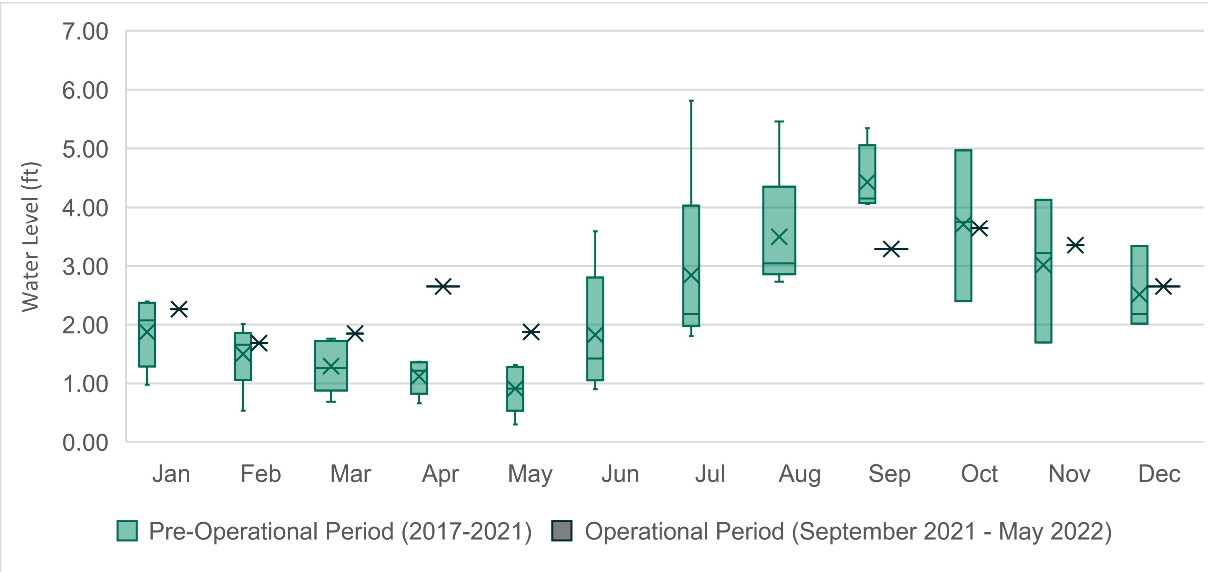


Data Source: SJRWMD data downloaded from the Seminole County Water Atlas, URL: https://seminole.wateratlas.usf.edu/DataDownload/SelectStations.aspx, retrieved July 25, 2022. Notes: Station OW-CTR was established in Oct. 2020. Sites are located at: Lake Jesup near the outlet to the St. Johns River (OW-2 at 28.7648° latitude, -81.1763° longitude), near the center of the lake approximately 640 m east northeast of Bird Island (OW-CTR at 28.7268° latitude, -81.2111° longitude) and in the west basin (OW-4 at 28.7053° latitude, -81.2540° longitude; OW-6 at 28.7149° latitude, -81.2774° longitude). .

Figure 4. Box and Whisker Plot of Mean Monthly Chl-a, TP, and TN in Lake Jesup before (2017- 2021) and during Algae Operations (Sep. 2021 – May 2022)

Data Source: SJRWMD data downloaded from the Seminole County Water Atlas, URL: https://seminole.wateratlas.usf.edu/DataDownload/SelectStations.aspx, retrieved July 25, 2022. Notes: Boxes denote the 25th to 75th percentile range, horizontal lines through the boxes denote the median, whiskers denote the range, and 'X' symbols denote the mean. Green dots denote outliers.

Figure 5. Box and Whisker Plot of Mean Monthly Water Level at USGS Gauge Station 02234435 LAKE JESUP OUTLET NEAR SANFORD, FL before (2017- 2021) and during Algae Operations (Sep. 2021 – May 2022)



Data Source: USGS National Water Information System: Web Interface, URL: https://waterdata.usgs.gov/usa/nwis/uv?site_no=02234435, retrieved July 26, 2022. Notes: Boxes denote the 25th to 75th percentile range, horizontal lines through the boxes denote the median, whiskers denote the range, and 'X' symbols denote the mean.

6. Algae Harvesting Treatment Performance

6.1 Operations

The barge-mounted algae harvester was successfully operated with little variation from the target flow rate of 100 gpm [mean daily flow = 100.15 gpm (0.92 Standard Deviation [SD])], treating water for between 16.00 and 82.25 hours in each month and producing a total of 2,416,618 gal of treated water over the project duration (**Table 6**). Operations allowed field evaluation of control parameters that maximized efficiencies for treatments using standard (40 mg/L of ACH, 2 mg/L of PT-2160) and organic (2 mg/L PT-2160) conditioning of the water. Key optimal operating parameters that were established included:

- Mixing speeds of 40% and 20% in the coagulant and flocculant chambers, respectively for the standard treatment
- A mixing speed of 50% in the flocculant chamber for the organic treatment
- A recycle flow rate between 27% and 30% of the influent flow rate for optimal nanobubble formation to assist algae floc flotation. Higher recycle flow rate was most effective in Sep., Nov. and Dec. and the lower rate was most effective in all other months, regardless of treatment type (standard or organic). The differences may have resulted from changes in water quality and algae species affecting flotation.
- A float blanket skimming cycle of 1.6 and 2 skims per hour for the standard and organic treatments, respectively, to maximize algae removal while reducing the water content of the recovered algae slurry.

Table 6. Monthly Operational Hours and Water Treated by Treatment Type (Standard and Organic Treatments)

Year	Month	Operational Hours			Water Treated (gal)		
		Standard[1]	Organic[2]	Total	Standard[1]	Organic[2]	Total
2021	Sep	26.25		26.25	160,545		160,545
2021	Oct	21.75		21.75	134,814		134,814
2021	Nov	16.00		16.00	100,180		100,180
2021	Dec	25.50		25.50	158,564		158,564
2022	Jan	35.00	34.50	69.50	216,308	214,338	430,646
2022	Feb		68.25	68.25		424,934	424,934
2022	Mar	60.25	22.00	82.25	374,817	135,886	510,703
2022	Apr	57.00		57.00	358,816		358,816
2022	May	22.25		22.25	137,416		137,416
Total		**264.00**	**97.50**	**388.75**	**1,641,460**	**605,935**	**2,416,618**

Notes: Data shown are for operations once the system was up and running on each day (i.e., excludes data during startup of the system until operations stabilized). 1-standard treatment (40 mg/L ACH, 2 mg/L PT-2160). 2-organic treatment (optimal treatment of 2.0 mg/L PT-2160) and organic treatment tests (variable organic coagulant and flocculant concentrations). The optimal organic treatment was run for 76.5 hours treating a total of 475,533 gal.

Power consumption was relatively consistent during operations with an average daily current draw and power use of 7.87 amperes (SD = 0.54) and 5.88 kilowatts (kW) (SD = 0.40), respectively. With a total of 388.75 operational hours to process 2,416,618 gal of water, the energy used during operations was therefore 2,290 kWh or 0.000946 kWh/gal. Energy used to process the algae biomass at the WWTP is not known but would be expected to be negligible given the small volume of biomass (i.e., 5,015 gal.) that would have been fed into the current operations at the plant [the average daily flow at the Yankee Lake WWTP is 2.379 mgd (FDEP 2020)].

Only minor technical issues with the algae harvesting system occurred with little to no disruption of operations. The primary issue was clogging of the intake screen during the Feb. operations. The issue was resolved by retrofitting the valve assembly for ease of cleaning and replacing the recycle inlet piping housing and filter. Another issue that occurred was the pulling up sediments at the inlet, which was corrected by raising the inlet hose. These issues were able to be rapidly detected by the operators based on visual observations and through monitoring of turbidity in the influent water for the issue with sediment draw.

The barge was able to be successfully repositioned demonstrating that a mobile system is feasible. Spatial differences in algae conditions in Lake Jesup within the FDEP-approved operational area during operations, however, were relatively homogeneous based on visual field observations and supported by water quality monitoring by the SJRWMD (see **Section 5.2**). While feasible, moving the barge would not improve algae and nutrient removal rates under spatially homogeneous conditions such as those observed over the project. It is possible that greater accumulation of algae could have occurred outside of the operational area closer to the shoreline due to wind transport or nearshore localized bloom activity, which was not monitored. The benefits of a mobile harvester over a land-based system are further explored in **Section 8**.

The operations produced a total of 6,595 gal. of algae slurry. The amount of slurry produced varied by month as expected given the different number of hours that the system was operated in each month, changes in the number of skim cycles, and differences in the amount of slurry produced by the two treatment types (**Table 7**). Further, the reduction in the number of skim cycles following the Sep. operations reduced slurry production compared to other months when the standard treatment was used. The standard treatment produced 0.00360 gal. of slurry per gal. of water treated for a total slurry production of 5,915 gal. The organic treatment produced approximately two thirds less slurry per volume of water treated (0.00112 gal. of slurry per gal. of water treated) with a total production of 680 gal. during the project. The greater volume of slurry produced by the standard treatment is due to the more voluminous floc produced by ACH compared to the organic polymer. The number of skim cycles can affect the amount of slurry produced. The number of skim cycles was adjusted during operations, however, to minimize water content of the slurry skimmate such that the number of skims is not expected to have contributed substantially to the difference in slurry volume produced by the two treatment types. Of the slurry produced, 5,015 gal. were transported to the Yankee Lake WWTP for disposal, 880 gal. were transported offsite for independent research, and approximately 780 gal. were lost to degassing and evaporation.

Table 7. Slurry Production and Disposal

Parameter	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Total
	(gal.)									
Slurry produced - Standard treatment	960	385	410	520	965	0	1,170	955	550	5,915
Slurry produced - Organic treatment	0	0	0	0	185	325	170	0	0	680
Total slurry produced	960	385	410	520	1,150	325	1,340	955	550	6,595
Water treated	160,545	134,814	100,180	158,564	430,646	424,934	510,703	358,816	137,416	2,416,618
Slurry produced per gal. of water treated	0.0060	0.0029	0.0041	0.0033	0.0027	0.0008	0.0026	0.0027	0.0040	0.0027
Wash water to clean the harvester and slurry tanks	0	0	0	0	0	0	0	40	40	80
Transported to Yankee Lake WWTP	500	0	525	525	835	0	1,040	1,040	550	5,015
Used for research	50	0	0	0	500	160	170	0	0	880
Lost to degassing and evaporation	0	160	10	75	80	0	80	335	40	780

6.2 Water Quality

Algae harvesting with HFT has been proven in multiple previous pilot demonstration projects to effectively remove algae and other suspended particles from water as well as nutrients and algal toxins. The treatment has also been demonstrated to improve other water quality parameters that would benefit aquatic life (e.g., reducing elevated pH and increasing low dissolved oxygen concentrations common to HAB-impaired waters). Monitoring of influent (raw water from Lake Jesup) and effluent (treated water) during the project across a range of seasonal water quality conditions in Lake Jesup supported these previous studies. Water quality of the influent to the algae harvester during operations reflected water quality in Lake Jesup that is consistent with shallow, nutrient-enriched warm water lakes with high concentrations of algae. Comparing water quality of the influent with that of the effluent consistently demonstrated significant water quality benefits from algae harvesting using the standard and organic treatments.

Descriptive statistics for field parameters are provided in **Table 8** and **Table 9** for the standard and organic treatments, respectively, and for the laboratory parameters in **Table 10** and **Table 11** for the standard and organic treatments, respectively. Impacts of the treatment on water quality are described below with a focus on key performance indicator parameters relevant to HAB mitigation (i.e., Chl-a, TSS, TP, and TN) for each treatment type (i.e., standard and organic). Reported differences of significant or non-significant differences between the influent and effluent are based on statistical testing using paired Mann Whitney Tests for each parameter ($p < .05$).

Table 8. Summary of Field Parameter Results for the Standard Treatment

Month	Statistic	TEMP (°C)		SPCOND (µS/cm)		pH (SU)		DO (mg/L)		TURB (NTU)	
		INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF
Sep	n	7	7	7	7	7	7	7	7	4	4
	Mean	28.97	29.20	702.85	700.01	9.13	8.64	7.70	8.65	15.60	3.43
	SD	0.35	0.44	32.47	39.62	0.10	0.09	0.69	0.43	1.00	0.31
	Median	28.93	29.15	711.22	710.53	9.17	8.70	7.79	8.84	15.71	3.42
Oct	n	6	6	6	6	6	6	6	6	6	6
	Mean	27.15	27.45	617.87	619.31	8.91	8.38	8.68	9.30	17.42	3.85
	SD	1.05	1.21	6.00	8.73	0.19	0.24	1.23	0.53	1.43	0.64
	Median	27.75	28.12	615.88	616.40	8.96	8.32	8.69	9.33	17.69	3.93
Nov	n	4	4	4	4	4	4	4	4	8	8
	Mean	18.49	18.80	651.63	653.79	8.54	7.93	10.44	11.25	24.38	3.81
	SD	1.50	1.38	59.68	33.03	0.30	0.14	0.55	0.10	5.42	0.65
	Median	18.13	18.47	680.28	668.78	8.68	7.96	10.60	11.26	23.52	3.75
Dec	n	6	6	6	6	6	6	6	6	13	13
	Mean	20.83	20.95	592.64	588.94	8.89	8.25	10.22	10.95	22.99	2.91
	SD	2.19	2.17	90.11	79.61	0.17	0.19	1.36	0.72	6.49	0.95
	Median	22.08	22.15	587.79	584.47	8.80	8.17	9.85	10.64	22.33	3.04
Jan	n	8	8	8	8	8	8	8	8	11	11
	Mean	16.66	16.78	519.58	521.71	8.72	7.95	10.09	12.13	16.00	2.47
	SD	2.41	2.40	17.49	19.72	0.32	0.38	0.63	0.66	3.81	1.15
	Median	15.43	15.73	519.02	516.34	8.63	7.76	10.01	12.40	15.45	1.95
Mar	n	13	13	13	13	13	13	13	13	4	4
	Mean	22.21	22.08	729.42	656.44	8.58	7.99	8.94	10.35	25.18	2.40
	SD	1.87	2.09	96.06	68.96	0.33	0.34	1.86	0.79	6.41	0.66
	Median	22.79	22.61	727.38	628.74	8.65	7.97	9.07	10.28	21.87	2.05
Apr	n	11	11	11	11	11	11	11	11	46	46
	Mean	23.47	23.64	692.30	618.81	8.23	7.61	8.18	9.89	20.38	3.09
	SD	1.44	1.44	134.74	74.35	0.37	0.26	1.14	0.42	6.23	1.03
	Median	23.35	23.42	668.85	591.71	8.26	7.55	7.87	9.75	19.20	3.15
May	n	4	4	4	4	4	4	4	4	4	4
	Mean	28.79	28.91	532.54	526.50	9.09	8.59	8.90	9.38	15.60	3.43
	SD	0.57	0.54	14.39	9.01	0.06	0.05	0.45	0.12	1.00	0.31
	Median	28.82	28.94	533.67	525.74	9.08	8.59	8.87	9.35	15.71	3.42
Total	n	59	59	59	59	59	59	59	59	6	6
	Mean	23.05	23.17	647.02	616.70	8.69	8.09	9.01	10.25	17.42	3.85
	SD	4.30	4.36	111.34	78.54	0.41	0.43	1.51	1.19	1.43	0.64
	Median	22.85	23.03	651.37	614.61	8.72	8.08	9.06	10.07	17.69	3.93

Notes: Descriptive statistics were computed from mean daily values measured during operations. INF = Influent, EFF = Effluent

Table 9. Summary of Field Water Quality Parameters for the Organic Treatment

Month	Statistic	TEMP (°C)		SPCOND (µS/cm)		pH (SU)		DO (mg/L)		TURB (NTU)	
		INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF
Jan	n	2	2	2	2	2	2	2	2	2	2
	Mean	14.68	14.78	525.31	521.06	8.36	8.19	11.02	13.01	21.71	13.23
	SD	0.47	0.45	2.27	3.59	0.00	0.00	0.06	0.14	0.21	0.18
	Median	14.68	14.78	525.31	521.06	8.36	8.19	11.02	13.01	21.71	13.23
Feb	n	8	8	8	8	8	8	8	8	10	10
	Mean	21.14	21.28	670.37	656.66	9.34	9.37	12.04	11.50	26.09	15.20
	SD	2.37	2.35	49.86	46.63	0.13	0.12	1.09	0.72	3.13	1.79
	Median	21.19	21.34	683.53	667.24	9.38	9.36	11.92	11.22	25.90	15.02
March	n	3	3	3	3	3	3	3	3	3	3
	Mean	21.58	21.62	690.71	676.71	9.14	9.21	10.78	11.00	31.64	15.36
	SD	0.29	0.27	18.53	17.69	0.12	0.11	1.44	0.60	1.88	0.99
	Median	21.48	21.52	698.92	684.13	9.20	9.26	11.29	11.21	30.90	16.03
Total	n	13	13	13	13	13	13	13	13	15	15
	Mean	20.25	20.36	652.75	640.42	9.14	9.14	11.59	11.62	26.62	14.97
	SD	3.03	3.02	68.06	63.80	0.36	0.43	1.24	0.90	3.96	1.68
	Median	21.28	21.36	666.20	652.31	9.26	9.28	11.51	11.29	26.28	14.94

Notes: Descriptive statistics were computed from mean daily values measured during operations. INF = Influent, EFF = Effluent

Table 10. Standard Treatment Influent and Effluent Water Quality (Laboratory Parameters)

Analyte	Units	Influent							Effluent							% Reduction
		n	n<MDL	Mean	SD	Min	Max	Median	n	n<MDL	Mean	SD	Min	Max	Median	
Al	mg/L	13	2	0.159	0.102	0.024	0.370	0.160	14	0	0.415	0.274	0.070	1.300	0.330	-373%
Al, Dissolved	mg/L	14	11	0.044	0.021	0.024	0.093	0.043	14	6	0.066	0.033	0.024	0.130	0.061	-77%
VSS	mg/L	15	8	41	10	26	51	50	15	15	11	4	6.7	17	10	70%
TSS	mg/L	15	0	39	7.7	30	52	38	15	10	6.5	2.1	3.3	9.4	6.8	83%
ALK	mg/L	15	0	70	5.0	60	77	70	15	0	65	6	57	78	64	6%
TOC	mg/L	15	0	15	2.2	8.7	20	15	15	0	10	1.3	9.0	13	10	28%
DOC	mg/L	15	0	15	1.8	9.2	17	15	15	0	10	1.2	8.8	13	10	29%
cBOD5	mg/L	Not Analyzed							15	7	3.0	1.2	2.0	6.0	2.3	--
Chl-a	mg/m^3	15	0	132	48	63	220	140	15	0	22	16	3.0	51	18	85%
TKN	mg/L	14	0	1.76	0.65	0.81	2.60	1.85	14	0	0.84	0.18	0.54	1.10	0.86	43%
TKN, Dissolved	mg/L	14	0	0.90	0.47	0.49	2.50	0.78	14	0	0.60	0.16	0.44	1.00	0.58	29%
NO3-N	mg/L	7	7	0.010	0.000	0.010	0.010	0.010	12	11	0.010	0.001	0.010	0.015	0.010	0%
NO3NO2-N	mg/L	11	9	0.024	0.030	0.010	0.094	0.010	13	9	0.017	0.021	0.010	0.091	0.010	-2%
NO3NO2-N, Dissolved	mg/L	12	11	0.016	0.020	0.010	0.083	0.010	14	13	0.016	0.021	0.010	0.091	0.010	-1%
NO2-N	mg/L	8	7	0.011	0.002	0.010	0.017	0.010	11	10	0.010	0.000	0.010	0.011	0.010	4%
NH4	mg/L	15	15	0.10	0.00	0.10	0.10	0.10	15	15	0.10	0.00	0.10	0.10	0.10	0%
TN	mg/L	11	0	1.61	0.65	0.81	2.60	1.40	12	0	0.83	0.18	0.54	1.10	0.83	43%
TN, Dissolved	mg/L	12	0	0.93	0.51	0.49	2.50	0.78	13	0	0.60	0.17	0.44	1.00	0.54	34%
TN, Particulate (1)	mg/L	11	4	0.70	0.55	0.00	1.75	0.60	12	3	0.23	0.21	0.00	0.56	0.18	34%
TP	mg/L	15	0	0.071	0.017	0.047	0.096	0.075	15	11	0.010	0.002	0.010	0.016	0.010	85%
TP, Dissolved	mg/L	15	14	0.0109	0.0048	0.0096	0.0290	0.0096	15	15	0.0096	0.0000	0.0096	0.0096	0.0096	4%
TP, Particulate (1)	mg/L	15	0	0.0600	0.0165	0.0374	0.0864	0.0570	15	0	0.0008	0.0017	0.0000	0.0064	0.0000	99%
PO4-P	mg/L	14	1	0.041	0.018	0.005	0.081	0.039	13	10	0.006	0.002	0.005	0.011	0.005	79%

Notes: 1 - Particulate fractions are calculated by subtracting the dissolved fraction from the total fraction.

Table 11. Organic Treatment Influent and Effluent Water Quality (Laboratory Parameters)

Analyte	Units	Influent							Effluent							% Reduction
		n	n<MDL	Mean	SD	Min	Max	Median	n	n<MDL	Mean	SD	Min	Max	Median	
Al	mg/L	3	0	0.157	0.059	0.110	0.240	0.120	4	2	0.070	0.023	0.054	0.110	0.058	60%
Al, Dissolved	mg/L	3	3	0.054	0.000	0.054	0.054	0.054	4	4	0.054	0.000	0.054	0.054	0.054	0%
VSS	mg/L	4	4	50	0	50	50	50	4	4	38	13	25	50	37.5	25%
TSS	mg/L	4	0	42	5	37	50	39.5	4	1	24	2	22	26	24	42%
ALK	mg/L	4	0	77	1	75	78	76.5	4	0	76	3	72	79	76.5	1%
TOC	mg/L	4	0	18	1	16	19	18	4	0	19	1	17	19	19	-4%
DOC	mg/L	4	0	18	1	17	18	17.5	4	0	18	0	18	19	18	-4%
cBOD5	mg/L	Not Analyzed							4	0	17.2	5.4	7.8	21.0	20.0	--
Chl-a	mg/m^3	4	0	210	49	170	290	190	4	0	133	22	120	170	120	36%
TKN	mg/L	3	0	2.73	0.39	2.20	3.10	2.90	3	0	2.17	0.31	1.90	2.60	2.00	20%
TKN, Dissolved	mg/L	3	0	1.46	0.69	0.77	2.40	1.20	3	0	1.26	0.67	0.74	2.20	0.83	13%
NO3-N	mg/L	3	3	0.010	0.000	0.010	0.010	0.010	3	3	0.010	0.000	0.010	0.010	0.010	0%
NO3NO2-N	mg/L	4	4	0.010	0.000	0.010	0.010	0.010	4	4	0.010	0.000	0.010	0.010	0.010	0%
NO3NO2-N, Dissolved	mg/L	4	4	0.010	0.000	0.010	0.010	0.010	4	4	0.010	0.000	0.010	0.010	0.010	0%
NO2-N	mg/L	4	4	0.010	0.000	0.010	0.010	0.010	4	4	0.010	0.000	0.010	0.010	0.010	0%
NH4	mg/L	4	4	0.10	0.00	0.10	0.10	0.10	4	4	0.10	0.00	0.10	0.10	0.10	0%
TN	mg/L	3	0	2.73	0.39	2.20	3.10	2.90	3	0	2.17	0.31	1.90	2.60	2.00	20%
TN, Dissolved	mg/L	3	0	1.46	0.69	0.77	2.40	1.20	3	0	1.26	0.67	0.74	2.20	0.83	13%
TN, Particulate (1)	mg/L	3	1	1.34	0.95	0.00	2.13	1.90	3	1	1.01	0.77	0.00	1.86	1.17	24%
TP	mg/L	4	0	0.051	0.015	0.030	0.068	0.052	4	1	0.028	0.017	0.010	0.052	0.026	43%
TP, Dissolved	mg/L	4	4	0.0096	0.0000	0.0096	0.0096	0.0096	4	4	0.0096	0.0000	0.0096	0.0096	0.0096	0%
TP, Particulate (1)	mg/L	4	0	0.0409	0.0153	0.0204	0.0584	0.0424	4	0	0.0186	0.0166	0.0000	0.0424	0.0159	54%
PO4-P	mg/L	3	0	0.045	0.010	0.032	0.057	0.047	2	0	0.020	0.012	0.009	0.032	0.020	52%

Notes: 1 - Particulate fractions are calculated by subtracting the dissolved fraction from the total fraction.

6.2.1 Field Parameters

The algae harvesting treatment resulted in a small but statistically significant increase in mean daily water temperatures of the treated water. The temperature of the influent varied seasonally (**Figure 6**) but the warming effect of the treatment remained consistently low with an increase in mean daily temperature of 0.12 °C and 0.11 °C for the standard and organic treatments, respectively. This small change would not be considered to impair water quality for aquatic life. Small temperature changes can be expected as the water is exposed to ambient air temperature for a short period during the treatment process and there is no significant chemical or physical process during the treatment that would be expected to alter water temperature.

Specific conductivity was statistically lower in the effluent compared to the influent for the standard treatment but not for the organic treatment. As with temperature, specific conductivity varied seasonally, but the effect of the standard treatment was consistently small (**Figure 6**) with a difference of 30.32 µS/cm in mean daily specific conductivity between the influent and effluent, which would not be expected to have any impact on aquatic life. A reduction in specific conductivity can be expected for the standard treatment due to the removal of anions such as phosphate, nitrate, and sulphate (reducing conductivity) by the ACH. The PT-2160 is cationic and would also remove anions, however, the lower dosages PT-2160 would be expected to have a much lower effect on anions explaining the lack of change in specific conductivity for the organic treatment.

Influent to the algae harvester had very high pH, which is characteristic of surface water with abundant aquatic plants and algae. During photosynthesis, algae and aquatic plants take up carbon dioxide (CO2), a weak acid, causing the pH to increase. Standard treatment significantly decreased average daily pH, with a difference of 0.98 SU in mean daily pH between the influent and effluent. A reduction in pH can be expected because ACH is acidic producing hydrogen ions when hydrolyzed:

$$Al_2(OH)_5Cl \rightarrow Al_2(OH)_5^+ + Cl^- + H_2O \rightarrow 2Al(OH)_3 + H^+ + Cl^-$$

There was no significant difference in pH for the organic treatment. While PT-2160 is acidic, the effects on the treated water would be minimal due to the low dosages used for the treatment.

Differences in dissolved oxygen concentrations between the influent and effluent were variable throughout the operational period (**Figure 6**). Despite that variability, mean daily DO concentrations were significantly higher in the effluent than in the influent for the standard treatment with a difference of 0.98 mg/L in mean daily DO between the influent and effluent. By contrast, there was no significant difference in DO between the influent and effluent with the organic treatment. The ability to increase DO concentrations, however, is unlikely to differ between the two treatment types. In both treatments, the recycle system that produces the microscopic air bubbles for flotation would contribute to an increase in DO in the effluent as oxygen in the recycle water becomes absorbed by the process water en route to the flotation chamber. The amount of oxygen that can be absorbed by the process depends on the saturation potential of the influent which varies with temperature and pressure, and the DO concentration in the influent. The treatment is expected to increase DO concentrations to a greater extent at lower influent dissolved oxygen concentrations and temperatures. During the organic treatment, it is likely that DO was supersaturated in the influent such that the recycle water would not further saturate the water with oxygen.

Algae harvesting greatly improved water clarity as evidenced by significant reductions in turbidity. Turbidity is an optical characteristic of water and is a measurement of the amount of light scattering in water. Dissolved and suspended matter can increase turbidity including suspended sediments, algae and other plankton, and dissolved colored organic compounds. Turbidity of the influent was highly variable but generally followed seasonal patterns in algae concentrations in Lake Jesup over the operational period (see **Section 5.2**), increasing in winter and then decreasing in spring (**Figure 7**). For the standard treatment, turbidity was consistently reduced to very low levels [maximum = 5.45 NTU, mean = 3.85 NTU (0.64 SD)] across the wide range of influent turbidity [11.2 - 36.2 NTU, mean = 17.42 (1.43 SD)] (**Figure 7**, **Figure 8**) as would be expected with the effective removal of solids from water. While not as effective as the standard treatment, the organic treatment also significantly decreased turbidity, with lower levels in the effluent [mean = 14.97 NTU (1.68 SD)] compared to the influent [mean = 26.62 NTU (3.96 SD)]. The standard and organic treatments reduced mean daily turbidity by 78% and 44%, respectively.

Figure 6. Trends in Mean Daily Temperature (TEMP), Specific Conductivity (SPCOND), pH and Dissolved Oxygen (DO) in the Algae Harvester Influent and Effluent

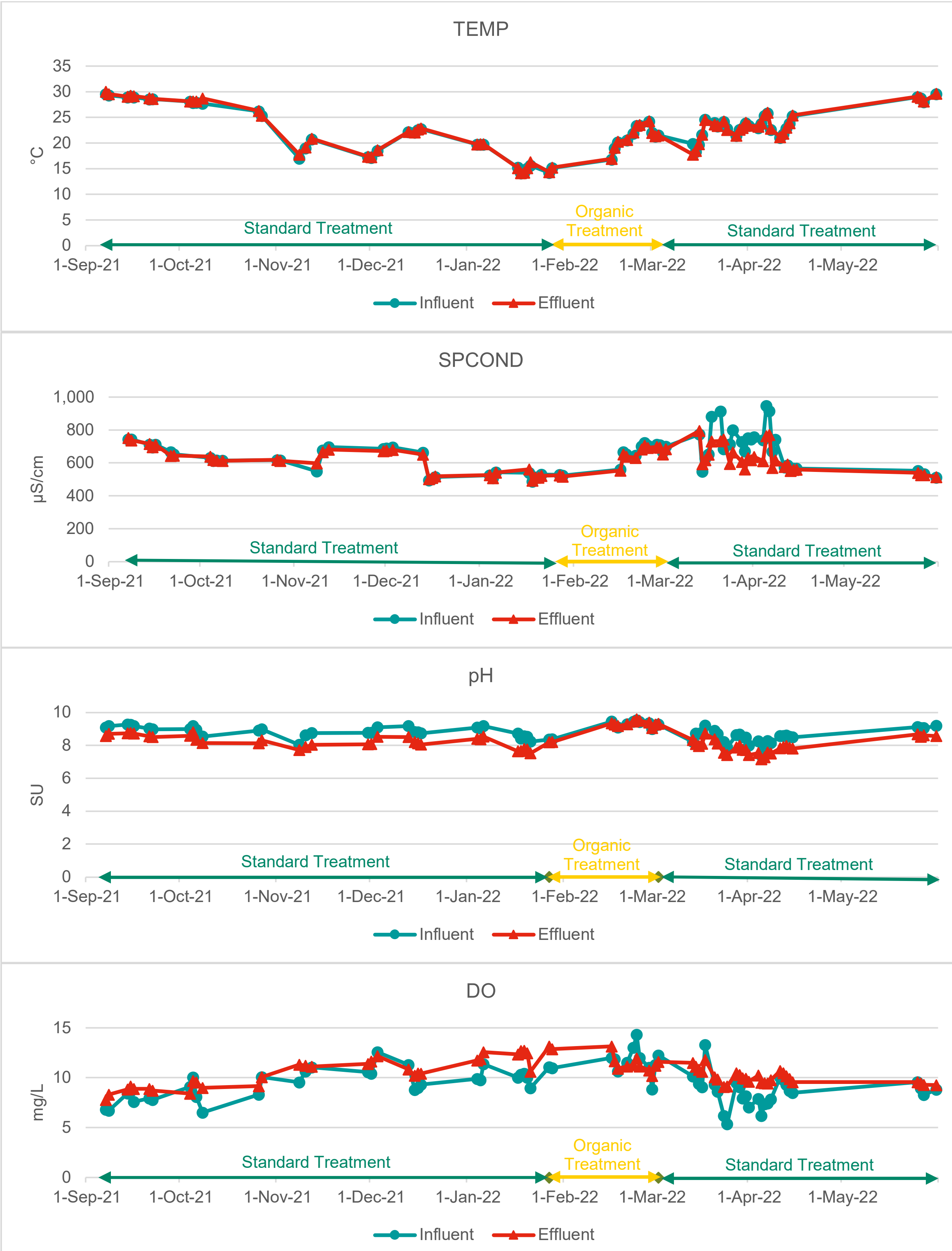
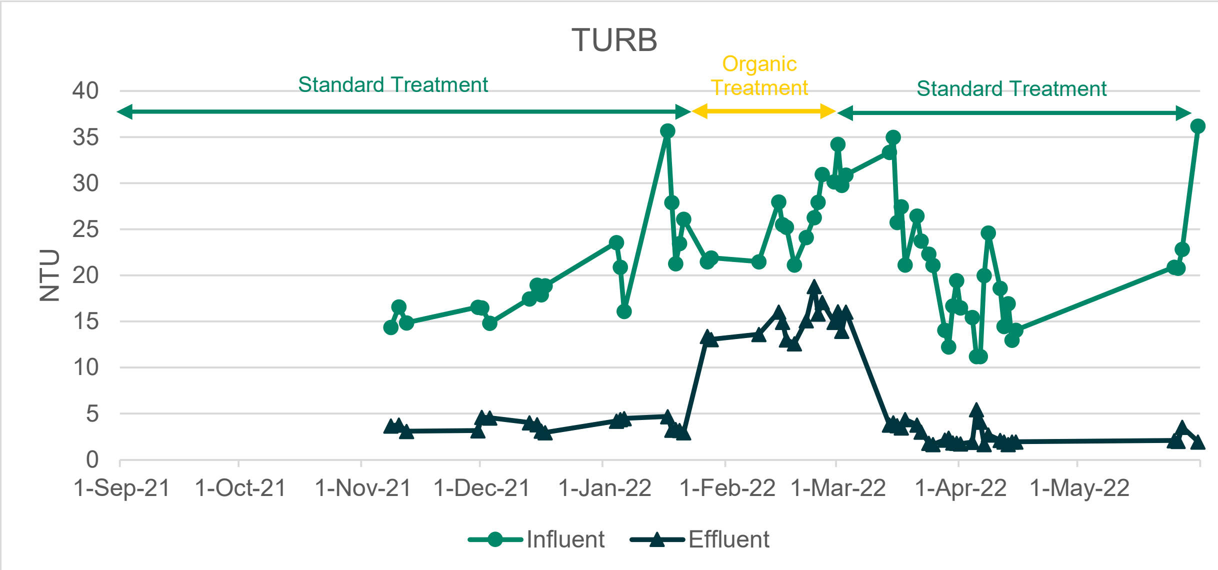
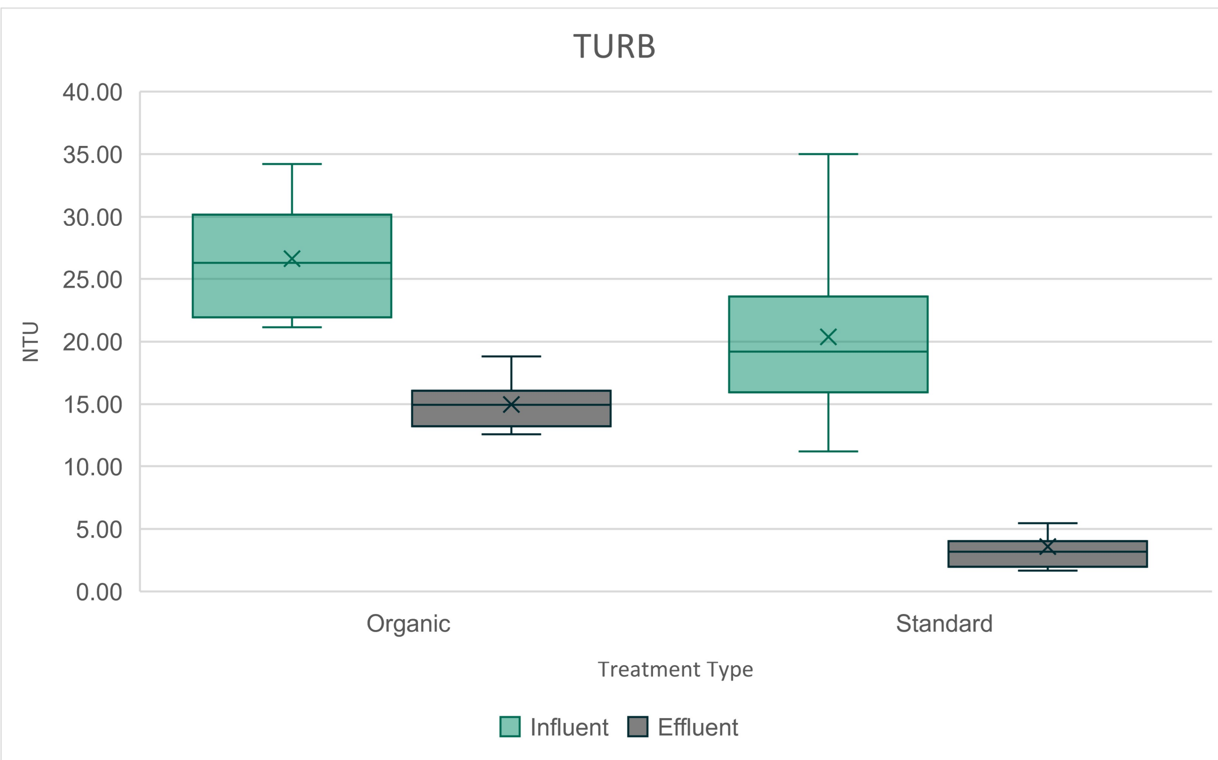


Figure 7. Trends in Mean Daily Turbidity (TURB) in the Algae Harvester Influent and Effluent (Nov. 2021 – May 2022)



Notes: Turbidity measured using a HACH 2100 portable turbidimeter beginning in November (turbidity data collected previously by the EXO2 sondes was rejected due to issues with interference and measurement drift.

Figure 8. Box and Whisker Plots of Mean Daily Turbidity (TURB) in the Algae Harvester Influent and Effluent (Nov. 2021 – May 2022)



Notes: Turbidity measured using a HACH 2100 portable turbidimeter beginning in November (turbidity data collected previously by the EXO2 sondes was rejected due to issues with interference and measurement drift. Boxes denote the 25th to 75th percentile range, horizontal lines through the boxes denote the median, whiskers denote the range, and 'X' symbols denote the mean.

Differences in turbidity between influent and effluent are statistically significant (p <.001) based on paired Mann-Whitney Tests for both treatment types.

6.2.2 Key Indicators

Algae harvesting using the standard and organic treatments significantly reduced the concentrations of key indicators that are relevant to HAB mitigation and nutrient reduction including TSS, algae (as Chl-a), and the key nutrients, TP, and TN, that promote algae production. As will be demonstrated, treatment performance was consistent across the wide range of influent concentrations observed over the operational period. Changes in influent and effluent concentrations over time during operations are illustrated in **Figure 9**, and summarized in **Figure 10**. Performance metrics are included in **Table 12**.

Performance of the algae harvesting system to remove the key parameters can be expressed as percent reduction efficiency as:

$$\%\,Reduction\ Efficiency = \sum_{i=1}^{n} \frac{Influent\ Concentration_i - Effluent\ Concentration_i}{Influent\ Concentration_i} \times 100$$

Where:
n = number of samples
i = sample result

While percent reduction efficiency provides an overall estimate of performance, this metric is dependent on the initial concentration and the MDL of the parameter of interest. For example, if the initial concentration for TP is 0.100 mg/L and the effluent concentration is equal to the MDL at 0.010 mg/L, then the % reduction for TP would be 90%. By contrast, if the initial concentration of TP is 0.050 mg/L and the effluent concentration is equal to the MDL at 0.01 mg/L, then the % reduction for TP would be only 80%. The same issue holds true for comparing percent removal efficiencies of different parameters with different concentrations relative to MDLs. For example, TP and TN influent concentrations averaged 0.071 mg/L and 2.73 mg/L and the MDLs for TP and TN were 0.0096 mg/L and 0.11 mg/L. If treatment removes 100% of the detectible TP and TN, the reduction efficiency would be 86% for TP and 96% for TN. If the treatment is not affected by the initial concentration (i.e., treatment results in similar effluent concentrations despite difference in the influent concentrations), then percent efficiency does not fully capture treatment performance when considering effluent quality.

Algae harvesting using the standard treatment resulted in similar concentrations of key parameters in the effluent over highly variable influent concentrations (**Figure 9**, **Figure 10**). The resultant concentration of the key parameters in the effluent is therefore also a valuable metric to evaluate treatment performance. The organic treatment also consistently reduced TSS and Chl-a to similar concentrations in the effluent but effluent concentrations for TP and TN varied with influent concentrations (**Figure 9**, **Figure 10**). Percent reduction in TP and TN for the organic treatment is therefore a more meaningful performance metric than effluent concentration for these parameters based on results of this study. There were, however, fewer data points for the evaluation of the organic treatment than for the standard treatment. Additional data on the effectiveness of the organic treatment across a wider range of influent conditions would be beneficial to evaluate performance more confidently.

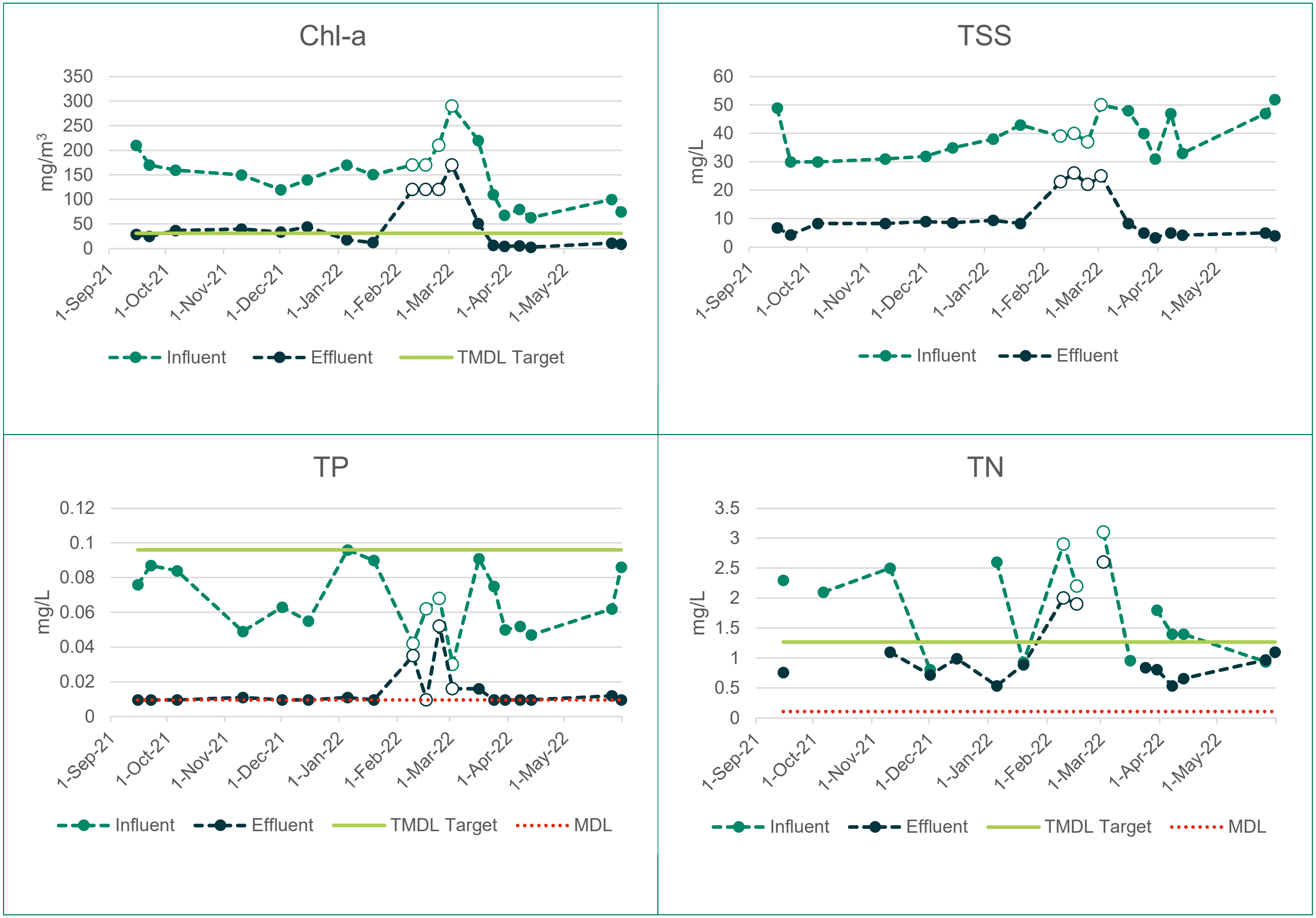
The standard treatment using ACH was highly effective at reducing concentrations of key parameters with reduction efficiencies of 85% for Chl-a and TP, 83% for TSS, and 43% for TN. The process was therefore about twice as efficient at removing Chl-a, TP, and TSS than TN based on percent reduction efficiency. The lower treatment potential for TN can be explained, in part, by the large proportion of nitrogen that was present in the dissolved fraction. Of the samples analyzed, an average of 58% of the TN was dissolved, while an average of only 15% of the TP was dissolved. The key parameters were reduced to low concentrations in the effluent consistent with highly clarified water free of measurable TSS, and concentrations of Chl-a, TP and TN that are lower than TMDL target concentrations for the lake (**Table 12, Figure 9**).

The organic treatment without the coagulant, ACH, was less effective than the standard treatment, but still resulted in significant removal of the key indicator parameters. The reduction efficiencies were 36% for Chl-a, 42% for TSS, 43% for TP, and 20% for TN. As with the standard treatment, the reduced efficiency for TN removal is consistent with the high percentage of nitrogen present in the dissolved form (53% dissolved). The key parameter concentrations in the effluent, while not meeting TMDL targets for Lake Jesup, were significantly lower than those in the influent (**Table 12, Figure 9**). Organic treatment while less effective than the standard treatment, would still provide water quality benefits for HAB mitigation.

Table 12. Performance Metrics for Key Indicators by Treatment Type

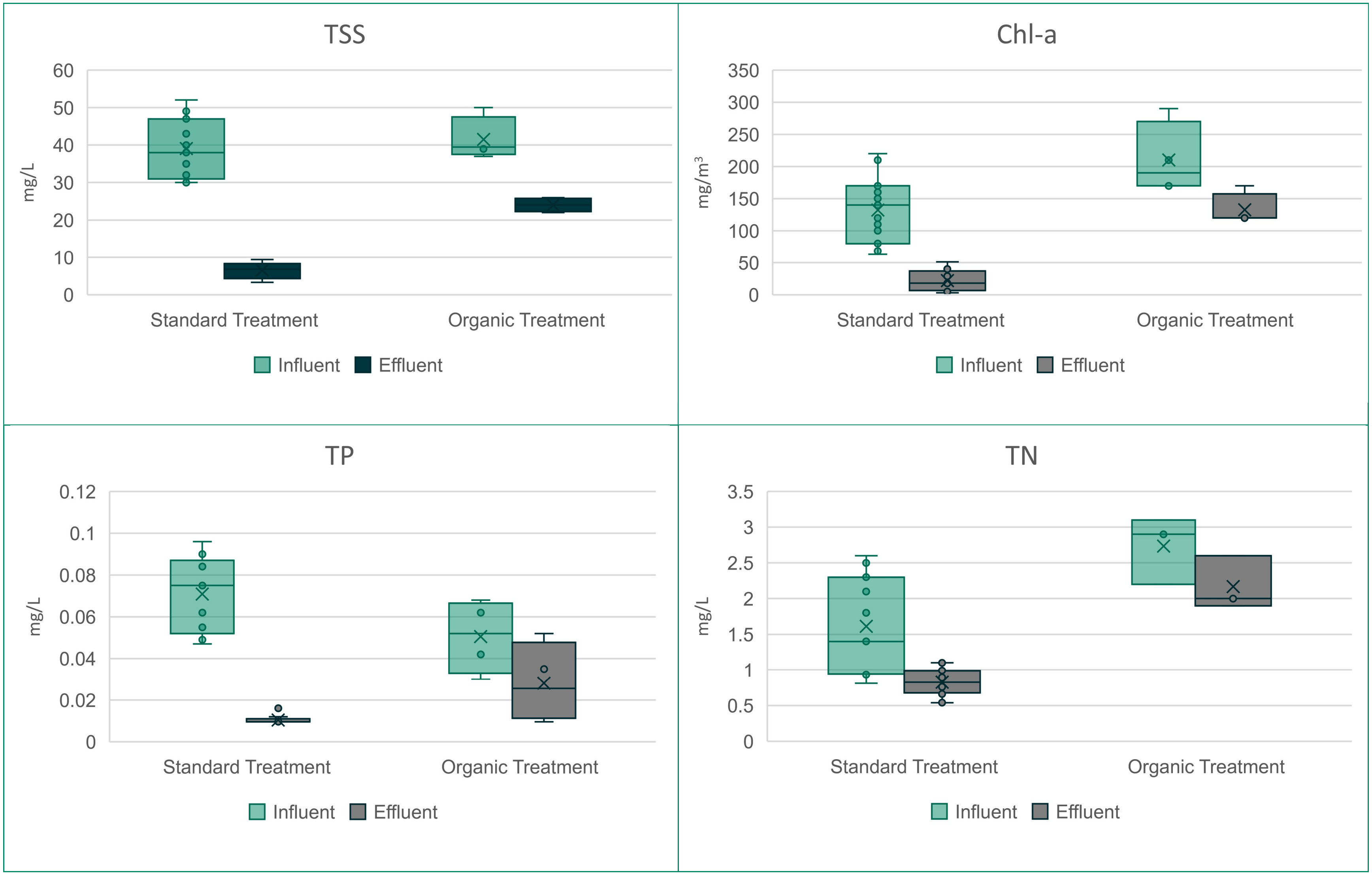
Treatment Type	Parameter	Influent Concentration		Performance Metric		
				Effluent Concentration		% Reduction
		Mean	SD	Mean	SD	
Standard	Chl-a (mg/m^3)	132	48.1	22.0	15.6	85%
	TSS (mg/L)	39	8	7	2	83%
	TP (mg/L)	0.071	0.017	0.010	0.002	85%
	% dissolved	15%	28%	93%	0%	
	TN	1.61	0.65	0.83	0.18	43%
	% dissolved	58%	79%	73%	90%	
Organic	Chl-a (mg/m^3)	210	49.0	132.5	21.7	36%
	TSS (mg/L)	42	5	24	2	42%
	TP (mg/L)	0.051	0.015	0.028	0.017	43%
	% dissolved	19%	0%	34%	0%	
	TN (mg/L)	2.73	0.39	2.17	0.31	20%
	% dissolved	53%	179%	58%	216%	

Figure 9. Trends in Key Performance Indicators – Total Suspended Solids (TSS), Chlorophyll-a (Chl-a), Total Phosphorus (TP), and Total Nitrogen (TN)



Notes: Closed circles denote standard treatment (ACH = 40 mg/L, PT-2160 = 2 mg/L). Open circles denote organic treatment (PT-2160 = 2 mg/L). TMDL = Total Maximum Daily Load, MDL = Method Detection Limit

Figure 10. Box and Whisker Plots of Key Performance Indicators – Total Suspended Solids (TSS), Chlorophyll-a (Chl-a), Total Phosphorus (TP), and Total Nitrogen (TN)



Notes: Boxes denote the 25th to 75th percentile range, horizontal lines through the boxes denote the median, whiskers denote the range, and 'X' symbols denote the mean. Differences between influent and effluent are statistically significant (p <.001) for each parameter based on paired Mann-Whitney Tests for both treatment types.

7. Environmental Safety

7.1 Effluent Toxicity

Algae harvesting using HFT effluent did not cause acute or chronic toxicity to *C. dubia* or *P. promelas* based on WET tests on influent and effluent performed during operations using the standard and organic treatments. No acute toxicity of the influent or effluent occurred on any of the sampling events (**Table 13**). While several instances of chronic toxicity to *C. dubia* occurred for the effluent (**Table 13**), further investigation suggest that treatment was not the cause of the toxicity. Chronic toxicity to *C. dubia* was discovered for the effluent in Oct. and Nov. (standard treatment), which was not expected based on WET tests performed using similar treatment in other HFT projects. Further, the HFT had no impacts to water quality parameters monitored during the study that would be expected to adversely affect aquatic life. Chronic toxicity was therefore suspected for raw water in Lake Jesup. WET tests for chronic toxicity conducted on influent samples confirmed this hypothesis. Influent was chronically toxic to *C. dubia* on all three events sampled (Dec., Feb., March) and to *P. promelias* on the February event (**Table 13**). Except for *C. dubia* in Feb. and *P. promelas* in March, the effluent had a lower toxicity [higher Inhibition Concentration (IC_{25})] than the influent water suggesting that water treated by HFT was less chronically toxic than untreated water from Lake Jesup.

Table 13. Summary of Whole Effluent Toxicity (WET) Tests Collected During HFT Operations

Date		Influent		Effluent	
	Species	Chronic	Acute	Chronic	Acute
	Permit Requirement:	IC_{25}>/=100%	96 hr. LC_{50}>/=100%	IC_{25}>/=100%	96 hr. LC_{50}>/=100%
21-Oct-22	*Ceriodaphnia dubia*	Not tested		48.22%	>100%
	Pimephales promelas			Not tested	
21-Nov-22	*Ceriodaphnia dubia*	Not tested		13.20%	>100%
	Pimephales promelas			100%	>100%
21-Dec-22	*Ceriodaphnia dubia*	18.50%	>100%	75.00%	>100%
	Pimephales promelas	100%	>100%	100%	>100%
22-Jan-22	*Ceriodaphnia dubia*	Not tested		89.40%	>100%
	Pimephales promelas			100%	>100%
22-Feb-22	*Ceriodaphnia dubia*	22.30%	>100%	19.80%	>100%
	Pimephales promelas	93.10%	>100%	100%	>100%
22-Mar-22	*Ceriodaphnia dubia*	71.80%	>100%	100%	>100%
	Pimephales promelas	100%	>100%	40.00%	>100%
22-Apr-22	*Ceriodaphnia dubia*	Invalid Test		100%	>100%
	Pimephales promelas	100%	100%	100%	>100%

Notes: Highlighted values indicate failure of the chronic and acute WET tests. IC_{25} = Inhibition Concentration (IC) of effluent which causes a 25% reduction in growth or reproduction of test organisms. 96 hr. LC_{50} = Lethal Concentration (LC) that causes mortality of 50% of the text organisms in a 96-hour period.

7.2 Airborne Algal Toxins

Algae harvesting using HFT removes and concentrates algae biomass into a 2-3% slurry that can contain algal toxins. Algal toxins can be aerosolized if they are not cell-bound (i.e., 'free' toxins), and airborne toxins can potentially pose a health risk from inhalation. Schaefer (2020) detected microcystins in the nasal passages of 95% of participants near an algae bloom in Florida in 2018. While the HFT does not rupture the cell walls of cyanobacteria during treatment, AECOM modified the HFT to mitigate potential exposure of microcystin to staff and visitors. The HFT was fitted system with a vacuum system terminating in a 55-gal drum lined with granular activated carbon. The

HFT was capped so air flow in the flotation chamber can be directed to the granular activated carbon unit to absorb airborne toxins and minimize the potential for release of the toxins to the atmosphere.

Endotoxins and cyanotoxins in air samples during background and operational times were low and not considered to have posed a health risk to staff during operations at the time of sampling. Endotoxins were detected at low concentrations (range = 0.078 EU/ m^3 – 2.5 EU/m^3) in all area and personal samples. There is no regulatory exposure standard for endotoxin in air for the US, however, The Netherlands has a recommended limit of 50 EU/m^3, which is an 8-hour health-based exposure guideline (Dutch Expert Committee on Occupational Standards of the National Health Council). No cyanotoxins (MCs/NODs, anatoxin-a and cylindrospermopsin) were not detected in the personal or area samples.

Low concentrations of algal toxins in air were expected given a) the low concentrations of cyanotoxins in the influent during operations MCs/NODs range = 1.86 ng/mL - 2.85 ng/mL and in Lake Jesup at OW-CTR (MCs/NODs = 0.47, no detections for anatoxin-a, cylindrospermopsin and saxitoxin on March 23), and b) mitigation measures (granular activated carbon filtration) to prevent potential release of toxins to air.

8. Treatment Design and Cost Effectiveness

8.1 Treatment Needs

TMDLs for TP (41,888 lb/yr) and TN (545,203 lb/yr) were adopted to achieve a Trophic State Index of 65.5 for the lake, which corresponds to long-term annual average concentrations of 31.2 µg/L for Chl-a, 96 µg/L for TP, and 1,270 µg/L for TN (Gao, 2006). The BMAP provides nutrient load allocations to reduce TP and TN loads from watershed sources, but additional reduction is required to address loads from in-lake sources (groundwater and sediment flux). The TMDL calls for a 45.5% and 16.7% reduction in TP and TN loads from in-lake sources, respectively. This requires a reduction of 15,883 lb/yr for TP and 31,178 lb/yr for TN. The timeline to achieve the TMDLs is 2030.

8.2 Treatment Approach

Algae harvesting with HFT and the standard treatment (with ACH as a coagulant and PT-2160 as a flocculant) can be upscaled to remove sufficient nutrients to achieve the TMDL load reductions from in-lake sources in Lake Jesup. The results of this research demonstrated that while a mobile system is feasible, it would be limited to a small HFT algae harvesting unit like the one used in this project due to the shallow water in Lake Jesup. The seasonal lowering of water levels, however, would also limit mobility of even a small unit particularly during the summer at Lake Jesup. A larger, onshore system with inlet piping to draw water from offshore areas of the lake would be more cost effective considering additional costs associated with a mobile unit (e.g., barge, marine support), potential issues with low water levels, and the large-scale treatment required for Lake Jesup to meet TMDL nutrient reduction targets. A mobile unit would be more advantageous in lakes where there are significant algae accumulations (i.e., surface scums or mats) that develop in localized areas in the lake or for emergency response use.

AECOM has developed a large scale HFT algae harvester that can process water at a rate of 1 million gallons per day (mgd). The 1-mgd harvesters are sized so they can be moved by transport truck on US highways without special permits and multiple units can be used in tandem to achieve the required treatment flows to meet nutrient reduction goals. The mobility and modular design of the harvesters provides treatment flexibility, allowing units to be added, removed, or moved to different locations as treatment needs change.

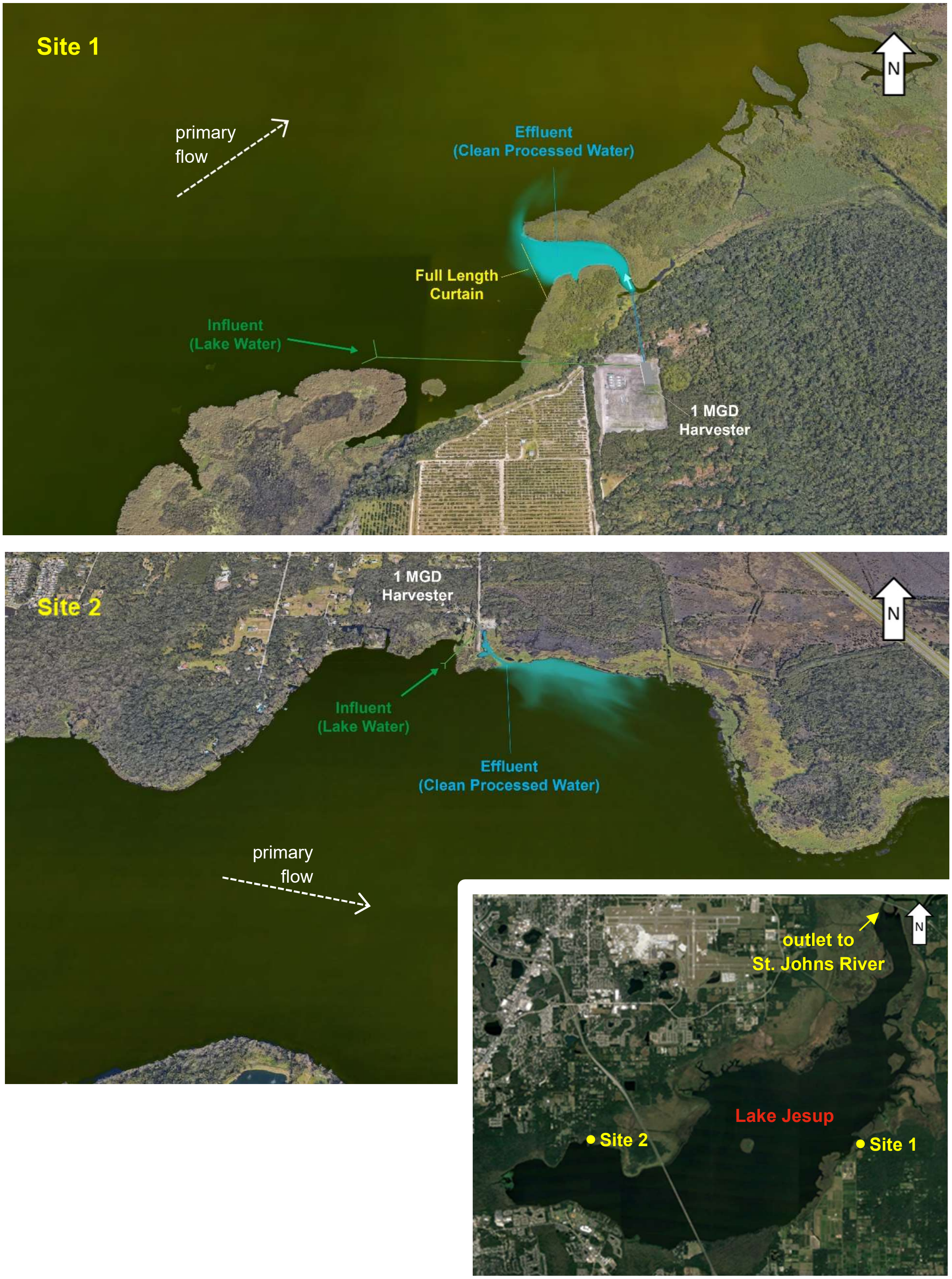
For Lake Jesup, each 1-mgd algae harvester can remove 387 lb/yr of TP, 5,297 lb/yr of TN, and 77,979 lb/yr of TSS. This removal capability is based on the mean concentrations of TP, TN and TSS in Lake Jesup over the past five years and the average concentrations of these parameters in treated effluent observed in this study (**Table 12**). Algae harvesting upscaled to treat approximately 40 mgd of water would be needed to achieve the TP target load reduction for in-lake phosphorus sources in Lake Jesup. The TN target load reduction for in-lake sources would require treatment of approximately 6 mgd of water. These estimates assume that the system would be operated 24 hours per day, 365 days per year.

With implementation of a 40-mgd algae harvesting system, the TMDL targets for TP and TN are expected to be met within about one year and continued operation of the harvesters would be needed to maintain target nutrient levels until in-lake sources (i.e., sediment flux and algae assimilation) are sufficiently reduced. This approach is aggressive, however, and the TMDL targets could also be achieved by treating a smaller volume of water over a longer period. This treatment option could provide a significant cost savings in the overall restoration of the lake.

AECOM recommends that a valued engineering study be conducted to quantify the cost/benefit of expanding the cleanup duration/schedule with the use of fewer algae harvesters for whole lake restoration as well as for a phased treatment approach. The study would require water quality modeling to predict changes in nutrient flux from the sediments and assimilation of nutrients by algae over time with the different treatment scenarios. As a first step to the full-scale treatment, AECOM also recommends that a 1-mgd to 5-mgd system be implemented to verify/validate the model results and more confidently define the full-scale treatment needs. Additional 1-mgd units can then be added in a phased approach to meet treatment needs in the longer term.

The operation of a smaller algae harvesting system (1-5 mgd) as a first step to full-scale treatment would still remove a substantial amount of nutrients that would contribute to meeting the nutrient reduction goals for the lake. Moreover, the system can be designed to maximize water quality improvements in specific areas of the lake by directing and containing the discharge of the treated water. By way of example, **Figure 11** and **Figure 12** provide hypothetical treatment design concepts for a 1-mgd and a 5-mgd algae harvesting system, respectively, at two locations in Lake Jesup. Site 1 is located on the southeast side of the lake on SJRWMD lands, and Site 2 is located on the northwest side of the lake at the Lake Jesup Wilderness Area. These sites are for illustrative purposes only. For the 1-mgd concepts, the treated effluent is discharged to a containment area to minimize mixing of the treated water with untreated lake water. For the 5-mgd scenarios, the treated water is discharged to provide improved water quality within the area of the discharge plume, which can be directed to specific areas of concern (e.g., sensitive nearshore aquatic habitat area) that would benefit from improved water quality. In both scenarios, the nutrient reduction provided by the algae harvesting would contribute to lower nutrient concentrations in the whole lake and therefore help meet the TMDL objectives.

Figure 11. 1-mgd Harvesting Design Concepts at Lake Jesup



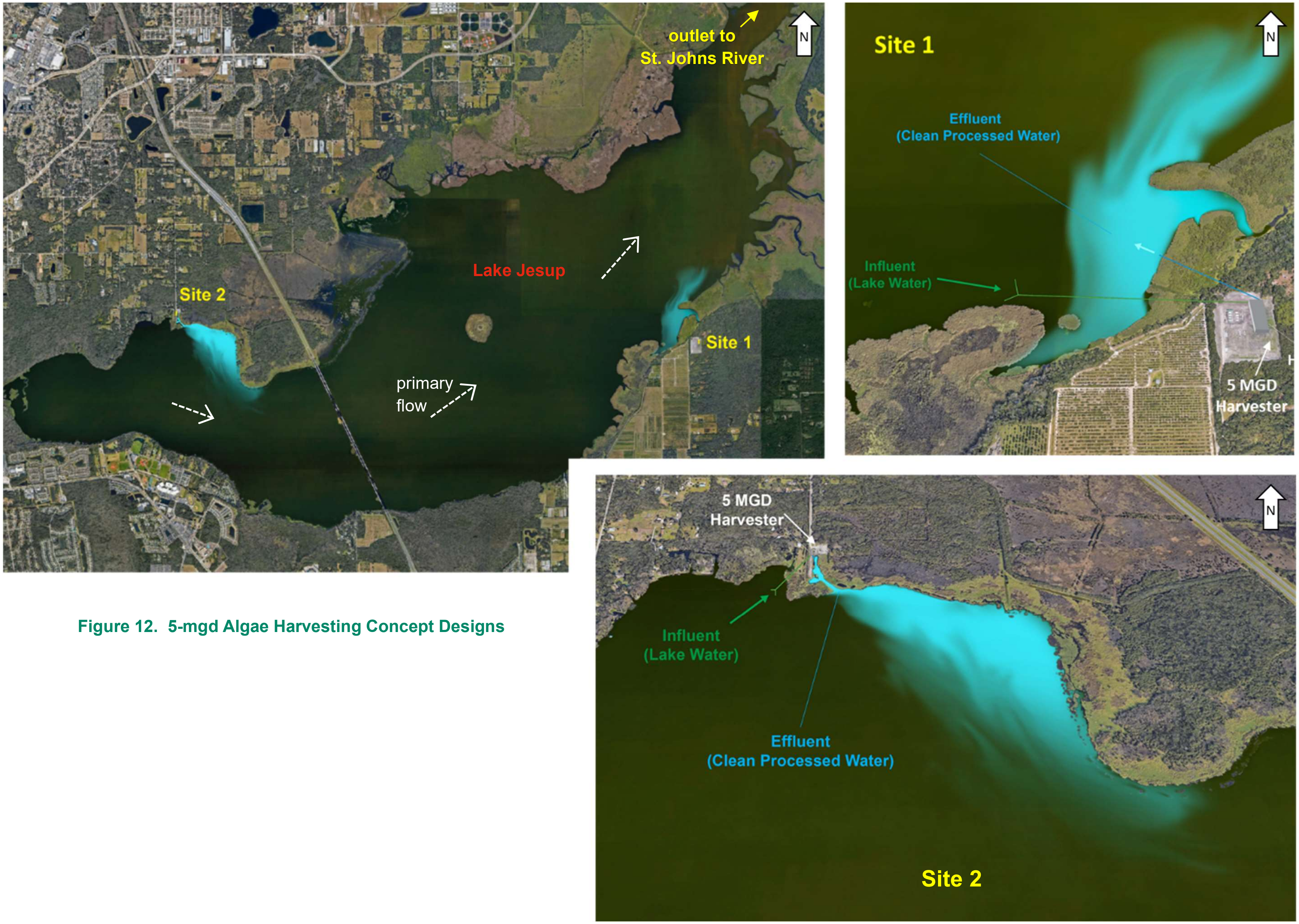


Figure 12. 5-mgd Algae Harvesting Concept Designs

8.3 Cost Effectiveness

The cost of an HFT algae harvesting system to meet TMDL targets for in-lake nutrients will depend on the system size, design, and implementation strategy. For budgeting purposes, a rough order-of-magnitude cost for a 1-mgd, 5-mgd, and 40-mgd land-based system is provided in **Table 14**. These costs illustrate significant economies of scale. Amortized over 25 years, the cost of the treatment for a 1-mgd system would be $739 per pound of TP removed, $54 per pound of TN removed, and $4 per pound of TSS removed. The cost per pound of nutrients removed is reduced by approximately 39% for a 5-mgd system and by 57% for a 40 mgd system. The costs on a per pound basis would be expected to increase over time as nutrient and solids concentrations in the lake will decline with treatment.

Table 14. Rough Order-of-Magnitude Cost for Implementation of Algae Harvesting using HFT at Lake Jesup

Item	Treatment Size:	1-MGD	5-MGD	40-MGD
Capital/Engineering		$ 1,900,000	$ 6,725,000	$ 43,325,000
engineering		$ 100,000	$ 125,000	$ 250,000
permitting		$ 50,000	$ 75,000	$ 75,000
site preparation (pad, fencing, security)		$ 150,000	$ 250,000	$ 750,000
power hook-up		$ 50,000	$ 50,000	$ 50,000
intake system		$ 50,000	$ 250,000	$ 1,500,000
discharge system		$ 75,000	$ 150,000	$ 1,200,000
algae harvester		$ 1,000,000	$ 5,000,000	$ 36,000,000
dewatering unit		$ 350,000	$ 700,000	$ 2,500,000
support equipment (storage tanks, trailer, etc.)		$ 75,000	$ 125,000	$ 1,000,000
Operations (cost/yr)		$ 210,000	$ 600,000	$ 3,200,000
electric		$ 30,000	$ 150,000	$ 1,200,000
coagulant/flocculant		$ 30,000	$ 150,000	$ 900,000
labor		$ 125,000	$ 250,000	$ 1,000,000
Monitoring		$ 25,000	$ 50,000	$ 100,000
Estimated Cost per Year (25-year amortized)		$ 286,000	$ 869,000	$ 4,933,000
Operating Cost per Gallon of Water Treated		$ 0.21	$ 0.18	$ 0.08
Cost/lb P per year		$ 739	$ 449	$ 319
Cost/lb N per year		$ 54	$ 33	$ 23
Cost/lb TSS per year		$ 4	$ 2	$ 2
Cost Reduction per 1-mgd			39%	57%

The costs for algae harvesting are anticipated to be reduced with valorization of the recovered algae biomass into biofertilizer or biofuel, making the technology even more cost-effective. Additionally, progress towards implementing Intelligent Process Automation System (IPAS) into operations will reduce onsite labor requirements and further optimize efficiencies which will provide additional cost savings. Preliminary estimates suggest that the use of IPAS could drop the labor costs by as much as 50%.

9. References

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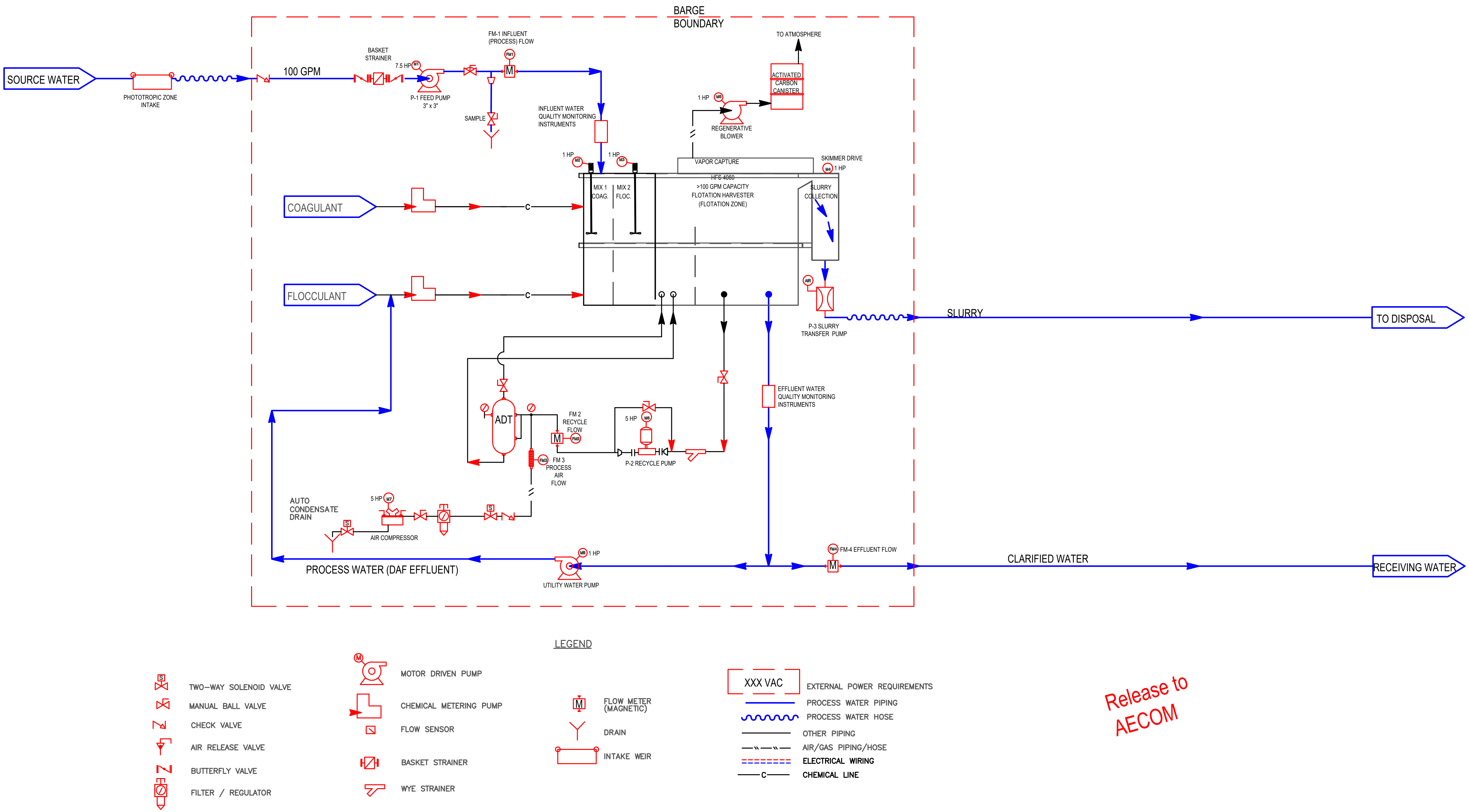
Appendix A Process Flow and System Arrangement Diagrams



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ECOSA PROCESS TECHNOLOGIES
ASHEVILLE, NC USA

WASTEWATER TREATMENT
PRODUCT RECOVERY
WATER RECOVERY
WATER REUSE

Algae Recovery Process
Process Flow Diagram
100 GPM SJRWMD Lake Jesup Barge

Figure 1

REV	BY	DESCRIPTION	DATE
REV			
4			
3			
2			
1			

PLOT DATE:			
DRAWN BY:	D. PINELLI	DATE:	10–23–20
CHECKED BY:		DATE:	
PROJECT ENG.		DATE:	
APPROVED BY:		DATE:	
CUSTOMER		DATE:	

SCALE: NTS
DRAWING NO.: B–101–60640336
REVISION: 0
DRAWING NAME.: JESUP PFD

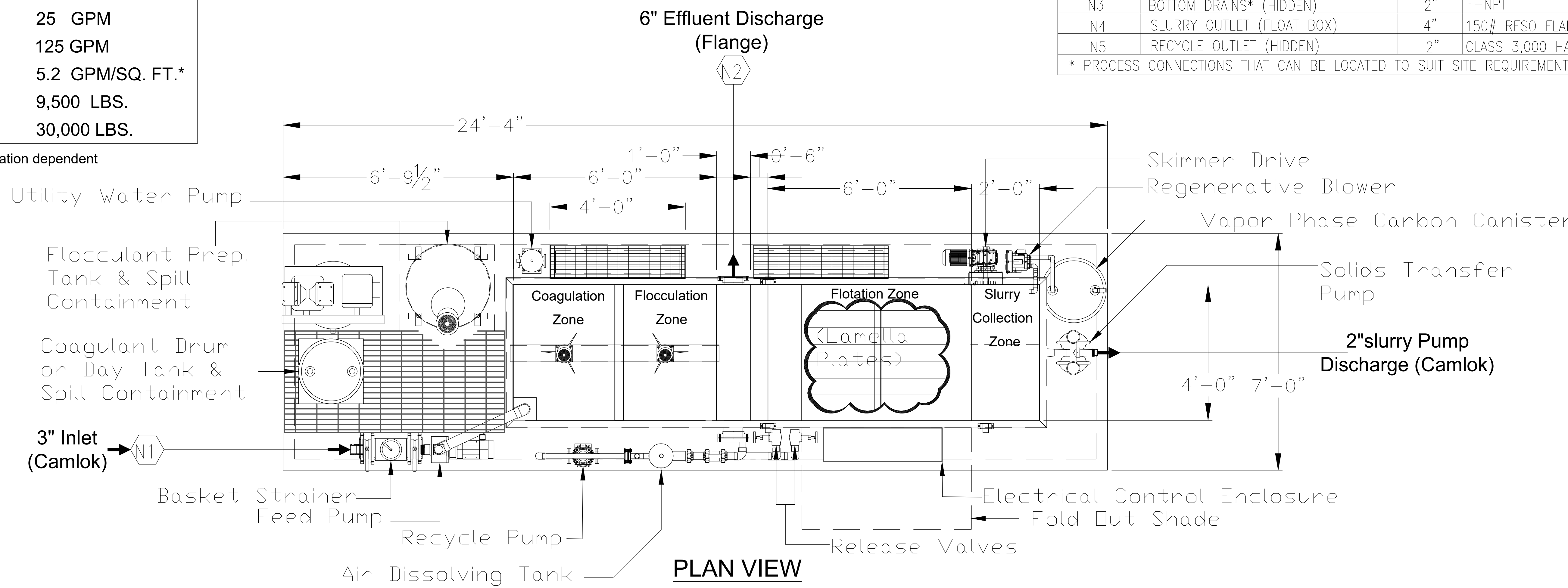
SYSTEM DESCRIPTION

MODEL NO.	HFS-4060
EFFECTIVE FLOTATION AREA	24 SQ. FT.
NOMINAL FLOW	100 GPM
RECYCLE FLOW RATE	25 GPM
COMBINED FLOW	125 GPM
HYDRAULIC LOADING RATE	5.2 GPM/SQ. FT.*
APPROXIMATE WEIGHT	9,500 LBS.
EST. OPERATING WEIGHT	30,000 LBS.

* Actual Hydraulic Loading Rate is application dependent

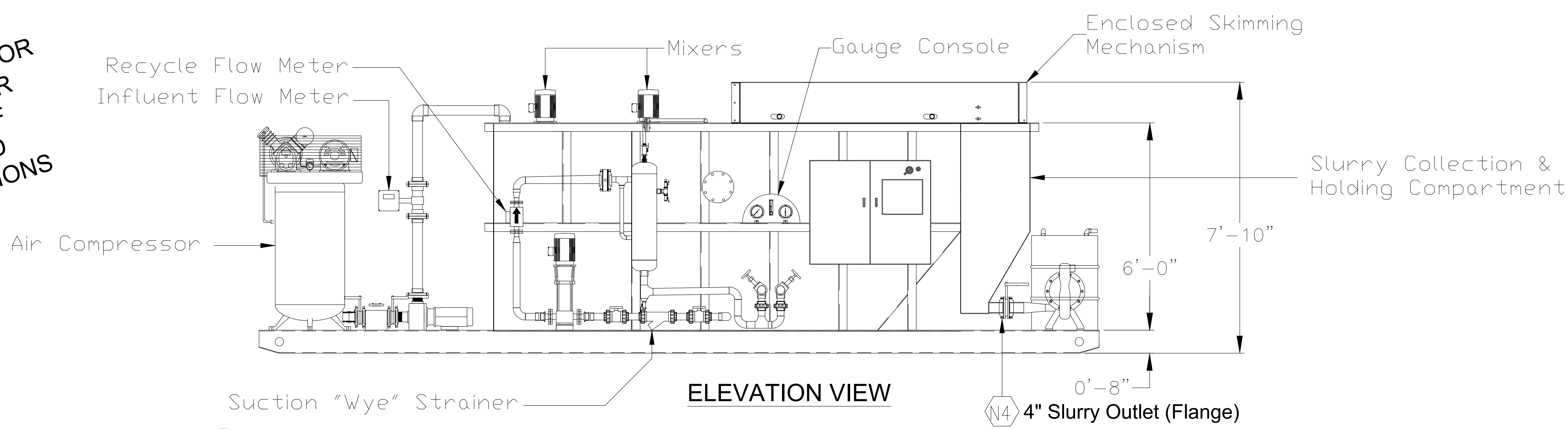
PROCESS CONNECTIONS*			
NOZZLE	SERVICE	SIZE	TYPE
N1	FEED PUMP SUCTION	3"	F-NPT with MALE cAMLOK
N2	DISCHARGE* (EITHER SIDE)	6"	150# ANSI FLANGE PATTERN
N3	BOTTOM DRAINS* (HIDDEN)	2"	F-NPT
N4	SLURRY OUTLET (FLOAT BOX)	4"	150# RFSO FLANGE
N5	RECYCLE OUTLET (HIDDEN)	2"	CLASS 3,000 HALF CPLG.

* PROCESS CONNECTIONS THAT CAN BE LOCATED TO SUIT SITE REQUIREMENTS



PLAN VIEW

NOT FOR FABRICATION OR CONSTRUCTION. FOR CONFIRMATION OF DIMENSIONS AND EQUIPMENT LOCATIONS ONLY.



ELEVATION VIEW

AECOM

1020 HOLLAND DRIVE, SUITE 104
BOCA RATON, FLORIDA 33487 -1350
PH: (561) 962-2578 FAX: (561) 994-6524
CERT. OF AUTHORIZATION NO. 8115

DAVID P. HAYMAN LICENSE No. 48082 STATE OF FLORIDA PROFESSIONAL ENGINEER

This item has been digitally signed and sealed by DAVID P. HAYMAN P.E. NUMBER:48082 on the date adjacent to the seal. Printed copies of this document are not considered sign and sealed. The signature must be verified on any electronic copy

HFS-4060 SWT DAF
SJRWMD LAKE JESUP
GENERAL ARRANGEMENT

REV	BY	DESCRIPTION	DATE				
REV	BY	DESCRIPTION	DATE	PLOT DATE:			
REV	BY	DESCRIPTION	DATE	DRAWN BY:	D PINELLI	DATE:	10/23/20
REV	BY	DESCRIPTION	DATE	CHECKED BY:		DATE:	
REV	BY	DESCRIPTION	DATE	PROJECT ENG.		DATE:	
REV	BY	DESCRIPTION	DATE	APPROVED BY:		DATE:	
1	DJP	UPDATE_DRAWING_MODEL_-NUMBER	10-29-20	CUSTOMER		DATE:	

SCALE: NONE
DRAWING NO.: D100-HFS4060-60640336
REVISION: 1
DRAWING NAME.: JESUP GA

Appendix B Data Verification Reports

Lake Jesup
Data Review Summary

Sample Delivery Group: 680-204447-1, 680-204927-1
Sampling Date: September 15 and 22, 2021
Data Reviewer: Katie Abbott Date Completed: February 27, 2022
Peer Reviewer: Brian Rothmeyer Date Completed: February 28, 2022

The table below summarizes the results presented in these data packages.

Field Identification	Sample Type	Laboratory Identification	Matrix	Analyses			
				Total Aluminum Metals (200.7)	Dissolved Aluminum (200.7)	General Chemistry – Total	General Chemistry - Dissolved
Data Package 680-204447-1							
Influent	N	680-204447-1	Water	X	X	X	X
Effluent	N	680-204447-2	Water	X	X^m	X^m	X
Data Package 680-204927-1							
Influent	N	680-204927-1	Water	X	X	X	X
Effluent	N	680-204927-2	Water	X	X	X	X

Sample Type: N – Normal
X^m – Matrix Spike/ Matrix Spike Duplicate

Analyses: Dissolved/Total Recoverable Metals (200.7) – Aluminum
General Chemistry (Total) – Total Suspended Solids (SM2540D), Total Volatile Suspended Solids (SM2540E), Total Kjeldahl Nitrogen (351.2), Nitrate as Nitrogen (N) (353.2), Nitrate/Nitrite as N (353.2), Nitrite as N (353.2), Total Phosphorous (365.1), Orthophosphate (365.1), Ammonia as N (350.1), Total Organic Carbon (5310B), Total Alkalinity (SM2320B) , Chlorophyll a (SM10200)
[1]Analysis includes Carbonaceous Biological Oxygen Demand (CBOD) (SM5210B)
General Chemistry (Dissolved) – Dissolved Kjeldahl Nitrogen (351.2), Dissolved Nitrate/Nitrite (353.2), Dissolved Phosphorous (365.1), Dissolved Organic Carbon (5310B), Total Dissolved Nitrogen (Total Nitrogen)

This report contains the final results of the data validation conducted for water samples collected September 15th and 22nd, 2021 for the Lake Jesup sampling. The sample results were presented in two data packages. The data review was conducted in accordance with National Functional Guidelines for Inorganic Superfund Methods Data Review (EPA November 2020), and evaluation of laboratory criteria, as applicable.

General Overall Assessment:

_______ Data are usable without qualification.
_______ Data are usable with qualification (noted below and summarized in Attachment A).
___X___ Some or all data are unusable for any purpose (detailed below).

Case Narrative Comments: Any case narrative comments concerning data qualification were address was noted in the table below.

Trace level detects, reported between the method detection limit (MDL) and the practical quantitation limit (PQL), have been qualified as estimated (J lq). The other exceptions are covered in the following table.

Review Parameter	Criteria Met?	Comments
Chain of Custody & Sample Receipt	Yes	The samples were received by Eurofins TestAmerica Savannah, Eurofins Xenco, and ENCO Laboratories in good condition and were consistent with the accompanying chain of custody (COC). The cooler temperatures upon receipt were within the recommended ≤6 degrees Celsius (°C) temperature range.
Reporting	NA	**Data Package 680-204927-1** A revised report was issued by the laboratory to correct the total nitrate/nitrite as nitrogen (N) results erroneously reported in the initial report.
Holding Times	No	With the exceptions noted below, the analyses was conducted within the method required holding time. **Data Package 680-204927-1** Due to a shipping delay, the analysis of orthophosphate, nitrate/nitrite as N, nitrate as N, and nitrite as N results for samples Influent and Effluent, and the carbonaceous biochemical oxygen demand (CBOD) on sample Effluent were performed after the method required holding times had expired. As a result, the associated detected results were qualified as estimated (J- ht) and non-detect results were qualified as unusable (R ht).
Laboratory Blanks • Method Blank (MB)	Yes	Target analytes were not detected within the method blanks.
Matrix Quality Control • Matrix Spike/ Matrix Spike Duplicate **680-204447-1** Effluent (Dissolved Aluminum. Orthophosphate) **680-204927-1** Influent (Dissolved Phosphorus, Total Phosphorus) Effluent (Nitrate/Nitrite as N, Nitrite as N, Orthophosphate) • Laboratory Duplicate **680-204447-1** Influent (VSS, TSS) Effluent (DOC,CBOD) **680-204927-1** Influent (VSS, TSS) Effluent (DOC, TOC) • Total vs. Partial Analyses Kjeldahl Nitrogen, Nitrate/Nitrite, Phosphorous, Organic Carbon, Nitrogen (Total Nitrogen)	No	**Matrix Spike/ Matrix Spike Duplicate (MS/MSD)** With the exception listed in Table 1, the MS/MSD recoveries and relative percent differences (RPDs) met quality control criteria. Results in the native sample greater than four times the concentration of the spike added during digestions/extractions are not considered to be a representative measure of accuracy. Further action with respect to the spike recovery evaluation or qualification of data was not considered necessary. **Laboratory Duplicate** The comparison between results of the parent sample and laboratory duplicate met the criteria listed below. • When both the sample and duplicate values are >5x the practical quantitation limit (PQL) acceptable sampling and analytical precision is indicated by an RPD meeting laboratory limits. • Where the result for one or both analytes of the field duplicate pair is <5xPQL, satisfactory precision is indicated if the absolute difference between the field duplicate results is <1xPQL. **Total vs. Partial Analyses** The following criteria were used to evaluate the total versus partial results: • In instances where the value for a partial analysis exceed that for a total analysis and both of the results are >5xPQL, the criterion utilized is that the two values should agree within ±30%.

Review Parameter	Criteria Met?	Comments
		• In instances where the value for a partial analysis exceeds that for a total analysis and either of the results is <5xPQL, the absolute difference between the results is compared against an evaluation criterion of 2xPQL. The total sample results and associated partial sample results met the concentration-dependent criteria.
Laboratory Performance • Laboratory Control Sample	Yes	One LCS and/or LCSD per method per analytical batch was prepared and analyzed. The LCS recoveries and LCS/LCSD RPDs were within the laboratory acceptance limits. These results are indicative of an acceptable level of accuracy and precision with respect to the analytical method.
Field Quality Control • Trip Blank/Field Blank Not Applicable • Field Duplicate None	NA	**Trip Blank/Field Blank** A trip blank and field blank were not applicable for the methods performed. **Field Duplicate** A field duplicate was not performed on the samples in these data packages.
Non-detect results with unaltered reporting limits	No	Due to matrix interferences several samples were reported as non-detect at elevated reporting limits. These non-detect results will need to be evaluated with respect to project objectives.
Package Completeness	No	With the exception of the orthophosphate, nitrate/nitrite as N, nitrate as N, and nitrite as N results qualified as unusable (R) due to analysis performed outside of hold, the results are usable as qualified for the project objective. The data are greater than 94% complete.

ºC – Degrees Celsius
% – Percent
≤ – Less Than or Equal To
> – Greater Than
± – Plus or Minus
CBOD – Carbonaceous Biochemical Oxygen Demand
COC – Chain of Custody
DOC – Dissolved Organic Carbon
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate

Qualifiers

J – Estimated
J- – Estimated, Low Bias
R – Unusable

Reason Codes

ht – Holding time exceedance
lq – Result detected between the MDL and PQL.

MDL – Method Detection Limit
MS – Matrix Spike
MSD – Matrix Spike Duplicate
N – Nitrogen
PQL – Practical Quantitation Limit
RPDs – Relative Percent Differences
TOC – Total Organic Carbon
TSS – Total Suspended Solids
VOCs – Volatile Organic Compounds
VSS – Volatile Suspended Solids

Table 1: MS/MSD Recovery and RPD Outliers and Resultant Data Qualification

Associated Sample	Analyte	%R (Limits)	RPD (Limit)	Qualification
Data Package 680-204447-1				
Effluent	Orthophosphate	**88/86** (90-110)	2 (20)	As the potential bias was considered to be low, the associated result was qualified as estimated (UJ m).

Bold indicates a value that is outside of acceptance limits
%R – Percent Recoveries
% – Percent
MS/MSD – Matrix Spike/Matrix Spike Duplicate
RPD – Relative Percent Difference
Qualifiers
UJ – Estimated
Reason Codes
m – Matrix spike recovery outliers

Attachment A: Summary of Qualified Data
Lake Jesup - September 2021

LAB ID	SAMPLE ID	MATRIX	METHOD	ANALYTE	UNITS	RESULT	DETECTED	PQL	MDL	DILUTION	FRACTION	QUALIFIERS	REASON CODE
680-204447-1	Influent	Water	200.7	Dissolved Aluminum	mg/L	0.093	YES	0.2	0.024	1	Dissolved	J	lq
680-204447-2	Effluent	Water	200.7 Rev 4.4	Aluminum	mg/L	0.07	YES	0.2	0.024	1	Total	J	lq
680-204447-2	Effluent	Water	365.1/LL	Orthophosphate as P	mg/L	0.005	NO	0.005	0.005	1	Total	UJ	m
680-204927-1	Inflluent	Water	200.7 Rev 4.4	Aluminum	mg/L	0.03	YES	0.2	0.024	1	Total	J	lq
680-204927-1	Inflluent	Water	353.2	Nitrate as N	mg/L	0.01	NO	0.05	0.01	1	Total	R	ht
680-204927-1	Inflluent	Water	353.2	Nitrite as N	mg/L	0.01	NO	0.05	0.01	1	Total	R	ht
680-204927-1	Inflluent	Water	353.2	Nitrate Nitrite as N	mg/L	0.01	NO	0.05	0.01	1	Total	R	ht
680-204927-1	Inflluent	Water	365.1/LL	Orthophosphate as P	mg/L	0.036	YES	0.005	0.005	1	Total	J-	ht
680-204927-2	Effluent	Water	200.7	Dissolved Aluminum	mg/L	0.083	YES	0.2	0.024	1	Dissolved	J	lq
680-204927-2	Effluent	Water	SM5210B CBOD	Carbonaceous Biochemical Oxygen Demand	mg/L	3.2	YES	2	2	1	Total	J-	ht
680-204927-2	Effluent	Water	353.2	Nitrate as N	mg/L	0.01	NO	0.05	0.01	1	Total	R	ht
680-204927-2	Effluent	Water	353.2	Nitrite as N	mg/L	0.01	NO	0.05	0.01	1	Total	R	ht
680-204927-2	Effluent	Water	353.2	Nitrate Nitrite as N	mg/L	0.01	NO	0.05	0.01	1	Total	R	ht
680-204927-2	Effluent	Water	365.1/LL	Orthophosphate as P	mg/L	0.005	NO	0.005	0.005	1	Total	R	ht

Definitions

ID	Identification
mg/L	Miligrams Per Liter
MDL	Method Detection Lim
N	Nitrate
P	Phosphorus
PQL	Practical Quantitation

Qualifiers

J-	Estimated, Low Bias
UJ/J	Estimated
R	Unusable

Reason Codes

ht	Holding Time Exceeda
lq	Restult Detected Between The MDL and
m	Matrix Spike Recovery Outliers

Lake Jesup
Data Review Summary

Sample Delivery Group: 680-205535-1
Sampling Date: October 6, 2021
Data Reviewer: Jamie Herman Date Completed: April 1, 2022
Peer Reviewer: Katie Abbott Date Completed: April 6, 2022

The table below summarizes the results presented in these data packages.

Field Identification	Sample Type	Laboratory Identification	Matrix	Analyses			
				Total Aluminum Metals (200.7)	Dissolved Aluminum (200.7)	General Chemistry – Total	General Chemistry - Dissolved
Data Package 680-205535-1							
Influent	N	680-205535-1	Water	X	X^m	X^m	X
Effluent	N	680-205535-2	Water	X	X^m	X^m	X

Sample Type: N – Normal
X^m – Matrix Spike/ Matrix Spike Duplicate

Analyses: Dissolved/Total Recoverable Metals (200.7) – Aluminum
General Chemistry (Total) – Total Suspended Solids (SM2540D), Total Volatile Suspended Solids (SM2540E), Total Kjeldahl Nitrogen (351.2), Nitrate as Nitrogen (N) (353.2), Nitrate/Nitrite as N (353.2), Nitrite as N (353.2), Total Phosphorous (365.1), Orthophosphate (365.1), Ammonia as N (350.1), Total Organic Carbon (5310B), Total Alkalinity (SM2320B), Chlorophyll a (SM10200)
[1]Analysis includes Carbonaceous Biological Oxygen Demand (CBOD) (SM5210B)
General Chemistry (Dissolved) – Dissolved Kjeldahl Nitrogen (351.2), Dissolved Nitrate/Nitrite (353.2), Dissolved Phosphorous (365.1), Dissolved Organic Carbon (5310B), Total Dissolved Nitrogen (Total Nitrogen)

This report contains the final results of the data validation conducted for water samples collected October 6th, 2021, for the Lake Jesup sampling. The sample results were presented in one data package. The data review was conducted in accordance with National Functional Guidelines for Inorganic Superfund Methods Data Review (EPA November 2020), and evaluation of laboratory criteria, as applicable.

General Overall Assessment:

_______ Data are usable without qualification.
_______ Data are usable with qualification (noted below and summarized in Attachment A).
___X___ Some or all data are unusable for any purpose (detailed below and summarized in Attachment A).

Case Narrative Comments: Any case narrative comments concerning data qualification were address as noted in the table below.

Trace level detects, reported between the method detection limit (MDL) and the practical quantitation limit (PQL), have been qualified as estimated (J lq). Any additional exceptions are included in the following table.

<table>
<tr><th>Review
Parameter</th><th>Criteria Met?</th><th>Comments</th></tr>
<tr><td>Chain of Custody & Sample Receipt</td><td>Yes</td><td>The samples were received by Eurofins TestAmerica Savannah, Eurofins Xenco, and ENCO Laboratories in good condition and were consistent with the accompanying chain of custody (COC). The cooler temperatures upon receipt were within the recommended ≤6 degrees Celsius (°C) temperature range.</td></tr>
<tr><td>Holding Times</td><td>No</td><td>With the exceptions noted below, the analyses were conducted within the method required holding time.
<table>
<tr><th>Sample</th><th>Analyte</th><th>Qualifier</th></tr>
<tr><td rowspan="4">Influent</td><td>Nitrate as N</td><td>J- ht</td></tr>
<tr><td>Nitrite as N</td><td>R ht</td></tr>
<tr><td>Nitrate-Nitrite as N</td><td>J- ht</td></tr>
<tr><td>Total Nitrogen</td><td>J- ht</td></tr>
</table>
Notes:
ht – Holding Time Exceedance
J- - Estimated, Low Bias
N – Nitrogen
R – Unusable

Due to over dilution in the initial analysis, the re-analysis of nitrate/nitrite as N, nitrate as N, and nitrite as N results for sample Influent were performed after the method required holding times had expired. Therefore, the associated detected results were qualified as estimated (J- ht) and non-detect result was qualified as unusable (R ht).</td></tr>
<tr><td>Laboratory Blanks
• Method Blank (MB)</td><td>Yes</td><td>Target analytes were not detected within the method blanks.</td></tr>
<tr><td>Matrix Quality Control
• Matrix Spike/ Matrix Spike Duplicate
Influent (Nitrate/Nitrite as N, Nitrite as N)
Effluent (Total Phosphorus, Dissolved Organic Carbon)

• Laboratory Duplicate
Influent (VSS, TSS)
Effluent (Alkalinity, CBOD)

• Total vs. Partial Analyses
Kjeldahl Nitrogen, Nitrate/Nitrite, Phosphorous, Organic Carbon, Nitrogen (Total Nitrogen)</td><td>Yes</td><td>Matrix Spike/ Matrix Spike Duplicate (MS/MSD)

The MS/MSD recoveries and relative percent differences (RPDs) met quality control criteria.

Results in the native sample greater than four times the concentration of the spike added during digestions/extractions are not considered to be a representative measure of accuracy. Further action with respect to the spike recovery evaluation or qualification of data was not considered necessary.

Laboratory Duplicate

The comparison between results of the parent sample and laboratory duplicate met the criteria listed below.

• When both the sample and duplicate values are >5x the practical quantitation limit (PQL) acceptable sampling and analytical precision is indicated by an RPD meeting laboratory limits.
• Where the result for one or both analytes of the field duplicate pair is <5xPQL, satisfactory precision is indicated if the absolute difference between the field duplicate results is <1xPQL.

Total vs. Partial Analyses

The following criteria were used to evaluate the total versus partial results:

• In instances where the value for a partial analysis exceed that for a total analysis and both of the results are >5xPQL, the criterion utilized is that the two values should agree within</td></tr>
</table>

Review Parameter	Criteria Met?	Comments
		±30%. • In instances where the value for a partial analysis exceeds that for a total analysis and either of the results is <5xPQL, the absolute difference between the results is compared against an evaluation criterion of 2xPQL. The total sample results and associated partial sample results met the concentration-dependent criteria.
Laboratory Performance • Laboratory Control Sample	Yes	One laboratory control sample (LCS) and/or laboratory control sample duplicate (LCSD) per method per analytical batch was prepared and analyzed. The LCS recoveries and LCS/LCSD RPDs were within the laboratory acceptance limits. These results are indicative of an acceptable level of accuracy and precision with respect to the analytical method.
Field Quality Control • Trip Blank/Field Blank Not Applicable • Field Duplicate None	NA	**Trip Blank/Field Blank** A trip blank and field blank were not applicable for the methods performed. **Field Duplicate** A field duplicate was not performed on the samples in these data packages.
Non-detect results with unaltered reporting limits	Yes	Due to matrix interferences several samples were reported as non-detect at elevated reporting limits. These non-detect results will need to be evaluated with respect to project objectives. **Method SM2540D Total Suspended Solids (TSS)** In addition, the laboratory noted that reduced volume was used due to less than 2.5mg (milligrams) produced in the initial anlaysis. The associed reporting limits were elvated accordingly. The associated non-detect result will need to be evaluated by the end user of the data with respect to project objectives.
Package Completeness	No	With the exception of the nitrite as N results qualified as unusable (R) due to analysis performed outside of hold; the results are considered usable as qualified for the project objective. The data are greater than 97% complete.

ºC – Degrees Celsius
% – Percent
≤ – Less Than or Equal To
> – Greater Than
± – Plus or Minus
COC – Chain of Custody
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
MDL – Method Detection Limit
mg - milligrams
MS – Matrix Spike
MSD – Matrix Spike Duplicate
N – Nitrogen
PQL – Practical Quantitation Limit
RPDs – Relative Percent Differences
TSS – Total Suspended Solids
Qualifiers
J – Estimated
J- – Estimated, Low Bias
R – Unusable
Reason Codes
ht – Holding time exceedance

ld – Laboratory Duplicate RPDs (Matrix Duplicate, MSD/LCSD)
lq – Result detected between the MDL and PQL.

Attachment A: Summary of Qualified Data
Lake Jesup - October 2021

LAB ID	SAMPLE	MATRIX	METHOD	ANALYTE	UNITS	RESULT	DETECTED	PQL	MDL	DILUTION	FRACTION	QUALIFIERS	REASON CODE
680-205535-1	Influent	Water	353.2	Nitrate Nitrite as N	mg/L	0.01	YES	0.05	0.01	1	Dissolved	J-	lq,ht
680-205535-1	Influent	Water	353.2	Nitrite as N	mg/L	0.01	NO	0.05	0.01	1	Dissolved	R	ht
680-205535-1	Influent	Water	353.2	Nitrate as N	mg/L	0.01	YES	0.05	0.01	1	Dissolved	J-	lq,ht
680-205535-1	Influent	Water	Total Nitrogen	Nitrogen, Total	mg/L	0.76	YES	0.25	0.11	1	Dissolved	J-	ht
680-205535-1	Influent	Water	200.7	Dissolved Aluminum	mg/L	0.032	YES	0.2	0.024	1	Dissolved	J	lq
680-205535-2	Effluent	Water	200.7	Dissolved Aluminum	mg/L	0.1	YES	0.2	0.024	1	Dissolved	J	lq
680-205535-1	Influent	Water	200.7 Rev 4.4	Aluminum	mg/L	0.07	YES	0.2	0.024	1	Total	J	lq

Definitions

ID	Identification
mg/L	Miligrams Per Liter
MDL	Method Detection Limit
N	Nitrogen
PQL	Practical Quantitation Limit

Qualifiers

J-	Estimated, Low Bias
J	Estimated
R	Unusable

Reason Codes

ht	Holding Time Exceedance
lq	Restult Detected Between The MDL and PQL

Lake Jesup
Data Review Summary

Sample Delivery Group: 680-207435-1
Sampling Date: November 10, 2021
Data Reviewer: Jamie Herman Date Completed: April 1, 2022
Peer Reviewer: Katie Abbott Date Completed: April 6, 2022

The table below summarizes the results presented in this data package.

Field Identification	Sample Type	Laboratory Identification	Matrix	Analyses			
				Total Aluminum Metals (200.7)	Dissolved Aluminum (200.7)	General Chemistry – Total	General Chemistry - Dissolved
Data Package 680-207435-1							
Influent	N	680-207435-1	Water	X	X^m	X^m	X
Effluent	N	680-207435-2	Water	X	X	X	X

Sample Type: N – Normal
X^m – Matrix Spike/ Matrix Spike Duplicate

Analyses: Dissolved/Total Recoverable Metals (200.7) – Aluminum
General Chemistry (Total) – Total Suspended Solids (SM2540D), Total Volatile Suspended Solids (SM2540E), Total Kjeldahl Nitrogen (351.2), Nitrate as Nitrogen (N) (353.2), Nitrate/Nitrite as N (353.2), Nitrite as N (353.2), Total Phosphorous (365.1), Orthophosphate (365.1), Ammonia as N (350.1), Total Organic Carbon (5310B), Total Alkalinity (SM2320B) , Chlorophyll a (SM10200)
[1]Analysis includes Carbonaceous Biological Oxygen Demand (CBOD) (SM5210B)
General Chemistry (Dissolved) – Dissolved Kjeldahl Nitrogen (351.2), Dissolved Nitrate/Nitrite (353.2), Dissolved Phosphorous (365.1), Dissolved Organic Carbon (5310B), Total Dissolved Nitrogen (Total Nitrogen)

This report contains the final results of the data validation conducted for water samples collected November 10th, 2021 for the Lake Jesup sampling. The sample results were presented in one data package. The data review was conducted in accordance with National Functional Guidelines for Inorganic Superfund Methods Data Review (EPA November 2020), and evaluation of laboratory criteria, as applicable.

General Overall Assessment:

_______ Data are usable without qualification.
___X___ Data are usable with qualification (noted below and summarized in Attachment A).
_______ Some or all data are unusable for any purpose (noted below and summarized in Attachment A).

Case Narrative Comments: Any case narrative comments concerning data qualification were address was noted in the table below.

Trace level detects, reported between the method detection limit (MDL) and the practical quantitation limit (PQL), have been qualified as estimated (J lq). The other exceptions are covered in the following table.

<table>
<tr><th>Review Parameter</th><th>Criteria Met?</th><th>Comments</th></tr>
<tr><td>Chain of Custody & Sample Receipt</td><td>Yes</td><td>The samples were received by Eurofins TestAmerica Savannah, Eurofins Xenco, and ENCO Laboratories in good condition and were consistent with the accompanying chain of custody (COC). The cooler temperatures upon receipt were within the recommended ≤6 degrees Celsius (°C) temperature range.</td></tr>
<tr><td>Holding Times</td><td>Yes</td><td>The samples were analyzed within the method required holding times.</td></tr>
<tr><td>Reporting</td><td>NA</td><td>A revised report was issued by the laboratory to remove erroneously reported laboratory quality control (QC) results for method SM2320B Total Alkalinity.</td></tr>
<tr><td>Laboratory Blanks
• Method Blank (MB)</td><td>No</td><td>Target analytes were not detected within the method blanks, with the following exception:
<table>
<tr><th>Analyte</th><th>Concentration</th><th>Qualifiers</th></tr>
<tr><td colspan="3">MB 1K12032-BLK1</td></tr>
<tr><td>Chlorophyll a</td><td>0.53 mg/m^3</td><td>No Qualification</td></tr>
</table>
Notes:
MB – Method Blank
mg/m^3 – Milligrams per cubic Meter

As the associated results were >5x the concentration of the blank contamination, data qualification was not considered necessary.</td></tr>
<tr><td>Matrix Quality Control
• Matrix Spike/ Matrix Spike Duplicate
Influent (Dissolved Aluminum, Orthophosphate)

• Laboratory Duplicate
Influent (DOC)
Effluent (CBOD)

• Total vs. Partial Analyses
Kjeldahl Nitrogen, Nitrate/Nitrite, Phosphorous, Organic Carbon, Nitrogen (Total Nitrogen)</td><td>No</td><td>Matrix Spike/ Matrix Spike Duplicate (MS/MSD)

With the exception listed in Table 1, the MS/MSD recoveries and relative percent differences (RPDs) met quality control criteria.

Results in the native sample greater than four times the concentration of the spike added during digestions/extractions are not considered to be a representative measure of accuracy. Further action with respect to the spike recovery evaluation or qualification of data was not considered necessary.

Laboratory Duplicate

The comparison between results of the parent sample and laboratory duplicate met the criteria listed below, with the following exception:
<table>
<tr><th>Analyte</th><th>Parent Sample Result</th><th>Field Duplicate Result</th><th>Criteria not Met</th><th>Qualifier</th></tr>
<tr><td colspan="5">Effluent</td></tr>
<tr><td>CBOD</td><td>3.3 mg/L</td><td>5.79 mg/L</td><td>>1xPQL</td><td>J ld</td></tr>
</table>
Notes:
> - Greater than
CBOD – Carbonaceous Biochemical Oxygen Demand
J – Estimated
ld - Laboratory Duplicate RPDs (Matrix Duplicate, MSD, LCSD)
mg/L – Milligrams per Liter
PQL – Practical Quantitation Limit

• When both the sample and duplicate values are >5x the practical quantitation limit (PQL) acceptable sampling and analytical precision is indicated by an RPD meeting laboratory limits.

• Where the result for one or both analytes of the laboratory duplicate pair is <5xPQL, satisfactory precision is indicated if the absolute difference between the field duplicate results is <1xPQL.</td></tr>
</table>

<table>
<tr><th>Review
Parameter</th><th>Criteria
Met?</th><th>Comments</th></tr>
<tr><td></td><td></td><td>Total vs. Partial Analyses

The following criteria were used to evaluate the total versus partial results:
In instances where the value for a partial analysis exceed that for a total analysis and both of the results are >5xPQL, the criterion utilized is that the two values should agree within ±30%.
In instances where the value for a partial analysis exceeds that for a total analysis and either of the results is <5xPQL, the absolute difference between the results is compared against an evaluation criterion of 2xPQL.
The total sample results and associated partial sample results met the concentration-dependent criteria.</td></tr>
<tr><td>Laboratory Performance
Laboratory Control Sample</td><td>No</td><td>One LCS and/or LCSD per method per analytical batch was prepared and analyzed. The LCS recoveries and LCS/LCSD RPDs were within the laboratory acceptance limits. These results are indicative of an acceptable level of accuracy and precision with respect to the analytical method.

<table><tr><th>Analyte</th><th>Recovery (%)</th><th>Limits (%)</th><th>Qualifiers</th></tr><tr><td colspan="4">LCS 680-694001/3</td></tr><tr><td>CBOD</td><td>128/112</td><td>85-115</td><td>J+ l</td></tr></table>Notes:
% - Percent
Bold - indicates a value that is outside of acceptance limits.
CBOD – Carbonaceous Biochemical Oxygen Demand
J+ - Estimated, High Bias
l – LCS Recoveries
LCS – Laboratory Control Sample</td></tr>
<tr><td>Field Quality Control
Trip Blank/Field Blank
Not Applicable
Field Duplicate
None</td><td>NA</td><td>Trip Blank/Field Blank

A trip blank and field blank were not applicable for the methods performed.

Field Duplicate

A field duplicate was not performed on the samples in this data package.</td></tr>
<tr><td>Non-detect results with unaltered reporting limits</td><td>No</td><td>Due to matrix interferences several samples were reported as non-detect at elevated reporting limits. These non-detect results will need to be evaluated with respect to project objectives.</td></tr>
<tr><td>Package Completeness</td><td>Yes</td><td>The results are usable as qualified for the project objective. The data are 100% complete.</td></tr>
</table>

ºC – Degrees Celsius
% – Percent
≤ – Less Than or Equal To
> – Greater Than
± – Plus or Minus
CBOD – Carbonaceous Biochemical Oxygen Demand
COC – Chain of Custody
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
MDL – Method Detection Limit
MS – Matrix Spike
MSD – Matrix Spike Duplicate
N – Nitrogen
PQL – Practical Quantitation Limit
RPDs – Relative Percent Differences
TOC – Total Organic Carbon

Qualifiers
J – Estimated
J- – Estimated, Low Bias
J+ - Estimated, High Bias
Reason Codes
l – LCS recovers
ld - Laboratory Duplicate RPDs (Matrix Duplicate, MSD, LCSD)
lq – Result detected between the MDL and PQL.

Table 1: MS/MSD Recovery and RPD Outliers and Resultant Data Qualification

Associated Sample	Analyte	%R (Limits)	RPD (Limit)	Qualification
Data Package 680-207435-1				
Influent	Orthophosphate	**9/8** (90-110)	4 (20)	As the potential bias was considered to be low, the associated result was qualified as estimated (J- m).

Bold - indicates a value that is outside of acceptance limits
%R – Percent Recoveries
% – Percent
MS/MSD – Matrix Spike/Matrix Spike Duplicate
RPD – Relative Percent Difference
Qualifiers
J- – Estimated, Low Bias
Reason Codes
m – Matrix spike recovery outliers

Attachment A: Summary of Qualified Data
Lake Jesup - November 2021

LAB ID	SAMPLE	MATRIX	METHOD	ANALYTE	UNITS	RESULT	DETECTED	PQL	MDL	DILUTION	FRACTION	QUALIFIERS	REASON CODE
680-207345-2	Effluent	Water	365.1	Total Phosphorus as P	mg/L	0.011	YES	0.02	0.0096	1	Total	J	lq
680-207345-1	Influent	Water	365.1/LL	Orthophosphate as P	mg/L	0.024	YES	0.005	0.005	1	Total	J-	m
680-207345-2	Effluent	Water	SM5210B CBOD	Carbonaceous Biochemical Oxygen Demand	mg/L	3.3	YES	2	2	1	Total	J+	l, ld

Definitions

ID	Identification
mg/L	Miligrams Per Liter
MDL	Method Detection Limit
PQL	Practical Quantitation Limit

Qualifiers

J-	Estimated, Low Bias
J	Estimated
J+	Estimated, High Bias

Reason Codes

l	LCS Recoveries
ld	Laboratory Duplicate RPDs (Matrix Duplicate, MSD, LCSD)
lq	Restult Detected Between the MDL and PQL
m	Matrix Spike Recovery

Lake Jesup
Data Review Summary

Sample Delivery Group: 680-208162-1 and 680-208981-1
Sampling Date: December 1st, 2021 and December 15th, 2021
Data Reviewer: Jamie Herman Date Completed: April 8, 2022
Peer Reviewer: Katie Abbott Date Completed: April 13, 2022

The table below summarizes the results presented in this data package.

Field Identification	Sample Type	Laboratory Identification	Matrix	Analyses			
				Total Aluminum Metals (200.7)	Dissolved Aluminum (200.7)	General Chemistry – Total	General Chemistry - Dissolved
Data Package 680-208162-1							
Influent	N	680-208162-1	Water	X	X	X^m	X^m
Effluent	N	680-208162-2	Water	X	X	X	X
Data Package 680-208981-1							
Influent	N	680-208981-1	Water	X	X	X^m	X^m
Effluent	N	680-208981-2	Water	X	X	X	X

Sample Type: N – Normal
X^m – Matrix Spike/ Matrix Spike Duplicate

Analyses: Dissolved/Total Recoverable Metals (200.7) – Aluminum
General Chemistry (Total) – Total Suspended Solids (SM2540D), Total Volatile Suspended Solids (SM2540E), Total Kjeldahl Nitrogen (351.2), Nitrate as Nitrogen (N) (353.2), Nitrate/Nitrite as N (353.2), Nitrite as N (353.2), Total Phosphorous (365.1), Orthophosphate (365.1), Ammonia as N (350.1), Total Organic Carbon (5310B), Total Alkalinity (SM2320B), Chlorophyll a (SM10200)
[1]Analysis includes Carbonaceous Biological Oxygen Demand (CBOD) (SM5210B)
General Chemistry (Dissolved) – Dissolved Kjeldahl Nitrogen (351.2), Dissolved Nitrate/Nitrite (353.2), Dissolved Phosphorous (365.1), Dissolved Organic Carbon (5310B), Total Dissolved Nitrogen (Total Nitrogen)

This report contains the final results of the data validation conducted for water samples collected in December 2021 for the Lake Jesup sampling. The sample results were presented in two data packages. The data review was conducted in accordance with National Functional Guidelines for Inorganic Superfund Methods Data Review (EPA November 2020), and evaluation of laboratory criteria, as applicable.

General Overall Assessment:

_______ Data are usable without qualification.
__X__ Data are usable with qualification (noted below and summarized in Attachment A).
_______ Some or all data are unusable for any purpose (noted below and summarized in Attachment A).

Case Narrative Comments: Any case narrative comments concerning data qualification were addressed as noted in the table below.

Trace level detects, reported between the method detection limit (MDL) and the practical quantitation limit (PQL), have been qualified as estimated (J lq). The other exceptions are covered in the following table.

<table>
<tr><th>Review Parameter</th><th>Criteria Met?</th><th>Comments</th></tr>
<tr><td>Chain of Custody & Sample Receipt</td><td>Yes</td><td>The samples were received by Eurofins TestAmerica Savannah, Eurofins Xenco, and ENCO Laboratories in good condition and were consistent with the accompanying chain of custody (COC). The cooler temperatures upon receipt were within the recommended ≤6 degrees Celsius (°C) temperature range.</td></tr>
<tr><td>Holding Times</td><td>Yes</td><td>The samples were analyzed within the method required holding times.</td></tr>
<tr><td>Laboratory Blanks
Method Blank (MB)</td><td>No</td><td>Target analytes were not detected within the method blanks, with the following exceptions:
<table>
<tr><th>Analyte</th><th>Concentration</th><th>Qualifiers</th></tr>
<tr><td colspan="3">680-208162-1</td></tr>
<tr><td colspan="3">MB 1L03038-BLK1</td></tr>
<tr><td>Chlorophyll a</td><td>0.53 mg/m^3</td><td>No Qualification</td></tr>
<tr><td colspan="3">680-208981-1</td></tr>
<tr><td colspan="3">MB 1L16034-BLK1</td></tr>
<tr><td>Chlorophyll a</td><td>0.53 mg/m^3</td><td>No Qualification</td></tr>
</table>
Notes:
MB – Method Blank
mg/m^3 – Milligrams per cubic Meter

As the associated results were >5x the concentration of the blank contamination, data qualification was not considered necessary.</td></tr>
<tr><td>Matrix Quality Control
Matrix Spike/ Matrix Spike Duplicate
680-208162-1
Influent (Orthophosphate, Nitrate-Nitrite as N, Total Phosphorus)

680-208981-1
Influent (Orthophosphate, Nitrate-Nitrite as N)
Laboratory Duplicate
680-208162-1
Influent (VSS, TSS, TOC)

680-208981-1
Influent (VSS, TSS, Alkalinity)
Total vs. Partial Analyses
Kjeldahl Nitrogen, Nitrate/Nitrite, Phosphorous, Organic Carbon, Nitrogen (Total Nitrogen)</td><td>No</td><td>Matrix Spike/ Matrix Spike Duplicate (MS/MSD)

The MS/MSD recoveries and relative percent differences (RPDs) met quality control criteria, with the following exceptions:
<table>
<tr><th>Associated Sample</th><th>Analyte</th><th>%R (Limits)</th><th>RPD (Limit)</th><th>Qualification</th></tr>
<tr><td colspan="5">Data Package 680-208162-1</td></tr>
<tr><td>Influent</td><td>Orthophosphate as P</td><td>2/1
(90-110)</td><td>0
(20)</td><td>As the potential bias was considered to be low, the associated result was qualified as estimated (J- m).</td></tr>
<tr><td colspan="5">Data Package 680-208981-1</td></tr>
<tr><td>Influent</td><td>Orthophosphate as P</td><td>68/67
(90-110)</td><td>2
(20)</td><td>As the potential bias was considered to be low, the associated result was qualified as estimated (J- m).</td></tr>
</table>
Bold - indicates a value that is outside of acceptance limits
%R – Percent Recoveries % – Percent RPD – Relative Percent Difference
Qualifiers
J- – Estimated, Low Bias
Reason Codes
m – Matrix spike recovery outliers

Laboratory Duplicate
The comparison between results of the parent sample and laboratory duplicate met the criteria listed below.
When both the sample and duplicate values are >5x the practical quantitation limit (PQL) acceptable sampling and analytical precision is indicated by an RPD meeting laboratory limits.
Where the result for one or both analytes of the laboratory duplicate pair is <5xPQL, satisfactory precision is indicated if the absolute difference between the field duplicate results is <1xPQL.</td></tr>
</table>

Review Parameter	Criteria Met?	Comments
		Total vs. Partial Analyses The following criteria were used to evaluate the total versus partial results: • In instances where the value for a partial analysis exceed that for a total analysis and both of the results are >5xPQL, the criterion utilized is that the two values should agree within ±30%. • In instances where the value for a partial analysis exceeds that for a total analysis and either of the results is <5xPQL, the absolute difference between the results is compared against an evaluation criterion of 2xPQL. The total sample results and associated partial sample results met the concentration-dependent criteria.
Laboratory Performance • Laboratory Control Sample	Yes	One LCS and/or LCSD per method per analytical batch was prepared and analyzed. The LCS recoveries and LCS/LCSD RPDs were within the laboratory acceptance limits. These results are indicative of an acceptable level of accuracy and precision with respect to the analytical method.
Field Quality Control • Trip Blank/Field Blank Not Applicable • Field Duplicate None	NA	**Trip Blank/Field Blank** A trip blank and field blank were not applicable for the methods performed. **Field Duplicate** A field duplicate was not performed on the samples in this data package.
Non-detect results with unaltered reporting limits	No	Due to matrix interferences several samples were reported as non-detect at elevated reporting limits. These non-detect results will need to be evaluated with respect to project objectives.
Package Completeness	Yes	The results are usable as qualified for the project objective. The data are 100% complete.

ºC – Degrees Celsius
% – Percent
≤ – Less Than or Equal To
> – Greater Than
± – Plus or Minus
COC – Chain of Custody
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
MDL – Method Detection Limit
MS – Matrix Spike
MSD – Matrix Spike Duplicate
P - Phosphorus
PQL – Practical Quantitation Limit
RPDs – Relative Percent Differences

Qualifiers
J- – Estimated, Low Bias

Reason Codes
ht – Holding times
lq – Result detected between the MDL and PQL.
m – Matrix Spike Recovery

Attachment A: Summary of Qualified Data

Lake Jesup - December 2021

LAB ID	SAMPLE	MATRIX	METHOD	ANALYTE	UNITS	RESULT	DETECTED	PQL	MDL	DILUTION	FRACTION	QUALIFIERS	REASON CODE
680-208162-1	Influent	Water	200.7	Aluminum	mg/L	0.099	YES	0.2	0.024	1	Total	J	lq
680-208162-1	Influent	Water	365.1/LL	Orthophosphate as P	mg/L	0.041	YES	0.005	0.005	1	Total	J-	m
680-208162-2	Effluent	Water	200.7	Dissolved Aluminum	mg/L	0.041	YES	0.2	0.024	1	Dissolved	J	lq
680-208981-1	Influent	Water	200.7	Aluminum	mg/L	0.16	YES	0.2	0.024	1	Total	J	lq
680-208981-1	Influent	Water	353.2	Nitrate Nitrite as N	mg/L	0.012	YES	0.05	0.01	1	Total	J	lq
680-208981-1	Influent	Water	353.2	Nitrate-Nitrite, Dissolved	mg/L	0.049	YES	0.05	0.01	1	Dissolved	J	lq
680-208981-1	Influent	Water	353.2	Nitrite as N	mg/L	0.017	YES	0.05	0.01	1	Total	J	lq
680-208981-1	Influent	Water	365.1/LL	Orthophosphate as P	mg/L	0.036	YES	0.005	0.005	1	Total	J-	m
680-208981-2	Effluent	Water	200.7	Dissolved Aluminum	mg/L	0.07	YES	0.2	0.024	1	Dissolved	J	lq
680-208981-2	Effluent	Water	353.2	Nitrate Nitrite as N	mg/L	0.011	YES	0.05	0.01	1	Total	J	lq
680-208981-2	Effluent	Water	353.2	Nitrite as N	mg/L	0.011	YES	0.05	0.01	1	Total	J	lq

Definitions

ID Identification

mg/L Miligrams Per Liter

MDL Method Detection Limit

PQL Practical Quantitation Limit

Qualifiers

J- Estimated, Low Bias

J Estimated

Reason Codes

lq Restult Detected Between the MDL and PQL

m Matrix Spike Recovery

Lake Jesup
Data Review Summary

Sample Delivery Group: 680-209712-1, 610-210283 and 680-210527-1
Sampling Date: January 5th, 19th, and 26th, 2022,
Data Reviewer: Jamie Herman — Date Completed: April 8, 2022
Peer Reviewer: Katie Abbott — Date Completed: May 6, 2022

The table below summarizes the results presented in this data package.

Field Identification	Sample Type	Laboratory Identification	Matrix	Analyses			
				Total Aluminum Metals (200.7)	Dissolved Aluminum (200.7)	General Chemistry – Total	General Chemistry - Dissolved
Data Package 680-209712-1							
Influent	N	680-209712-1	Water	X	Xm	Xm	Xm
Effluent	N	680-209712-2	Water	X	X	X1	X
Data Package 680-210283-1							
Influent	N	680-210283-1	Water	Xm	X	Xm	Xm
Effluent	N	680-210283-2	Water	X	X	X1	X
Influent	N	680-210308-1	Water	---	---	Xm	Xm
Effluent	N	680-210308-2	Water	---	---	X	X
Data Package 680-210527-1							
Influent	N	680-210527-1	Water	X	X	Xm	X
Effluent	N	680-210527-2	Water	X	X	X1	X

Sample Type: N – Normal
Xm – Matrix Spike/ Matrix Spike Duplicate

Analyses: Dissolved/Total Recoverable Metals (200.7) – Aluminum
General Chemistry (Total) – Total Suspended Solids (SM2540D), Total Volatile Suspended Solids (SM2540E), Total Kjeldahl Nitrogen (351.2), Nitrate as Nitrogen (N) (353.2), Nitrate/Nitrite as N (353.2), Nitrite as N (353.2), Total Phosphorous (365.1), Orthophosphate (365.1), Ammonia as N (350.1), Total Organic Carbon (5310B), Total Alkalinity (SM2320B), Chlorophyll a (SM10200)
[1]Analysis includes Carbonaceous Biological Oxygen Demand (CBOD) (SM5210B)
General Chemistry (Dissolved) – Dissolved Kjeldahl Nitrogen (351.2), Dissolved Nitrate/Nitrite (353.2), Dissolved Phosphorous (365.1), Dissolved Organic Carbon (5310B), Total Dissolved Nitrogen (Total Nitrogen)

This report contains the final results of the data validation conducted for water samples collected January 2022 for the Lake Jesup sampling. The sample results were presented in three data packages. The data review was conducted in accordance with National Functional Guidelines for Inorganic Superfund Methods Data Review (EPA November 2020), and evaluation of laboratory criteria, as applicable.

General Overall Assessment:

_______ Data are usable without qualification.
__X__ Data are usable with qualification (noted below and summarized in Attachment A).
_______ Some or all data are unusable for any purpose (noted below and summarized in Attachment A).

Case Narrative Comments: Any case narrative comments concerning data qualification were address was noted in the table below.

Trace level detects, reported between the method detection limit (MDL) and the practical quantitation limit (PQL), have been qualified as estimated (J lq). The other exceptions are covered in the following table.

Review Parameter	Criteria Met?	Comments
Chain of Custody & Sample Receipt	Yes	The samples were received by Eurofins TestAmerica Savannah, Eurofins Xenco, and ENCO Laboratories in good condition and were consistent with the accompanying chain of custody (COC). The cooler temperatures upon receipt were within the recommended ≤6 degrees Celsius (°C) temperature range.
Holding Times	Yes	The samples were analyzed within the method required holding times.
Case Narrative	NA	**Data Package 680-210283-1:** The laboratory noted the incubator exceeded the method SM5210B required temperature criteria of 20±1°C for sample Effluent. Therefore, the associated CBOD (Carbonaceous Biochemical Oxygen Demand) result was qualified as estimated (UJ pr).
Laboratory Blanks • Method Blank (MB)	Yes	Target analytes were not detected within the method blanks.
Matrix Quality Control • Matrix Spike/ Matrix Spike Duplicate **680-209712-1** Influent (Dissolved Aluminum, Orthophosphate as P (Phosphorus), Nitrate-Nitrite as Nitrogen (N), Total/Dissolved Phosphorus, Total Organic Carbon (TOC)) **680-210283-1** Influent (Total Aluminum, Nitrate as N, Orthophosphate as P) **680-210527-1** Influent (Nitrate as N) • Laboratory Duplicate **680-209712-1** None reported in this data package **680-210283-1** Influent (Total Volatile Solids (TVS), Total Suspended Solids (TSS)) Effluent (Carbonaceous Biochemical Oxygen Demand (CBOD)) **680-210527-1** Influent (TVS, TSS) Effluent (CBOD) • Total vs. Partial Analyses Kjeldahl Nitrogen, Nitrate/Nitrite, Phosphorous, Organic Carbon, Nitrogen (Total Nitrogen)	No	**Matrix Spike/ Matrix Spike Duplicate (MS/MSD)** With the exceptions listed in Table 1, the MS/MSD recoveries and relative percent differences (RPDs) met quality control criteria. An MS/MSD was not performed for total and dissolved Kjeldahl nitrogen, nitrite as N, total and dissolved ammonia or dissolved organic carbon. Therefore, there is no measure of accuracy and precision as it pertains to the sample matrix for this parameter. **Laboratory Duplicate** The comparison between results of the parent sample and laboratory duplicate met the criteria listed below. • When both the sample and duplicate values are >5x the practical quantitation limit (PQL) acceptable sampling and analytical precision is indicated by an RPD meeting laboratory limits. • Where the result for one or both analytes of the laboratory duplicate pair is <5xPQL, satisfactory precision is indicated if the absolute difference between the field duplicate results is <1xPQL. **Total vs. Partial Analyses** The following criteria were used to evaluate the total versus partial results: • In instances where the value for a partial analysis exceed that for a total analysis and both of the results are >5xPQL, the criterion utilized is that the two values should agree within ±30%. • In instances where the value for a partial analysis exceeds that for a total analysis and either of the results is <5xPQL, the absolute difference between the results is compared against an

Review Parameter	Criteria Met?	Comments
		evaluation criterion of 2xPQL. The total sample results and associated partial sample results met the concentration-dependent criteria.
Laboratory Performance • Laboratory Control Sample	Yes	With the exceptions listed in Table 2, one laboratory control sample (LCS) and/or laboratory control sample duplicate (LCSD) per method per analytical batch was prepared and analyzed. The LCS recoveries and LCS/LCSD RPDs were within the laboratory acceptance limits. These results are indicative of an acceptable level of accuracy and precision with respect to the analytical method. **Method 2540E Total Volatile Solids** For total volatile solids, the residue from the total suspended solids (TSS) is ignited to a constant weight at 550°C and the remaining solids represent the fixed suspended solids while the weight lost on ignition represents the volatile solids. An LCS/LCSD is analyzed for TSS; however, the LCS/LCSD are not ignited to a constant weight at 550°C, nor is a new LCS/LCSD prepared and analyzed. As an LCS/LCSD is not performed for total volatile solids, accuracy and precision with respect to the method could not be assessed for this parameter.
Field Quality Control • Trip Blank/Field Blank Not Applicable • Field Duplicate None reported in this data package	NA	**Trip Blank/Field Blank** A trip blank and field blank were not applicable for the methods performed. **Field Duplicate** A field duplicate was not performed on the samples in this data package.
Non-detect results with unaltered reporting limits	No	Due to matrix interferences several samples were reported as non-detect at elevated reporting limits. These non-detect results will need to be evaluated with respect to project objectives.
Report	NA	**Data Package 680-210527-1** During review of this data package, the reviewer noted unnecessary quality control samples associated with method SM2320B were erroneously reported by the laboratory. Additionally, an incorrect sample identification (ID) was reported. The laboratory revised and reissued the data package to remove the erroneous quality control results for SM2320B, and the sample ID was revised to match the COC.
Package Completeness	Yes	The results are usable as qualified for the project objective. The data are 100% complete.

ºC – Degrees Celsius
% – Percent
≤ – Less Than or Equal To
> – Greater Than
± – Plus or Minus
COC – Chain of Custody
ID - Identification
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
MDL – Method Detection Limit
MS – Matrix Spike
MSD – Matrix Spike Duplicate
N – Nitrogen
P - Phosphorus
PQL – Practical Quantitation Limit
RPDs – Relative Percent Differences
TSS – Total Suspended Solids
TVS – Total Volatile Solids

Qualifiers
J- – Estimated, Low Bias
UJ - Estimated

Reason Codes
lq – Result detected between the MDL and PQL.
m – Matrix Spike Recovery
pr – Professional Judgment

Table 1: MS/MSD Recovery and RPD Outliers and Resultant Data Qualification

Associated Samples	Analyte	%R (Limits)	RPD (Limit)	Qualification
Data Package 680-209712-1				
Influent	Orthophosphate as P	**26/25** (90-110)	2 (20)	As the potential bias was considered to be low, the associated result was qualified as estimated (J- m).
	Total Organic Carbon	**131/132** (80-120)	0 (25)	As the potential bias was considered to be high, the associated result was qualified as estimated (J+ m).
	TOC Result 1	**130/132** (80-120)	1 (25)	
	TOC Result 2	**132/132** (80-120)	0 (25)	
Data Package 680-210283-1				
Influent	Orthophosphate as P	**65/63** (90-110)	2 (20)	As the potential bias was considered to be low, the associated result was qualified as estimated (J- m).

Bold - indicates a value that is outside of acceptance limits
% – Percent
%R – Percent Recoveries
P - Phosphorus
RPD – Relative Percent Difference
TOC – Total Organic Carbon

Qualifiers
J- – Estimated, Low Bias
J+ - Estimated, High Bias
Reason Codes
m – Matrix spike recovery outliers

Table 2: LCS/LCSD Recovery and RPD Outliers and Resultant Data Qualification

Associated Samples	Analyte	%R (Limits)	RPD (Limit)	Qualification
Data Package 680-210283-1				
LCS 680-705447/10 **LCSD 680-705447/31** Influent Effluent	Alkalinity	100/**89** (90-112)	12 (30)	As the potential bias was considered to be low, the associated result was qualified as estimated (J-/UJ l).
LCS 680-703714/2 **LCSD 680-703714/3** Effluent	CBOD	**81/84** (85-115)	4 (30)	

Bold - indicates a value that is outside of acceptance limits
% – Percent
%R – Percent Recoveries
CBOD – Carbonaceous Biochemical Oxygen Demand
RPD – Relative Percent Difference

Qualifiers
J- – Estimated, Low Bias
UJ – Estimated
Reason Codes
l – Laboratory Control Spike Recovery

Attachment A: Summary of Qualified Data
Lake Jesup - January 2022

SDG	LAB ID	SAMPLE	MATRIX	METHOD	ANALYTE	UNITS	RESULT	DETECTED	PQL	MDL	DILUTION	FRACTION	QUALIFIERS	REASON CODE
680-209712-1	680-209712-1	Influent	Water	200.7	Aluminum	mg/L	0.13	YES	0.2	0.024	1	Total	J	lq
680-209712-1	680-209712-1	Influent	Water	365.1/LL	Orthophosphate as P	mg/L	0.059	YES	0.005	0.005	1	Total	J-	m
680-209712-1	680-209712-1	Influent	Water	SM 5310B	Total Organic Carbon	mg/L	16	YES	1	0.5	1	Total	J+	m
680-209712-1	680-209712-2	Effluent	Water	200.7	Dissolved Aluminum	mg/L	0.074	YES	0.2	0.024	1	Dissolved	J	lq
680-209712-1	680-209712-2	Effluent	Water	365.1	Total Phosphorus as P	mg/L	0.011	YES	0.02	0.0096	1	Total	J	lq
680-210283-1	680-210283-1	Influent	Water	200.7	Aluminum	mg/L	0.17	YES	0.2	0.024	1	Total	J	lq
680-210283-1	680-210283-1	Influent	Water	SM2320 B	Total Alkalinity	mg/L	60	YES	5	5	1	Total	J-	l
680-210283-1	680-210283-2	Effluent	Water	SM2320 B	Total Alkalinity	mg/L	64	YES	5	5	1	Total	J-	l
680-210283-1	680-210283-2	Effluent	Water	SM5210B CBOD	Carbonaceous Biochemical Oxygen Demand	mg/L	2	NO	2	2	1	Total	UJ	l,pr
680-210283-1	680-210308-1	Influent	Water	365.1/LL	Orthophosphate as P	mg/L	0.061	YES	0.005	0.005	1	Total	J-	m
680-210527-1	680-210527-1	Influent	Water	200.7	Aluminum	mg/L	0.14	YES	0.2	0.054	1	Total	J	lq

Definitions

ID	Identification
mg/L	Miligrams Per Liter
MDL	Method Detection Limit
PQL	Practical Quantitation Limit

Qualifiers

J+	Estimated, High Bias
J-	Estimated, Low Bias
J	Estimated
UJ	Estimated

Reason Codes

l	Laboratory Control Spike Recovery
lq	Result Detected Between the MDL and PQL
m	Matrix Spike Recovery
pr	Professional Judgment

Lake Jesup
Data Review Summary

Sample Delivery Group: 680-211134-1, 680-211425-1, and 680-211715-1
Sampling Date: February 9th, 16th, and 23rd, 2022
Data Reviewer: Jamie Herman Date Completed: May 11, 2022
Peer Reviewer: Katie Abbott Date Completed: June 6, 2022

The table below summarizes the results presented in this data package.

Field Identification	Sample Type	Laboratory Identification	Matrix	Analyses			
				Total Aluminum Metals (200.7)	Dissolved Aluminum (200.7)	General Chemistry – Total	General Chemistry - Dissolved
Data Package 680-211134-1							
Influent	N	680-211134-1	Water	X	X	X^m	X
Effluent	N	680-211134-2	Water	X	X	X^1	X
Data Package 680-211425-1							
Influent	N	680-211425-1	Water	X	X^m	X	X^m
Effluent	N	680-211425-2	Water	X	X	X^{1m}	X^m
Data Package 680-211715-1							
Influent	N	680-211715-1	Water	X	X^m	X^m	X
Effluent	N	680-211715-2	Water	X	X	X^1	X

Sample Type: N – Normal
X^m – Matrix Spike/ Matrix Spike Duplicate

Analyses: Dissolved/Total Recoverable Metals (200.7) – Aluminum
General Chemistry (Total) – Total Suspended Solids (SM2540D), Total Volatile Suspended Solids (SM2540E), Total Kjeldahl Nitrogen (351.2), Nitrate as Nitrogen (N) (353.2), Nitrate/Nitrite as N (353.2), Nitrite as N (353.2), Total Phosphorous (365.1), Orthophosphate (365.1), Ammonia as N (350.1), Total Organic Carbon (5310B), Total Alkalinity (SM2320B), Chlorophyll a (SM10200)
[1]Analysis includes Carbonaceous Biological Oxygen Demand (CBOD) (SM5210B)
General Chemistry (Dissolved) – Dissolved Kjeldahl Nitrogen (351.2), Dissolved Nitrate/Nitrite (353.2), Dissolved Phosphorous (365.1), Dissolved Organic Carbon (5310B), Total Dissolved Nitrogen (Total Nitrogen)

This report contains the final results of the data validation conducted for water samples collected February 2022 for the Lake Jesup sampling. The sample results were presented in three data packages. The data review was conducted in accordance with National Functional Guidelines for Inorganic Superfund Methods Data Review (EPA November 2020), and evaluation of laboratory criteria, as applicable.

General Overall Assessment:

_______ Data are usable without qualification.
___X___ Data are usable with qualification (noted below and summarized in Attachment A).
_______ Some or all data are unusable for any purpose (noted below and summarized in Attachment A).

Case Narrative Comments: Any case narrative comments concerning data qualification were address was noted in the table below.

Trace level detects, reported between the method detection limit (MDL) and the practical quantitation limit (PQL), have been qualified as estimated (J lq). The other exceptions are covered in the following table.

Review Parameter	Criteria Met?	Comments
Chain of Custody & Sample Receipt	Yes	The samples were received by Eurofins TestAmerica Savannah, Eurofins Xenco, and ENCO Laboratories in good condition and were consistent with the accompanying chain of custody (COC). The cooler temperatures upon receipt were within the recommended ≤6 degrees Celsius (°C) temperature range.
Holding Times	No	With the exceptions noted below, the analyses were conducted within the method required holding time. **Data Package 680-211134-1** Due to a shipping delay, the analysis of orthophosphate was performed after the method required holding time of 48 hours had expired. As a result, the associated detected results were qualified as estimated (J- ht). **Data Package 680-211715-1** Due to a shipping delay, the analysis of orthophosphate was performed after the method required holding time of 48 hours had expired. As a result, the associated detected results were qualified as estimated (J- ht).
Laboratory Blanks • Method Blank (MB)	Yes	Target analytes were not detected within the method blanks.
Matrix Quality Control • Matrix Spike/ Matrix Spike Duplicate **680-211134-1** Influent (Total Nitrate as N, Total Nitrite as N, Total/Dissolved Phosphorus, Orthophosphate) **680-211425-1** Influent (Dissolved Aluminum, Dissolved Nitrate-Nitrite) Effluent (Dissolved/Total Nitrate-Nitrite) **680-211715-1** Influent (Dissolved Aluminum, Total Nitrate as N, Total Nitrite as N) • Laboratory Duplicate **680-211134-1** Effluent (CBOD) **680-211425-1** Influent (TVS, TSS) **680-211715-1** Effluent (Alkalinity, CBOD) • Total vs. Partial Analyses Kjeldahl Nitrogen, Nitrate/Nitrite, Phosphorous, Organic Carbon, Nitrogen (Total Nitrogen)	No	**Matrix Spike/ Matrix Spike Duplicate (MS/MSD)** With the exception listed in Table 1, the MS/MSD recoveries and relative percent differences (RPDs) met quality control criteria. An MS/MSD was not performed for total and dissolved Kjeldahl nitrogen (TKN), total and dissolved ammonia, or total and dissolved organic carbon. Therefore, there is no measure of accuracy and precision as it pertains to the sample matrix for these parameters. **Laboratory Duplicate** The comparison between results of the parent sample and laboratory duplicate met the criteria listed below. • When both the sample and duplicate values are >5x the practical quantitation limit (PQL) acceptable sampling and analytical precision is indicated by an RPD meeting laboratory limits. • Where the result for one or both analytes of the laboratory duplicate pair is <5xPQL, satisfactory precision is indicated if the absolute difference between the field duplicate results is <1xPQL. **Total vs. Partial Analyses** The following criteria were used to evaluate the total versus partial results: • In instances where the value for a partial analysis exceed that for a total analysis and both of the results are >5xPQL, the

Review Parameter	Criteria Met?	Comments
		criterion utilized is that the two values should agree within ±30%. • In instances where the value for a partial analysis exceeds that for a total analysis and either of the results is <5xPQL, the absolute difference between the results is compared against an evaluation criterion of 2xPQL. The total sample results and associated partial sample results met the concentration-dependent criteria.
Laboratory Performance • Laboratory Control Sample	No	With the exceptions listed in Table 2, one Laboratory Control Sample (LCS) and/or Laboratory Control Sample Duplicate (LCSD) per method per analytical batch was prepared and analyzed. The LCS recoveries and LCS/LCSD RPDs were within the laboratory acceptance limits. These results are indicative of an acceptable level of accuracy and precision with respect to the analytical method. **Method 2540E Total Volatile Solids** For total volatile solids, the residue from the total suspended solids (TSS) is ignited to a constant weight at 550°C and the remaining solids represent the fixed suspended solids while the weight lost on ignition represents the volatile solids. An LCS/LCSD is analyzed for TSS; however, the LCS/LCSD are not ignited to a constant weight at 550°C, nor is a new LCS/LCSD prepared and analyzed. As an LCS/LCSD is not performed for total volatile solids, accuracy and precision with respect to the method could not be assessed for this parameter.
Field Quality Control • Trip Blank/Field Blank Not Applicable • Field Duplicate None reported in this data package	NA	**Trip Blank/Field Blank** A trip blank and field blank were not applicable for the methods performed. **Field Duplicate** A field duplicate was not performed on the samples in this data package.
Non-detect results with unaltered reporting limits	No	Due to matrix interferences several samples were reported as non-detect at elevated reporting limits. These non-detect results will need to be evaluated with respect to project objectives.
Report	NA	**Data Package 680-211134-1** During review of this data package, the reviewer noted missing quality control samples associated with method 353.2 for nitrite as n. The laboratory revised and reissued the data package to include the missing quality control results **Data Package 680-211715-1** A revised report was provided by the laboratory due to a laboratory identified reporting issue associated with the 353.2 nitrate. The nitrite quality control results were included in this revision. There were no changes to the sample analytical results; therefore, further action was considered unnecessary.
Package Completeness	Yes	The results are usable as qualified for the project objective. The data are 100% complete.

ºC – Degrees Celsius % – Percent

≤ – Less Than or Equal To
> – Greater Than
± – Plus or Minus
COC – Chain of Custody
ID - Identification
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
MDL – Method Detection Limit
MS – Matrix Spike
MSD – Matrix Spike Duplicate
N – Nitrogen
P - Phosphorus
PQL – Practical Quantitation Limit
RPDs – Relative Percent Differences
TSS – Total Suspended Solids
TVS – Total Volatile Solids

Qualifiers
J- – Estimated, Low Bias

Reason Codes
lq – Result detected between the MDL and PQL.
m – Matrix Spike Recovery

Table 1: MS/MSD Recovery and RPD Outliers and Resultant Data Qualification

Associated Samples	Analyte	%R (Limits)	RPD (Limit)	Qualification
Data Package 680-211134-1				
Influent	Orthophosphate as P	**45/44** (90-110)	2 (20)	As the potential bias was considered to be low, the detected result was qualified as estimated (J- m).

Bold - indicates a value that is outside of acceptance limits
% – Percent
%R – Percent Recoveries
P - Phosphorus
RPD – Relative Percent Difference

Qualifiers
J- – Estimated, Low Bias

Reason Codes
m – Matrix spike recovery outliers

Table 2: LCS/LCSD Recovery and RPD Outliers and Resultant Data Qualification

Associated Samples	Analyte	%R (Limits)	RPD (Limit)	Qualification
Data Package 680-211425-1				
LCS 680-707396/2 **LCSD 680-707396/3** Effluent	CBOD	113/**117** (85-115)	4 (30)	As the potential bias was considered to be high, the detected result was qualified as estimated (J+ l).
Data Package 680-211715-1				
LCS 680-708214/2 **LCSD 680-708214/3** Effluent	CBOD	**30/21** (85-115)	**35** (30)	As the potential bias was considered to be low, the detected result was qualified as estimated (J- l).

Bold - indicates a value that is outside of acceptance limits
% – Percent
%R – Percent Recoveries
CBOD – Carbonaceous Biochemical Oxygen Demand
RPD – Relative Percent Difference

Qualifiers
J- – Estimated, Low Bias

Reason Codes
l – Laboratory Control Spike Recovery Outliers

Attachment A: Summary of Qualified Data
Lake Jesup - February 2022

LAB ID	SAMPLE	MATRIX	METHOD	ANALYTE	UNITS	RESULT	DETECTED	PQL	MDL	DILUTION	FRACTION	QUALIFIERS	REASON CODE
680-211134-1	Influent	Water	200.7	Dissolved Aluminum	mg/L	0.095	YES	0.2	0.054	1	Dissolved	J	lq
680-211134-1	Influent	Water	365.1/LL	Orthophosphate as P	mg/L	0.047	YES	0.005	0.005	1	Total	J-	ht,m
680-211134-2	Effluent	Water	200.7 Rev 4.4	Aluminum	mg/L	0.11	YES	0.2	0.054	1	Total	J	lq
680-211134-2	Effluent	Water	365.1/LL	Orthophosphate as P	mg/L	0.032	YES	0.005	0.005	1	Total	J-	ht
680-211425-1	Influent	Water	200.7 Rev 4.4	Aluminum	mg/L	0.12	YES	0.2	0.054	1	Total	J	lq
680-211425-2	Effluent	Water	SM5210B CBOD	Carbonaceous Biochemical Oxygen Demand	mg/L	20	YES	2	2	1	Total	J+	l
680-211715-1	Infuent	Water	200.7 Rev 4.4	Aluminum	mg/L	0.11	YES	0.2	0.054	1	Total	J	lq
680-211715-1	Infuent	Water	365.1/LL	Orthophosphate as P	mg/L	0.032	YES	0.005	0.005	1	Total	J-	ht
680-211715-2	Effluent	Water	365.1/LL	Orthophosphate as P	mg/L	0.0089	YES	0.005	0.005	1	Total	J-	ht
680-211715-2	Effluent	Water	SM5210B CBOD	Carbonaceous Biochemical Oxygen Demand	mg/L	21	YES	2	2	1	Total	J-	l

Definitions

ID	Identification
mg/L	Miligrams Per Liter
MDL	Method Detection Limit
PQL	Practical Quantitation Limit

Qualifiers

J+	Estimated, High Bias
J-	Estimated, Low Bias
J	Estimated

Reason Codes

ht	Holding Time
l	Laboratory Control Spike Recovery
lq	Result Detected Between the MDL and PQL
m	Matrix Spike Recovery

Lake Jesup
Data Review Summary

Sample Delivery Group: 680-212002-1, 680-212818-1, 680-213080-1, and 680-213302-1
Sampling Date: March 2nd, 16th, 24th, and 30th, 2022
Data Reviewer: Jamie Herman Date Completed: June 16, 2022
Peer Reviewer: Katie Abbott Date Completed: July 11, 2022

The table below summarizes the results presented in this data package.

Field Identification	Sample Type	Laboratory Identification	Matrix	Analyses			
				Total Aluminum Metals (200.7)	Dissolved Aluminum (200.7)	General Chemistry – Total	General Chemistry - Dissolved
Data Package 680-212002-1							
Influent	N	680-212002-1	Water	X	X[m]	X[m]	X
Effluent	N	680-212002-2	Water	X	X	X[1,m]	X[m]
DUP-1	FD	680-212002-3	Water	X	X	X[1]	X[m]
FIELD BLANK	FB	680-212002-4	Water	X	X	X[1,2]	X
Data Package 680-212818-1							
Influent	N	680-212818-1	Water	X	X	X[m]	X
Effluent	N	680-212818-2	Water	X	X	X[1,m]	X
Influent-Dup	FD	680-212824-1	Water	X	X	X	X
Effluent-Dup	FD	680-212824-2	Water	X	X	X[1,m]	X
Data Package 680-213080-1							
Influent	N	680-213080-1	Water	X	X	X[m]	X[m]
Effluent	N	680-213080-2	Water	X[m]	X	X[1,m]	X
Data Package 680-213302-1							
Influent	N	680-213302-1	Water	X[m]	X	X	X
Effluent	N	680-213302-2	Water	X	X	X[1]	X

Sample Type: N – Normal
X[m] – Matrix Spike/ Matrix Spike Duplicate

Analyses: Dissolved/Total Recoverable Metals (200.7) – Aluminum
General Chemistry (Total) – Total Suspended Solids (SM2540D), Total Volatile Suspended Solids (SM2540E), Total Kjeldahl Nitrogen (351.2), Nitrate as Nitrogen (N) (353.2), Nitrate/Nitrite as N (353.2), Nitrite as N (353.2), Total Phosphorous (365.1), Orthophosphate (365.1), Ammonia as N (350.1), Total Organic Carbon (5310B), Total Alkalinity (SM2320B), Chlorophyll a (SM10200)
[1]Analysis includes Carbonaceous Biological Oxygen Demand (CBOD) (SM5210B)
[2]Analysis does not include Alkalinity (SM2320B)
General Chemistry (Dissolved) – Dissolved Kjeldahl Nitrogen (351.2), Dissolved Nitrate/Nitrite (353.2), Dissolved Phosphorous (365.1), Dissolved Organic Carbon (5310B), Total Dissolved Nitrogen (Total Nitrogen)

This report contains the final results of the data validation conducted for water samples collected March 2022 for the Lake Jesup sampling. The sample results were presented in four data packages. The data review was conducted in accordance with National Functional Guidelines for Inorganic Superfund Methods Data Review (EPA November 2020), and evaluation of laboratory criteria, as applicable.

General Overall Assessment:

_______ Data are usable without qualification.
_______ Data are usable with qualification (noted below and summarized in Attachment A).
___X___ Some or all data are unusable for any purpose (noted below and summarized in Attachment A).

Case Narrative Comments: Any case narrative comments concerning data qualification were address was noted in the table below.

Trace level detects, reported between the method detection limit (MDL) and the practical quantitation limit (PQL), have been qualified as estimated (J lq). The other exceptions are covered in the following table.

Review Parameter	Criteria Met?	Comments
Chain of Custody & Sample Receipt	No	The samples were received by Eurofins TestAmerica Savannah, Eurofins Xenco, and ENCO Laboratories in good condition and were consistent with the accompanying chain of custody (COC). The cooler temperatures upon receipt were within the recommended ≤6 degrees Celsius (°C) temperature range. **Data Package 680-212002-1** The laboratory noted that one, 1 liter container for sample Effluent was received broken. Sufficient volume remained for analysis; as such further action was considered unnecessary.
Holding Times	No	With the exceptions noted below, the analyses were conducted within the method required holding time. **Data Package 680-212002-1** Due to laboratory error, the analysis of carbonaceous biological oxygen demand (CBOD) was performed after the method required holding time of 48 hours had expired for sample FIELD BLANK. As a result, the associated non-detected result was qualified as unusable (R ht). **Data Package 680-212818-1** Due to a shipping delay, the analysis of orthophosphate, nitrate as nitrogen (N), and nitrite as N on samples Influent and Influent-DUP, and the CBOD, orthophosphate, nitrate as N, and nitrite as N on samples Effluent and Effluent-DUP were performed after the method required holding time of 48 hours had expired. As a result, the associated detected results were qualified as estimated (J- ht). The associated non-detected results were qualified as unusable (R ht).
Laboratory Blanks • Method Blank (MB)	Yes	The target analytes were not detected within the method blanks.
Matrix Quality Control • Matrix Spike/ Matrix Spike Duplicate **680-212002-1** Influent (Dissolved Aluminum, Nitrite as N, Orthophosphate) Effluent (Total/Dissolved TKN, Total/Dissolved Phosphorus) DUP-1 (DOC) **680-212818-1** Influent (Total Nitrate as n) Effluent (Orthophosphate) Effluent-Dup (Total Ammonia)	No	**Matrix Spike/ Matrix Spike Duplicate (MS/MSD)** With the exceptions listed in Table 1, the MS/MSD recoveries and relative percent differences (RPDs) met quality control criteria. An MS/MSD was not performed for dissolved ammonia. Therefore, there is no measure of accuracy and precision as it pertains to the sample matrix for this parameter. **Laboratory Duplicate** With the exceptions listed in Table 2, the comparison between

Review Parameter	Criteria Met?	Comments
680-213080-1 Influent (Dissolved Nitrate-Nitrite, Orthophosphate, DOC, TOC) Effluent (Total Aluminum. Total Nitrite as N, Total Nitrate-Nitrite as N) **680-213302-1** Influent (Orthophosphate, TOC) • Laboratory Duplicate **680-212002-1** Influent (TVS, TSS, Alkalinity) DUP-1 (Alkalinity) FIELD BLANK (CBOD) – Not evaluated, not an appropriate Matrix **680-212818-1** Influent (TVS, TSS) Effluent (CBOD) **680-213080-1** Influent (TVS, TSS) **680-213302-1** Influent (TVS, TSS) Effluent (CBOD) • Total vs. Partial Analyses Kjeldahl Nitrogen, Nitrate/Nitrite, Phosphorous, Organic Carbon, Nitrogen (Total Nitrogen)		results of the parent sample and laboratory duplicate met the criteria listed below. • When both the sample and duplicate values are >5x the practical quantitation limit (PQL) acceptable sampling and analytical precision is indicated by an RPD meeting laboratory limits. • Where the result for one or both analytes of the laboratory duplicate pair is <5xPQL, satisfactory precision is indicated if the absolute difference between the field duplicate results is <1xPQL. **Total vs. Partial Analyses** The following criteria were used to evaluate the total versus partial results: • In instances where the value for a partial analysis exceed that for a total analysis and both of the results are >5xPQL, the criterion utilized is that the two values should agree within ±30%. • In instances where the value for a partial analysis exceeds that for a total analysis and either of the results is <5xPQL, the absolute difference between the results is compared against an evaluation criterion of 2xPQL. The total sample results and associated partial sample results met the concentration-dependent criteria.
Laboratory Performance • Laboratory Control Sample	No	With the exception listed in Table 3, one laboratory control sample (LCS) and/or laboratory control sample duplicate (LCSD) per method per analytical batch was prepared and analyzed. The LCS recoveries and LCS/LCSD RPDs were within the laboratory acceptance limits. These results are indicative of an acceptable level of accuracy and precision with respect to the analytical method. **Method 2540E Total Volatile Solids** For total volatile solids, the residue from the total suspended solids (TSS) is ignited to a constant weight at 550°C and the remaining solids represent the fixed suspended solids while the weight lost on ignition represents the volatile solids. An LCS/LCSD is analyzed for TSS; however, the LCS/LCSD are not ignited to a constant weight at 550°C, nor is a new LCS/LCSD prepared and analyzed. As an LCS/LCSD is not performed for total volatile solids, accuracy and precision with respect to the method could not be assessed for this parameter.
Field Quality Control • Trip Blank/Field Blank **680-212002-1** FIELD BLANK • Field Duplicate **680-212002-1** Effluent/DUP-1 **680-212818-1** Influent/Influent-Dup Effluent/Effluent-Dup	No	**Trip Blank/Field Blank** A trip blank was not applicable for the methods performed. With the exceptions listed in Table 4, no target analytes reported in the associated field blank. **Field Duplicate** With the exceptions listed in Table 5, the field duplicate sample results satisfied the evaluation criteria below:

Review Parameter	Criteria Met?	Comments
		• When both the sample and duplicate values are >5xRL acceptable sampling and analytical precision is indicated by a RPD between the results of ≤30%. • Where the result for one or both analytes of the field duplicate pair is <5xRL, satisfactory precision is indicated if the absolute difference between the field duplicate results is <2xRL.
Non-detect results with unaltered reporting limits	No	Due to matrix interferences several samples were reported as non-detect at elevated reporting limits. These non-detect results will need to be evaluated with respect to project objectives.
Report	NA	**Data Package 680-212002-1** A revised report was provided by the laboratory due to a laboratory identified reporting issue associated with the 353.2 nitrate. There were no changes to the sample analytical results; therefore, further action was considered unnecessary. **Data Package 680-213080-1** A revised report was provided by the laboratory due to a laboratory identified reporting issue associated with the 353.2 nitrate. There were no changes to the sample analytical results; therefore, further action was considered unnecessary. **Data Package 680-213302-1** A revised report was provided by the laboratory due to a laboratory identified reporting issue associated with the 353.2 nitrate. In addition, an unnecessary quality control sample associated with method 365.1 was erroneously reported by the laboratory. There were no changes to the sample analytical results; therefore, further action was considered unnecessary.
Package Completeness	No	With the exception of the orthophosphate, nitrate as N, and nitrite as N on samples Influent and Influent-DUP, and the CBOD, orthophosphate, nitrate as N, and nitrite as N on samples Effluent and Effluent-DUP results in data package 680-212818-1, which were qualified as unusable (R) due to analysis performed outside of hold, the results are usable as qualified for the project objective. The data are greater than 96% complete.

ºC – Degrees Celsius
% – Percent
≤ – Less Than or Equal To
> – Greater Than
± – Plus or Minus
CBOD – Carbonaceous Biological Oxygen Demand
COC – Chain of Custody
DOC – Dissolved Organic Carbon
ID - Identification
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
MDL – Method Detection Limit
MS – Matrix Spike
MSD – Matrix Spike Duplicate
N – Nitrogen
P - Phosphorus
PQL – Practical Quantitation Limit
RPDs – Relative Percent Differences
TKN – Total Kjeldahl Nitrogen
TOC – Total Organic Carbon
TSS – Total Suspended Solids
TVS – Total Volatile Solids

Qualifiers
J- – Estimated, Low Bias
R – Unusable

Reason Codes
ht – Holding Time
lq – Result detected between the MDL and PQL.

Table 1: MS/MSD Recovery and RPD Outliers and Resultant Data Qualification

Associated Samples	Analyte	%R (Limits)	RPD (Limit)	Qualification
Data Package 680-212002-1				
Influent	Orthophosphate as P	**2/2** (90-110)	0 (20)	As the potential bias was considered to be low, the detected result was qualified as estimated (J- m).
Data Package 680-212818-1				
Effluent	Orthophosphate as P	**67/68** (90-110)	1 (20)	As the potential bias was considered to be low, the detected result was qualified as estimated (J- m).
Effluent-Dup	Ammonia	**112/112** (90-110)	0 (30)	As the potential bias was considered to be high and the associated sample result was non-detect, qualification was not considered necessary.
Data Package 680-213080-1				
Effluent	Nitrite as N	110/**111** (90-110)	1 (10)	As the potential bias was considered to be high and the associated sample result was non-detect, qualification was not considered necessary.
	Nitrate-Nitrite as N	**128/128** (90-110)	0 (10)	
Influent	Orthophosphate as P	**23/22** (90-110)	1 (20)	As the potential bias was considered to be low, the non-detect result was qualified as unusable (J- m).
Data Package 680-213302-1				
Influent	Orthophosphate as P	**20/18** (90-110)	6 (20)	As the potential bias was considered to be low, the detected result was qualified as estimated (J- m).

Bold - indicates a value that is outside of acceptance limits
% – Percent
%R – Percent Recoveries
N – Nitrogen
P - Phosphorus
RPD – Relative Percent Difference

Qualifiers
J- – Estimated, Low Bias
Reason Codes
m – Matrix spike recovery outliers

Table 2: Laboratory Duplicate Outliers and Resultant Data Qualification

Associated Samples	Analyte	Parent Result	Duplicate Result	Criteria not Met	Qualification
Data Package 680-212818-1					
Effluent	CBOD	4.5 mg/L	13.7 mg/L	Absolute Difference >1xPQL	As the absolute difference between the laboratory duplicate results is >1xPQL, the associated results were qualified as estimated (J ld).

> - Greater than
mg/L – Milligrams per Liter
PQL – Practical Quantitation limit

Qualifiers
J - Estimated
Reason Codes
ld – Laboratory Duplicate RPDs

Table 3: LCS/LCSD Recovery and RPD Outliers and Resultant Data Qualification

Associated Samples	Analyte	%R (Limits)	RPD (Limit)	Qualification
Data Package 680-212002-1				
LCS 680-709064/2 **LCSD 680-709064/3** Effluent DUP-1	CBOD	112/**124** (85-115)	10 (30)	As the potential bias was considered to be high, the detected result was qualified as estimated (J+ l).

Bold - indicates a value that is outside of acceptance limits
% – Percent
%R – Percent Recoveries
CBOD – Carbonaceous Biochemical Oxygen Demand
RPD – Relative Percent Difference

Qualifiers
J+ – Estimated, High Bias
Reason Codes
l – Laboratory Control Spike Recovery Outliers

Table 4: Trip Blank/Field Blank Outliers and Resultant Data Qualification

Blank/ Associated Samples	Analyte	Concentration	Qualification
Data Package 680-212002-1			
FIELD BLANK Influent Effluent DUP-1	Kjeldahl Nitrogen	0.14 mg/L	The associated sample results were reported at concentrations >5x the concentration of the blank contamination or non-detect; therefore, qualification was considered unnecessary.
	Nitrate Nitrite as N	0.015 mg/L	
	Nitrogen, total	0.14 mg/L	
	Nitrate-Nitrite, dissolved	0.022 mg/L	
	Kjeldahl Nitrogen, dissolved	0.37 mg/L	The associated sample results were reported at concentrations <5x the concentration of the blank contamination; therefore, results were qualified as non-detect (U bf).
	Nitrogen, dissolved	0.39 mg/L	

> - Greater than
mg/L – Milligrams per Liter
N – Nitrogen

Qualifiers
U – Non-detect
Reason Codes
bf – Field Blank Contamination

Table 5: Field Duplicate Outliers and Resultant Data Qualification

Associated Samples	Analyte	Parent Result	Duplicate Result	Criteria not Met	Qualification
Data Package 680-212818-1					
Influent/ Influent-Dup	Nitrogen, Total	0.96 mg/L	2.1 mg/L	Absolute Difference >2xPQL	As the absolute difference between the parent and field duplicate results is >2xPQL, the associated results were qualified as estimated (J fd).
Effluent/ Effluent-Dup	Kjeldahl Nitrogen	0.98 mg/L	0.55 mg/L		
	CBOD	4.5 mg/L	15 mg/L		

> - Greater than
mg/L – Milligrams per Liter
PQL – Practical Quantitation limit

Qualifiers
J - Estimated
Reason Codes
fd – Field Duplicate RPDs

Attachment A: Summary of Qualified Data
Lake Jesup - March 2022

SDG	LAB ID	SAMPLE	MATRIX	METHOD	ANALYTE	UNITS	RESULT	DETECTED	PQL	MDL	DILUTION	FRACTION	QUALIFIERS	REASON CODE
680-212002-1	680-212002-1	Influent	Water	351.2	Total Kjeldahl Nitrogen, Dissolved	mg/L	<1.2	NO	1.2	1.2	1	Dissolved	U	bf
680-212002-1	680-212002-1	Influent	Water	365.1/LL	Orthophosphate as P	mg/L	0.045	YES	0.005	0.005	1	Total	J-	m
680-212002-1	680-212002-1	Influent	Water	Total Nitrogen	Nitrogen, Total Dissolved	mg/L	<1.2	NO	1.2	1.2	1	Dissolved	U	bf
680-212002-1	680-212002-2	Effluent	Water	200.7	Aluminum	mg/L	0.061	YES	0.2	0.054	1	Total	J	lq
680-212002-1	680-212002-2	Effluent	Water	351.2	Total Kjeldahl Nitrogen, Dissolved	mg/L	<0.74	NO	0.74	0.74	1	Dissolved	U	bf
680-212002-1	680-212002-2	Effluent	Water	365.1	Total Phosphorus as P	mg/L	0.016	YES	0.02	0.0096	1	Total	J	lq
680-212002-1	680-212002-2	Effluent	Water	SM 5210B CBOD	Carbonaceous Biochemical Oxygen Demand	mg/L	20	YES	2	2	1	Total	J+	l
680-212002-1	680-212002-2	Effluent	Water	Total Nitrogen	Nitrogen, Total Dissolved	mg/L	<0.74	NO	0.74	0.74	1	Dissolved	U	bf
680-212002-1	680-212002-3	DUP-1	Water	351.2	Total Kjeldahl Nitrogen, Dissolved	mg/L	<0.79	NO	0.79	0.79	1	Dissolved	U	bf
680-212002-1	680-212002-3	DUP-1	Water	SM 5210B CBOD	Carbonaceous Biochemical Oxygen Demand	mg/L	16	YES	2	2	1	Total	J+	l
680-212002-1	680-212002-3	DUP-1	Water	Total Nitrogen	Nitrogen, Total Dissolved	mg/L	< 0.79	NO	0.79	0.79	1	Dissolved	U	bf
680-212002-1	680-212002-4	FIELD BLANK	Water	351.2	Nitrogen, Kjeldahl	mg/L	0.14	YES	0.2	0.1	1	Total	J	lq
680-212002-1	680-212002-4	FIELD BLANK	Water	353.2	Nitrate Nitrite as N	mg/L	0.015	YES	0.05	0.01	1	Total	J	lq
680-212002-1	680-212002-4	FIELD BLANK	Water	353.2	Nitrate-Nitrite, Dissolved	mg/L	0.022	YES	0.05	0.01	1	Dissolved	J	lq
680-212002-1	680-212002-4	FIELD BLANK	Water	SM 5210B CBOD	Carbonaceous Biochemical Oxygen Demand	mg/L	2	NO	2	2	1	Total	R	ht
680-212002-1	680-212002-4	FIELD BLANK	Water	Total Nitrogen	Nitrogen, Total	mg/L	0.14	YES	0.25	0.11	1	Total	J	lq
680-212818-1	680-212818-1	Influent	Water	200.7	Dissolved Aluminum	mg/L	0.18	YES	0.2	0.054	1	Dissolved	J	lq
680-212818-1	680-212818-1	Influent	Water	353.2	Nitrite as N	mg/L	0.01	NO	0.05	0.01	1	Total	R	ht
680-212818-1	680-212818-1	Influent	Water	365.1/LL	Orthophosphate as P	mg/L	0.081	YES	0.005	0.005	1	Total	J-	ht
680-212818-1	680-212818-1	Influent	Water	Nitrate by calc	Nitrate as N	mg/L	0.01	NO	0.05	0.01	1	Total	R	ht
680-212818-1	680-212818-1	Influent	Water	Total Nitrogen	Nitrogen, Total	mg/L	0.96	YES	0.25	0.11	1	Total	J	fd
680-212818-1	680-212818-2	Effluent	Water	351.2	Nitrogen, Kjeldahl	mg/L	0.98	YES	0.2	0.1	1	Total	J	fd
680-212818-1	680-212818-2	Effluent	Water	353.2	Nitrate Nitrite as N	mg/L	0.012	YES	0.05	0.01	1	Total	J	lq
680-212818-1	680-212818-2	Effluent	Water	353.2	Nitrite as N	mg/L	0.01	NO	0.05	0.01	1	Total	R	ht
680-212818-1	680-212818-2	Effluent	Water	365.1	Total Phosphorus as P	mg/L	0.016	YES	0.02	0.0096	1	Total	J	lq
680-212818-1	680-212818-2	Effluent	Water	365.1/LL	Orthophosphate as P	mg/L	0.011	YES	0.005	0.005	1	Total	J-	ht,m
680-212818-1	680-212818-2	Effluent	Water	Nitrate by calc	Nitrate as N	mg/L	0.01	NO	0.05	0.01	1	Total	R	ht
680-212818-1	680-212818-2	Effluent	Water	SM 5210B CBOD	Carbonaceous Biochemical Oxygen Demand	mg/L	4.5	YES	2	2	1	Total	J-	ht,ld,fd
680-212818-1	680-212824-1	Influent-DUP	Water	353.2	Nitrate-Nitrite, Dissolved	mg/L	0.012	YES	0.05	0.01	1	Dissolved	J	lq
680-212818-1	680-212824-1	Influent-DUP	Water	353.2	Nitrite as N	mg/L	0.01	NO	0.05	0.01	1	Total	R	ht
680-212818-1	680-212824-1	Influent-DUP	Water	365.1/LL	Orthophosphate as P	mg/L	0.069	YES	0.005	0.005	1	Total	J-	ht
680-212818-1	680-212824-1	Influent-DUP	Water	Nitrate by calc	Nitrate as N	mg/L	0.11	YES	0.05	0.01	1	Total	J-	ht
680-212818-1	680-212824-1	Influent-DUP	Water	Total Nitrogen	Nitrogen, Total	mg/L	2.1	YES	0.25	0.11	1	Total	J	fd
680-212818-1	680-212824-2	Effluent-DUP	Water	351.2	Nitrogen, Kjeldahl	mg/L	0.55	YES	0.2	0.1	1	Total	J	fd
680-212818-1	680-212824-2	Effluent-DUP	Water	353.2	Nitrate Nitrite as N	mg/L	0.018	YES	0.05	0.01	1	Total	J	lq
680-212818-1	680-212824-2	Effluent-DUP	Water	353.2	Nitrite as N	mg/L	0.01	NO	0.05	0.01	1	Total	R	ht
680-212818-1	680-212824-2	Effluent-DUP	Water	365.1	Total Phosphorus as P	mg/L	0.015	YES	0.02	0.0096	1	Total	J	lq
680-212818-1	680-212824-2	Effluent-DUP	Water	365.1/LL	Orthophosphate as P	mg/L	0.011	YES	0.005	0.005	1	Total	J-	ht
680-212818-1	680-212824-2	Effluent-DUP	Water	Nitrate by calc	Nitrate as N	mg/L	0.01	NO	0.05	0.01	1	Total	R	ht
680-212818-1	680-212824-2	Effluent-DUP	Water	SM 5210B CBOD	Carbonaceous Biochemical Oxygen Demand	mg/L	15	YES	2	2	1	Total	J-	ht, fd
680-213080-1	680-213080-1	Influent	Water	365.1/LL	Orthophosphate as P	mg/L	0.035	YES	0.01	0.005	1	Total	J-	m
680-213302-1	680-213302-1	Influent	Water	200.7	Aluminum	mg/L	0.19	YES	0.2	0.054	1	Total	J	lq
680-213302-1	680-213302-1	Influent	Water	353.2	Nitrite as N	mg/L	0.015	YES	0.05	0.01	1	Total	J	lq
680-213302-1	680-213302-1	Influent	Water	365.1/LL	Orthophosphate as P	mg/L	0.031	YES	0.005	0.005	1	Total	J-	m
680-213302-1	680-213302-2	Effluent	Water	353.2	Nitrate Nitrite as N	mg/L	0.011	YES	0.05	0.01	1	Total	J	lq

Definitions

ID	Identification
mg/L	Miligrams Per Liter
MDL	Method Detection Limit
PQL	Practical Quantitation Limit

Qualifiers

J+	Estimated, High Bias
J-	Estimated, Low Bias
J	Estimated
R	Unusable
U	Non-Detect

Reason Codes

bf	Field Blank Contamination
fd	Field Duplicate RPDs
ht	Holding Time
l	Laboratory Control Spike Recovery
ld	Laboratory Duplicate RPDs (Matrix Duplicate, MSD, LCSD)
lq	Result Detected Between the MDL and PQL
m	Matrix Spike Recovery

Lake Jesup
Data Review Summary

Sample Delivery Group: 680-213728-1 and 680-214040-1
Sampling Date: April 7th, and 13th, 2022
Data Reviewer: Jamie Herman — Date Completed: June 27, 2022
Peer Reviewer: Katie Abbott — Date Completed: July 11, 2022

The table below summarizes the results presented in this data package.

Field Identification	Sample Type	Laboratory Identification	Matrix	Analyses			
				Total Aluminum Metals (200.7)	Dissolved Aluminum (200.7)	General Chemistry – Total	General Chemistry - Dissolved
Data Package 680-213728-1							
Influent	N	680-213728-1	Water	X	X^{m}	X^{m}	X
Effluent	N	680-213728-2	Water	X	X	$X^{1,m}$	X^{m}
Field Blank	FB	680-213728-3	Water	X	X	$X^{1,2,m}$	X^{m}
DUP	FD	680-213728-4	Water	X	X	X^{1}	X^{m}
Data Package 680-214040-1							
Influent	N	680-214040-1	Water	X	X	X^{m}	X^{m}
Effluent	N	680-214040-2	Water	X	X^{m}	$X^{1,m}$	X^{m}

Sample Type: FB – Field Blank FD - Field Duplicate N – Normal
X^{m} – Matrix Spike/ Matrix Spike Duplicate

Analyses: Dissolved/Total Recoverable Metals (200.7) – Aluminum
General Chemistry (Total) – Total Suspended Solids (SM2540D), Total Volatile Suspended Solids (SM2540E), Total Kjeldahl Nitrogen (351.2), Nitrate as Nitrogen (N) (353.2), Nitrate/Nitrite as N (353.2), Nitrite as N (353.2), Total Phosphorous (365.1), Orthophosphate (365.1), Ammonia as N (350.1), Total Organic Carbon (5310B), Total Alkalinity (SM2320B), Chlorophyll a (SM10200)
[1]Analysis includes Carbonaceous Biological Oxygen Demand (CBOD) (SM5210B)
[2]Analysis does not include Alkalinity (SM2320B)
General Chemistry (Dissolved) – Dissolved Kjeldahl Nitrogen (351.2), Dissolved Nitrate/Nitrite (353.2), Dissolved Phosphorous (365.1), Dissolved Organic Carbon (5310B), Total Dissolved Nitrogen (Total Nitrogen)

This report contains the final results of the data validation conducted for water samples collected April 2022 for the Lake Jesup sampling. The sample results were presented in four data packages. The data review was conducted in accordance with National Functional Guidelines for Inorganic Superfund Methods Data Review (EPA November 2020), and evaluation of laboratory criteria, as applicable.

General Overall Assessment:

_______ Data are usable without qualification.
_______ Data are usable with qualification (noted below and summarized in Attachment A).
___X___ Some or all data are unusable for any purpose (noted below and summarized in Attachment A).

Case Narrative Comments: Any case narrative comments concerning data qualification were address was noted in the table below.

Trace level detects, reported between the method detection limit (MDL) and the practical quantitation limit (PQL), have been qualified as estimated (J lq). The other exceptions are covered in the following table.

Review Parameter	Criteria Met?	Comments
Chain of Custody & Sample Receipt	Yes	The samples were received by Eurofins TestAmerica Savannah, Eurofins Xenco, and ENCO Laboratories in good condition and were consistent with the accompanying chain of custody (COC). The cooler temperatures upon receipt were within the recommended ≤6 degrees Celsius (°C) temperature range.
Holding Times	No	With the exception noted below, the analyses were conducted within the method required holding time. **Data Package 680-214040-1** Due to laboratory error, the analysis of nitrite as n was performed 26 hours after the method required holding time of 48 hours for samples Influent and Effluent; therefore, the associated non-detect results for nitrite as n, and the calculated nitrate as n results, were qualified as unusable (R ht).
Laboratory Blanks • Method Blank (MB)	No	With the exception listed in Table 1, the target analytes were not detected within the method blanks.
Matrix Quality Control • Matrix Spike/ Matrix Spike Duplicate **680-213728-1** Influent (Dissolved Aluminum, Orthophosphate) Effluent (DOC, Ammonia) DUP (Dissolved Phosphorus) Field Blank (Dissolved Nitrate-Nitrite as N, Nitrite as N) – Not evaluated, not an appropriate Matrix **680-214040-1** Influent (Total/Dissolved Nitrate-Nitrite as N, Dissolved Phosphorus) Effluent (Dissolved Aluminum, DOC, TOC) • Laboratory Duplicate **680-213728-1** Influent (TVS, TSS) **680-214040-1** Influent (TVS, TSS) Effluent (Alkalinity, CBOD) • Total vs. Partial Analyses Kjeldahl Nitrogen, Nitrate/Nitrite, Phosphorous, Organic Carbon, Nitrogen (Total Nitrogen)	No	**Matrix Spike/ Matrix Spike Duplicate (MS/MSD)** With the exceptions listed in Table 2, the MS/MSD recoveries and relative percent differences (RPDs) met quality control criteria. An MS/MSD was not performed for total aluminum; therefore, there is no measure of accuracy and precision as it pertains to the sample matrix for this parameter. **Laboratory Duplicate** The comparison between results of the parent sample and laboratory duplicate met the criteria listed below. • When both the sample and duplicate values are >5x the practical quantitation limit (PQL) acceptable sampling and analytical precision is indicated by an RPD meeting laboratory limits. • Where the result for one or both analytes of the laboratory duplicate pair is <5xPQL, satisfactory precision is indicated if the absolute difference between the field duplicate results is <1xPQL. **Total vs. Partial Analyses** The following criteria were used to evaluate the total versus partial results: • In instances where the value for a partial analysis exceed that for a total analysis and both of the results are >5xPQL, the criterion utilized is that the two values should agree within ±30%. • In instances where the value for a partial analysis exceeds that for a total analysis and either of the results is <5xPQL, the absolute difference between the results is compared against an evaluation criterion of 2xPQL.

Review Parameter	Criteria Met?	Comments
		The total sample results and associated partial sample results met the concentration-dependent criteria.
Laboratory Performance • Laboratory Control Sample	Yes	One laboratory control sample (LCS) and/or laboratory control sample duplicate (LCSD) per method per analytical batch was prepared and analyzed. The LCS recoveries and LCS/LCSD RPDs were within the laboratory acceptance limits. These results are indicative of an acceptable level of accuracy and precision with respect to the analytical method. **Method 2540E Total Volatile Solids** For total volatile solids, the residue from the total suspended solids (TSS) is ignited to a constant weight at 550°C and the remaining solids represent the fixed suspended solids while the weight lost on ignition represents the volatile solids. An LCS/LCSD is analyzed for TSS; however, the LCS/LCSD are not ignited to a constant weight at 550°C, nor is a new LCS/LCSD prepared and analyzed. As an LCS/LCSD is not performed for total volatile solids, accuracy and precision with respect to the method could not be assessed for this parameter.
Field Quality Control • Trip Blank/Field Blank **680-213728-1** Field Blank **680-214040-1** None reported in this data package • Field Duplicate **680-213728-1** Influent/DUP **680-214040-1** None reported in this data package	No	**Trip Blank/Field Blank** A trip blank was not applicable for the methods performed. With the exceptions listed in Table 3, no target analytes reported in the associated field blank. **Field Duplicate** With the exceptions listed in Table 4, the field duplicate sample results satisfied the evaluation criteria below: • When both the sample and duplicate values are >5xRL acceptable sampling and analytical precision is indicated by a RPD between the results of ≤30%. • Where the result for one or both analytes of the field duplicate pair is <5xRL, satisfactory precision is indicated if the absolute difference between the field duplicate results is <2xRL.
Non-detect results with unaltered reporting limits	No	Due to matrix interferences several samples were reported as non-detect at elevated reporting limits. These non-detect results will need to be evaluated with respect to project objectives.
Report	NA	**Data Package 680-213728-1** A revised report was provided by the laboratory due to a laboratory identified reporting issue associated with the 353.2 nitrate. There were no changes to the sample analytical results; therefore, further action was considered unnecessary. The laboratory revised and reissued the data package to remove erroneous total and dissolved Kjeldahl nitrogen by 351.2 quality control (QC) sample results. **Data Package 680-214040-1** A revised report was provided by the laboratory due to a laboratory identified reporting issue associated with the 353.2 nitrate. There were no changes to the sample analytical results;

Review Parameter	Criteria Met?	Comments
		therefore, further action was considered unnecessary.
Package Completeness	No	With the exception of nitrate as N, and nitrite as N results qualified as unusable (R) due to analysis performed outside of hold, and orthophosphate results qualified as unusable due to matrix spike recoveries below the rejection point, the results are usable as qualified for the project objective. The data are greater than 95% complete.

ºC – Degrees Celsius
% – Percent
≤ – Less Than or Equal To
> – Greater Than
± – Plus or Minus
CBOD – Carbonaceous Biological Oxygen Demand
COC – Chain of Custody
DOC – Dissolved Organic Carbon
ID - Identification
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
MDL – Method Detection Limit
MS – Matrix Spike
MSD – Matrix Spike Duplicate
N – Nitrogen
P - Phosphorus
PQL – Practical Quantitation Limit
RPDs – Relative Percent Differences
TKN – Total Kjeldahl Nitrogen
TOC – Total Organic Carbon
TSS – Total Suspended Solids
TVS – Total Volatile Solids

Qualifiers
J – Estimated
R – Unusable

Reason Codes
ht – Holding Time
lq – Result detected between the MDL and PQL.

Table 1: Laboratory Blank Outliers and Resultant Data Qualification

Laboratory Blank/ Associated Samples	Analyte	Concentration	Qualification
Data Package 680-213728-1			
MB 860-48921/31-A Effluent	Total Phosphorus as P	0.0153 mg/L	The associated sample result was non-detect; therefore, qualification was considered unnnecessary.

< - Less Than
MB – Method Blank
mg/L – Milligrams per Liter
P - Phosphorus

Qualifiers
U – Non-detect
Reason Codes
bl – Laboratory Blank Contamination

Table 2: MS/MSD Recovery and RPD Outliers and Resultant Data Qualification

Associated Samples	Analyte	%R (Limits)	RPD (Limit)	Qualification
Data Package 680-213728-1				
DUP	Phosphorus, dissolved	91/**89** (90-110)	3 (20)	As the potential bias was considered to be low, the non-detect result was qualified as estimated (UJ m).
Influent	Orthophosphate as P	**9/8** (90-110)	5 (20)	As the potential bias was considered to be low, the non-detect result was qualified as unusable (R m).

Bold - indicates a value that is outside of acceptance limits
% – Percent
%R – Percent Recoveries
P - Phosphorus
RPD – Relative Percent Difference

Qualifiers
R – Unusable
UJ – estimated
Reason Codes
m – Matrix spike recovery outliers

Table 3: Trip Blank/Field Blank Outliers and Resultant Data Qualification

Blank/ Associated Samples	Analyte	Concentration	Qualification
Data Package 680-213728-1			
Field Blank Influent Effluent DUP	Nitrite Nitrite as N	0.012 mg/L	The associated sample results were non-detect; therefore, qualification was considered unnecessary.
	Nitrate as N	0.012 mg/L	
	Nitrate-Nitrite, dissolved	0.013 mg/L	

mg/L – Milligrams per Liter
N – Nitrogen

Table 4: Field Duplicate Outliers and Resultant Data Qualification

Associated Samples	Analyte	Parent Result	Duplicate Result	Criteria not Met	Qualification
Data Package 680-213728-1					
Influent/DUP	TOC	8.7 mg/L	13 mg/L	<30% RPD	As the relative percent difference between the field duplicate results is >30%, the associated results were qualified as estimated (J fd)
	DOC	9.2 mg/L	13 mg/L		

> - Greater than
DOC – Dissolved Organic Carbon
mg/L – Milligrams per Liter
PQL – Practical Quantitation limit
TOC – Total Organic Carbon

Qualifiers
J - Estimated
Reason Codes
fd – Field Duplicate RPDs

Attachment A: Summary of Qualified Data
Lake Jesup - April 2022

LAB ID	SAMPLE	MATRIX	METHOD	ANALYTE	UNITS	RESULT	DETECTED	PQL	MDL	DILUTION	FRACTION	QUALIFIERS	REASON CODE
680-213728-1	Influent	Water	365.1/LL	Orthophosphate as P	mg/L	0.038	YES	0.005	0.005	1	Total	R	m
680-213728-1	Influent	Water	SM 5310B	Dissolved Organic Carbon	mg/L	9.2	YES	1	0.5	1	Dissolved	J	fd
680-213728-1	Influent	Water	SM 5310B	Total Organic Carbon	mg/L	8.7	YES	1	0.5	1	Total	J	fd
680-213728-3	Field Blank	Water	353.2	Nitrate Nitrite as N	mg/L	0.012	YES	0.05	0.01	1	Total	J	lq
680-213728-3	Field Blank	Water	353.2	Nitrate-Nitrite, Dissolved	mg/L	0.013	YES	0.05	0.01	1	Dissolved	J	lq
680-213728-3	Field Blank	Water	Nitrate by calc	Nitrate as N	mg/L	0.012	YES	0.05	0.01	1	Total	J	lq
680-213728-4	DUP	Water	365.1	Phosphorus, Dissolved	mg/L	0.0096	NO	0.02	0.0096	1	Dissolved	UJ	m
680-213728-4	DUP	Water	SM 5310B	Dissolved Organic Carbon	mg/L	13	YES	1	0.5	1	Dissolved	J	fd
680-213728-4	DUP	Water	SM 5310B	Total Organic Carbon	mg/L	13	YES	1	0.5	1	Total	J	fd
680-214040-1	Influent	Water	353.2	Nitrite as N	mg/L	0.01	NO	0.05	0.01	1	Total	R	ht
680-214040-1	Influent	Water	Nitrate by calc	Nitrate as N	mg/L	0.01	NO	0.05	0.01	1	Total	R	ht
680-214040-2	Effluent	Water	200.7	Dissolved Aluminum	mg/L	0.068	YES	0.2	0.054	1	Dissolved	J	lq
680-214040-2	Effluent	Water	353.2	Nitrite as N	mg/L	0.01	NO	0.05	0.01	1	Total	R	ht
680-214040-2	Effluent	Water	Nitrate by calc	Nitrate as N	mg/L	0.01	NO	0.05	0.01	1	Total	R	ht

Definitions

ID	Identification
mg/L	Miligrams Per Liter
MDL	Method Detection Limit
PQL	Practical Quantitation Limit

Qualifiers

J	Estimated
R	Unusable
UJ	Estimated

Reason Codes

fd	Field Duplicate RPDs
ht	Holding Time
lq	Result Detected Between the MDL and PQL
m	Matrix Spike Recovery Outliers

Lake Jesup
Data Review Summary

Sample Delivery Group: 680-216122-1, and 680-216287-1
Sampling Date: May 26th and 31st, 2022
Data Reviewer: Jamie Herman Date Completed: July 8, 2022
Peer Reviewer: Katie Abbott Date Completed: July 19, 2022

The table below summarizes the results presented in this data package.

Field Identification	Sample Type	Laboratory Identification	Matrix	Analyses: Total Aluminum Metals (200.7)	Analyses: Dissolved Aluminum (200.7)	Analyses: General Chemistry – Total	Analyses: General Chemistry - Dissolved
Data Package 680-216122-1							
Influent	N	680-216122-1	Water	X	X	X^m	X^m
Effluent	N	680-216122-2	Water	X	X^m	X[1]	X
Data Package 680-216287-1							
Influent	N	680-216287-1	Water	--	--	X^m	X
Effluent	N	680-216287-2	Water	--	--	X^m	X
Influent	N	680-216329-1	Water	X	X	X	X
Effluent	N	680-216329-2	Water	X	X	X[1]	X

Sample Type: N – Normal X^m – Matrix Spike/ Matrix Spike Duplicate -- - Not analyzed for this parameter

Analyses: Dissolved/Total Recoverable Metals (200.7) – Aluminum
General Chemistry (Total) – Total Suspended Solids (SM2540D), Total Volatile Suspended Solids (SM2540E), Total Kjeldahl Nitrogen (351.2), Nitrate as Nitrogen (N) (353.2), Nitrate/Nitrite as N (353.2), Nitrite as N (353.2), Total Phosphorous (365.1), Orthophosphate (365.1), Ammonia as N (350.1), Total Organic Carbon (5310B), Total Alkalinity (SM2320B), Chlorophyll a (SM10200)
[1]Analysis includes Carbonaceous Biological Oxygen Demand (CBOD) (SM5210B)
General Chemistry (Dissolved) – Dissolved Kjeldahl Nitrogen (351.2), Dissolved Nitrate/Nitrite (353.2), Dissolved Phosphorous (365.1), Dissolved Organic Carbon (5310B), Total Dissolved Nitrogen (Total Nitrogen)

This report contains the final results of the data validation conducted for water samples collected May 2022 for the Lake Jesup sampling. The sample results were presented in four data packages. The data review was conducted in accordance with National Functional Guidelines for Inorganic Superfund Methods Data Review (EPA November 2020), and evaluation of laboratory criteria, as applicable.

General Overall Assessment:

_______ Data are usable without qualification.
_______ Data are usable with qualification (noted below and summarized in Attachment A).
___X___ Some or all data are unusable for any purpose (noted below and summarized in Attachment A).

Case Narrative Comments: Any case narrative comments concerning data qualification were address was noted in the table below.

Trace level detects, reported between the method detection limit (MDL) and the practical quantitation limit (PQL), have been qualified as estimated (J lq). The other exceptions are covered in the following table.

Review Parameter	Criteria Met?	Comments
Chain of Custody & Sample Receipt	Yes	The samples were received by Eurofins TestAmerica Savannah, Eurofins Xenco, and ENCO Laboratories in good condition and were consistent with the accompanying chain of custody (COC). The cooler temperatures upon receipt were within the recommended ≤6 degrees Celsius (°C) temperature range.
Holding Times	No	With the exception noted below, the analyses were conducted within the method required holding time. **Data Package 680-216287-1** Due to a laboratory error, the analysis of nitrate as nitrogen (N) and nitrite as N on sample Influent (680-216329-1) and carbonaceous biochemical oxygen demand (CBOD), nitrite as N, and nitrate as N on sample Effluent (680-216329-2) were performed 4 to 5 hours after the method required holding time of 48 hours had expired. As a result, the associated non-detect results were qualified as unusable (R ht), detected results were qualified as estimated (J- ht).
Laboratory Blanks • Method Blank (MB)	No	With the exception listed in Table 1, the target analytes were not detected within the method blanks.
Matrix Quality Control • Matrix Spike/ Matrix Spike Duplicate **680-216122-1** Influent (Nitrite, Total/Dissolved Phosphorus Effluent (Dissolved Aluminum) **680-216287-1** Influent (Nitrite, Total Phosphorus) Effluent (Total Phosphorus) • Laboratory Duplicate **680-216122-1** Influent (TVS, TSS) Effluent (Alkalinity) **680-216287-1** Effluent (Alkalinity) • Total vs. Partial Analyses Kjeldahl Nitrogen, Nitrate/Nitrite, Phosphorous, Organic Carbon, Nitrogen (Total Nitrogen)	No	**Matrix Spike/ Matrix Spike Duplicate (MS/MSD)** With the exceptions listed in Table 2, the MS/MSD recoveries and relative percent differences (RPDs) met quality control criteria. An MS/MSD was not performed for total and dissolved Kjeldahl nitrogen, total and dissolved nitrate-nitrite as n, orthophosphate, ammonia, dissolved and total organic carbon. Therefore, there is no measure of accuracy and precision as it pertains to the sample matrix for this parameter. **Laboratory Duplicate** The comparison between results of the parent sample and laboratory duplicate met the criteria listed below. • When both the sample and duplicate values are >5x the practical quantitation limit (PQL) acceptable sampling and analytical precision is indicated by an RPD meeting laboratory limits. • Where the result for one or both analytes of the laboratory duplicate pair is <5xPQL, satisfactory precision is indicated if the absolute difference between the field duplicate results is <1xPQL. **Total vs. Partial Analyses** The following criteria were used to evaluate the total versus partial results: • In instances where the value for a partial analysis exceed that for a total analysis and both of the results are >5xPQL, the criterion utilized is that the two values should agree within ±30%. • In instances where the value for a partial analysis exceeds that for a total analysis and either of the results is <5xPQL, the absolute difference between the results is compared against an

Review Parameter	Criteria Met?	Comments
		evaluation criterion of 2xPQL. The total sample results and associated partial sample results met the concentration-dependent criteria.
Laboratory Performance • Laboratory Control Sample	Yes	One laboratory control sample (LCS) and/or laboratory control sample duplicate (LCSD) per method per analytical batch was prepared and analyzed. The LCS recoveries and LCS/LCSD RPDs were within the laboratory acceptance limits. These results are indicative of an acceptable level of accuracy and precision with respect to the analytical method. **Method 2540E Total Volatile Solids** For total volatile solids, the residue from the total suspended solids (TSS) is ignited to a constant weight at 550°C and the remaining solids represent the fixed suspended solids while the weight lost on ignition represents the volatile solids. An LCS/LCSD is analyzed for TSS; however, the LCS/LCSD are not ignited to a constant weight at 550°C, nor is a new LCS/LCSD prepared and analyzed. As an LCS/LCSD is not performed for total volatile solids, accuracy and precision with respect to the method could not be assessed for this parameter.
Field Quality Control • Trip Blank/Field Blank **680-216122-1** None reported in this data package **680-216287-1** None reported in this data package • Field Duplicate **680-216122-1** None reported in this data package **680-216287-1** None reported in this data package	NA	**Trip Blank/Field Blank** A trip blank was not applicable for the methods performed. A field blank was not submitted in these data packages. **Field Duplicate** A field duplicate was not performed on the samples in this data packages.
Non-detect results with unaltered reporting limits	No	Due to matrix interferences several samples were reported as non-detect at elevated reporting limits. These non-detect results will need to be evaluated with respect to project objectives.
Report	NA	**Data Package 680-216287-1** Due to laboratory error, the data package was revised as the sample collection time for sample Effluent was logged incorrectly. In addition, further clarification was provided in the case narrative concerning the 365.1 total phosphorus method blank association. There were no changes to the sample analytical results; therefore, further action was considered unnecessary.
Package Completeness	Yes	The results are usable as qualified for the project objective. The data are greater than 94% complete.

ºC – Degrees Celsius
% – Percent
≤ – Less Than or Equal To
> – Greater Than
± – Plus or Minus
CBOD – Carbonaceous Biological Oxygen Demand
COC – Chain of Custody
ID - Identification
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
MDL – Method Detection Limit
MS – Matrix Spike
MSD – Matrix Spike Duplicate
N – Nitrogen
P - Phosphorus
PQL – Practical Quantitation Limit
RPDs – Relative Percent Differences
TKN – Total Kjeldahl Nitrogen
TSS – Total Suspended Solids
TVS – Total Volatile Solids

Qualifiers
J – Estimated
J- – Estimated, Low Bias
R – Unusable

Reason Codes
ht – Holding Time
lq – Result detected between the MDL and PQL.

Table 1: Laboratory Blank Outliers and Resultant Data Qualification

Laboratory Blank/ Associated Samples	Analyte	Concentration	Qualification
Data Package 680-216287-1			
MB 860-57403/31-A Effluent	Total Phosphorus as P	0.0167 mg/L	The associated sample result was non-detect; therefore, qualification was considered unnecessary.

MB – Method Blank
mg/L – Milligrams per Liter
P - Phosphorus

Table 2: MS/MSD Recovery and RPD Outliers and Resultant Data Qualification

Associated Samples	Analyte	%R (Limits)	RPD (Limit)	Qualification
Data Package 680-216122-1				
Influent	Phosphorus, dissolved	**130/126** (90-110)	3 (20)	As the potential bias was considered to be high, and the associated sample results were non-detect, qualification was considered unnecessary.
	Total Phosphorus as P	**130/126** (90-110)	3 (20)	

Bold - indicates a value that is outside of acceptance limits
% – Percent
%R – Percent Recoveries
P - Phosphorus
RPD – Relative Percent Difference

Attachment A: Summary of Qualified Data
Lake Jesup - May 2022

SDG	LAB ID	SAMPLE	MATRIX	METHOD	ANALYTE	UNITS	RESULT	DETECTED	PQL	MDL	DILUTION	FRACTION	QUALIFIERS	REASON CODE
680-216122-1	680-216122-1	Influent	Water	200.7	Dissolved Aluminum	mg/L	0.072	YES	0.2	0.054	1	Dissolved	J	lq
680-216122-1	680-216122-2	Effluent	Water	200.7	Dissolved Aluminum	mg/L	0.13	YES	0.2	0.054	1	Dissolved	J	lq
680-216122-1	680-216122-2	Effluent	Water	365.1	Total Phosphorus as P	mg/L	0.012	YES	0.02	0.0096	1	Total	J	lq
680-216287-1	680-216329-1	Influent	Water	353.2	Nitrate-Nitrite, Dissolved	mg/L	0.015	YES	0.05	0.01	1	Dissolved	J	lq
680-216287-1	680-216329-1	Influent	Water	353.2	Nitrite as N	mg/L	0.01	NO	0.05	0.01	1	Total	R	ht
680-216287-1	680-216329-1	Influent	Water	Nitrate by calc	Nitrate as N	mg/L	0.01	NO	0.05	0.01	1	Total	R	ht
680-216287-1	680-216329-2	Effluent	Water	200.7	Dissolved Aluminum	mg/L	0.12	YES	0.2	0.054	1	Dissolved	J	lq
680-216287-1	680-216329-2	Effluent	Water	353.2	Nitrate Nitrite as N	mg/L	0.015	YES	0.05	0.01	1	Total	J	lq
680-216287-1	680-216329-2	Effluent	Water	353.2	Nitrate-Nitrite, Dissolved	mg/L	0.01	YES	0.05	0.01	1	Dissolved	J	lq
680-216287-1	680-216329-2	Effluent	Water	353.2	Nitrite as N	mg/L	0.01	NO	0.05	0.01	1	Total	R	ht
680-216287-1	680-216329-2	Effluent	Water	Nitrate by calc	Nitrate as N	mg/L	0.015	YES	0.05	0.01	1	Total	J-	lq,ht
680-216287-1	680-216329-2	Effluent	Water	SM 5210B CBOD	Carbonaceous Biochemical Oxygen Demand	mg/L	2	NO	2	2	1	Total	R	ht

Definitions

ID	Identification
mg/L	Miligrams Per Liter
MDL	Method Detection Limit
PQL	Practical Quantitation Limit

Qualifiers

J-	Estimated, Low Bias
J	Estimated
R	Unusable

Reason Codes

ht	Holding Time
lq	Result Detected Between the MDL and PQL

Appendix C Analysis of Reversals

Appendix B

Analysis of Reversals

Analyte (mg/L)	Method Detection Limit (mg/L)	9/15/2021 Influent			9/15/2021 Effluent			9/22/2021 Influent			9/22/2021 Effluent			10/6/2021 Influent			10/6/2021 Effluent		
		Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)
Aluminum	0.024, 0.054	1.1			0.070	J		0.030	J		0.30			0.070	J		0.32		
Aluminum, Dissolved	0.024, 0.054	0.093	J		0.024	U		0.024	U		0.083	J		0.032	J		0.10	J	
% dissolved		8%			34%			80%			28%			46%			31%		
Organic Carbon, Total	0.50	16			10			15			9.9			15			11		
Organic Carbon, Dissolved	0.50	16			9.9			15			10			16			11		
% dissolved		100%			99%			100%			101%			107%			100%		
Nitrogen, Kjeldahl	1.00	2.3			0.76			2.5			0.88			2.1			0.56	Rw	
Nitrogen, Kjeldahl, Dissolved	0.10	2.5			0.78			0.79			0.62			0.75			0.77	Rw	
% dissolved		109%			103%			32%			70%			36%			138%		
Nitrate Nitrite as N	0.010	0.010	U		0.010	U			R			R		0.010	U		0.010	U	
Nitrate Nitrite as N, Dissolved	0.010	0.010	U		0.010	U		0.010	U		0.010	U		0.010	J-		0.010	U	
% dissolved		100%			100%			#VALUE!			#VALUE!			100%			100%		
Nitrate Nitrite as N	0.010	0.010	U		0.010	U			R			R		0.010	U		0.010	U	
Nitrite as N	0.010	0.010	U		0.010	U			R			R			R		0.010	U	
% NO2		100%			100%			#VALUE!			#VALUE!			#VALUE!			100%		
Nitrogen, Total	0.11	2.3			0.76			2.5		Rp	0.88		Rp	2.1			0.56	Rp	
Nitrogen, Total Dissolved	0.11	2.5			0.78			0.79			0.62			0.76	Q		0.77	Rp	
% dissolved		109%			103%			32%			70%			36%			138%		
Nitrate as N	0.010	0.010	U		0.010	U			R			R		0.010	J-	Rp	0.010	U	
Missing part (NO3NO2, NO2)?														Yes					
Phosphorus as P, Total	0.0096	0.076			0.0096	U		0.087			0.0096	U		0.084			0.0096	U	
Phosphorus as P, Total Dissolved	0.0096	0.0096	U		0.0096	U		0.0096	U		0.0096	U		0.0096	U		0.0096	U	
% dissolved		13%			100%			11%			100%			11%			100%		
Phosphorus as P, Total	0.0096	0.076			0.0096	U		0.087			0.0096	U		0.084			0.0096	U	
Orthophosphate as P	0.0050	0.051			0.0050	UJ		0.036	J-			R		0.0050	U		0.0050	U	
% PO4		67%			52%			41%			#VALUE!			6%			52%		
Total Volatile Suspended Solids	Varies	50	U		10	U		50	U		6.7	U		30			17	U	
Total Suspended Solids	Varies	49			6.8			30			4.3			30			8.3	U	
% Volatile		Cannot be computed due to variable MDL						Cannot be computed due to variable MDL						Cannot be computed due to variable MDL					

Notes:

J: Estimated

J-: Estimated, low bias

J+: Estimated, High bias

J3: Estimated value; value may not be accurate. Spike recovery or RPD outside of criteria

R: Unusable

Rp: parts or fractions of the associated sample analyte results are missing (not analyzed or rejected)

Rw: sum of reported parts or fractions for the associated sample analyte results exceeds 120% of the corresponding reported or calculated whole

UJ:Estimated

Appendix B

Analysis of Reversals

Analyte (mg/L)	11/10/2021			11/10/2021			12/1/2021			12/1/2021			12/15/2021			12/15/2021		
	Influent			Effluent			Influent			Effluent			Influent			Effluent		
	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)
Aluminum	0.024	U		0.40			0.099	I		0.48			0.16	I		1.3		
Aluminum, Dissolved	0.024	U		0.024	U		0.024	U		0.041	I		0.024	U		0.070	I	
% dissolved	100%			6%			24%			9%			15%			5%		
Organic Carbon, Total	20			13			15			11			16			12		
Organic Carbon, Dissolved	15			11			17			12			15			12		
% dissolved	75%			85%			113%			109%			94%			100%		
Nitrogen, Kjeldahl	2.4			1.1			0.81			0.72			2.2		Rw	0.98		
Nitrogen, Kjeldahl, Dissolved	1.2			0.68			0.93			0.72			2.9		Rw	1.0		
% dissolved	50%			62%			115%			100%			132%			102%		
Nitrate Nitrite as N	0.083			0.091			0.010	U		0.010	U		0.012	I	Rw	0.011	I	
Nitrate Nitrite as N, Dissolved	0.083			0.091			0.010	U		0.010	U		0.049	I	Rw	0.010	U	
% dissolved	100%			100%			100%			100%			408%			91%		
Nitrate Nitrite as N	0.083			0.091			0.010	U		0.010	U		0.012	I	Rw	0.011	I	
Nitrite as N	0.010	U		0.010	U		0.010	U		0.010	U		0.017	I		0.011	U	
% NO2	12%			11%			100%			100%			142%			100%		
Nitrogen, Total	2.5			1.1			0.81			0.72			2.2		Rp	0.99		
Nitrogen, Total Dissolved	1.3			0.77			0.93			0.72			2.9		Rp	1.0		
% dissolved	52%			70%			115%			100%			132%			101%		
Nitrate as N	0.010	U		0.010	U		0.010	U		0.010	U		0.010	U	Rp	0.010	U	
Missing part (NO3NO2, NO2)?													Yes					
Phosphorus as P, Total	0.049			0.011	J		0.063			0.0096	U		0.055			0.0096	U	
Phosphorus as P, Total Dissolved	0.0096	U		0.0096	U		0.0096	U		0.0096	U		0.0096	U		0.0096	U	
% dissolved	20%			87%			15%			100%			17%			100%		
Phosphorus as P, Total	0.049			0.011	J		0.063			0.0096	U		0.055			0.0096	U	
Orthophosphate as P	0.0240	J-		0.0050	U		0.0410	Q J3		0.013		Rw	0.0360	J3		0.0050	U	
% PO4	49%			45%			65%			135%			65%			52%		
Total Volatile Suspended Solids	26			17	U		29			10	U		26			10	U	
Total Suspended Solids	31			8.3	U		32			9.0			35			8.6		
% Volatile	Cannot be computed due to variable MDL						Cannot be computed due to variable MDL						Cannot be computed due to variable MDL					

Notes:

J: Estimated

J-: Estimated, low bias

J+: Estimated, High bias

J3: Estimated value; value may not be accurate. Spike recovery or RPD outside of criteria

R: Unusable

Rp: parts or fractions of the associated sample analyte results are missing (not analyzed or rejected)

Rw: sum of reported parts or fractions for the associated sample analyte results exceeds 120% of the corresponding reported or calculated whole

UJ:Estimated

Appendix B
Analysis of Reversals

Analyte (mg/L)	1/5/2022 Influent			1/5/2022 Effluent			1/19/2022 Influent			1/19/2022 Effluent			1/26/2022 Influent			1/26/2022 Effluent		
	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)
Aluminum	0.13	J		0.39			0.17	J		0.38			0.14	J		0.054	U	
Aluminum, Dissolved	0.024	U		0.074	J		0.024	U		0.024	U		0.054	U		0.054	U	
% dissolved	18%			19%			14%			6%			39%			100%		
Organic Carbon, Total	16	J+		11			16			9.7			17			17		
Organic Carbon, Dissolved	16			11			15			8.8			16			17		
% dissolved	100%			100%			94%			91%			94%			100%		
Nitrogen, Kjeldahl	2.6			0.54			0.93			0.89			0.88			1.4		
Nitrogen, Kjeldahl, Dissolved	0.85			0.45			0.75			0.45			0.76			0.76		
% dissolved	33%			83%			81%			51%			86%			54%		
Nitrate Nitrite as N	0.010	U		0.010	U		0.010	U		0.010	U		0.010	U		0.010	U	
Nitrate Nitrite as N, Dissolved	0.010	U		0.010	U		0.010	U		0.010	U		0.010	U		0.010	U	
% dissolved	100%			100%			100%			100%			100%			100%		
Nitrate Nitrite as N	0.010	U		0.010	U		0.010	U		0.010	U		0.010	U		0.010	U	
Nitrite as N	0.010	U		0.010	U			nd			nd			nd			nd	
% NO2	100%			100%			0%			0%			0%			0%		
Nitrogen, Total	2.6			0.54			0.93			0.89			0.88			1.4		
Nitrogen, Total Dissolved	0.85			0.45			0.75			0.45			0.76			0.76		
% dissolved	33%			83%			81%			51%			86%			54%		
Nitrate as N	0.010	U		0.010	U		0.010	U		0.010	U		0.010	U		0.010	U	
Missing part (NO3NO2, NO2)?																		
Phosphorus as P, Total	0.096			0.011	J		0.090			0.0096	U		0.097			0.060		
Phosphorus as P, Total Dissolved	0.0096	U		0.0096	U		0.0096	U		0.0096	U		0.0096	U		0.0096	U	
% dissolved	10%			87%			11%			100%			10%			16%		
Phosphorus as P, Total	0.096			0.011	J		0.090			0.0096	U		0.097			0.060		
Orthophosphate as P	0.059	J-		0.0088			0.061	J-		0.0078			0.055			0.040		
% PO4	61%			80%			68%			81%			57%			67%		
Total Volatile Suspended Solids	34			10	U		50	U		17	U		50	U		50	U	
Total Suspended Solids	38			9.4			43			8.3	U		39			25	U	
% Volatile	Cannot be computed due to variable MDL						Cannot be computed due to variable MDL						Cannot be computed due to variable MDL					

Notes:
J: Estimated
J-: Estimated, low bias
J+: Estimated, High bias
J3: Estimated value; value may not be accurate. Spike recovery or RPD outside of criteria
R: Unusable
Rp: parts or fractions of the associated sample analyte results are missing (not analyzed or rejected)
Rw: sum of reported parts or fractions for the associated sample analyte results exceeds 120% of the corresponding reported or calculated whole
UJ:Estimated

Appendix B

Analysis of Reversals

Analyte (mg/L)	2/9/2022 Influent			2/9/2022 Effluent			2/16/2022 Influent			2/16/2022 Effluent			2/23/2022 Influent			2/23/2022 Effluent		
	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)
Aluminum	0.054	U	Rw	0.11	J		0.12	J		0.054	U		0.11	J		0.054	U	
Aluminum, Dissolved	0.095	J	Rw	0.054	U		0.054	U		0.054	U		0.054	U		0.054	U	
% dissolved	176%			49%			45%			100%			49%			100%		
Organic Carbon, Total	16			17			18			19			18			19		
Organic Carbon, Dissolved	17			18			17			18			18			19		
% dissolved	106%			106%			94%			95%			100%			100%		
Nitrogen, Kjeldahl	2.9			2.0			2.2			1.9			2.2		Rw	2.1		Rw
Nitrogen, Kjeldahl, Dissolved	0.77			0.83			2.4			2.2			2.8		Rw	2.9		Rw
% dissolved	27%			42%			109%			116%			127%			138%		
Nitrate Nitrite as N	0.010	U		0.010	U		0.010	U		0.010	U		0.010	U		0.010	U	
Nitrate Nitrite as N, Dissolved	0.010	U		0.010	U		0.010	U		0.010	U		0.010	U		0.010	U	
% dissolved	100%			100%			100%			100%			100%			100%		
Nitrate Nitrite as N	0.010	U		0.010	U		0.010	U		0.010	U		0.010	U		0.010	U	
Nitrite as N	0.010	U		0.010	U		0.010	U		0.010	U		0.010	U		0.010	U	
% NO2	100%			100%			100%			100%			100%			100%		
Nitrogen, Total	2.9			2.0			2.2			1.9			2.2		Rp	2.1		Rp
Nitrogen, Total Dissolved	0.77			0.83			2.4			2.2			2.8		Rp	2.9		Rp
% dissolved	27%			42%			109%			116%			127%			138%		
Nitrate as N	0.010	U		0.010	U			NA			NA		0.010	U		0.010	U	
Missing part (NO3NO2, NO2)?																		
Phosphorus as P, Total	0.042			0.035			0.062			0.0096	U		0.068			0.052		
Phosphorus as P, Total Dissolved	0.0096	U		0.0096	U		0.0096	U		0.0096	U		0.0096	U		0.0096	U	
% dissolved	23%			27%			15%			100%			14%			18%		
Phosphorus as P, Total	0.042			0.035			0.062			0.0096	U		0.068			0.052		
Orthophosphate as P	0.047	J-		0.032	J-		0.057			0.032		RW	0.032	J-		0.0089	J-	
% PO4	112%			91%			92%			333%			47%			17%		
Total Volatile Suspended Solids	50	U		25	U		50	U		50	U		50	U		25		
Total Suspended Solids	39			23			40			26			37			22		
% Volatile	Cannot be computed due to variable MDL						Cannot be computed due to variable MDL						Cannot be computed due to variable MDL					

Notes:

J: Estimated

J-: Estimated, low bias

J+: Estimated, High bias

J3: Estimated value; value may not be accurate. Spike recovery or RPD outside of criteria

R: Unusable

Rp: parts or fractions of the associated sample analyte results are missing (not analyzed or rejected)

Rw: sum of reported parts or fractions for the associated sample analyte results exceeds 120% of the corresponding reported or calculated whole

UJ:Estimated

Appendix B

Analysis of Reversals

Analyte (mg/L)	3/2/2022 Influent			3/2/2022 Effluent			3/16/2022 Influent			3/16/2022 Effluent			3/24/2022 Influent			3/24/2022 Effluent		
	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)
Aluminum	0.24			0.061	J		0.054	U	Rw	0.054	U	Rw	0.30			0.30		
Aluminum, Dissolved	0.054	U		0.054	U		0.180	J	Rw	0.320		Rw	0.054	U		0.054	U	
% dissolved	23%			89%			333%			593%			18%			18%		
Organic Carbon, Total	19			19			16			10			15			9.1		
Organic Carbon, Dissolved	18			18			17			10			15			9.1		
% dissolved	95%			95%			106%			100%			100%			100%		
Nitrogen, Kjeldahl	3.1			2.6			0.96			0.98	J		2.6			0.84		
Nitrogen, Kjeldahl, Dissolved	1.2	U		0.74	U		0.49			0.66			0.63			0.44		
% dissolved	39%			28%			51%			67%			24%			52%		
Nitrate Nitrite as N	0.010	U		0.010	U		0.094			0.012	J	Rw	0.010	U	Rw	0.010	U J3	
Nitrate Nitrite as N, Dissolved	0.010	U		0.010	U		0.010	U		0.130		Rw	0.150		Rw	0.010	U	
% dissolved	100%			100%			11%			1083%			1500%			100%		
Nitrate Nitrite as N	0.010	U		0.010	U		0.094			0.012	J	Rw	0.010	U	Rw	0.010	U J3	
Nitrite as N	0.010	U		0.010	U			R			R		0.010	U		0.010	U	
% NO2	100%			100%			#VALUE!			#VALUE!			100%			100%		
Nitrogen, Total	3.1			2.6			0.96	J		0.98		Rp	2.6		Rp	0.84		
Nitrogen, Total Dissolved	1.2	U		0.74	U		0.49			0.79		Rp	0.78		Rp	0.44		
% dissolved	39%			28%			51%			81%			30%			52%		
Nitrate as N	0.010	U		0.010	U			R			R		0.010	U	Rp	0.010	U	
Missing part (NO3NO2, NO2)?							Yes			Yes			Yes					
Phosphorus as P, Total	0.030			0.016	J		0.091			0.016	J		0.075			0.0096	U	
Phosphorus as P, Total Dissolved	0.0096	U		0.0096	U		0.0096	U		0.0096	U		0.0096	U		0.0096	U	
% dissolved	32%			60%			11%			60%			13%			100%		
Phosphorus as P, Total	0.030			0.016	J		0.091			0.016	J		0.075			0.0096	U	
Orthophosphate as P	0.045	J-	Rw	0.022		Rw	0.081	J-		0.011	J-		0.035	J-		0.0050	U	
% PO4	150%			138%			89%			69%			47%			52%		
Total Volatile Suspended Solids	50	U		50	U		50	U		17	U		32			10	U	
Total Suspended Solids	50			25			48			8.3	U		40			5.0	U	
% Volatile	Cannot be computed due to variable MDL						Cannot be computed due to variable MDL						Cannot be computed due to variable MDL					

Notes:

J: Estimated

J-: Estimated, low bias

J+: Estimated, High bias

J3: Estimated value; value may not be accurate. Spike recovery or RPD outside of criteria

R: Unusable

Rp: parts or fractions of the associated sample analyte results are missing (not analyzed or rejected)

Rw: sum of reported parts or fractions for the associated sample analyte results exceeds 120% of the corresponding reported or calculated whole

UJ:Estimated

Appendix B

Analysis of Reversals

Analyte (mg/L)	3/30/2022			3/30/2022			4/7/2022			4/7/2022			4/13/2022			4/13/2022		
	Influent			Effluent			Influent			Effluent			Influent			Effluent		
	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)
Aluminum	0.19	J		0.34			0.37			0.65			0.26			0.32		
Aluminum, Dissolved	0.054	U		0.054	U		0.054	U		0.054	U		0.054	U		0.068	J	
% dissolved	28%			16%			15%			8%			21%			21%		
Organic Carbon, Total	15			9.6			8.7	J		13			14			9.0		
Organic Carbon, Dissolved	16			9.7			9.2	J		13			14			8.9		
% dissolved	107%			101%			106%			100%			100%			99%		
Nitrogen, Kjeldahl	1.8			0.81			1.4			0.54			1.4			0.66		
Nitrogen, Kjeldahl, Dissolved	0.66			0.54			0.76			0.46			0.8			0.64		
% dissolved	37%			67%			54%			85%			57%			97%		
Nitrate Nitrite as N	0.010	U		0.011	I		0.010	U		0.010	U		0.010	U		0.010	U	
Nitrate Nitrite as N, Dissolved	0.010	U		0.010	U		0.010	U		0.010	U		0.010	U		0.010	U	
% dissolved	100%			91%			100%			100%			100%			100%		
Nitrate Nitrite as N	0.010	U		0.011	I		0.010	U		0.010	U		0.010	U		0.010	U	
Nitrite as N	0.015	J	Rw	0.010	U		0.010	U		0.010	U			R			R	
% NO2	150%			91%			100%			100%			#VALUE!			#VALUE!		
Nitrogen, Total	1.8			0.81			1.4			0.54			1.4			0.66		
Nitrogen, Total Dissolved	0.66			0.54			0.76			0.46			0.8			0.64		
% dissolved	37%			67%			54%			85%			57%			97%		
Nitrate as N	0.015	I	Rp	0.010	U		0.010	U		0.010	U			R			R	
Missing part (NO3NO2, NO2)?	Yes												Yes			Yes		
Phosphorus as P, Total	0.050			0.0096	U		0.052			0.0096	U		0.047			0.0096	U	
Phosphorus as P, Total Dissolved	0.0096	U		0.0096	U		0.0096	U		0.0096	U		0.0096	U		0.0096	U	
% dissolved	19%			100%			18%			100%			20%			100%		
Phosphorus as P, Total	0.050			0.0096	U		0.052			0.0096	U		0.047			0.0096	U	
Orthophosphate as P	0.031	J-		0.0050	U			R		0.0050	U		0.027			0.0050	U	
% PO4	62%			52%			#VALUE!			52%			57%			52%		
Total Volatile Suspended Solids	50	U		6.7	U		50	U		10	U		33	U		8.3	U	
Total Suspended Solids	31			3.3	U		47			5.0	U		33			4.2	U	
% Volatile	Cannot be computed due to variable MDL						Cannot be computed due to variable MDL						Cannot be computed due to variable MDL					

Notes:

J: Estimated

J-: Estimated, low bias

J+: Estimated, High bias

J3: Estimated value; value may not be accurate. Spike recovery or RPD outside of criteria

R: Unusable

Rp: parts or fractions of the associated sample analyte results are missing (not analyzed or rejected)

Rw: sum of reported parts or fractions for the associated sample analyte results exceeds 120% of the corresponding reported or calculated whole

UJ:Estimated

Appendix B

Analysis of Reversals

Analyte (mg/L)	5/26/2022 Influent			5/26/2022 Effluent			5/31/2022 Influent			5/31/2022 Effluent			Unusable Data - Counts			
	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Rw	Rp	R	Total
Aluminum	0.21			0.30			0.054	U		0.26			3	0	0	3
Aluminum, Dissolved	0.072	J		0.13	J		0.054	U		0.12	J		3	0	0	3
% dissolved	34%			43%			100%			46%						
Organic Carbon, Total	14			9.0			14			9.3			0	0	0	0
Organic Carbon, Dissolved	16			9.8			14			9.3			0	0	0	0
% dissolved	114%			109%			100%			100%						
Nitrogen, Kjeldahl	0.94			0.97			1.9			1.10			4	0	0	4
Nitrogen, Kjeldahl, Dissolved	0.58			0.44			0.84			0.53			4	0	0	4
% dissolved	62%			45%			44%			48%						
Nitrate Nitrite as N	0.010	U		0.010	U		0.010	U	Rw	0.015	J		4	0	2	6
Nitrate Nitrite as N, Dissolved	0.010	U		0.010	U		0.015	J	Rw	0.010	I		4	0	0	4
% dissolved	100%			100%			150%			67%						
Nitrate Nitrite as N	0.010	U		0.010	U		0.010	U	Rw	0.015	J		4	0	2	6
Nitrite as N	0.010	U		0.010	U			R		0.010	R		1	0	9	10
% NO2	100%			100%			#VALUE!			67%						
Nitrogen, Total	0.94			0.97			1.9		Rp	1.10			0	9	0	9
Nitrogen, Total Dissolved	0.58			0.44			0.86		Rp	0.54			0	7	0	7
% dissolved	62%			45%			45%			49%						
Nitrate as N	0.010	U		0.010	U			R		0.015	J-		0	4	7	11
Missing part (NO3NO2, NO2)?							Yes									
Phosphorus as P, Total	0.062			0.012	J		0.086			0.010	U		0	0	0	0
Phosphorus as P, Total Dissolved	0.0096	U J3		0.0096	U		0.0290			0.0096	U		0	0	0	0
% dissolved	15%			80%			34%			100%						
Phosphorus as P, Total	0.062			0.012	J		0.086			0.010	U		0	0	0	0
Orthophosphate as P	0.041			0.0050	U		0.051			0.0050	U		4	0	2	6
% PO4	66%			42%			59%			52%						
Total Volatile Suspended Solids	50	U		10	U		51			8.1	U		0	0	0	0
Total Suspended Solids	47			5.0	U		52			4.0	U		0	0	0	0
% Volatile	Cannot be computed due to variable MDL						Cannot be computed due to variable MDL									
											Total		31	20	22	73

Notes:

J: Estimated

J-: Estimated, low bias

J+: Estimated, High bias

J3: Estimated value; value may not be accurate. Spike recovery or RPD outside of criteria

R: Unusable

Rp: parts or fractions of the associated sample analyte results are missing (not analyzed or rejected)

Rw: sum of reported parts or fractions for the associated sample analyte results exceeds 120% of the corresponding reported or calculated whole

UJ:Estimated

Appendix D Laboratory Water Quality Results

Appendix D

Laboratory Water Quality Results

Date:	Method Detection	9/15/2021				9/22/2021				10/6/2021				11/10/2021				12/1/2021				12/15/2021			
Time:	Limit	12:00		13:00		12:00		13:00		12:00		12:30		11:30		12:00		11:30		12:00		12:00		12:30	
Analyte	(mg/L)	Influent		Effluent		Influent		Effluent		Influent		Effluent		Influent		Effluent		Influent		Effluent		Influent		Effluent	
Aluminum	0.024, 0.054	1.1		0.070	J	0.030	J	0.30		0.070	J	0.32		0.024	U	0.40		0.099	I	0.48		0.16	I	1.3	
Aluminum, Dissolved	0.024, 0.054	0.093	J	0.024	U	0.024	U	0.083	J	0.032	J	0.10	J	0.024	U	0.024	U	0.024	U	0.041	I	0.024	U	0.070	I
Total Volatile Suspended Solids	Varies	50	U	10	U	50	U	6.7	U	30		17	U	26		17	U	29		10	U	26		10	U
Total Suspended Solids	Varies	49		6.8		30		4.3		30		8.3	U	31		8.3	U	32		9.0		35		8.6	
Alkalinity, Total	5.0	67		57		63		60		70		60		65		78		65		61		70		61	
Organic Carbon, Total	0.50	16		10		15		9.9		15		11		20		13		15		11		16		12	
Organic Carbon, Dissolved	0.50	16		9.9		15		10		16		11		15		11		17		12		15		12	
Carbonaceous Biochemical	2.0			3.1			NA	3.2	J-	NA		2.3			NA	3.3	J+		NA	2.0	U		NA	2.9	
Chlorophyll-a, Corrected (mg/m^3)	1.0	210		29		170		25		160		37		150	V	40	V	120	V	34	V	140	V	44	V
Nitrogen, Kjeldahl	0.10	2.3		0.76		2.5		0.88		2.1			Rw	2.4		1.1		0.81		0.72			Rw	0.98	
Nitrogen, Kjeldahl, Dissolved	0.10	2.5		0.78		0.79		0.62		0.75			Rw	1.2		0.68		0.93		0.72			Rw	1.0	
Nitrate as N	0.010	0.010	U	0.010	U		R		R		Rp	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U		Rp	0.010	U
Nitrate Nitrite as N	0.010	0.010	U	0.010	U		R		R	0.010	U	0.010	U	0.083		0.091		0.010	U	0.010	U		Rw	0.011	I
Nitrate Nitrite as N, Dissolved	0.010	0.010	U	0.010	U	0.010	U	0.010	U	0.010	J-	0.010	U	0.083		0.091		0.010	U	0.010	U		Rw	0.010	U
Nitrite as N	0.010	0.010	U	0.010	U		R		R		R	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.017	I	0.011	U
Ammonia	0.10	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U
Nitrogen, Total	0.10	2.3		0.76			Rp		Rp	2.1			Rp	2.5		1.1		0.81		0.72			Rp	0.99	
Nitrogen, Total Dissolved	0.10	2.5		0.78		0.79		0.62		0.76	Q		Rp	1.3		0.77		0.93		0.72			Rp	1.0	
Phosphorus as P, Total	0.0096	0.076		0.0096	U	0.087		0.0096	U	0.084		0.0096	U	0.049		0.011	J	0.063		0.0096	U	0.055		0.0096	U
Phosphorus as P, Total Dissolved	0.0096	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U
Orthophosphate as P	0.0050	0.051		0.0050	UJ	0.036	J-		R	0.0050	U	0.0050	U	0.0240	J-	0.0050	U	0.0410	Q J3		Rw	0.0360	J3	0.0050	U

Notes:

I: The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit

J3: Estimated value; value may not be accurate. Spike recovery or RPD outside of criteria

Q: Sample held beyond the accepted holding time

U: Indicates that the compound was anlyzed for but not detected

V: Indicates that the analyte was detected at or above the method detection limit in both the sample and the associated method

J: Estimated

UJ:Estimated

J-: Estimated, low bias

J+: Estimated, High bias

R: Unusable

Rp: parts or fractions of the associated sample analyte results are missing (not analyzed or rejected)

Rw: sum of reported parts or fractions for the associated sample analyte results exceeds 120% of the corresponding reported or calculated whole

Date:	1/5/2022				1/19/2022				1/26/2022				2/9/2022				2/16/2022				2/23/2022				3/2/2022			
Time:	**10:00**		**10:30**		**10:00**		**10:30**		**9:30**		**10:00**		**10:00**		**10:30**		**9:00**		**9:36**		**9:00**		**9:30**		**10:00**		**10:30**	
Analyte	**Influent**		**Effluent**		**Influent**		**Effluent**		**Influent**		**Effluent**		**Influent**		**Effluent**		**Influent**		**Effluent**		**Influent**		**Effluent**		**Influent**		**Effluent**	
Aluminum	0.13	J	0.39		0.17	J	0.38		0.14	J	0.054	U		Rw	0.11	J	0.12	J	0.054	U	0.11	J	0.054	U	0.24		0.061	J
Aluminum, Dissolved	0.024	U	0.074	J	0.024	U	0.024	U	0.054	U	0.054	U		Rw	0.054	U	0.054	U	0.054	U	0.054	U	0.054	U	0.054	U	0.054	U
Total Volatile Suspended Solids	34		10	U	50	U	17	U	50	U	50	U	50	U	25	U	50	U	50	U	50	U	25		50	U	50	U
Total Suspended Solids	38		9.4		43		8.3	U	39		25	U	39		23		40		26		37		22		50		25	
Alkalinity, Total	73		60		60	J-	64	J-	66		67		77		76		78		79		76		72		75		77	
Organic Carbon, Total	16	J+	11		16		9.7		17		17		16		17		18		19		18		19		19		19	
Organic Carbon, Dissolved	16		11		15		8.8		16		17		17		18		17		18		18		19		18		18	
Carbonaceous Biochemical		NA	6.0			NA	2.0	UJ		NA	11			NA	7.8			NA	20	J+		NA	21	J-		NA	20	J+
Chlorophyll-a, Corrected (mg/m3)	170		18		150		12		120		84		170		120		170		120		210		120		290		170	
Nitrogen, Kjeldahl	2.6		0.54		0.93		0.89		0.88		1.4		2.9		2.0		2.2		1.9			Rw		Rw	3.1		2.6	
Nitrogen, Kjeldahl, Dissolved	0.85		0.45		0.75		0.45		0.76		0.76		0.77		0.83		2.4		2.2			Rw		Rw	1.2	U	0.74	U
Nitrate as N	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U		NA		NA	0.010	U	0.010	U	0.010	U	0.010	U
Nitrate Nitrite as N	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U
Nitrate Nitrite as N, Dissolved	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U
Nitrite as N	0.010	U	0.010	U		NA		NA		NA		NA	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U
Ammonia	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.100	U	0.10	U	0.10	U
Nitrogen, Total	2.6		0.54		0.93		0.89		0.88		1.4		2.9		2.0		2.2		1.9			Rp		Rp	3.1		2.6	
Nitrogen, Total Dissolved	0.85		0.45		0.75		0.45		0.76		0.76		0.77		0.83		2.4		2.2			Rp		Rp	1.2	U	0.74	U
Phosphorus as P, Total	0.096		0.011	J	0.090		0.0096	U	0.097		0.060		0.042		0.035		0.062		0.0096	U	0.068		0.052		0.030		0.016	J
Phosphorus as P, Total Dissolved	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U
Orthophosphate as P	0.059	J-	0.0088		0.061	J-	0.0078		0.055		0.040		0.047	J-	0.032	J-	0.057			Rw	0.032	J-	0.0089	J-		Rw		Rw

Notes:
I: The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
J3: Estimated value; value may not be accurate. Spike recovery or RPD outside of criteria
Q: Sample held beyond the accepted holding time
U: Indicates that the compound was anlyzed for but not detected
V: Indicates that the analyte was detected at or above the method detection limit in both the sample and the associated method
J: Estimated
UJ:Estimated
J-: Estimated, low bias
J+: Estimated, High bias
R: Unusable
Rp: parts or fractions of the associated sample analyte results are missing (not analyzed or rejected)
Rw: sum of reported parts or fractions for the associated sample analyte results exceeds 120% of the corresponding reported or calculated whole

Appendix D

Laboratory Water Quality Results

Date:	3/16/2022				3/24/2022				3/30/2022				4/7/2022				4/13/2022				5/26/2022				5/31/2022			
Time:	**10:00**		**11:00**		**9:00**		**10:00**		**10:00**		**10:30**		**10:00**		**10:30**		**9:00**		**9:30**		**9:00**		**9:30**		**10:00**		**10:30**	
Analyte	**Influent**		**Effluent**		**Influent**		**Effluent**		**Influent**		**Effluent**		**Influent**		**Effluent**		**Influent**		**Effluent**		**Influent**		**Effluent**		**Influent**		**Effluent**	
Aluminum		Rw		Rw	0.30		0.30		0.19	J	0.34		0.37		0.65		0.26		0.32		0.21		0.30		0.054	U	0.26	
Aluminum, Dissolved		Rw		Rw	0.054	U	0.054	U	0.054	U	0.054	U	0.054	U	0.054	U	0.054	U	0.068	J	0.072	J	0.13	J	0.054	U	0.12	J
Total Volatile Suspended Solids	50	U	17	U	32		10	U	50	U	6.7	U	50	U	10	U	33	U	8.3	U	50	U	10	U	51		8.1	U
Total Suspended Solids	48		8.3	U	40		5.0	U	31		3.3	U	47		5.0	U	33		4.2	U	47		5.0	U	52		4.0	U
Alkalinity, Total	77		72		76		75		77		72		75		66		71		66		70		64		68		61	
Organic Carbon, Total	16		10		15		9.1		15		9.6		8.7	J	13		14		9.0		14		9.0		14		9.3	
Organic Carbon, Dissolved	17		10		15		9.1		16		9.7		9.2	J	13		14		8.9		16		9.8		14		9.3	
Carbonaceous Biochemical		NA	4.5	J-		NA	2	U		NA	5.0			NA	2.0	U		NA	2.0	U		NA	2.0	U		NA	2.0	R
Chlorophyll-a, Corrected (mg/m3)	220		51		110		6.5		68		4.9		80		5.9		63		3.0		100		11.0		75		9.3	
Nitrogen, Kjeldahl	0.96		0.98	J	2.6		0.84		1.8		0.81		1.4		0.54		1.4		0.66		0.94		0.97		1.9		1.10	
Nitrogen, Kjeldahl, Dissolved	0.49		0.66		0.63		0.44		0.66		0.54		0.76		0.46		0.8		0.64		0.58		0.44		0.84		0.53	
Nitrate as N		R		R		Rp	0.010	U		Rp	0.010	U	0.010	U	0.010	U		R		R	0.010	U	0.010	U		R	0.015	J-
Nitrate Nitrite as N	0.094			Rw		Rw	0.010	U J3	0.010	U	0.011	I	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U		Rw	0.015	J
Nitrate Nitrite as N, Dissolved	0.010	U		Rw		Rw	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U		Rw	0.010	I
Nitrite as N		R		R	0.010	U	0.010	U		Rw	0.010	U	0.010	U	0.010	U		R		R	0.010	U	0.010	U		R	0.010	R
Ammonia	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U
Nitrogen, Total	0.96	J		Rp		Rp	0.84		1.8		0.81		1.4		0.54		1.4		0.66		0.94		0.97			Rp	1.10	
Nitrogen, Total Dissolved	0.49			Rp		Rp	0.44		0.66		0.54		0.76		0.46		0.8		0.64		0.58		0.44			Rp	0.54	
Phosphorus as P, Total	0.091		0.016	J	0.075		0.0096	U	0.050		0.0096	U	0.052		0.0096	U	0.047		0.0096	U	0.062		0.012	J	0.086		0.010	U
Phosphorus as P, Total Dissolved	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U	0.0096	U J3	0.0096	U	0.0290		0.0096	U
Orthophosphate as P	0.081	J-	0.011	J-	0.035	J-	0.0050	U	0.031	J-	0.0050	U		R	0.0050	U	0.027		0.0050	U	0.041		0.0050	U	0.051		0.0050	U

Notes:

I: The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit

J3: Estimated value; value may not be accurate. Spike recovery or RPD outside of criteria

Q: Sample held beyond the accepted holding time

U: Indicates that the compound was anlyzed for but not detected

V: Indicates that the analyte was detected at or above the method detection limit in both the sample and the associated method

J: Estimated

UJ:Estimated

J-: Estimated, low bias

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R: Unusable

Rp: parts or fractions of the associated sample analyte results are missing (not analyzed or rejected)

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