FINAL

AECOM

Intact Cellular Algae Harvesting with Simultaneous Nutrient Export to Mitigate Harmful Algae Blooms (HABs)

Apalachee Regional Park (ARP) HAB and Nutrient Project

Northwest Florida Water Management District

Project number: 60631973

December 23, 2022

This report was funded under the Innovative Technologies for Harmful Algal Blooms Program through a grant agreement from the Florida Department of Environmental Protection. The views, statements, findings, conclusions, and recommendations expressed herein are those of the author(s) and do not necessarily reflect the views of the State of Florida or any of its subagencies.

81 Water Management Drive
Havana, FL 32333 4712

Delivering a better world

Quality information

Prepared by	Checked by	Verified by	Approved by
			
Tammy Karst-Riddoch, Ph.D. Senior Limnologist	William H. Colona III, PG Senior Project Geologist	William H. Colona III, P.G., Senior Project Geologist	Daniel J. Levy, P.G., Vice President, Environment, National Director, Algae

Jack Levy, GIT
Geologist, Project Scientist

Trevor Campbell
Environmental Scientist

Revision History

Revision	Revision date	Details	Authorized	Position
1	2.20.2023	Revised to address FDEP comments from 2.6.2023	Tammy Karst-Riddoch	Senior Limnologist

Distribution List

Association / Company Name
Northwest Florida Water Management District (NWFWMD)
Florida Department of Environmental Protection (FDEP)

Prepared for:

Northwest Florida Water Management District
81 Water Management Drive
Havana, FL 32333-4712

Executive Summary

In 2020, the Northwest Florida Water Management District (NWFWMD) 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 to Mitigate Harmful Algae Blooms (HABs)**. The NWFWMD contracted with AECOM Technical Services, Inc. (AECOM) to design and implement the project.

The purpose of the research project was to demonstrate an innovative, high-flow capacity algae harvesting system using AECOM's Hydronucleation Flotation Technology (HFT, previously known as Hydronucleation Flotation System) as a sustainable and environmentally safe lake management solution to address HABs in Leon County, Florida. The research aimed to generate representative operational and treatment efficiency data for a system operating over an approximate eight-month period spanning a range of water quality conditions and to document the environmental safety of the operations with respect to water and air quality.

The project was originally planned to be conducted at Lake Munson in Leon County. The study location was changed to ARP Pond shortly after the project was executed due unforeseen site conditions (low algae levels) at Lake Munson that were not suitable for the research. Prior to relocation, NWFWMD and AECOM co-hosted a media day event on June 12, 2021 at the Lake Munson site to showcase the project. The event was well attended with representatives from NWFWMD, FDEP, Leon County, and other local and state government entities as well as interested members of the public. AECOM staff provided tours of the harvester as well as bench-scale demonstrations to show how the technology works.

The project schedule was changed due to the relocation of the study location from Lake Munson to ARP Pond with the original project end date extended from Dec. 1, 2021 to March 1, 2023. All original work plan tasks were completed except for the modeling of nutrient loading into Wakulla Springs from Lake Munson, which was removed from the project tasks after the move to ARP Pond.

An algae harvester with HFT and a rated process flow of one million gallons per day (mgd) was tested for the project, with operations conducted on select days in each month from Nov. 17, 2021 through June 30, 2022. In total, the system was operated for 480 hours on 79 days, treating 14,475,864 gal of ARP Pond water. A total of 16,720 gal of slurry were generated; 66% of the slurry was disposed of at the Thomas P. Smith Wastewater Treatment Plant and the remainder was used for research by others.

Operations were performed using different combinations of coagulant (ACH) and organic flocculant (PT-2160), including:

- standard treatment [50 parts per million (ppm) ACH, 2 ppm PT-2160 and 20 ppm ACH, 1 ppm PT-2160]
- organic treatment (2 ppm PT-2160)
- coagulant only treatment (40 ppm ACH)

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

- Mixing speeds of 40% and 35% in the coagulant and flocculant chambers, respectively, to optimize floc formation
- A recycle flow rate between 25% and 30% of the influent flow rate for optimal nanobubble formation to assist algae floc flotation
- A float blanket skimming cycle of 0.5 and 1.2 skims per hour to maximize algae removal while reducing the water content of the recovered algae slurry

Monitoring of influent (raw water from ARP Pond entering the algae harvesting unit) and effluent (water discharged back to ARP Pond after treatment) during the project across a range of seasonal water quality conditions 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 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 using the ACH coagulant provides the greatest water quality benefits. The organic treatment shows promise as a viable alternative where the use of an organic option is needed (e.g., to reduce inorganic content of the algae slurry for beneficial reuse options).

Summary of Algae Harvesting Performance Metrics

Treatment Type	Parameter	Influent Concentration		Performance Metric			
				Effluent Concentration		% Reduction	
		Mean	Median	Mean	Median	Mean	Median
Standard (20 ppm ACH, 1 ppm PT-2160)	Chl-a (mg/m^3)	59	56	12	4	80%	94%
	TSS (mg/L)	11.1	11	5.1	5	54%	55%
	TP (mg/L)	0.074	0.078	0.015	0.0096	80%	88%
	TN (mg/L)	1.09	1.05	0.65	0.68	40%	45%
Organic (1 ppm PT-2160)	Chl-a (mg/m^3)	109	94	29	18	73%	81%
	TSS (mg/L)	13	11.5	6.3	5	54%	57%
	TP (mg/L)	0.091	0.079	0.026	0.022	71%	72%
	TN (mg/L)	1.30	0.97	0.81	0.69	37%	29%

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 chronic or acute toxicity to the tested organisms (*Ceriodaphnia dubia* and *Pimephales promelas*).

In conclusion, the 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 ARP Pond and other similarly nutrient-impacted waterbodies. By using the algae harvesting technology, the water quality in ARP pond can be restored to provide a safe recreational asset to Leon County and its residents.

Based on the results of this project, it is recommended that a 1-mgd algae harvester be purchased or leased to provide the County with the equipment necessary to restore water quality in ARP Pond while protecting human health and the environment. A 1-mgd harvester operated daily for eight hours per day would be able to treat the equivalent of the full volume of water in ARP Pond (13.8 million gallons of water) in about 40 days and reduce total phosphorus concentration in the pond by as much as 46% thus significantly reducing the threat of HABs. More information on the sources of nutrients and water is needed to understand how long the harvester would need to be operated. It is anticipated that after the initial period of continuous operations, the harvesting would be able to be reduced to maintain the health of the lake thus reducing operational costs.

Abbreviations

Abbreviation/Acronym	Definition
µg/L	microgram per liter
A	ampere
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
GAC	granular activated carbon
gal	gallon(s)
HAB	Harmful Algal Bloom
HFS	Hydronucleation 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
MOR	Monthly Operating Report
ng/m^3	nanograms per cubic meter
NOD	nodularin
NWFWMD	Northwest Florida Water Management District
PT-2160	Polytec 2160
QAPP	Quality Assurance Project Plan
SD	standard deviation
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**.*

Table of Contents

Figures

Tables

1. Introduction

In 2020, the Northwest Florida Water Management District (NWFWMD) 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 to Mitigate Harmful Algae Blooms (HABs)** [Apalachee Regional Park (ARP) Pond HAB and Nutrient Removal Project][1]. The NWFWMD contracted with AECOM Technical Services, Inc. (AECOM) to design and implement the project.

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 social, economic, and environmental damages caused by HABs can be mitigated in the near term.

Over the years, several in-lake techniques have been developed to manage HABs. 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 these methods often have limited or short-term success in shallow lakes and can be cost-prohibitive for large water bodies. Algae harvesting with innovative Hydronucleation Flotation Technology (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 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 and is removed by a skimmer. Clean, clear, and low-nutrient water is returned to the water body providing multiple benefits to reduce the risk of HABs. The recovered algae biomass can be beneficially used as bioplastics, biocrude, biogas, and biofertilizer, to reduce waste and offset treatment costs.

Several pilot projects have documented the effectiveness of algae harvesting with 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 total nitrogen (TN) (AECOM, 2019; Paige et al., 2020, 2021). These studies used a small algae harvester with a capacity to treat flows up to about 120 gallons per minute (gpm). While extremely effective in these demonstration projects, up-scaling of the HFT technology for broad application requires further study to determine its effectiveness at higher treatment flows and 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 by the HFT. 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 conditioners may need to be adjusted over the course of a full-scale treatment to optimize performance.

[1] The project was originally planned to be conducted at Lake Munson, Leon County, FL. The study location was changed to ARP Pond shortly after the project was executed due unforeseen site conditions (low algae levels) at Lake Munson that were not suitable for the project.

The purpose of this research project was to demonstrate the use of a high flow capacity HFT algae harvester (700 gpm) as a sustainable and environmentally safe management tool to effectively address eutrophication and HABs. The research was intended to generate representative operational and treatment efficiency data under varying environmental conditions over an approximate seven to ten-month operational period at Apalachee Regional Park (ARP) Pond, Leon County, FL. The project was originally planned to be conducted at Lake Munson, Leon County, FL. The study location was changed to ARP Pond shortly after the project was executed due unforeseen site conditions (low algae levels) at Lake Munson that were not suitable for the project.

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
- An improved understanding of treatment optimization (e.g., coagulant/flocculant usage) for successful application of the technology over variable physical, chemical, and biological conditions
- 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

Ultimately, the information gained from this research will be useful to support the development of an optimal algae harvesting treatment plan as an innovative tool to help mitigate HABs and associated water quality concerns in other nutrient-impacted waterbodies in Florida and the nation.

This Final Report documents the activities and findings of the ARP Pond HAB and Nutrient Removal Project.[2]

2. Project Location

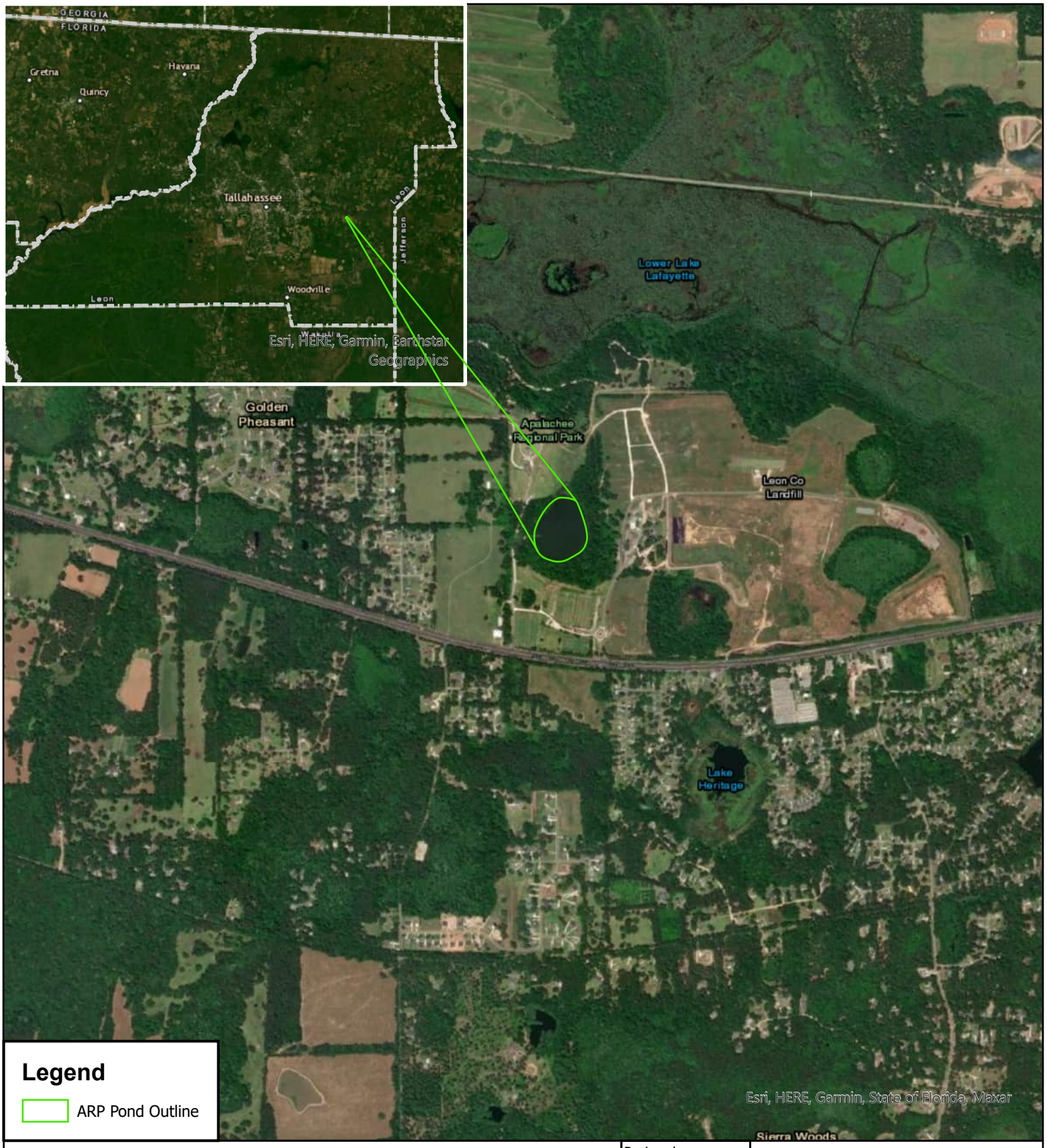
The study location in the original approved scope of work for the project was Lake Munson. Prior to system startup and shake-down operations (June 21 to July 9, 2021) phytoplankton concentrations were very low at Lake Munson. This condition was documented by field instruments and water quality laboratory analysis performed in accordance with the approved Quality Assurance Project Plan (QAPP). Similarly, from the time operations began (July 12, 2021) phytoplankton concentrations remained low and a discussion was initiated to suspend operations and identify another water body located in Leon County, Florida that exhibited conditions more favorable for meeting the design objectives of the Lake Munson pilot demonstration project. System operations at Lake Munson were halted on July 29, 2021.

Field screening of nine waterbodies identified by the NWFWMD, all located within Leon County, Florida was conducted by AECOM and the NWFWMD in late-August and early September 2021. AECOM and the NWFWMD selected ARP Pond as an alternate site for the project following field screening of nine waterbodies in Leon County and with approval by FDEP.

The screening exercise identified an approximate 10-acre pond with favorable conditions for algae harvesting in ARP (**Figure 1**). The ARP is located east of Tallahassee, Florida on the north side of US Highway 27, referred to locally as Apalachee Parkway. As with the Lake Munson site, the ARP Pond is located on property owned by Leon County, Florida, and operated by the Leon County Parks and Recreation Department (LCPRD). Details of the screening exercise are provided in the Monthly Operating Report No. 2 Revision 1 (May 9, 2022) prepared by AECOM for the NWFWMD.

During a site visit on September 20, 2021, NWFWMD, LCPRD, and AECOM agreed that ARP Pond was a suitable site for relocating the Lake Munson treatment system, and the recommended move was agreed upon by FDEP.

[2] The results of activities performed at the Lake Munson site are documented in a System Installation and Startup Report (Jan. 24, 2022) and a Monthly Operating Report (MOR) (May 9, 2022) prepared for the NWFWMD and approved by FDEP, and not included in this Final Report.



Legend

ARP Pond Outline

Parcel ID: 3204208510000
7550 Apalachee Pkwy,
Tallahassee, FL 32311

N
W E
S

0 0.13 0.25 0.5 Miles

AECOM

Designed	TC
Drawn	JRL
Checked	TC
Peer Review	TKR
Project Manager	AM
Project Number	60631973

Figure 1

Project Location

12/28/2022

3. Project Schedule and Financial Summary

AECOM's contract with NWFWMD for the project was executed June 10, 2020, and effective through to May 1, 2022. The contract was extended and the timeline to complete the project tasks and deliverables was changed to March 1, 2023, with approval by FDEP to accommodate the additional time needed to relocate the project site from Lake Munson to ARP Pond. The end dates for the project tasks and deliverables were also extended in the agreement between NWFWMD and FDEP (**Table 1**) with a final project end date of March 1, 2023. All tasks and deliverables were completed within the final approved project schedule end date of March 1, 2023 as per the agreement between NWFWMD and FDEP. The original scope of work included modeling of nutrient loads from Lake Munson to Wakulla Springs, but this task was removed from the scope following the change in project location to the ARP Pond site.

Table 1. Project Schedule per NWFWMD and FDEP Agreement

Task/Deliverable	Original End Date	Amended End Date
Draft Quality Assurance Project Plan	07/01/2019	12/31/2022
Final Quality Assurance Project Plan	07/01/2019	12/31/2022
Design and Permitting	07/01/2019	12/31/2022
Site Preparation, Installation and System Start-up	07/01/2019	12/31/2022
Site Operation, Maintenance and Monitoring	07/01/2019	09/30/2022
Decommissioning/Site Restoration	07/01/2019	09/30/2022
Draft Final Report	07/01/2019	09/15/2022
Final Report	07/01/2019	10/15/2022

The actual cost of the project was equal to the original approved budget of $1,646,630.

4. Activities

4.1 Permitting and Planning

The permits obtained for the project included:

- FDEP - Industrial Wastewater Permit No. FL0A00016-001-IW7B (Feb. 12, 2021)
- Leon County - Environmental Management Permit LEM20-00074 (Nov. 10, 2020)
- Leon County – Temporary Construction Staging Permit LDV2000555 (Lake Munson) (Dec. 20, 2020)
- City of Tallahassee - Discharge Permit # 20200507-003 (July 27, 2020)

Approvals were obtained from the permitting entities for the relocation of the project site to ARP pond as follows:

- FDEP – Written approval from Katie Ates, FDEP, Northwest District, Water & Wastewater Permitting on Oct. 5, 2021
- Leon County – Written approval from Nawfal R. Ezzagaghi, P.E., Director, Leon County Environmental Services Division on Oct. 1, 2021
- City of Tallahassee – Written approval from Cory Seay, Supervisor (Aquifer Protection & Industrial Pretreatment), City of Tallahassee - Underground Utilities & Public Infrastructure on Oct. 7, 2021

Other project-related approvals and plans included:

- Quality Assurance Project Plan (QAPP) (approved by FDEP Dec. 9, 2020, revised March 11, 2022)

- Site Access License Agreement, Leon County, Gil Wates Preserve Park (Lake Munson) (Sep. 22, 2020)
- Safety, Health, and Environment Plan (Aug. 31, 2020)

4.2 Mobilization, System Installation and Start-Up

The algae harvester with HFT and a rated process flow of 700 gpm, or 1 mgd, used for this project was designed and fabricated by AECOM and Ecosa Process Technologies. The unit was scaled to be the maximum size that can be transported on US highways by tractor trailer without the need for special permits to facilitate transport. Diagrams showing the process flow and general arrangement of the treatment system are provided in **Appendix A**.

Site preparation and system mobilization, installation and start-up occurred from Nov. 3 to Nov. 11, 2021 at the ARP project site. The site layout showing the position of major equipment and the intake and discharge pipes are illustrated in **Figure 2**. These activities were also completed at the Lake Munson site between April 1 and July 9, 2021 as documented in the System Installation and Startup Report (Jan. 24, 2022).

Bench testing was performed on ARP Pond water collected near the intake assembly of the algae harvester during mobilization. The water samples 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 for testing in this project based on their previous good performance at similar freshwater pilot study sites in Florida. Based on results of the bench testing, a dose of 50 parts per million (ppm) for ACH and 2 ppm for PT-2160 provided suitable algae floc characteristics for effective separation of the algae from water and was used for standard operations. The treatment was altered during operations to test other combinations of ACH and PT-2160 as described in **Section 4.3**.

Details of the mobilization, installation, and start-up including maps and photologs are provided in the Monthly Operating Report No. 2, Revision 1 (May 9, 2022) prepared by AECOM for the NWFWMD.

4.3 Operations

Algae harvesting at Lake Munson and ARP Pond was conducted on select days during each month of project operations as summarized in **Table 2** with scheduling based on available staff and lake and weather conditions. The system was typically operational between 9:00 EST and 16:00 EST, with start and end times varying depending on several factors including system maintenance needs, weather, and specific research objectives. Operations were also performed continuously from 9:30 EST on May 11, 2022 to 11:00 EST on May 12, 2022 at ARP Pond to document system performance with diurnal changes in pond algae levels. In total, the system was operated at Lake Munson for 19.08 hours on 5 days from July 12, 2021 through July 29, 2021 and at Lake Munson for 480 hours on 79 days from Nov. 17, 2021 through June 30, 2022.

Table 2. Algae Harvesting Operations Summary

Location	Month-Year	Days of Operation	Hours of Operation
Lake Munson	Jul-21	5	19.08
ARP Pond	Nov-21	3	15.00
	Dec-21	4	21.25
	Jan-22	8	41.75
	Feb-22	18	106.75
	Mar-22	6	38.25
	Apr-22	12	74.00
	May-22[1]	15	113.00
	Jun-22	13	70.00
Total		84	499.08

Notes: 1 - Includes continuous operations from 9:30 EST on May 11, 2022 to 11:00 EST on May 12, 2022 to document system performance with diurnal changes in algae levels.

Projected Coordinate System: NAD 1983 2011 StatePlane Florida North FIPS 0903 Ft US

Geographic Coordinate System: GCS NAD 1983 2011

AECOM

N
W E
S

0 90 180 360
Feet

Scale: 1:1,733

Designed	TC
Drawn	JRL
Checked	TC
Peer Review	TKR
Project Manager	AM
Project Number	60631973

Figure 2. ARP Pond Site Layout

Parcel ID: 3204208510000
7550 Apalachee Pkwy, Tallahassee, FL 32311

The algae harvester was operated at the target flow rate of 700 gpm ± 1% at Lake Munson, which is the rated flow capacity of the unit. Operations at ARP Pond used a lower target flow rate of 500 gpm ± 1%. The process water flow rate was limited to 500 gpm because supply chain issues made it necessary to use a 6-inch "lay flat" hose for the effluent discharge which tends to kink at higher flow rates, thus restricting the flow. A constant flow rate is achieved with an integrated variable flow drive (VFD) which controls the electrical current to the intake pump. Flow meters on the algae harvester electronically communicate with the VFD to keep a constant flow at the target rate.

Various system process controls were varied during operations to optimize algae separation from water including:

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

Operations were performed to test the standard treatment using ACH at 50 mg/L and PT-2160 at 2.0 mg/L that was determined through bench testing (see **Section 4.2**) at Lake Munson (July 2021) and for the first two months at ARP Pond (Nov. and Dec., 2021). The treatment was altered during the remainder of the project to test other combinations of coagulant (ACH) and organic flocculant (PT-2160) as summarized in **Table 3**.

Table 3. Coagulant and Flocculant Treatments at Lake Munson (July 12-29, 2021) and ARP Pond (Nov. 15, 2021 – June 20, 2022)

Standard Treatment		Coagulant Only	Organic
50 mg/L ACH, 2 mg/L PT-2160	20 mg/L ACH, 1 mg/L PT-2160	40 mg/L ACH	2 mg/L PT-2160
July 12-29; Nov. 17-18, 22	Jan. 18-21, 26-28, 31	Apr. 11-14	Feb. 1-3, 7-11, 14-17, 21-25, 28
Dec. 6, 7, 13, 14	Apr. 19-21, 25-29		Mar. 1, 2, 10, 14, 17, 30
	May 3-4, 11-12, 16, 18		May 19-26, 31
	June 1-2, 13-16, 20-21, 23, 27-30		

Harvested algae biomass was collected in an on-site 500-gal poly-tank. The biomass was then transferred from the poly-tank to a in a vacuum truck and transported off-site by a licensed waste hauler to the T.P. Smith septage receiving station in Tallahassee, FL for permitted disposal.

Monthly Operating Reports (MORs) 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 the monitoring activities 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 at ARP Pond.

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 every 15 minutes during operations. The data were downloaded at least monthly.

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 on the algae harvester to collect continuous measurements of temperature, specific conductivity (SPCOND), pH, dissolved oxygen (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 HFT algae harvester.

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 EXO2 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 and evidence of interference likely due to a combination of factors (e.g., 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 2100Q) 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 harvester for laboratory analysis of water quality parameters. Samples were collected once per week in each operational week for a total of 24 sampling events (**Table 4**). Field blanks and field duplicates were collected on three events at ARP Pond (**Table 5**).

Whole Effluent Toxicity (WET) testing (acute, chronic) of the effluent was conducted in April 2022 (**Table 5**). In compliance with the National Pollutant Discharge Elimination System FDEP Industrial Wastewater Facility Permit No. FL0A00016-001-IW7B, grab water samples were collected over a series of 2-3 days from the effluent sampling port. 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*).

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 operation 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).

Table 4. 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	Varies
Total Suspended Solids (TSS)	SM 2540D	Varies
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	1.00 µg/L
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 s/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 5. Water Quality Monitoring Events

Location	Treatment Type	Influent/Effluent Sampling Date	Field Duplicates / Field Blanks	WET Tests[1]
Lake Munson	50 mg/L ACH, 2 mg/L PT-2160	14-Jul-21		✓
		20-Jul-21		
		29-Jul-21		
ARP Pond		18-Nov-21		
		22-Nov-21		
		7-Dec-21		
		14-Dec-21		
	20 mg/L ACH, 1 mg/L PT-2160	19-Jan-22		
		27-Jan-22		
	2 mg/L PT-2160	3-Feb-22		
		8-Feb-22		
		15-Feb-22		
		24-Feb-22	✓	
		1-Mar-22		
		10-Mar-22		
		17-Mar-22		
	20 mg/L ACH	14-Apr-22		
	20 mg/L ACH, 1 mg/L PT-2160	20-Apr-22	✓	
		27-Apr-22		✓ (effluent only)
		4-May-22		
		12-May-22		
		18-May-22		
	2 mg/L PT-2160	25-May-22		
	20 mg/L ACH, 1 mg/L PT-2160	2-Jun-22		
		16-Jun-22		
		23-Jun-22	✓	
		28-Jun-22		

Notes: ACH=aluminum chlorohydrate, PT-2160 is an organic flocculant; WET=Whole Effluent Toxicity, mg/L=milligrams per liter; 1 – sampling for WET tests included the collection of grab samples on each of three days for each test. Samples were collected on July 12, 14, and 16, 2021 for Lake Munson and April 27, 28, and 29, 2022 for ARP Pond.

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**.

Three field duplicates and field blanks (February 24, April 20, and June 23) were conducted on influent and effluent laboratory analysis. The field duplicates on February 24 and June 23 showed concerning results when compared to the standard analysis and such differences led to AECOM validation qualifiers presented in **Appendix B**.

Descriptive statistics were computed for each parameter by treatment type (standard and organic). Differences between 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 included collection of area and personal air samples during non-operational (background) and operational conditions. Non-operational sampling was performed on March 29, 2022, after seven days without operations. The operational sampling was performed on March 30 and April 13, 2022. Area samples were collected in four fixed locations including one upwind station (northeast of the harvester) and three downwind stations (southeast, south and west of the harvester). Personal samples were collected from the breathing zone of the operator (Trevor Campbell) and were intended to measure actual exposure of the worker for comparison with occupational exposure limits. A field blank was collected on each sampling event. 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.

The cyanotoxin 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

NWFWMD and AECOM co-hosted a media day event on June 12, 2021 at Lake Munson control structure at 1519 La France Rd in Tallahassee, FL. The event was well attended with representatives from NWFWMD, FDEP, Leon County, and other local and state government entities as well as interested members of the public. AECOM staff provided tours of the harvester as well as bench-scale demonstrations to showcase the technology.

No official public event was hosted at the ARP site but the site was opened to the public and tours were given periodically to local and state representatives and the general public.

A video presentation of the ARP work can be accessed at the link:
https://www.youtube.com/watch?v=acab4ia4p9s&list=PLuMz7fdvlAtGfH2MI_iFAE8X7G97QZmiX

Lake Munson Media Day Event Photos

4.6 Decommissioning and Site Restoration

The ARP Pond site was decommissioned and restored on Aug. 22, 2022 with the completion of the project. The remaining piping and equipment were removed from the Lake Munson site on Dec. 15, 2022 and the concrete pad was left intact per an agreement with Leon County Department of Parks and Recreation.

5. Algae Harvesting Treatment Performance

Due to the lack of algae at Lake Munson, operating conditions were not representative of normal operations for the algae harvesting system and are therefore not included in the following sections. Details of the treatment performance at the Lake Munson site is provided in the Monthly Operating Report (MOR) (May 9, 2022) prepared for the NWFWMD and approved by FDEP.

5.1 Operations

The HFT algae harvester was successfully operated with little variation from the target flow rate of 500 gpm [mean daily flow = 500.1 gpm (4.77 Standard Deviation [SD])], treating water for a total of 480 hours and producing a total of 14,475,864 gal of treated water over the project duration (**Table 6**). Operations allowed field evaluation of control parameters that maximized efficiencies for treatments using standard (ACH and PT-2160), coagulant only (ACH) and organic (PT-2160) conditioning of the water. Key optimal operating parameters that were established by the system operator, were consistent for the different treatment types, and included:

- Mixing speeds of 40% and 35% in the coagulant and flocculant chambers, respectively, to optimize floc formation
- A recycle flow rate between 25% and 30% of the influent flow rate for optimal nanobubble formation to assist algae floc flotation
- A float blanket skimming cycle of 0.5 and 1.2 skims per hour 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

Year	Month	Operational Hours				Water Treated (gal)			
Treatment Type:		Standard[1]	Coagulant Only[2]	Organic[3]	Total	Standard[1]	Coagulant Only[2]	Organic[3]	Total
2021	Nov	15.00	-	-	15.00	462,113	-	-	462,113
	Dec	21.25	-	-	21.25	637,735	-	-	637,735
2022	Jan	41.75	-	-	41.75	1,253,679	-	-	1,253,679
	Feb	-	-	106.75	106.75	-	-	3,200,625	3,200,625
	Mar	-	-	38.25	38.25	-	-	1,148,320	1,148,320
	Apr	47.25	26.75	-	74.00	1,418,347	802,388	-	2,220,735
	May	51.75	-	61.25	113.00	1,552,057	-	1,836,827	3,388,884
	Jun	70.00	-	-	70.00	2,163,774	-	-	2,163,774
Total		247.00	26.75	206.25	480.00	7,487,704	802,388	6,185,772	14,475,864

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 (2021: 50 mg/L ACH, 2 mg/L PT-2160); 2022: 20 mg/L ACH, 1 mg/L PT-2160). 2-coagulant only treatment (20 mg/L ACH). 3-organic treatment (2.0 mg/L PT-2160).

Power consumption was relatively consistent during operations with an average daily current draw and power use of 25.00 Ampere (A) (SD = 1.44) and 18.68 Kilowatt (kW) (SD = 1.07), respectively. With a total of 480 operational hours to process 14,475,864 gal of water, the energy used during operations was therefore 8,962 kWh or 619 kWh/million gal Energy used to process the algae biomass at the WWTP is not known but would be expected to be

negligeable given the small volume of biomass (i.e., 11,100 gal) that would have been fed into the current operations at the plant [the rated capacity permitted at the Thomas P. Smith WWTP is 26.5 mgd (FDEP 2020)].

Only minor technical issues with the algae harvesting system occurred with little to no disruption of operations. The primary issue was the polymer pump malfunction during April activities and no polymer was used in the algae harvesting process for the Apr. 11-14 operations. The issue was resolved by replacing the control box for the pump.

The operations produced a total of 16,885 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 (that changes the water content of the slurry), changes in degassing and evaporative losses, and differences in the amount of slurry produced by the different treatment types (**Table 7**). The treatments using ACH produced 0.0015 gal of slurry per gal of water treated for a total slurry production of 12,150 gal. The organic treatment produced approximately 43% less slurry (0.0008 gal of slurry per gal of water treated) with a total production of 4,570 gal during the project. The greater volume of slurry produced when using ACH is due to the more voluminous floc produced by this coagulant 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, 11,100 gal were transported to the Thomas P. Smith WWTP for disposal, 3,750 gal were transported offsite for independent research, and approximately 1,770 gal were lost to degassing and evaporation.

Table 7. Slurry Production and Disposal

Parameter	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
					(gal)				
Slurry Produced - ACH Treatments	1,300	1,100	1,300	0	0	3,300	2,100	3,050	12,150
Slurry Produced - Organic Treatment	0	0	0	2,350	965	0	1,420	0	4,735
Total Slurry Produced	1,300	1,100	1,300	2,350	965	3,300	3,520	3,050	16,885
Water Treated	462,113	637,735	1,253,679	3,200,625	1,148,320	2,220,735	3,388,884	2,163,774	14,475,864
Slurry Produced per gal of Water Treated	0.0028	0.0017	0.0010	0.0007	0.0008	0.0015	0.0010	0.0014	0.0012
Equipment Wash Water	0	0	0	0	0	0	0	100	100
Slurry Transported to T.P. Smith WWTP	0	1,000	2,100	0	0	2,700	500	4,800	11,100
Slurry Used for Research	0	0	0	1,500	750	0	1,500	0	3,750
Slurry Lost to Degassing and Evaporation	130	115	130	250	85	340	385	335	1,770

5.2 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 DO concentrations common to HAB-impaired waters). Monitoring of influent (raw water from ARP Pond) and effluent (treated water prior to discharge back to ARP Pond) during the project across a range of seasonal water quality conditions in ARP Pond supported these previous studies. Water quality of the influent to the HFT algae harvester during operations reflected water quality in ARP Pond that is consistent with 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 with HFT using the standard and organic treatments.

Descriptive statistics for field parameters are provided in **Table 8** for the standard treatment and **Table 9** for the coagulant only and organic treatments, and for the laboratory parameters in **Table 10** and **Table 11** for the standard and organic treatments, respectively. Impacts of HFT 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 the standard and organic treatments (no laboratory testing was performed on samples from the ACH only treatment). Reported significant or non-significant differences between the influent and effluent are based on statistical testing using Mann Whitney Tests for each parameter ($p < .05$).

Table 8. Summary of Daily Field Parameter Results for the Standard Treatment[1]

Month-Year	Statistic	TEMP (°C)		SPCOND (µS/cm)		pH (SU)		DO (mg/L)		TURB (NTU)	
		INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF
Nov-21	n	3	3	3	3	3	3	3	3	3	3
	Mean	18.71	18.40	117.77	124.53	7.93	7.36	9.78	10.79	12.12	3.24
	SD	0.33	0.32	0.26	0.36	NA	NA	0.40	0.36	0.14	0.24
	Median	18.58	18.57	117.76	124.55	8.03	7.40	9.99	10.91	12.10	3.30
Dec-21	n	4	4	4	4	4	4	4	4	4	4
	Mean	18.08	18.06	120.84	127.75	7.46	7.11	7.77	8.97	13.48	3.29
	SD	0.78	0.93	0.61	0.55	NA	NA	0.38	0.26	0.98	0.38
	Median	17.90	18.11	120.92	127.95	7.47	7.12	7.66	8.86	13.69	3.27
Jan-22	n	8	8	8	8	8	8	8	8	8	8
	Mean	12.80	12.65	95.14	97.73	7.65	7.47	10.58	11.51	14.65	3.48
	SD	0.48	0.55	0.26	1.25	NA	NA	0.84	0.60	0.55	0.52
	Median	12.83	12.82	95.22	97.42	7.75	7.46	10.68	11.42	14.82	3.45
Apr-22	n	8	8	8	8	8	8	8	8	8	8
	Mean	24.68	24.45	95.43	95.03	7.64	7.75	7.34	10.11	14.11	2.49
	SD	1.83	1.31	1.09	0.78	NA	NA	1.45	1.39	1.80	0.27
	Median	25.14	25.23	95.71	95.11	7.91	8.49	7.18	10.41	14.57	2.52
May-22	n	6	6	6	6	6	6	6	6	6	6
	Mean	27.77	27.35	96.92	96.45	7.77	8.40	7.34	10.62	10.15	2.16
	SD	1.48	0.78	2.43	2.32	NA	NA	3.55	1.36	0.67	0.13
	Median	27.80	27.28	96.15	96.05	8.20	8.55	8.13	10.28	10.10	2.13
Jun-22	n	13	13	13	13	13	13	13	13	13	13
	Mean	32.14	31.99	103.30	103.92	8.02	7.62	8.24	8.54	7.88	2.20
	SD	1.32	1.26	2.45	2.98	NA	NA	1.15	0.86	0.90	0.35
	Median	32.27	32.08	103.78	103.50	8.03	7.59	8.35	8.52	7.56	2.25
Total	n	42	42	42	42	42	42	42	42	42	42
	Mean	24.11	23.91	102.04	103.72	7.74	7.55	8.45	9.90	11.52	2.67
	SD	7.31	7.25	8.71	10.89	NA	NA	2.06	1.49	3.01	0.64
	Median	25.54	25.47	99.54	99.66	7.89	7.56	8.52	9.99	12.05	2.52

Notes: Descriptive statistics were computed from mean daily values measured during operations. For pH, the mean and median values were calculated from the equivalent hydronium ion [H_3O^+] molar concentration and then back-transformed to pH to provide "true" values. Back-transformation of H_30^+ to pH is not statistically valid and is therefore noted as NA (not applicable). INF = Influent, EFF = Effluent

1-standard treatment (2021: 50 mg/L ACH, 2 mg/L PT-2160; 2022: 20 mg/L ACH, 1 mg/L PT-2160).

Table 9. Summary of Field Water Quality Parameters for the Organic and Coagulant Only Treatments

Month	Statistic	TEMP (°C)		SPCOND (µS/cm)		pH (SU)		DO (mg/L)		TURB (NTU)	
		INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF
Organic Treatment[1]											
Feb	n	18	18	18	18	18	18	18	18	17	17
	Mean	16.34	16.08	93.03	91.01	8.23	8.13	11.78	12.17	15.93	3.85
	SD	3.53	3.45	1.32	3.13	NA	NA	1.37	1.02	3.17	0.36
	Median	14.91	14.42	92.64	91.66	8.93	8.56	11.67	12.43	15.90	3.93
Mar	n	6	6	6	6	6	6	6	6	6	6
	Mean	20.07	19.73	88.42	89.00	8.45	8.17	8.93	10.20	19.23	5.52
	SD	1.11	1.14	3.75	1.92	NA	NA	2.22	1.92	0.85	1.19
	Median	20.34	19.76	87.70	89.28	8.96	8.84	8.70	10.27	19.15	5.22
May	n	9	9	9	9	9	6	9	9	9	9
	Mean	28.93	28.85	98.72	99.89	8.80	8.27	9.14	9.95	11.00	4.44
	SD	0.68	0.54	1.06	2.36	NA	NA	1.70	1.43	1.15	0.30
	Median	28.85	28.86	98.39	99.00	8.96	8.91	9.24	9.84	11.15	4.42
Total	n	33	33	33	33	33	33	33	33	32	32
	Mean	20.45	20.23	93.75	93.07	8.37	8.21	10.54	11.21	15.17	4.33
	SD	6.00	6.04	4.00	5.05	NA	NA	2.13	1.71	3.77	0.85
	Median	19.83	19.58	93.81	92.98	8.96	8.79	10.69	11.22	15.10	4.12
Coagulant Only Treatment[2]											
Apr	n	4	4	4	4	4	4	4	4	4	4
	Mean	23.06	22.18	95.43	96.88	4	4	7.56	9.70	18.96	5.49
	SD	0.70	0.96	0.62	0.71	7.70	7.50	0.51	0.11	1.50	0.48
	Median	23.16	22.31	95.68	96.88	NA	NA	7.56	9.75	19.38	5.40

Notes: Descriptive statistics were computed from mean daily values measured during operations. For pH, the mean and median values were calculated from the equivalent hydronium ion [H_3O^+] molar concentration and then back-transformed to pH to provide "true" values. Back-transformation of H_30^+ to pH is not statistically valid and is therefore noted as NA (not applicable). Turbidity was not measured on Feb. 1, 2022 due to meter malfunction. INF = Influent, EFF = Effluent
1-coagulant only treatment (20 mg/L ACH), 2-organic treatment (2.0 mg/L PT-2160)

Table 10. Standard Treatment[1] 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	Mean	Median
ALK	mg/L as $CaCO_3$	14	0	49	6	41	58	47.5	14	0	50	12	36	87	47	0%	1%
Al	mg/L	13	3	0.134	0.085	0.051	0.37	0.12	14	0	0.806	0.987	0.12	3.7	0.3	-502%	-150%
Al, Dissolved	mg/L	13	7	0.052	0.015	0.025	0.089	0.051	14	12	0.070	0.083	0.024	0.35	0.051	-36%	0%
NH4	mg/L	14	8	0.098	0.077	0.024	0.29	0.1	14	9	0.094	0.077	0.024	0.3	0.0995	4%	1%
Chl-a	mg/m^3	15	0	50	23	11	98	44	15	3	10	14	1	53	4	80%	92%
NO3-N	mg/L	10	4	0.051	0.055	0.016	0.18	0.0205	10	5	0.037	0.036	0.012	0.13	0.018	29%	12%
NO3NO2-N	mg/L	11	3	0.043	0.034	0.016	0.13	0.027	11	4	0.041	0.034	0.012	0.13	0.02	4%	26%
NO3NO2-N, Dissolved	mg/L	12	7	0.038	0.031	0.01	0.12	0.018	12	7	0.039	0.033	0.01	0.13	0.018	-4%	0%
NO2-N	mg/L	11	10	0.015	0.004	0.01	0.018	0.018	11	10	0.015	0.004	0.01	0.018	0.018	-6%	0%
TKN	mg/L	12	0	1.07	0.30	0.44	1.5	1.10	12	3	0.73	0.39	0.26	1.5	0.65	32%	41%
TKN, Dissolved	mg/L	13	1	0.75	0.29	0.26	1.4	0.68	13	2	0.56	0.28	0.26	1.1	0.4	26%	41%
TN	mg/L	10	0	1.14	0.25	0.74	1.6	1.15	10	2	0.77	0.41	0.26	1.5	0.601	33%	48%
TN, Dissolved	mg/L	9	0	0.88	0.29	0.58	1.5	0.85	9	1	0.60	0.33	0.26	1.2	0.4	32%	53%
DOC	mg/L	12	0	7.2	0.5	6.4	8.1	7.2	14	0	5.0	1.0	3.7	6.8	4.9	30%	32%
TOC	mg/L	12	0	7.8	0.9	6.8	9.6	7.6	14	0	5.7	0.8	4.2	7.1	5.7	27%	26%
PO4-P	mg/L	13	1	0.017	0.007	0.005	0.026	0.018	14	9	0.006	0.002	0.005	0.010	0.005	64%	71%
TP	mg/L	13	2	0.075	0.027	0.024	0.110	0.072	13	11	0.013	0.008	0.0096	0.038	0.0096	83%	87%
TP, Dissolved	mg/L	14	5	0.020	0.007	0.0096	0.031	0.02	13	13	0.010	0.0004	0.0096	0.011	0.0096	51%	52%
TSS	mg/L	13	1	9.7	3.8	4	17	10	14	8	6.3	3.1	2.5	13	5.25	35%	48%
VSS	mg/L	14	8	7.7	2.5	4	13	7.25	14	12	9.0	6.4	2.5	20	5.5	-17%	24%
MC/NODs	ng/mL	15	12	1.00	1.79	0.30	6.09	0.30	15	13	0.33	0.11	0.30	0.72	0.30	(2)	(2)

Notes: 1 - (2021: 50 mg/L ACH, 2 mg/L PT-2160); 2022: 20 mg/L ACH, 1 mg/L PT-2160); 2 - % reductions were not calculated for MC/NODs due to the large number of non-detects in the influent.

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	Mean	Median
ALK	mg/L as $CaCO_3$	8	0	48	9	40	70	44	8	0	42	6	28	51	43	13%	2%
Al	mg/L	7	2	0.131	0.077	0.051	0.28	0.13	7	6	0.082	0.052	0.051	0.19	0.051	37%	61%
Al, Dissolved	mg/L	8	7	0.067	0.026	0.051	0.13	0.051	7	7	0.054	0.007	0.051	0.07	0.051	20%	0%
NH4	mg/L	6	4	0.061	0.054	0.024	0.16	0.024	8	2	0.084	0.054	0.024	0.15	0.076	-38%	-217%
Chl-a	mg/m^3	8	0	109	53	34	220	94	8	0	29	26	7.2	76	18	73%	81%
NO3-N	mg/L	7	2	0.091	0.159	0.018	0.48	0.026	7	5	0.030	0.027	0.018	0.097	0.018	67%	31%
NO3NO2-N	mg/L	7	2	0.091	0.159	0.018	0.48	0.026	7	5	0.030	0.027	0.018	0.097	0.018	67%	31%
NO3NO2-N, Dissolved	mg/L	7	3	0.024	0.007	0.018	0.038	0.019	7	4	0.020	0.003	0.018	0.026	0.018	16%	5%
NO2-N	mg/L	7	7	0.018	0.000	0.018	0.018	0.018	8	8	0.018	0.000	0.018	0.018	0.018	0%	0%
TKN	mg/L	8	0	1.26	0.53	0.52	2	1.17	7	0	0.79	0.31	0.55	1.5	0.72	37%	38%
TKN, Dissolved	mg/L	8	1	0.58	0.22	0.34	1.1	0.505	7	2	0.49	0.17	0.26	0.79	0.47	17%	7%
TN	mg/L	7	0	1.30	0.59	0.54	2	0.97	6	0	0.81	0.34	0.55	1.5	0.69	37%	29%
TN, Dissolved	mg/L	7	1	0.52	0.12	0.38	0.77	0.5	6	2	0.44	0.13	0.26	0.62	0.46	16%	8%
DOC	mg/L	8	0	6.6	0.5	5.9	7.6	6.7	7	0	6.0	0.4	5.3	6.6	6.0	9%	10%
TOC	mg/L	8	0	7.8	1.1	6.4	9.4	7.7	7	0	7.2	0.5	6.4	8.1	7.1	7%	7%
PO4-P	mg/L	7	4	0.020	0.018	0.005	0.054	0.015	5	3	0.016	0.014	0.005	0.039	0.006	20%	57%
TP	mg/L	7	0	0.091	0.042	0.044	0.180	0.079	6	2	0.026	0.017	0.0096	0.058	0.022	71%	72%
TP, Dissolved	mg/L	8	3	0.015	0.006	0.0096	0.026	0.0135	6	4	0.014	0.009	0.0096	0.033	0.0096	12%	29%
TSS	mg/L	8	0	13.6	6.8	5.5	28	11.5	8	4	6.3	3.2	3.5	14	5	54%	57%
VSS	mg/L	8	1	10.3	7.1	2.5	27	7	8	4	4.4	2.3	2.5	9	3.5	57%	50%
MC/NODs	ng/mL	8	5	0.42	0.22	0.30	0.85	0.30	8	8	0.30	0	0.30	0.30	0.30	(1)	(1)

Notes: 1 - % reductions were not calculated for MC/NODs due to the large number of non-detects in the influent.

5.2.1 Field Parameters

The HFT algae harvesting treatment did not affect water temperature across the range of seasonal surface water temperatures at ARP Pond **(Figure 3**), with no statically significant difference between median daily temperatures of the influent and effluent. The treatment is not expected to result in temperature changes as the water is exposed to ambient air temperature for a short period (approximately 30 minutes) during the treatment process and there is no significant chemical or physical process during the treatment that would be expected to alter water temperature.

SPCOND was statistically higher in the effluent compared to the influent for the standard treatment at the higher ACH dose of 50 ppm, but not at the lower ACH dose of 20 ppm or for the organic treatment. As with temperature, SPCOND varied seasonally, but the effect of the standard treatment using 50 ppm of ACH was consistently small (**Figure 3**) with a difference of 8.80 µS/cm between median daily SPCOND of the influent and effluent, which would not be expected to have any impact on aquatic life. An increase in SPCOND can occur when using ACH as this compound is cationic, contributing Al^{3+} ions to the water. ACH, however, also removes anions such as phosphate (PO_4^{2-}), nitrate (NO_3^-), and sulphate (SO_4^{2-}), which reduces conductivity. The change in SPCOND therefore depends on the balance between input of Al^{3-} and the removal of anions. 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 ion balance explaining the lack of change in SPCOND for the organic treatment.

The pH of the influent to the algae harvester was highly variable over the operational period with mean daily pH ranging from 7.17 to 9.68 (**Figure 3**). On average, daily pH was high (7.91) and was elevated above 9 on 20% of the operational days coincident with generally higher algal productivity. A sustained pH above 9 can adversely affect aquatic life.

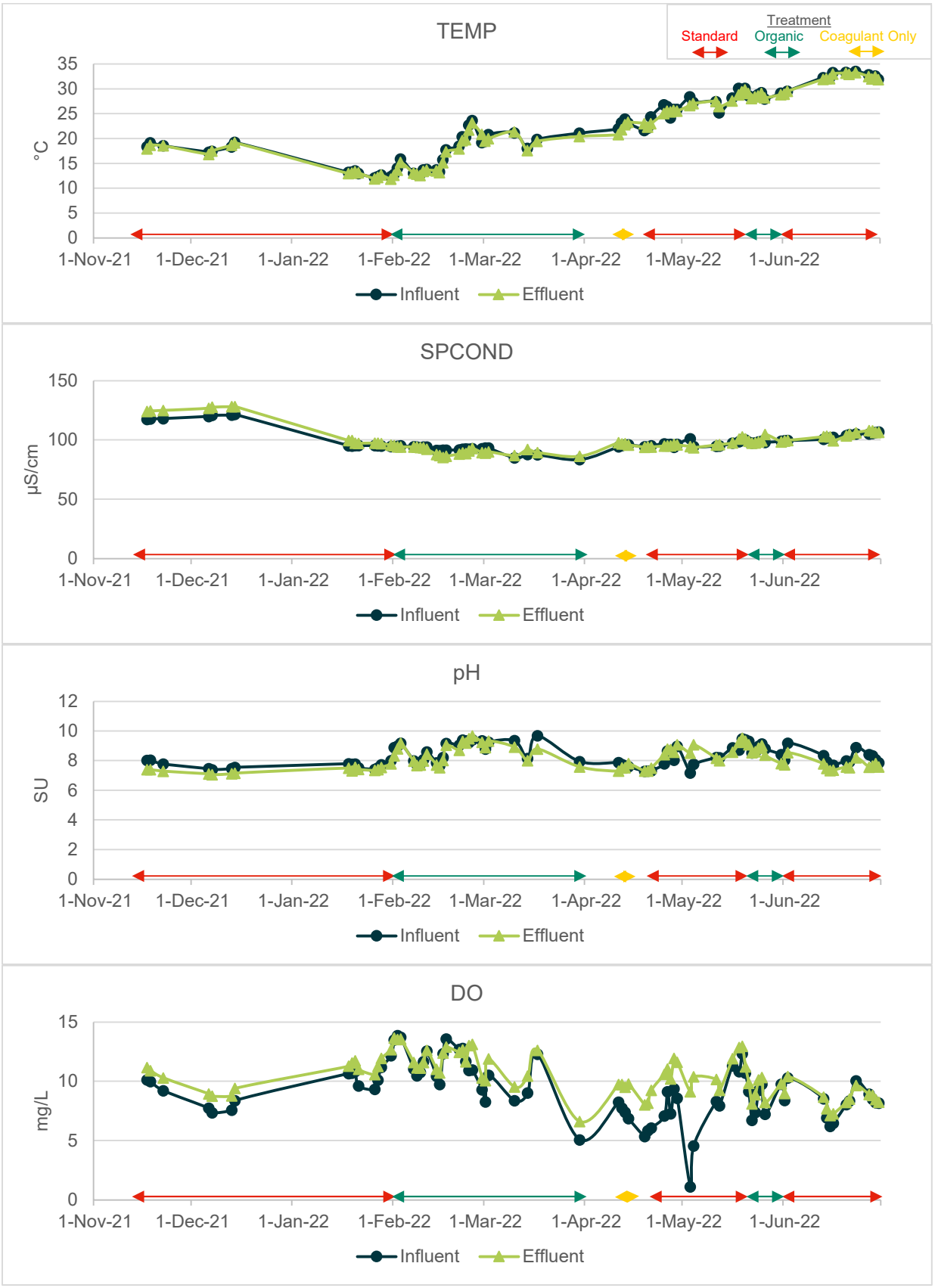
High pH is characteristic of surface water with abundant aquatic plants and algae. During photosynthesis, algae and aquatic plants take up carbon dioxide (CO_2), a weak acid, causing the pH to increase. Median daily pH was significantly lower in the effluent (7.16) than in the influent (7.56) for the standard treatment with an ACH dose of 50 ppm. The change in pH was less than 1 pH unit and therefore meets the requirements of the Florida water quality standards for Class III waterbodies (Rule 62-302.520 of the Florida Administrative Code [F.A.C]). A reduction in pH can be expected because ACH is acidic producing hydrogen ions when hydrolyzed:

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

The degree of change in pH depends on the dosage of ACH used and the buffering capacity of the raw water being treated. For ARP Pond water, the buffering capacity was sufficient to prevent a significant change in pH at the lower ACH dose of 20 ppm. There was no significant difference in pH for the organic treatment. While PT-2160 is also acidic, the effects on the treated water would be minimal due to the low dosages used for the treatment. A reduction in pH by algae harvesting, if it occurs, would provide water quality benefits at times when pH is elevated due to algal activity, and would not be expected to exceed the 1 pH unit change required by the F.A.C.

DO concentrations varied considerably in the influent and followed a similar pattern as pH (**Figure 3**), with higher concentrations typically occurring at times of relatively higher algal production. Despite that variability, mean daily DO concentrations were significantly higher in the effluent (10.44 mg/L [1.68 SD]) than in the influent (9.28 mg/L [2.39 SD]. The increase in DO concentrations is not dependent upon treatment types, but results from the introduction of DO by the recycle system. The recycle system produces the microscopic air bubbles for flotation that contain oxygen, which is absorbed by the process water on 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 therefore expected to increase DO concentrations to a greater extent at lower influent DO concentrations and temperatures. Oxygenation of water by algae harvesting would provide significant benefits during periods of high algae bloom activity that cause DO to drop to low levels at night due to respiration.

Figure 3. Trends in Mean Daily Temperature (TEMP), Specific Conductivity (SPCOND), pH and Dissolved Oxygen (DO) in the Influent and Effluent



Turbidity of the influent was highly variable but generally followed seasonal patterns in algae concentrations (as Chl-a, see **Section 5.2.2**) over the operational period increasing in winter and then decreasing in spring (**Figure 4**).

Algae harvesting greatly improved water clarity as evidenced by significant reductions in turbidity in the treated water compared to the raw water from ARP. Turbidity is an optical characteristic of water and is a measurement of the amount of light scattering in water. Dissolved and suspended matter including sediment, algae and other plankton, and dissolved colored organic compounds, can increase turbidity. All treatment types significantly reduced turbidity (**Figure 5**) with the greatest reduction achieved when using the standard treatment with 20 ppm ACH [mean = 2.55 NTU (1.14 SD)] across a wide range of influent turbidity [6.89 – 17.3 NTU, mean = 11.24 (2.43 SD)] (**Figure 5)**. While not as effective as the standard treatment, the organic treatment also significantly decreased turbidity, with lower levels in the effluent [mean = 4.33 NTU (0.85 SD)] compared to the influent [mean = 15.17 NTU (3.77 SD)].

Figure 4. Trends in Mean Daily Turbidity (TURB) in the Influent and Effluent

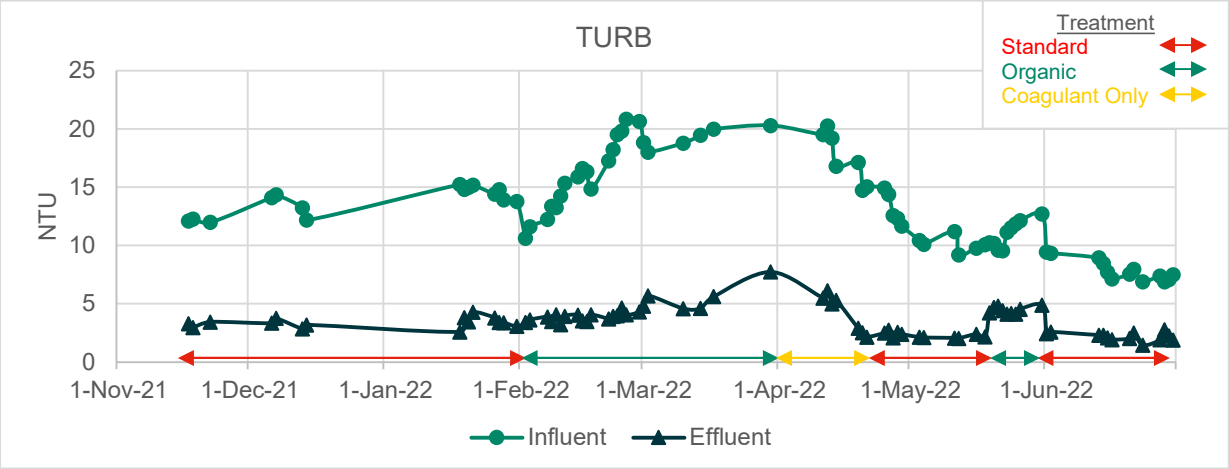
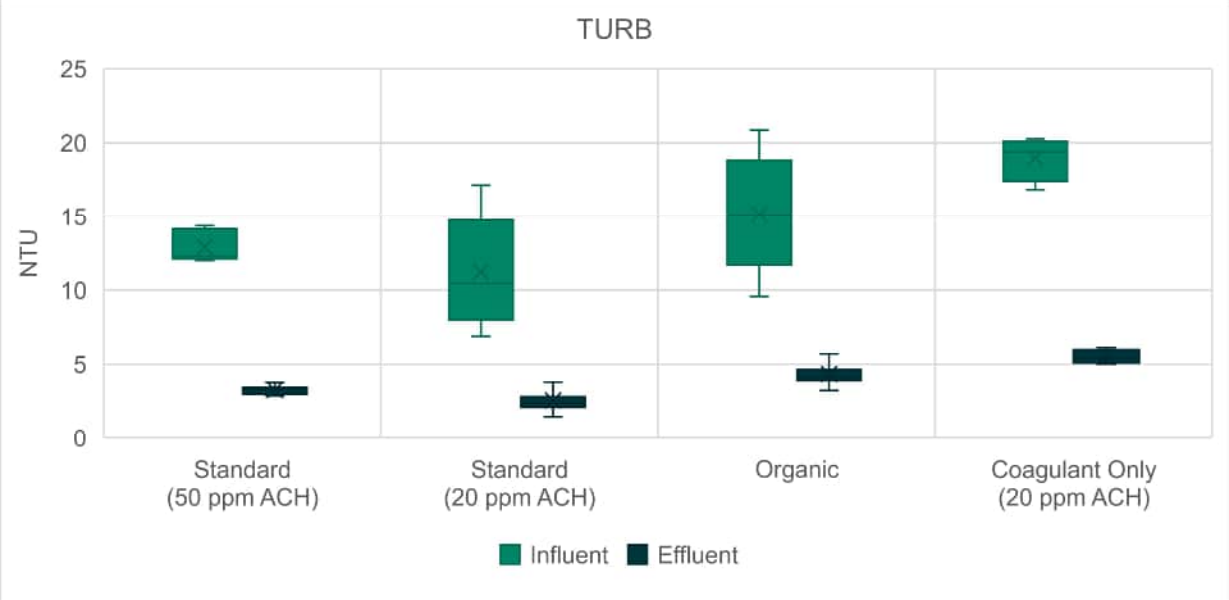


Figure 5. Box and Whisker Plots of Mean Daily Turbidity (TURB) in the Influent and Effluent



Notes: Boxes denote the 25th to 75th percentile range, whiskers denote the range, '–' and 'X' symbols denote the median and mean, respectively. Differences in turbidity between influent and effluent for each treatment are statistically significant (Mann Whitney Test, p <.0.0001).

5.2.2 Key Indicators

The algae harvesting research at ARP Pond successfully identified optimal operations and coagulant and flocculant usage) for standard and organic treatments to best reduce the concentrations of key indicator parameters that are relevant to HAB mitigation including TSS, algae (as Chl-a), and algae macronutrients (TP and TN). Changes in influent and effluent concentrations of the key indicators over time for each treatment type are illustrated in **Figure 6**, and summarized in **Figure 7**. Performance metrics are included in **Table 12**.

Performance of the algae harvester to remove 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%. In both cases, the treatment removed 100% of the detectible TP. 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 0.076 mg/L and 1.30 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 87% for TP and 92% 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. In summary, percent reduction efficiency can be used to provide a general indication of performance for a parameter of interest, but this metric is not appropriate for comparing treatment performance between different parameters with different MDLs and initial concentrations.

The standard treatment using ACH at the lower dose of 20 ppm was highly effective at reducing concentrations of key parameters with reduction efficiencies of 80% for Chl-a, 80% for TP, 54% for TSS, and 40% for TN (**Table 12**). While these removal efficiencies are generally lower than those observed for other similar demonstrations of the technology, they do not reflect a lower treatment performance. The lower % reduction efficiencies compared to other project sites reflect the lower concentrations of the key parameters in the influent from ARP Pond in this study. Even with the lower influent concentrations, the treatment was able to substantially improve water quality that would be of direct benefit for HAB mitigation when used at scale. The treated water had significantly lower concentrations of TSS and Chl-a (**Figure 6**, **Figure 7**) indicative of highly clarified water that would increase light penetration and reduce oxygen-consuming organic matter. Furthermore, TP and TN concentrations were also significantly reduced to low levels (**Figure 6**, **Figure 7**) that would reduce algae growth and the risk of future HABs. The resultant concentration of these key parameters in the effluent is therefore also a valuable metric to evaluate treatment performance for HAB mitigation.

There was no significant reduction in key parameter concentrations for standard treatment at the higher ACH dose (50 ppm) (**Figure 7**). The lack of significant change, however, was not due to the ability of the system to remove TSS, Chl-a, TP and TN, but reflects the wide range of influent concentrations of these parameters and their low concentrations in the influent from ARP Pond. At the time of testing for this treatment type (in November and December), algae levels were low and concentrations of TSS, Chl-a, and TP were not detected in one or more samples.

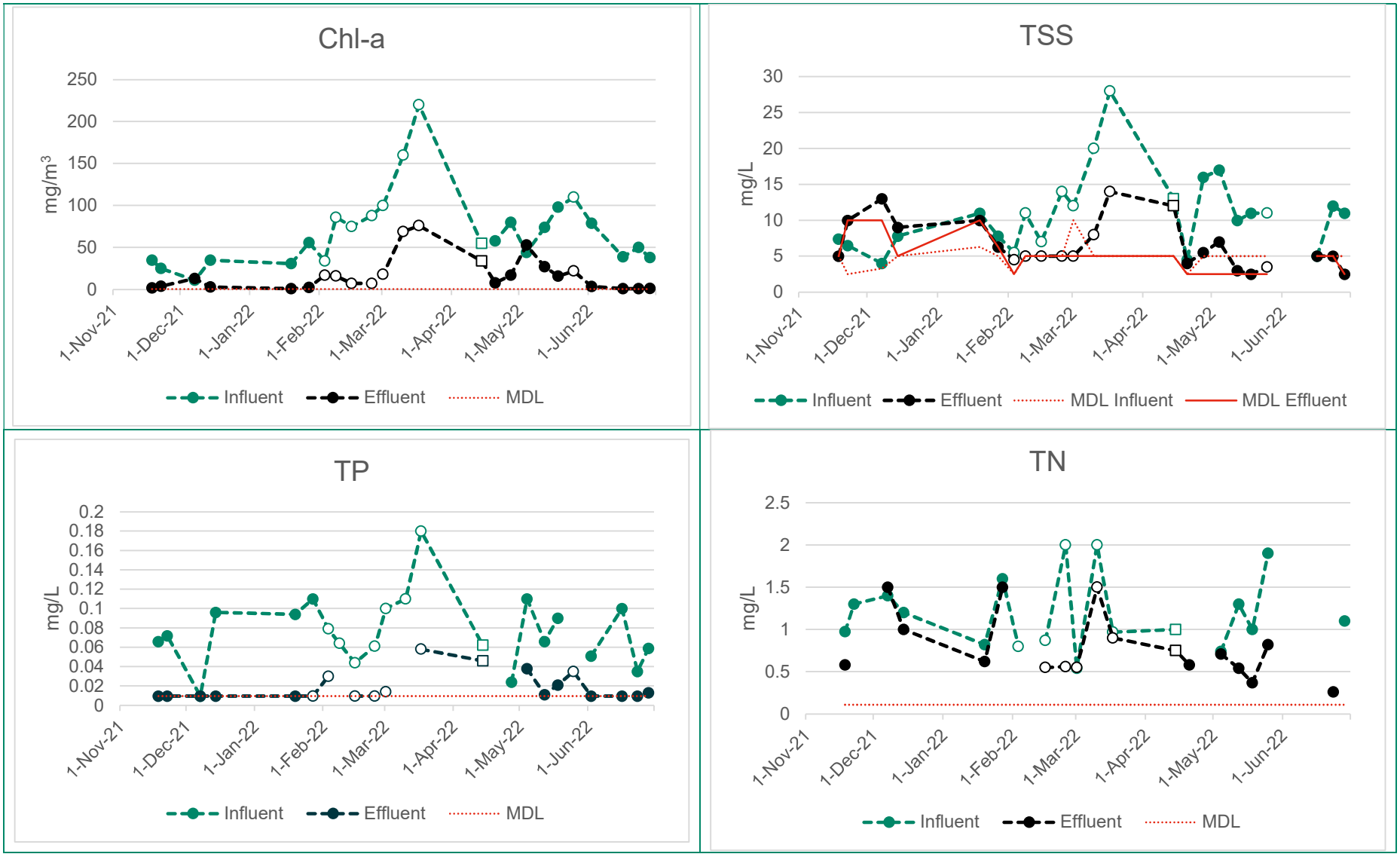
The organic treatment without the coagulant, ACH, had broadly similar performance as the standard treatment (20 ppm ACH) based on percent reduction efficiencies for the key parameters, which were 73% for Chl-a, 71% for TP, 54% for TSS, and 37% for TN. Based on concentrations, however, the organic treatment was less effective than the standard treatment using ACH (**Table 12**, **Figure 7**). The organic treatment, however, still significantly removed TSS,

Chl-a, and TP, and would provide substantial water quality benefits for HAB mitigation in situations where the use of an organic option is needed (e.g., to reduce inorganic content of the algae slurry for beneficial reuse options).

Table 12. Performance Metrics for Key Indicators by Treatment Type

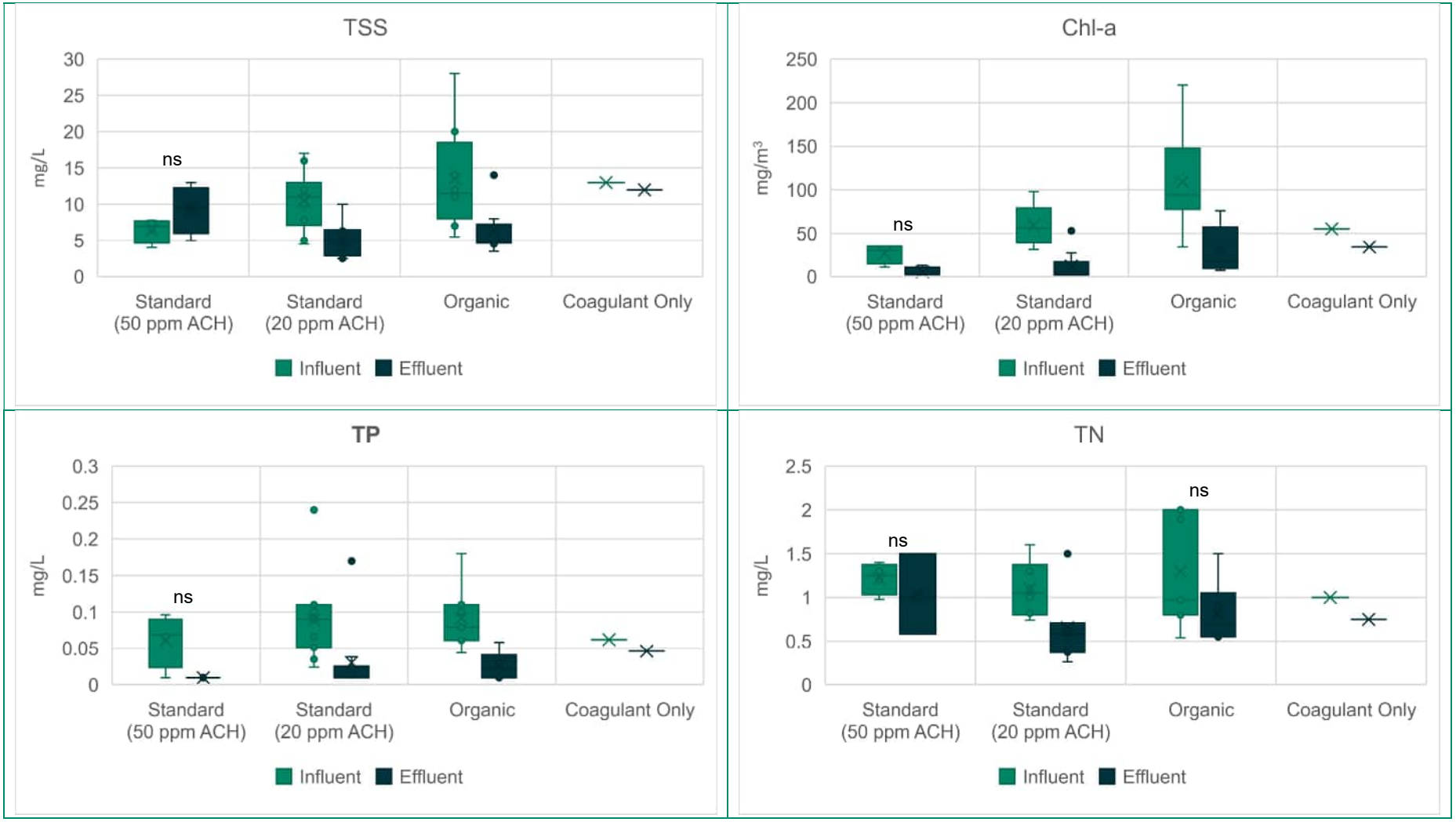
Treatment Type	Parameter	Influent Concentration			Performance Metric				
					Effluent Concentration			% Reduction	
		Mean	SD	Median	Mean	SD	Median	Mean	Median
Standard (20 ppm ACH, 1 ppm PT-2160)	Chl-a (mg/m^3)	59	20	56	12	15	4	80%	94%
	TSS (mg/L)	11.1	3.6	11	5.1	2.2	5	54%	55%
	TP (mg/L)	0.074	0.030	0.078	0.015	0.009	0.010	80%	88%
	% dissolved	51%		27%	67%		100%		
	TN	1.09	0.29	1.05	0.65	0.37	0.68	40%	45%
	% dissolved	74%		62%	78%		59%		
Organic (1 ppm PT-2160)	Chl-a (mg/m^3)	109	53	94	29	26	18	73%	81%
	TSS (mg/L)	13	6.8	11.5	6.3	3.2	5	54%	57%
	TP (mg/L)	0.091	0.042	0.079	0.026	0.017	0.022	71%	72%
	% dissolved	17%		17%	52%		44%		
	TN (mg/L)	1.30	0.59	0.97	0.81	0.31	0.69	37%	29%
	% dissolved	40%		52%	54%		67%		

Figure 6. 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 = 20 ppm, PT-2160 = 1 ppm). Open circles denote organic treatment (PT-2160 = 2 ppm). Open squares denote coagulant only treatment (ACH = 40 ppm). MDL = Method Detection Limit

Figure 7. 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, whiskers denote the range, '–' and 'X' symbols denote the median and mean, respectively. ns = not statistically different at p<0.05 (Mann-Whitney Tests. Results for the Coagulant Only treatment include a single sample therefore the median and mean are shown as equal, and differences between influent and effluent values cannot be statistically tested for this treatment type.

6. Environmental Safety

Algae harvesting with HFT is a no harm solution for HAB and nutrient mitigation, with no risk to the environment or health and safety from use of the technology. Two potential concerns, the use of chemical coagulants/flocculants and exposure to algal toxins, were identified early in the development of HFT and have been effectively mitigated through system design and operations. This is confirmed by laboratory testing of effluent quality for the protection of aquatic life, and air quality for algal toxins and volatile organics that could pose a risk to human health.

6.1 Effluent Quality

The coagulant, ACH, and the organic flocculant, PT-2160, were used in small amounts in the algae harvesting process to enhance separation of algae from water. These conditioners are approved by the National Sanitation Foundation (NSF) International and are commonly used for purification in potable water and wastewater treatment. Chemical constituents of these compounds (i.e., aluminum) occur naturally in surface water but can be toxic to aquatic life at high concentrations. The ACH can also cause a lowering of pH and an increase in conductivity. Use of ACH and PT-2160 at the low doses for algae harvesting did not cause changes to effluent quality that would adversely affect aquatic life, as evidenced by the following:

- Average total aluminum concentration increased from 0.128 mg/L in the influent to 0.344 mg/L in the effluent, which is well below the US EPA (2018) criterion of 0.800 mg/L (calculated based on mean effluent pH = 7.74 and DOC = 6.6 mg/L observed for the standard treatment (**Table 10**), and a conservative estimate for hardness of 25 mg/L as $CaCO_3$)
- There was no significant difference in average SPCOND (ACH and PT-2160 are cationic and could increase conductivity) between the influent and effluent (Mann Whitney Test, p>.5, see **Section 5.2.1**)
- The change in pH was less than 1 pH unit and therefore meets the requirements of the Florida water quality standards for Class III waterbodies (Rule 62-302.520 F.A.C) (see **Section 5.2.1**).

In addition, Whole Effluent Toxicity (WET) Testing demonstrated that the water treated by algae harvesting did not cause acute or chronic toxicity to *C. dubia* or *P. promelas* based on WET tests on influent and effluent performed during operations. The influent and effluent were not acutely toxic for either test organism (**Table 13**). While chronic toxicity to *C. dubia* occurred for the effluent (**Table 13**), chronic toxicity also occurred in the influent. The influent water had a chronic toxicity of both *C. dubia* and *P. promelas* with IC_{25} lower than that of the effluent, suggesting that the treated water was less chronically toxic than the raw water from ARP Pond, and that the treatment was not likely the cause of the toxicity.

Table 13. Summary of Whole Effluent Toxicity (WET) Tests Collected During 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%
April 2022	*Ceriodaphnia dubia*	15.3%	>100%	16.0%	>100%
	Pimephales promelas	82.4%	>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 test organisms in a 96-hour period.

6.2 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 algae harvesting does not rupture the cell walls of cyanobacteria during treatment, air sampling was conducted to ensure safety from cyanobacteria toxins (total microcystins and endotoxins) for staff and visitors.

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 = 0.029 EU/m^3 – 1.2 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 detected in the personal or area samples.

Low concentrations of algal toxins in air were expected given the low concentrations of cyanotoxins in the influent during operations MCs/NODs (range = 0.30 ng/mL – 6.50 ng/mL) in ARP Pond.

7. Path Forward

Algae harvesting using HFT can physically remove a significant amount of phosphorus and nitrogen from algae-impaired and nutrient-rich waterbodies like ARP Pond. The standard treatment using ACH for coagulation provides optimal performance producing high quality effluent; organic treatments also show promise. The effluent from the harvesting process provides clean, clarified water that would enhance healthy lake functioning such as SAV growth providing the platform for these waterbodies to restore themselves. These findings support the use of this technology to restore ARP Pond and other similarly nutrient-impacted waterbodies. By using the algae harvesting technology the water quality in ARP pond can be restored to provide a safe recreational asset to Leon County and its residents.

Left untreated, the water quality in ARP Pond could pose a risk to human health and the aquatic environment, and result in public use closures. To avert this situation, a 1-mgd harvester, the same size of unit used in this study, would be sufficient to improve the health of the lake over time. A 1-mgd harvester operated daily for eight hours per day would be able to treat the equivalent of the full volume of water in ARP Pond (13.8 million gallons of water) in about 40 days. Based on the results from this project, this would reduce the total phosphorus concentration in the pond by about 46% (assuming that no phosphorus is added to the pond during this time). While this would provide significant water quality benefits, more information on the sources of nutrients and water is needed to understand how long the harvester would need to be operated. It is anticipated that after the initial period of continuous operations, the harvesting would be able to be reduced to maintain the health of the lake thus reducing operational costs.

Since the pilot test was conducted during the low algae production season (fall/winter), we anticipate significantly higher algae production with the potential for HABs in late spring and summer. By having the harvester operating during the height of the algae growing season, HABs could be eliminated in a safe and efficient manner.

Based on the results of this project, it is recommended that a 1-mgd algae harvester be purchased or leased to provide the County with the equipment necessary to restore water quality in ARP Pond while protecting human health and the environment.

Significant technological advancements have been made that now allow the recovered algae biomass to be valorized into biofertilizer and/or biofuel. This breakthrough fosters sustainability and will help offset treatment cost. The algae harvesting program with the valorization of the biomass provides one of the most comprehensive, cost-effective, closed-loop solution to combat HABs with virtually little to no waste.

Going forward, other advancements have been made that will further streamline and reduce operation cost. For example, an Intelligent Process Automation System (IPAS) can be incorporated into operations to reduce onsite labor requirements and further optimize efficiencies which will provide additional cost savings. Preliminary estimates based on internal AECOM work suggest that the use of IPAS could drop the operational costs by as much as 50%.

8. References

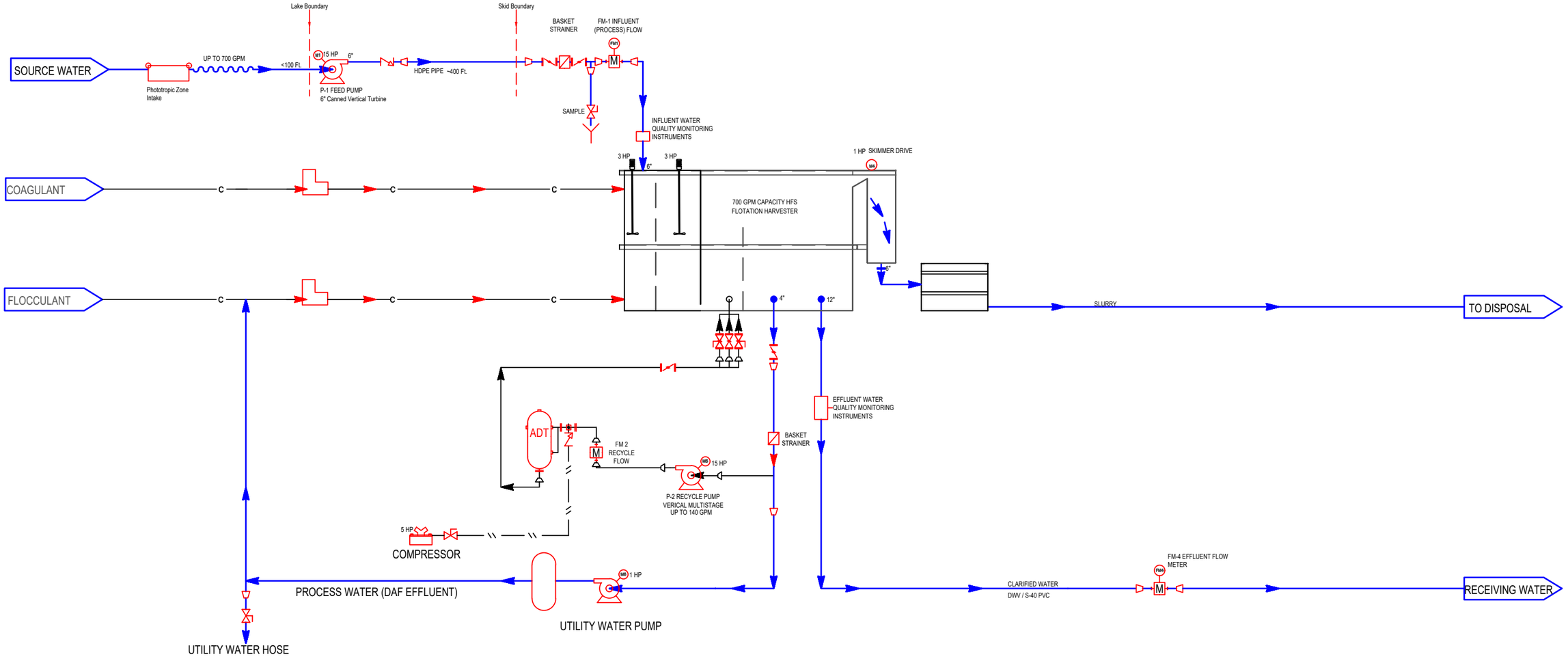
Adam M. Schaefera, L. Y. (2020). Exposure to microcystin among coastal residents during a cyanobacteria bloom in Florida. *Harmful Algae, Volume 92*.

AECOM, 2019, in review. Lake Agawam, New York, Innovative Algae Harvesting Demonstration Project. Technical Report prepared for New York State Office of General Services and New York State Department of Environment and Conservation.

Florida Department of Environmental Protection (FDEP), 2008. Process for Assessing Data Usability DEP-EA 001/07. 18 pp.

Page, M.A. et al., 2020. Harmful Algal Bloom Interception Treatment and Transformation System (HABITATS), Pilot Research Study Phase I, Summer 2019. U.S. Army Engineer Research and Development Center (ERDC) Technical Report no. ERDC TR-20-1. Accessed at https://hdl.handle.net/11681/35214.

Appendix A Process Flow and System Arrangement Diagrams



LEGEND

- M-NU-L B-LL V-LVE
- CHECK V-LVE
- -IR RELE-SE V-LVE
- BUTTERFLY V-LVE
- GLOBE V-LVE
- REDUCTION
- CHEMIC-L METERING PUMP
- MOTOR DRIVEN PUMP
- FLOW SENSOR
- FILTER / REGUL-TOR
- B-SKET STR-INER
- FLOW METER (M-GNETIC)
- DR-IN
- INT-KE -SSEMBLY
- XXX VAC — EXTERN-L POWER REQUIREMENTS
- PROCESS W-TER PIPING
- PROCESS W-TER HOSE
- OTHER PIPING
- -IR/G-S PIPING/HOSE
- ELECTRIC-L WIRING
- C — CHEMIC-L LINE

PROPRIET-RY and CONFIDENTI-L

ECOSA PROCESS TECHNOLOGIES

Algae Recovery Process
Process Flow Diagram
NWFWMD Lake Munson 700 GPM Capacity

REV	BY	DESCRIPTION	D-TE
REV			
4			
3			
2			
1	DJP	MULTIPLE	9-17-20

PLOT D-TE: | DR: D. PINELLI | D-TE: 9-3-20
CHECKED BY: | D-TE:
PROJECT ENG. | D-TE:
APPROVED BY: | D-TE:
CUSTOMER | D-TE:

SC-LE: NTS
DR I G NO.: B-101 P&ID
RE ISION: 1
DR I G N- E.: 700 GPM P&ID

Appendix B Data Verification Reports

ARP Pond
Data Review Summary

Sample Delivery Group: 680-207746-1
Sampling Date: November 18, 22, 2022
Data Reviewer: Katie Abbott Date Completed: February 22, 2022
Peer Reviewer: Brian Rothmeyer Date Completed: February 22, 2022

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

Field ID	Sample Type	Lab ID	Matrix	Analyses			
				Total Recoverable Metals (200.7)	Dissolved Metals (200.7)	General Chemistry – Total	General Chemistry - Dissolved
Data Package 680-207746-1							
Influent	N	680-207746-1	Water	X	X	X^m	X
Effluent	N	680-207746-2	Water	X	X	X	X
Data Package 680-207843-1							
Influent	N	680-207843-1	Water	X^m	X^m	X	X
Effluent	N	680-207843-2	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)
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 18th and 22nd, 2021 for the ARP Pond 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 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 was conducted within the method required holding time. **Data Package 680-207746-1** The analysis of orthophosphate on samples Influent and Effluent were performed outside of the method required holding time of 48 hours. As result, the associated non-detect results were qualified as unusable (R ht). **Data Package 680-207843-1** Due to a shipping delay, the analysis of orthophosphate and nitrate as N 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).
Laboratory Blanks • Method Blank (MB)	Yes	Target analytes were not detected within the method blanks.
Matrix Quality Control • Matrix Spike/ Matrix Spike Duplicate **680-207746-1** Influent (Nitrate/Nitrite as N, Nitrite as N, Ammonia) **680-207843-1** Influent (Total Recoverable Aluminum, Dissolved Aluminum, Dissolved Nitrate/Nitrite) Effluent (Nitrite as N, Total Phosphorous) • Laboratory Duplicate **680-207746-1** Influent (TSS, VSS) **680-207843-1** Influent (Dissolved Organic Carbon) • 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. 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%. • In instances where the value for a partial analysis exceeds that for a total analysis and either of the results is <5xPQL, the

Review Parameter	Criteria Met?	Comments
		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 nitrite results qualified as unusable due to MS/MSD recoveries below the rejection point, and the orthophosphate result reported 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
COC – Chain of Custody
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
MDL – Method Detection Limit
MS – Matrix Spike
MSD – Matrix Spike Duplicate
PQL – Practical Quantitation Limit
RPDs – Relative Percent Differences
VOCs – Volatile Organic Compounds

Qualifiers
J – Estimated
J- – Estimated, low bias
R – Unusable

Reason Codes
ht – Holding time exceedance
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 680-207746-1				
Influent	Nitrate/Nitrite as N	**83/82** (90-110)	0 (10	As the potential bias was considered to be low, the associated result was qualified as estimated (J- m).
	Nitrite as N	**0/0** (90-110)	NA	As the percent recoveries were below the rejection point of 35%, the associated non-detect result was qualified as unusable (R m).
Data Package 680-207843-1				
Effluent	Nitrite as N	**0/4** (90-110)	NA	As the percent recoveries were below the rejection point of 35%, the associated non-detect result was qualified as unusable (R m).
	Total Phosphorous	**113/112** (90-110)	1 (20)	As the potential bias was considered to be high, and the sample result was reported as non-detect, data qualification was not considered necessary.

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
R – Unusable
Reason Codes
m – Matrix spike recovery outliers

ARP Pond
Data Review Summary

Sample Delivery Group: 680-207746-1
Sampling Date: December 7th and 14th, 2021
Data Reviewer: Jamie Herman Date Completed: April 15th, 2022
Peer Reviewer: Brian Rothmeyer Date Completed: April 19th, 2022

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

Field Identification	Sample Type	Laboratory Identification	Matrix	Analyses			
				Total Recoverable Metals (200.7)	Dissolved Metals (200.7)	General Chemistry – Total	General Chemistry - Dissolved
Data Package 680-208435-1							
Influent	N	680-208435-1	Water	X	X	X^m	X
Effluent	N	680-208435-2	Water	X	X	X	X
Data Package 680-208841-1							
Influent	N	680-208841-1	Water	X	X	X	X
Effluent	N	680-208841-2	Water	X	X	X^m	X^m

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)
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 on December 7th and 14th, 2021 for the ARP Pond 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 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 analyses was conducted within the method required holding time.
Laboratory Blanks • Method Blank (MB)	Yes	Target analytes were not detected within the method blanks.
Matrix Quality Control • Matrix Spike/ Matrix Spike Duplicate **680-208435-1** Influent (Nitrate/Nitrite as Nitrogen (N), Dissolved/Total Phosphorus, Orthophosphate) **680-208841-1** Influent (Total/Dissolved Phosphorus, Orthophosphate) Effluent (Nitrite as N) • Laboratory Duplicate **680-208435-1** None reported in this data package **680-208841-1** None reported in this data package • 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 aluminum, total and dissolved Kjeldahl nitrogen, or total and dissolved organic carbon. Therefore, there is no measure of accuracy and precision as it pertains to the sample matrix for this parameter. **Laboratory Duplicate** A laboratory duplicate was not performed on a sample from the data packages reported. **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. **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.

Review Parameter	Criteria Met?	Comments
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 nitrite as N result for the Effluent sample reported in data package 680-208851-1, which was qualified as unusable (R) due to MS/MSD recoveries below the rejection point, the results are usable as qualified for the project objective. The data are greater than 98.7% 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
PQL – Practical Quantitation Limit
RPDs – Relative Percent Differences
TSS – Total Suspended Solids

Qualifiers
J – Estimated
J- – Estimated, low bias
R – Unusable

Reason Codes
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 680-208435-1				
Influent	Nitrate Nitrite as N	**85**/91 (90-110)	6 (20)	As the potential bias was considered to be low, the associated result was qualified as estimated (J- m).
Data Package 680-208851-1				
Effluent	Nitrite as N	**3/3** (90-110)	9 (10)	As the percent recoveries were below the rejection point of 30%, the associated non-detect result was qualified as unusable (R m).

%R – Percent Recoveries
RPD – Relative Percent Difference
% – Percent
N – Nitrogen

Qualifiers
J- – Estimated, Low Bias
R - Unusable

Reason Codes
m – Matrix spike recovery outliers

Bold - indicates a value that is outside of acceptance limits

Attachment A: Summary of Qualified Data
ARP Pond - December 2021

LAB ID	SAMPLE	MATRIX	METHOD	ANALYTE	UNITS	RESULT	DETECTED	PQL	MDL	DILUTION	FRACTION	QUALIFIERS	REASON CODE
680-208435-1	Influent	Water	200.7	Aluminum	mg/L	0.15	YES	0.2	0.024	1	Total	J	lq
680-208435-1	Influent	Water	200.7	Dissolved Aluminum	mg/L	0.063	YES	0.2	0.024	1	Dissolved	J	lq
680-208435-1	Influent	Water	353.2	Nitrate Nitrite as N	mg/L	0.035	YES	0.05	0.01	1	Total	J-	lq,m
680-208435-1	Influent	Water	353.2	Nitrate-Nitrite, Dissolved	mg/L	0.042	YES	0.05	0.01	1	Dissolved	J	lq
680-208435-1	Influent	Water	353.2	Nitrite as N	mg/L	0.012	YES	0.05	0.01	1	Total	J	lq
680-208435-1	Influent	Water	350.1	Ammonia as N	mg/L	0.21	YES	0.25	0.1	1	Total	J	lq
680-208435-1	Influent	Water	Nitrate by calc	Nitrate as N	mg/L	0.023	YES	0.05	0.01	1	Total	J	lq
680-208435-2	Effluent	Water	353.2	Nitrate Nitrite as N	mg/L	0.048	YES	0.05	0.01	1	Total	J	lq
680-208435-2	Effluent	Water	353.2	Nitrate-Nitrite, Dissolved	mg/L	0.041	YES	0.05	0.01	1	Dissolved	J	lq
680-208435-2	Effluent	Water	353.2	Nitrite as N	mg/L	0.013	YES	0.05	0.01	1	Total	J	lq
680-208435-2	Effluent	Water	350.1	Ammonia as N	mg/L	0.2	YES	0.25	0.1	1	Total	J	lq
680-208435-2	Effluent	Water	Nitrate by calc	Nitrate as N	mg/L	0.035	YES	0.05	0.01	1	Total	J	lq
680-208841-1	Influent	Water	200.7	Dissolved Aluminum	mg/L	0.055	YES	0.2	0.024	1	Dissolved	J	lq
680-208841-2	Effluent	Water	200.7	Dissolved Aluminum	mg/L	0.034	YES	0.2	0.024	1	Dissolved	J	lq
680-208841-3	Effluent	Water	353.2	Nitrite as N	mg/L	0.01	NO	0.05	0.01	1	Total	R	m

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

lq	Restult Detected Between the MDL and PQL
m	Matrix Spike Recovery

ARP Pond
Data Review Summary

Sample Delivery Group: 680-210287-1 and 680-210576-1
Sampling Date: January 19th, and 27th, 2022
Data Reviewer: Jamie Herman — Date Completed: April 26th, 2022
Peer Reviewer: Katie Abbott — Date Completed: May 6, 2022

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

Field Identification	Sample Type	Laboratory Identification	Matrix	Analyses			
				Total Recoverable Metals (200.7)	Dissolved Metals (200.7)	General Chemistry – Total	General Chemistry - Dissolved
Data Package 680-210287-1							
Influent	N	680-210287-1	Water	X	X	X^m	X^m
Effluent	N	680-210287-2	Water	X	X	X	X
Influent	N	680-210307-1	Water	X	X	X	X^m
Effluent	N	680-210307-2	Water	X	X	X	X
Data Package 680-210576-1							
Influent	N	680-210576-1	Water	X^m	X^m	X	X
Effluent	N	680-210576-2	Water	X	X	X^m	X^m

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)
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 on January 19th and 27th, 2022 for the ARP Pond 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 (detailed below and summarized in Attachment A).
_____ 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 addressed 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 and ENCO Laboratories in good condition and were consistent with the accompanying chain of custody (COC) with one exception. The cooler temperatures upon receipt were within the recommended ≤6 degrees Celsius (°C) temperature range. **Data Package 680-210287-1:** During review of the data package, it was noted that the following analyses requested on the COC were not reported by the laboratory for all samples: total Kjeldahl nitrogen (TKN), total nitrate-nitrite as nitrogen (N), dissolved nitrogen, and total nitrate. The laboratory was notified and indicated that the analyses were not performed due to laboratory error. In addition, the laboratory noted the dissolved nitrogen fraction was erroneously reported as the total nitrogen fraction. As the TKN, total nitrate-nitrite, total nitrogen, and total nitrate analysis would be performed grossly outside the method's technical holding times, the analyses were cancelled. The laboratory revised and reissued the report to correctly reference the dissolved nitrogen results, provide the missing COC page within the report, and complete the sample receipt checklist associated with the second page of the COC.
Holding Times	Yes	The analyses was conducted within the method required holding time.
Laboratory Blanks • Method Blank (MB)	Yes	Target analytes were not detected within the method blanks.
Matrix Quality Control • Matrix Spike/ Matrix Spike Duplicate **680-210287-1** Influent (Dissolved/Total Phosphorus, Dissolved Organic Carbon (DOC)) **680-210576-1** Influent (Total/Dissolved Aluminum, Total/Dissolved Phosphorus, Orthophosphate as P (Phosphorus), Total Ammonia as N (Nitrogen)) Effluent (Alkalinity) • Laboratory Duplicate **680-210287-1** None reported in this data package **680-210576-1** Influent (Total Suspended Solids (TSS), Total Volatile Solids (TVS)) • Total vs. Partial Analyses Phosphorous, Organic Carbon,	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, total and dissolved nitrate/nitrite as n, dissolved ammonia as n or 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

Review Parameter	Criteria Met?	Comments
		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 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	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	Yes	The data are considered 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
RPD – Relative Percent Difference
TSS – Total Suspended Solids
TVS – Total Volatile Solids
Qualifiers
J – Estimated
Reason Codes
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 680-210576-1				
Influent	Nitrite as N	107/**111** (90-110)	4 (10)	As the potential bias was considered to be high, and the associated results were non-detect, qualification was considered not necessary.

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

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

Associated Samples	Analyte	%R (Limits)	RPD (Limit)	Qualification
Data Package 680-210287-1				
LCS 680-705447/10 LCSD 680-705447/31	Alkalinity	100/**89** (90-112)	12 (30)	As the potential bias was considered to be low, the associated results were qualified as estimated (J- l).

Bold - indicates a value that is outside of acceptance limits
% – Percent
%R – Percent Recoveries
RPD – Relative Percent Difference
Qualifiers
J- – Estimated, Low Bias
Reason Codes
l – Laboratory Control Sample outliers

Attachment A: Summary of Qualified Data
ARP Pond - January 2022

LAB ID	SAMPLE	MATRIX	METHOD	ANALYTE	UNITS	RESULT	DETECTED	PQL	MDL	DILUTION	FRACTION	QUALIFIERS	REASON CODE
680-210287-1	Influent	Water	SM2320 B	Total Alkalinity	mg/L	41	YES	5	5	1	Total	J-	l
680-210287-1	Influent	Water	200.7	Dissolved Aluminum	mg/L	0.089	YES	0.2	0.024	1	Dissolved	J	lq
680-210287-2	Effluent	Water	SM2320 B	Total Alkalinity	mg/L	36	YES	5	5	1	Total	J-	l
680-210576-1	Influent	Water	365.1	Phosphorus, Dissolved	mg/L	0.019	YES	0.02	0.0096	1	Dissolved	J	lq
680-210576-1	Influent	Water	200.7	Aluminum	mg/L	0.12	YES	0.2	0.054	1	Total	J	lq
680-210576-2	Effluent	Water	200.7	Aluminum	mg/L	0.19	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, Low Bias
J	Estimated

Reason Codes

lq	Restult Detected Between the MDL and PQL
l	Laboratory Control Sample Outlier

ARP Pond
Data Review Summary

Sample Delivery Group: 680-214997-1, 680-215213-1, 680-215618-1, and 680-216041-1
Sampling Date: February 3rd, 8th, 15th, and 24th, 2022
Data Reviewer: Jamie Herman Date Completed: May 11, 2022
Peer Reviewer: Katie Abbott Date Completed: May 6, 2022

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

Field Identification	Sample Type	Laboratory Identification	Matrix	Analyses			
				Total Recoverable Metals (200.7)	Dissolved Metals (200.7)	General Chemistry – Total	General Chemistry - Dissolved
Data Package 680-214997-1							
Influent	N	680-214997-1	Water	X	X	X^m	X^m
Effluent	N	680-214997-2	Water	X	X	X	X
Data Package 680-215213-1							
Influent	N	680-215213-1	Water	X	X	X^m	X
Effluent	N	680-215213-2	Water	X	X	X	X
Data Package 680-215618-1							
Influent	N	680-215618-1	Water	X	X	X^m	X^m
Effluent	N	680-215618-2	Water	X	X	X	X
Data Package 680-216041-1							
INFLUENT	N	680-216041-1	Water	X	X^m	X^m	X^m
EFFLUENT	N	680-216041-2	Water	X	X	X	X
DUP-1	FD	680-216041-3	Water	X	X	X^m	X^m
POLYMER	N	680-216041-4	Water	---	---	X^1	X^1
FB	FB	680-216041-5	Water	X	X	X	X

Sample Type: FB – Field Blank FD – Field Duplicate N – Normal X^m – Matrix Spike/ Matrix Spike Duplicate
--- - Sample 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 (353.2/354.1), Total Phosphorous (365.1), Orthophosphate (365.1), Ammonia as N (350.1), Total Organic Carbon (5310B), Total Alkalinity (SM2320B), Chlorophyll a (SM10200)
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)
1 – Sample analyzed for informational purposes only. Data validation not required.

This report contains the final results of the data validation conducted for water samples collected in February 2022 for the ARP Pond 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 (detailed 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 addressed 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 and ENCO Laboratories in good condition and were consistent with the accompanying chain of custody (COC) with one exception. The cooler temperatures upon receipt were within the recommended ≤6 degrees Celsius (°C) temperature range.
Holding Times	No	With the exceptions below, the analyses was conducted within the method required holding time. **Data Package 400-215618-1** 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). The non-detected results were qualified as unusable (R ht). **Data Package 400-216041-1** Due to a laboratory shipping error, 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). The non-detected results were qualified as unusable (R ht).
Laboratory Blanks • Method Blank (MB)	No	With the exceptions listed in Table 1, the target analytes were not detected within the method blanks.
Matrix Quality Control • Matrix Spike/ Matrix Spike Duplicate **680-214997-1** Influent (Dissolved Nitrate-Nitrite as N, Total Nitrite as N, Orthophosphate, Total/Dissolved Phosphorus) **680-215213-1** Influent (Total Nitrate-Nitrite as N, Orthophosphate, TOC) **680-215618-1** Influent (Total/Dissolved Phosphorus, Orthophosphate) **680-216041-1** INFLUENT (Dissolved Aluminum, Total/Dissolved Nitrate-Nitrite as N, Total Nitrite as N, Orthophosphate) DUP-1 (Total/Dissolved Phosphorus) • Laboratory Duplicate **680-214997-1** None reported in this data package **680-215213-1** Influent (DOC) **680-215618-1** None reported in this data package	No	**Matrix Spike/ Matrix Spike Duplicate (MS/MSD)** With the exception 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, total and dissolved Kjeldahl nitrogen, or ammonia as n. 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

Review Parameter	Criteria Met?	Comments
680-216041-1 INFLUENT (DOC) DUP-1 (TVS, TSS) • Total vs. Partial Analyses Kjeldahl Nitrogen, Nitrate/Nitrite, Phosphorous, Organic Carbon, Nitrogen (Total Nitrogen)		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. With the exceptions in Table 3, 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 **Data Package 400-216041-1** FB • Field Duplicate **Data Package 400-216041-1** INFLUENT/DUP-1	No	**Trip Blank/ Field Blank** A trip blank was not applicable for the methods performed. With the exceptions listed in Table 4, the target analytes were not detected within the field blank. **Field Duplicate** The comparison between results of the parent sample and field 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 between the results of ≤30%. • 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 <2xPQL.
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 680-214997-1** The laboratory revised and reissued the data package to include the missing Chlorophyll A results. **Data Package 400-216041-1** The laboratory revised and reissued the data package to exclude sample POLYMER, as the sample was submitted for informational purposes only and did not require validation.
Package Completeness	Yes	The data are considered greater than 98% complete.

ºC – Degrees Celsius
% – Percent
≤ – Less Than or Equal To
> – Greater Than
± – Plus or Minus
COC – Chain of Custody

DOC – Dissolved Organic Carbon
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
RPD – Relative Percent Difference
TOC – Total Organic Carbon
TSS – Total Suspended Solids
TVS – Total Volatile Solids

Qualifiers
J – Estimated
J- - Estimated, bias low
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 680-215213-1			
MB 400-566618/1-A Effluent	Aluminum	0.162 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 bl).
MB 400-566963/19 Influent Effluent	Nitrate-Nitrite, dissolved	0.0180 mg/L	
Data Package 680-216041-1			
MB 400-568296/1-A INFLUENT EFFLUENT DUP-1 FB	Dissolved Aluminum	0.112 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 bl).

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

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 680-214997-1				
Influent	Nitrate-Nitrite, dissolved	**86/86** (90-110)	0 (4)	As the potential bias was considered to be low, and the associated non-detected results were qualified as estimated (UJ m).
Data Package 680-215213-1				
Influent	Nitrate Nitrite as N	**83/83** (90-110)	0 (4)	As the potential bias was considered to be low, the associated detected results were qualified as estimated (J- m).
	Total Organic Carbon	**114/118** (76-117)	1 (16)	As the potential bias was considered to be high, the associated detected results were qualified as estimated (J+ m).
Data Package 680-215618-1				
Influent	Phosphorus, dissolved	**116/116** (90-110)	0 (20)	As the potential bias was considered to be high, the associated detected results were qualified as estimated (J+ m).
	Total Phosphorus	**116/116** (90-110)	0 (20)	

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

Associated Samples	Analyte	%R (Limits)	RPD (Limit)	Qualification
Data Package 680-216041-1				
INFLUENT	Nitrate Nitrite as N	**171/163** (90-110)	**5** (4)	As the potential bias was considered to be high, and the associated sample results were non-detect, qualification was not considered necessary.
	Nitrate-Nitrite, dissolved	**171/163** (90-110)	**5** (4)	
	Nitrite as N	**3/3** (80-118)	2 (9)	As the potential bias was considered to be low, and the associated sample results were non-detect, results were qualified as unusable (R m).
	Orthophosphate	**88**/91 (90-110)	3 (20)	As the potential bias was considered to be low, the associated detected results were qualified as estimated (J- m).

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

Qualifiers
J- - Estimated, bias low
J+ - Estimated, bias high
R - Unusable
UJ - Estimated
Reason Codes
m – Matrix Spike Recovery

Table 3: Total vs Partial Analyses Outliers and Resultant Data Qualification

Associated Samples	Analyte	Total Result	Dissolved Result	Qualification
Data Package 680-215213-1				
Effluent	Phosphorus	0.037 mg/L	0.095 mg/L	As the absolute difference between the field duplicate results is >2xPQL, the associated results were qualified as estimated (J td).

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

Qualifiers
J - Estimated
Reason Codes
td - Dissolved significantly greater than total

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

Associated Samples	Analyte	Concentration	Qualification
Data Package 680-216041-1			
FB INFLUENT EFFLUENT DUP-1	Nitrate Nitrite as N	0.025 mg/L	The associated sample results were reported at concentrations >5x the concentration of the blank contamination or non-detect; therefore, qualificaton was not considered necessary.
	Nitrate-Nitrite, dissolved	0.025 mg/L	
	Nitrate as N	0.025 mg/L	
	Kjeldahl Nitrogen, dissolved	0.48 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, Total dissolved	0.51 mg/L	

FB – Field Blank
mg/L – Milligrams per Liter
N - Nitrogen

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

Attachment A: Summary of Qualified Data
ARP Pond - February 2022

LAB ID	SAMPLE	MATRIX	METHOD	ANALYTE	UNITS	RESULT	DETECTED	PQL	MDL	DILUTION	FRACTION	QUALIFIERS	REASON CODE
400-214997-1	Influent	Water	353.2	Nitrate-Nitrite, Dissolved	mg/L	0.018	NO	0.05	0.018	1	Dissolved	UJ	m
400-214997-1	Influent	Water	365.1	Phosphorus, Dissolved	mg/L	0.015	YES	0.02	0.0096	1	Dissolved	J	lq
400-214997-2	Effluent	Water	365.1	Phosphorus, Dissolved	mg/L	0.01	YES	0.02	0.0096	1	Dissolved	J	lq
400-215213-1	Influent	Water	353.2	Nitrate Nitrite as N	mg/L	0.027	YES	0.05	0.018	1	Total	J-	lq,m
400-215213-1	Influent	Water	353.2	Nitrate-Nitrite, Dissolved	mg/L	0.075	NO	0.075	0.075	1	Dissolved	U	bl
400-215213-1	Influent	Water	365.1	Phosphorus, Dissolved	mg/L	0.012	YES	0.02	0.0096	1	Dissolved	J	lq
400-215213-1	Influent	Water	200.7 Rev 4.4	Aluminum	mg/L	0.13	YES	0.2	0.051	1	Total	J	lq
400-215213-1	Influent	Water	Nitrate by calc	Nitrate as N	mg/L	0.027	YES	0.05	0.018	1	Total	J	lq
400-215213-1	Influent	Water	SM 5310B	Total Organic Carbon	mg/L	6.4	YES	1	0.5	1	Total	J+	m
400-215213-2	Effluent	Water	353.2	Nitrate Nitrite as N	mg/L	0.027	YES	0.05	0.018	1	Total	J	lq
400-215213-2	Effluent	Water	353.2	Nitrate-Nitrite, Dissolved	mg/L	0.082	NO	0.082	0.082	1	Dissolved	U	bl
400-215213-2	Effluent	Water	365.1	Total Phosphorus as P	mg/L	0.037	YES	0.02	0.0096	1	Total	J	td
400-215213-2	Effluent	Water	365.1	Phosphorus, Dissolved	mg/L	0.095	YES	0.02	0.0096	1	Dissolved	J	td
400-215213-2	Effluent	Water	200.7 Rev 4.4	Aluminum	mg/L	0.2	NO	0.2	0.19	1	Total	U	bl
400-215213-2	Effluent	Water	Nitrate by calc	Nitrate as N	mg/L	0.027	YES	0.05	0.018	1	Total	J	lq
400-215618-1	Influent	Water	351.2	otal Kjeldahl Nitrogen, Dissolv	mg/L	0.34	YES	0.5	0.26	1	Dissolved	J	lq
400-215618-1	Influent	Water	353.2	Nitrate Nitrite as N	mg/L	0.043	YES	0.05	0.018	1	Total	J	lq
400-215618-1	Influent	Water	353.2	Nitrate-Nitrite, Dissolved	mg/L	0.038	YES	0.05	0.018	1	Dissolved	J	lq
400-215618-1	Influent	Water	365.1	Total Phosphorus as P	mg/L	0.044	YES	0.02	0.0096	1	Total	J+	m
400-215618-1	Influent	Water	200.7 Rev 4.4	Aluminum	mg/L	0.072	YES	0.2	0.051	1	Total	J	lq
400-215618-1	Influent	Water	365.1/LL	Orthophosphate as P	mg/L	0.015	YES	0.005	0.005	1	Total	J-	ht
400-215618-1	Influent	Water	Nitrate by calc	Nitrate as N	mg/L	0.043	YES	0.05	0.018	1	Total	J	lq
400-215618-1	Influent	Water	Total Nitrogen	Nitrogen, Total	mg/L	0.38	YES	0.5	0.26	1	Dissolved	J	lq
400-215618-2	Effluent	Water	351.2	otal Kjeldahl Nitrogen, Dissolv	mg/L	0.45	YES	0.5	0.26	1	Dissolved	J	lq
400-215618-2	Effluent	Water	365.1/LL	Orthophosphate as P	mg/L	0.005	YES	0.005	0.005	1	Total	R	ht
400-215618-2	Effluent	Water	Total Nitrogen	Nitrogen, Total	mg/L	0.45	YES	0.5	0.26	1	Dissolved	J	lq
400-216041-1	INFLUENT	Water	351.2	otal Kjeldahl Nitrogen, Dissolv	mg/L	0.59	NO	0.59	0.59	1	Dissolved	U	bf
400-216041-1	INFLUENT	Water	354.1	Nitrite as N	mg/L	0.018	NO	0.1	0.018	1	Total	R	m
400-216041-1	INFLUENT	Water	200.7 Rev 4.4	Aluminum	mg/L	0.19	YES	0.2	0.051	1	Total	J	lq
400-216041-1	INFLUENT	Water	200.7 Rev 4.4	Dissolved Aluminum	mg/L	0.2	NO	0.2	0.073	1	Dissolved	U	bl
400-216041-1	INFLUENT	Water	365.1/LL	Orthophosphate as P	mg/L	0.018	YES	0.005	0.005	1	Total	J-	m,ht
400-216041-1	INFLUENT	Water	Total Nitrogen	Nitrogen, Total Dissolved	mg/L	0.59	NO	0.59	0.59	1	Dissolved	U	bf
400-216041-2	EFFLUENT	Water	350.1	Ammonia (undistilled)	mg/L	0.032	YES	0.05	0.024	1	Total	J	lq
400-216041-2	EFFLUENT	Water	351.2	otal Kjeldahl Nitrogen, Dissolv	mg/L	0.5	NO	0.5	0.47	1	Dissolved	U	bf
400-216041-2	EFFLUENT	Water	365.1/LL	Orthophosphate as P	mg/L	0.0064	YES	0.005	0.005	1	Total	J-	m,ht
400-216041-2	EFFLUENT	Water	Total Nitrogen	Nitrogen, Total Dissolved	mg/L	0.5	NO	0.5	0.47	1	Dissolved	U	bf
400-216041-3	DUP-1	Water	351.2	otal Kjeldahl Nitrogen, Dissolv	mg/L	0.57	NO	0.57	0.57	1	Dissolved	U	bf
400-216041-3	DUP-1	Water	365.1/LL	Orthophosphate as P	mg/L	0.018	YES	0.005	0.005	1	Total	J-	m,ht
400-216041-3	DUP-1	Water	Total Nitrogen	Nitrogen, Total Dissolved	mg/L	0.57	NO	0.57	0.57	1	Dissolved	U	bf
400-216041-5	FB	Water	351.2	otal Kjeldahl Nitrogen, Dissolv	mg/L	0.48	YES	0.5	0.26	1	Dissolved	J	lq

Attachment A: Summary of Qualified Data
ARP Pond - February 2022

LAB ID	SAMPLE	MATRIX	METHOD	ANALYTE	UNITS	RESULT	DETECTED	PQL	MDL	DILUTION	FRACTION	QUALIFIERS	REASON CODE
400-216041-5	FB	Water	353.2	Nitrate Nitrite as N	mg/L	0.025	YES	0.05	0.018	1	Total	J	lq
400-216041-5	FB	Water	353.2	Nitrate-Nitrite, Dissolved	mg/L	0.025	YES	0.05	0.018	1	Dissolved	J	lq
400-216041-5	FB	Water	200.7 Rev 4.4	Dissolved Aluminum	mg/L	0.34	NO	0.34	0.34	1	Dissolved	U	bl
400-216041-5	FB	Water	365.1/LL	Orthophosphate as P	mg/L	0.005	NO	0.005	0.005	1	Total	R	ht
400-216041-5	FB	Water	Nitrate by calc	Nitrate as N	mg/L	0.025	YES	0.05	0.018	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/UJ	Estimated
R	Unusable
U	Non-Detect

Reason Codes

bf	Field Blank Contamination
bl	Laboratory Blank Contamination
ht	Holding Time
lq	Result Detected Between the MDL and PQL
m	Matrix Spike Recovery
td	Dissolved significantly greater than total

ARP Pond
Data Review Summary

Sample Delivery Group: 400-216244-1, 400-216839-1, and 400-217096-1
Sampling Date: March 1st, 10th, and 17th, 2022
Data Reviewer: Jamie Herman Date Completed: August 31, 2022
Peer Reviewer: Katie Abbott Date Completed: September 16, 2022

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

Field Identification	Sample Type	Laboratory Identification	Matrix	Analyses			
				Total Recoverable Metals (200.7)	Dissolved Metals (200.7)	General Chemistry – Total	General Chemistry - Dissolved
Data Package 400-216244-1							
Influent	N	400-216244-1	Water	X^m	X^m	X^m	X^m
Effluent	N	400-216244-2	Water	X	X	X^m	X^m
Data Package 400-216839-1							
INFLUENT	N	400-216839-1	Water	X	X	X^m	X^m
EFFLUENT	N	400-216839-2	Water	X	X	X	X
Data Package 400-217096-1							
Influent	N	400-217096-1	Water	X	X	X	X
Effluent	N	400-217096-2	Water	X	X	X^m	X^m

Sample Type: N – Normal X^m – Matrix Spike/ Matrix Spike Duplicate --- - Sample 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 (353.2/354.1), Total Phosphorous (365.1), Orthophosphate (365.1), Ammonia as N (350.1), Total Organic Carbon (5310B), Total Alkalinity (SM2320B), Chlorophyll a (SM10200)
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 March 2022 for the ARP Pond 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 (detailed below and summarized in Attachment A).
_____ 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 addressed 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 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 analyses were conducted within the method required holding time.
Laboratory Blanks • Method Blank (MB)	No	With the exceptions listed in Table 1, the target analytes were not detected within the method blanks.
Matrix Quality Control • Matrix Spike/ Matrix Spike Duplicate **400-246244-1** Influent (Total/Dissolved Aluminum, Total/Dissolved Nitrate-Nitrite as N) Effluent (Total/Dissolved Phosphorus) **400-216839-1** INFLUENT (Ammonia, Total/Dissolved Kjeldahl nitrogen, Nitrite as N) EFFLUENT (Orthophosphate) **400-217096-1** Effluent (Total/Dissolved Phosphorus) • Laboratory Duplicate **400-216244-1** Influent (DOC) **400-216839-1** INFLUENT (DOC) **400-217096-1** Influent (TSS) • 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. **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. 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 None • Field Duplicate None	NA	**Trip Blank/ Field Blank** A trip blank was not applicable for the methods performed. A field was not submitted with the associated data packages.

Review Parameter	Criteria Met?	Comments
		Field Duplicate A field duplicate as not submitted with the associated 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	Yes	The data are considered 100% complete.

ºC – Degrees Celsius
% – Percent
≤ – Less Than or Equal To
> – Greater Than
± – Plus or Minus
COC – Chain of Custody
DOC – Dissolved Organic Carbon
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
RPD – Relative Percent Difference
TOC – Total Organic Carbon
TSS – Total Suspended Solids
TVS – Total Volatile Solids

Qualifiers
J – Estimated
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 400-216839-1			
MB 400-569722/1-A Influent Effluent	Dissolved Aluminum	0.0636 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 bl).

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

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 400-216244-1				
Influent	Nitrate-Nitrite, dissolved	**190/189** (90-110)	0 (4)	As the potential bias was considered to be high, and the associated detected results were qualified as estimated (J+ m).
	Nitrate-Nitrite as N	**190/189** (90-110)	0 (4)	
Data Package 400-216839-1				
INFLUENT	Nitrite as N	**198/216** (80-118)	8 (9)	As the potential bias was considered to be high, and the associated sample results were non-detect, qualification was not considered necessary.
EFFLUENT	Orthophosphate as P	**78/79** (90-110)	1 (20)	As the potential bias was considered to be low, the associated detected results were qualified as estimated (J- m).

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

Qualifiers
J- - Estimated, bias low
J+ - Estimated, bias high

Reason Codes
m – Matrix Spike Recovery

Attachment A: Summary of Qualified Data
ARP Pond - March 2022

LAB ID	SAMPLE	MATRIX	METHOD	ANALYTE	UNITS	RESULT	DETECTED	PQL	MDL	DILUTION	FRACTION	QUALIFIERS	REASON CODE
400-216244-1	Influent	Water	200.7	Aluminum	mg/L	0.14	YES	0.2	0.051	1	Total	J	lq
400-216244-1	Influent	Water	200.7	Dissolved Aluminum	mg/L	0.076	YES	0.2	0.051	1	Dissolved	J	lq
400-216244-1	Influent	Water	351.2	otal Kjeldahl Nitrogen, Dissolv	mg/L	0.44	YES	0.5	0.26	1	Dissolved	J	lq
400-216244-1	Influent	Water	353.2	Nitrate Nitrite as N	mg/L	0.018	YES	0.05	0.018	1	Total	J+	m,lq
400-216244-1	Influent	Water	353.2	Nitrate-Nitrite, Dissolved	mg/L	0.019	YES	0.05	0.018	1	Dissolved	J+	m,lq
400-216244-1	Influent	Water	Nitrate by calc	Nitrate as N	mg/L	0.018	YES	0.05	0.018	1	Total	J	lq
400-216244-1	Influent	Water	Total Nitrogen	Nitrogen, Total Dissolved	mg/L	0.46	YES	0.5	0.26	1	Dissolved	J	lq
400-216244-2	Effluent	Water	353.2	Nitrate-Nitrite, Dissolved	mg/L	0.02	YES	0.05	0.018	1	Dissolved	J	lq
400-216244-2	Effluent	Water	365.1	Total Phosphorus as P	mg/L	0.014	YES	0.02	0.0096	1	Total	J	lq
400-216839-1	INFLUENT	Water	200.7	Dissolved Aluminum	mg/L	<0.13	NO	0.2	0.13	1	Dissolved	U	bl
400-216839-1	INFLUENT	Water	351.2	otal Kjeldahl Nitrogen, Dissolv	mg/L	0.44	YES	0.5	0.26	1	Dissolved	J	lq
400-216839-1	INFLUENT	Water	353.2	Nitrate Nitrite as N	mg/L	0.031	YES	0.05	0.018	1	Total	J	lq
400-216839-1	INFLUENT	Water	353.2	Nitrate-Nitrite, Dissolved	mg/L	0.023	YES	0.05	0.018	1	Dissolved	J	lq
400-216839-1	INFLUENT	Water	Nitrate by calc	Nitrate as N	mg/L	0.031	YES	0.05	0.018	1	Total	J	lq
400-216839-1	INFLUENT	Water	Total Nitrogen	Nitrogen, Total Dissolved	mg/L	0.46	YES	0.5	0.26	1	Dissolved	J	lq
400-216839-2	EFFLUENT	Water	200.7	Aluminum	mg/L	0.13	YES	0.2	0.051	1	Total	J	lq
400-216839-2	EFFLUENT	Water	200.7	Dissolved Aluminum	mg/L	<0.07	NO	0.2	0.07	1	Dissolved	U	bl
400-216839-2	EFFLUENT	Water	353.2	Nitrate Nitrite as N	mg/L	0.023	YES	0.05	0.018	1	Total	J	lq
400-216839-2	EFFLUENT	Water	353.2	Nitrate-Nitrite, Dissolved	mg/L	0.022	YES	0.05	0.018	1	Dissolved	J	lq
400-216839-2	EFFLUENT	Water	365.1/LL	Orthophosphate as P	mg/L	0.014	YES	0.005	0.005	1	Total	J-	m
400-216839-2	EFFLUENT	Water	Nitrate by calc	Nitrate as N	mg/L	0.023	YES	0.05	0.018	1	Total	J	lq
400-217096-1	Influent	Water	353.2	Nitrate Nitrite as N	mg/L	0.026	YES	0.05	0.018	1	Total	J	lq
400-217096-1	Influent	Water	Nitrate by calc	Nitrate as N	mg/L	0.026	YES	0.05	0.018	1	Total	J	lq
400-217096-2	Effluent	Water	351.2	otal Kjeldahl Nitrogen, Dissolv	mg/L	0.3	YES	0.5	0.26	1	Dissolved	J	lq
400-217096-2	Effluent	Water	Total Nitrogen	Nitrogen, Total Dissolved	mg/L	0.3	YES	0.5	0.26	1	Dissolved	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
U	Non-Detect

Reason Codes

bl	Laboratory Blank Contamination
lq	Result Detected Between the MDL and PQL
m	Matrix Spike Recovery

ARP Pond
Data Review Summary

Sample Delivery Group: 400-218469-1, 400-218689-1, and 400-219090-1
Sampling Date: April 14th, 20th, and 27th, 2022
Data Reviewer: Jamie Herman Date Completed: August 31, 2022
Peer Reviewer: Katie Abbott Date Completed: September 16, 2022

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

Field Identification	Sample Type	Laboratory Identification	Matrix	Analyses			
				Total Recoverable Metals (200.7)	Dissolved Metals (200.7)	General Chemistry – Total	General Chemistry - Dissolved
Data Package 400-218469-1							
Influent	N	400-218469-1	Water	X	X^m	X	X
Effluent	N	400-218469-2	Water	X	X	X	X
Data Package 400-218689-1							
Influent	N	400-218689-1	Water	X	X	X^m	X^m
Effluent	N	400-218689-2	Water	X	X	X	X
Dup-1	FD	400-218689-3	Water	X	X	X	X
Field Blank	FB	400-218689-4	Water	X	X	X^{m1}	X
Data Package 400-219090-1							
Influent	N	400-218090-1	Water	X^m	X^m	X^m	X^m
Effluent	N	400-218090-2	Water	X	X	X	X

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 (353.2/354.1), Total Phosphorous (365.1), Orthophosphate (365.1), Ammonia as N (350.1), Total Organic Carbon (5310B), Total Alkalinity (SM2320B), Chlorophyll a (SM10200)
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)
[1] – Alkalinity not performed

This report contains the final results of the data validation conducted for water samples collected in April 2022 for the ARP Pond 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.
_____ Data are usable with qualification (detailed 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 addressed 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 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 400-218469-1** Multiple analytical runs for orthophosphate were reported for samples Influent and Effluent, results were selected for reporting using the following criteria: • If both results were non-detect, the results were qualified as unusable because the samples were analyzed outside the method required holding time. • If both results were reported as detected, the higher detected result was selected for reporting. • If one result was reported as non-detect and the other result was reported as detected, the detected result was selected for reporting. In addition, due to laboratory error, the orthophosphate analysis was performed 1-2 hours outside of the method required holding time of 48 hours. As a result, the associated detected results for samples Influent and Effluent were qualified as estimated (J- ht). **Data Package 400-218689-1** The laboratory noted that sample Dup-1 was analyzed outside the method required holding time for nitrate as nitrogen (N) and nitrite as N. However, this is a blind field duplicate, the collection time listed on the COC was listed ambiguously as 00:01. When the holding time is re-calculated using the accurate sample collection time, the sample was analyzed within hold; therefore, further action and qualification were not considered necessary. The total and dissolved Kjeldahl nitrogen re-analysis of sample Influent was performed 18 days outside of the method required holding time of 28 days. Due to field blank contamination, the total Kjeldahl nitrogen result was considered non-detect. Therefore, the associated total Kjeldahl nitrogen result was qualified as unusable (R ht) and the dissolved Kjeldahl nitrogen result was qualified as not reportable (DNR) due to holding time qualification; therefore, the results were reported by the initial analysis.
Report	NA	**Data Package 400-218689-1** A revised report was provided by the laboratory for sample Influent to correct the total Kjeldahl nitrogen result, which was initially reported as less than the dissolved Kjeldahl nitrogen result.

Review Parameter	Criteria Met?	Comments
Laboratory Blanks • Method Blank (MB)	Yes	The target analytes were not detected within the method blanks.
Matrix Quality Control • Matrix Spike/ Matrix Spike Duplicate **400-218469-1** Influent (Dissolved Aluminum) **400-218689-1** Influent (Dissolved Nitrate-Nitrite, Dissolved Phosphorus, Orthophosphate) Field Blank (TOC) - Not evaluated, not an appropriate Matrix **400-219090-1** Influent (Total/Dissolved Aluminum, Dissolved Phosphorus, Orthophosphate) • Laboratory Duplicate **400-218469-1** Influent (Alkalinity) **400-218689-1** Influent (TVS, TSS) **400-219090-1** Influent (DOC) • 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 aluminum. Therefore, there is no measure of accuracy and precision as it pertains to the sample matrix for this parameter. **Laboratory Duplicate** With the exception listed in Table 2, 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. 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 **Data Package 400-218639-1** Field Blank • Field Duplicate **Data Package 400-218639-1** Effluent/Dup-1	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** 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.
Package Completeness	Yes	With the exception of the total and dissolved Kjeldahl nitrogen re-analysis results associated with sample Influent, which were analyzed outside of the method holding time, the results are considered usable as qualified. As the initial analysis for the total and dissolved Kjeldahl nitrogen results were selected for reporting, the data are considered 100% complete.

ºC – Degrees Celsius
% – Percent
≤ – Less Than or Equal To
> – Greater Than
± – Plus or Minus
COC – Chain of Custody
DOC – Dissolved Organic Carbon
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
RPD – Relative Percent Difference
TOC – Total Organic Carbon
TSS – Total Suspended Solids
TVS – Total Volatile Solids

Qualifiers
J – Estimated
J- - Estimated, bias low
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 400-218689-1				
Influent	Nitrate-Nitrite, dissolved	**254/255** (90-110)	0 (4)	As the potential bias was considered to be high, and the associated sample results were non-detect, qualification was not considered necessary.
Data Package 400-219090-1				
Influent	Orthophosphate as P	**53/57** (90-110)	6 (20)	As the potential bias was considered to be low, the associated detected results were qualified as estimated (J- m).

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

Qualifiers
J- - Estimated, bias low

Reason Codes
m – Matrix Spike Recovery

Table 2: Laboratory Duplicate Outliers and Resultant Data Qualification

Associated Samples	Analyte	Parent Result	Duplicate Result	Criteria not Met	Qualification
Data Package 400-218689-1					
Influent	TSS	4.5 mg/L	9.00 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: Field Blank Outliers and Resultant Data Qualification

Blank/ Associated Samples	Analyte	Concentration	Qualification
Data Package 400-218639-1			
Field Blank Influent Effluent Dup-1	Total Kjeldahl nitrogen	1.8 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).
	Total phosphorus as P	0.14 mg/L	
	Nitrogen, total	1.8 mg/L	
	Phosphorus, dissolved	0.10 mg/L	

> - Greater than
mg/L – Milligrams per Liter

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

Attachment A: Summary of Qualified Data
ARP Pond - April 2022

LAB ID	SAMPLE	MATRIX	METHOD	ANALYTE	UNITS	RESULT	DETECTED	PQL	MDL	DILUTION	FRACTION	QUALIFIERS	REASON CODE
400-218469-1	Influent	Water	353.2	Nitrate Nitrite as N	mg/L	0.03	YES	0.05	0.018	1	Total	J	lq
400-218469-1	Influent	Water	365.1/LL	Orthophosphate as P	mg/L	0.021	YES	0.005	0.005	1	Total	J-	ht
400-218469-1	Influent	Water	365.1/LL	Orthophosphate as P	mg/L	0.013	YES	0.005	0.005	1	Total	DNR	DNR
400-218469-1	Influent	Water	Nitrate by calc	Nitrate as N	mg/L	0.03	YES	0.05	0.018	1	Total	J	lq
400-218469-2	Effluent	Water	200.7	Dissolved Aluminum	mg/L	0.13	YES	0.2	0.051	1	Dissolved	J	lq
400-218469-2	Effluent	Water	351.2	Total Kjeldahl Nitrogen, Dissolved	mg/L	0.48	YES	0.5	0.26	1	Dissolved	J	lq
400-218469-2	Effluent	Water	365.1/LL	Orthophosphate as P	mg/L	0.013	YES	0.005	0.005	1	Total	J-	ht
400-218469-2	Effluent	Water	365.1/LL	Orthophosphate as P	mg/L	<0.005	NO	0.005	0.005	1	Total	R	ht
400-218469-2	Effluent	Water	Total Nitrogen	Nitrogen, Total Dissolved	mg/L	0.48	YES	0.5	0.26	1	Dissolved	J	lq
400-218689-1	Influent	Water	200.7	Aluminum	mg/L	0.12	YES	0.2	0.051	1	Total	J	lq
400-218689-1	Influent	Water	351.2	Nitrogen, Kjeldahl	mg/L	<0.69	NO	0.69	0.69	1	Total	U	bf
400-218689-1	Influent	Water	351.2	Nitrogen, Kjeldahl	mg/L	<6.8	NO	6.8	6.8	1	Total	R	bf,ht
400-218689-1	Influent	Water	351.2	Nitrogen, Kjeldahl	mg/L	0.84	YES	0.5	0.26	1	Dissolved	DNR	DNR
400-218689-1	Influent	Water	365.1	Phosphorus, Dissolved	mg/L	<0.22	NO	0.22	0.22	1	Dissolved	U	bf
400-218689-1	Influent	Water	365.1	Total Phosphorus as P	mg/L	<0.24	NO	0.24	0.24	1	Total	U	bf
400-218689-1	Influent	Water	SM 2540D	Total Suspended Solids	mg/L	4.5	YES	2.5	2.5	1	Total	J	ld
400-218689-1	Influent	Water	Total Nitrogen	Nitrogen, Total	mg/L	<0.69	NO	0.69	0.69	1	Total	U	bf
400-218689-2	Effluent	Water	351.2	Nitrogen, Kjeldahl	mg/L	<0.58	NO	0.58	0.58	1	Total	U	bf
400-218689-2	Effluent	Water	351.2	Total Kjeldahl Nitrogen, Dissolved	mg/L	0.38	YES	0.5	0.26	1	Dissolved	J	lq
400-218689-2	Effluent	Water	365.1	Phosphorus, Dissolved	mg/L	<0.15	NO	0.15	0.15	1	Dissolved	U	bf
400-218689-2	Effluent	Water	365.1	Total Phosphorus as P	mg/L	<0.17	NO	0.17	0.17	1	Total	U	bf
400-218689-2	Effluent	Water	Total Nitrogen	Nitrogen, Total	mg/L	<0.58	NO	0.58	0.58	1	Total	U	bf
400-218689-2	Effluent	Water	Total Nitrogen	Nitrogen, Total Dissolved	mg/L	0.38	YES	0.5	0.26	1	Dissolved	J	lq
400-218689-3	Dup-1	Water	351.2	Nitrogen, Kjeldahl	mg/L	<0.5	NO	0.5	0.5	1	Total	U	bf
400-218689-3	Dup-1	Water	351.2	Total Kjeldahl Nitrogen, Dissolved	mg/L	0.37	YES	0.5	0.26	1	Dissolved	J	lq
400-218689-3	Dup-1	Water	365.1	Phosphorus, Dissolved	mg/L	<0.2	NO	0.2	0.2	1	Dissolved	U	bf
400-218689-3	Dup-1	Water	365.1	Total Phosphorus as P	mg/L	<0.13	NO	0.13	0.13	1	Total	U	bf
400-218689-3	Dup-1	Water	Total Nitrogen	Nitrogen, Total	mg/L	<0.5	NO	0.5	0.5	1	Total	U	bf
400-218689-3	Dup-1	Water	Total Nitrogen	Nitrogen, Total Dissolved	mg/L	0.37	YES	0.5	0.26	1	Dissolved	J	lq
400-219090-1	Influent	Water	351.2	Total Kjeldahl Nitrogen, Dissolved	mg/L	0.49	YES	0.5	0.26	1	Dissolved	J	lq
400-219090-1	Influent	Water	365.1/LL	Orthophosphate as P	mg/L	0.026	YES	0.005	0.005	1	Total	J-	m
400-219090-2	Effluent	Water	351.2	Total Kjeldahl Nitrogen, Dissolved	mg/L	0.37	YES	0.5	0.26	1	Dissolved	J	lq
400-219090-2	Effluent	Water	Total Nitrogen	Nitrogen, Total Dissolved	mg/L	0.43	YES	0.5	0.26	1	Dissolved	J	lq

Definitions

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

Qualifiers

DNR	Do Not Report
J-	Estimated, Low Bias
J	Estimated
R	Unusable

Attachment A: Summary of Qualified Data
ARP Pond - April 2022

LAB ID	SAMPLE	MATRIX	METHOD	ANALYTE	UNITS	RESULT	DETECTED	PQL	MDL	DILUTION	FRACTION	QUALIFIERS	REASON CODE

U Non-Detect

Reason Codes

bf	Field Blank Contamination
DNR	Do Not Report
ht	Holding Time Violation
lq	Result Detected Between the MDL and PQL
m	Matrix Spike Recovery

ARP Pond
Data Review Summary

Sample Delivery Group: 400-219428-1, 400-219817-1, 400-220081-1, and 400-220468-1
Sampling Date: May 4th, 12th, 18th, and 25th, 2022
Data Reviewer: Jamie Herman Date Completed: September 1st, 2022
Peer Reviewer: Katie Abbott Date Completed: September 16, 2022

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

Field Identification	Sample Type	Laboratory Identification	Matrix	Analyses			
				Total Recoverable Metals (200.7)	Dissolved Metals (200.7)	General Chemistry – Total	General Chemistry - Dissolved
Data Package 400-219428-1							
Influent	N	400-219428-1	Water	X	X	X	X^m
Effluent	N	400-219428-2	Water	X	X^m	X	X
Data Package 400-219817-1							
Influent	N	400-219817-1	Water	X	X	X	X^m
Effluent	N	400-219817-2	Water	X	X	X	X
Data Package 400-220081-1							
Influent	N	400-220081-1	Water	X	X	X^m	X^m
Effluent	N	400-220081-2	Water	X	X	X^m	X
Data Package 400-220468-1							
Influent	N	400-220468-1	Water	X	X	X^m	X^m
Effluent	N	400-220468-2	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 (353.2/354.1), Total Phosphorous (365.1), Orthophosphate (365.1), Ammonia as N (350.1), Total Organic Carbon (5310B), Total Alkalinity (SM2320B), Chlorophyll a (SM10200)
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 May 2022 for the ARP Pond 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 (detailed 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 addressed 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 Pensacola 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 400-220468-1** Due to laboratory error, the orthophosphate as phosphorus (P) analysis for sample Effluent was performed 487 hours outside the method holding time of 48 hours. The associated non-detect result was qualified as unusable (R ht).
Report	NA	**Data Package 400-219428-1** The laboratory revised and reissued the data package to include missing laboratory quality control sample associated with SM5310B for dissolved organic carbon.
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 **400-219428-1** Influent (Dissolved Phosphorus, Orthophosphate, Dissolved Nitrate/Nitrite) Effluent (Dissolved Aluminum) **400-219817-1** Influent (Total/Dissolved Nitrate-Nitrite, Dissolved Phosphorus, Orthophosphate) **400-220081-1** Influent (Total/Dissolved Phosphorus) Effluent (Ammonia) **400-220468-1** Influent (Total/Dissolved Phosphorus) • Laboratory Duplicate **400-219428-1** Influent (Alkalinity) **400-219817-1** Influent (DOC) **400-220081-1** Influent (Alkalinity, DOC) **400-220468-1** Influent (DOC) • 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 and total/dissolved Kjeldahl nitrogen. Therefore, there is no measure of accuracy and precision as it pertains to the sample matrix for these parameters. **Laboratory Duplicate** With the exception listed in Table 3, 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

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 None reported in the associated data packages • Field Duplicate None reported in the associated data packages	NA	**Trip Blank/ Field Blank** A trip blank was not applicable for the methods performed. A field blank was not submitted with the associated data packages. **Field Duplicate** A field duplicate was not collected for the associated samples.
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 total and dissolved nitrate/nitrite as n results for sample Influent, which were qualified as unusable (R) as the matrix spike recoveries were below the rejection point, and the orthophosphate as P results for sample Effluent, which was qualified as unusable (R) as the sample was analyzed after the method holding time had been grossly exceeded, the data are considered greater than 98% complete.

ºC – Degrees Celsius
% – Percent
≤ – Less Than or Equal To
> – Greater Than
± – Plus or Minus
COC – Chain of Custody
DOC – Dissolved Organic Carbon
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
RPD – Relative Percent Difference
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 400-219428-1			
MB 860-52628/4-A Influent Effluent	Total Phosphorus as P	0.0128 mg/L	The associated result for sample Effluent was reported at a concentration <5x the concentration of the blank contamination and was qualified as non-detect (U bl).

< - 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 400-219428-1				
Influent	Orthophosphate as P	**74/78** (90-110)	1 (20)	As the potential bias was considered to be low, the associated detected result was qualified as estimated (J- m).
Data Package 400-219817-1				
Influent	Nitrate/Nitrite as N	**8/7** (90-110)	**13** (4)	As the potential bias was considered to be low, and the percent recoveries were below the rejection point, the associated non-detect results were qualified as unusable (R m).
	Nitrate/Nitrite as N, Dissolved	**8/7** (90-110)	**13** (4)	
	Orthophosphate as P	**68/70** (90-110)	3 (20)	As the potential bias was considered to be low, the associated detected result was qualified as estimated (J- m).
Data Package 400-220081-1				
Influent	Phosphorus, Dissolved	**87**/90 (90-110)	4 (20)	As the potential bias was considered to be low, the associated detected results were qualified as estimated (J- m).
	Total Phosphorus as P	**87**/90 (90-110)	4 (20)	
Data Package 400-220468-1				
Influent	Phosphorus, Dissolved	108/**111** (90-110)	2 (20)	As the potential bias was considered to be high, the associated detected results were qualified as estimated (J+ m).
	Total Phosphorus as P	108/**111** (90-110)	2 (20)	

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

Qualifiers
J+ – Estimated, bias high
J- – Estimated, bias low
R – Unusable
Reason Codes
m – Matrix Spike Recovery

Table 3: Laboratory Duplicate Outliers and Resultant Data Qualification

Associated Samples	Analyte	Parent Result	Duplicate Result	Criteria not Met	Qualification
Data Package 400-219428-1					
Influent	Total Alkalinity	58 mg/L	40.5 mg/L	> Laboratory RPD	As the RPD between the laboratory duplicate results is greater than the laboratory RPD limit, the associated results were qualified as estimated (J ld).

> – Greater than
mg/L – Milligrams per Liter
RPD – Relative Percent Difference

Qualifiers
J – Estimated
Reason Codes
ld – Laboratory Duplicate RPDs

Attachment A: Summary of Qualified Data
ARP Pond - May 2022

LAB ID	SAMPLE	MATRIX	METHOD	ANALYTE	UNITS	RESULT	DETECTED	PQL	MDL	DILUTION	FRACTION	QUALIFIERS	REASON CODE
400-219428-1	Influent	Water	365.1/LL	Orthophosphate as P	mg/L	0.018	YES	0.005	0.005	1	Total	J-	m
400-219428-1	Influent	Water	SM 2320B	Alkalinity, Total	mg/L	58	YES	1	0.5	1	Total	J	ld
400-219428-2	Effluent	Water	365.1	Phosphorus, Dissolved	mg/L	0.011	YES	0.02	0.0096	1	Dissolved	J	lq
400-219428-2	Effluent	Water	365.1	Total Phosphorus as P	mg/L		NO	0.038	0.038	1	Total	U	bl
400-219817-1	Influent	Water	350.1	Ammonia (undistilled)	mg/L	0.036	YES	0.05	0.024	1	Total	J	lq
400-219817-1	Influent	Water	353.2	Nitrate Nitrite as N	mg/L	0.018	NO	0.05	0.018	1	Total	R	m
400-219817-1	Influent	Water	353.2	Nitrate-Nitrite, Dissolved	mg/L	0.018	NO	0.05	0.018	1	Dissolved	R	m
400-219817-1	Influent	Water	200.7 Rev 4.4	Aluminum	mg/L	0.17	YES	0.2	0.051	1	Total	J	lq
400-219817-1	Influent	Water	365.1/LL	Orthophosphate as P	mg/L	0.02	YES	0.005	0.005	1	Total	J-	m
400-219817-2	Effluent	Water	351.2	Total Kjeldahl Nitrogen, Dissolved	mg/L	0.28	YES	0.5	0.26	1	Dissolved	J	lq
400-219817-2	Effluent	Water	365.1	Total Phosphorus as P	mg/L	0.011	YES	0.02	0.0096	1	Total	J	lq
400-219817-2	Effluent	Water	Total Nitrogen	Nitrogen, Total Dissolved	mg/L	0.28	YES	0.5	0.26	1	Dissolved	J	lq
400-220081-1	Influent	Water	350.1	Ammonia (undistilled)	mg/L	0.037	YES	0.05	0.024	1	Total	J	lq
400-220081-1	Influent	Water	365.1	Phosphorus, Dissolved	mg/L	0.019	YES	0.02	0.0096	1	Dissolved	J-	m,lq
400-220081-1	Influent	Water	365.1	Total Phosphorus as P	mg/L	0.09	YES	0.02	0.0096	1	Total	J-	m
400-220081-1	Influent	Water	200.7 Rev 4.4	Dissolved Aluminum	mg/L	0.054	YES	0.2	0.051	1	Dissolved	J	lq
400-220081-2	Effluent	Water	350.1	Ammonia (undistilled)	mg/L	0.034	YES	0.05	0.024	1	Total	J	lq
400-220081-2	Effluent	Water	351.2	Nitrogen, Kjeldahl	mg/L	0.32	YES	0.5	0.26	1	Total	J	lq
400-220081-2	Effluent	Water	351.2	Total Kjeldahl Nitrogen, Dissolved	mg/L	0.3	YES	0.5	0.26	1	Dissolved	J	lq
400-220081-2	Effluent	Water	353.2	Nitrate Nitrite as N	mg/L	0.046	YES	0.05	0.018	1	Total	J	lq
400-220081-2	Effluent	Water	200.7 Rev 4.4	Aluminum	mg/L	0.19	YES	0.2	0.051	1	Total	J	lq
400-220081-2	Effluent	Water	200.7 Rev 4.4	Dissolved Aluminum	mg/L	0.14	YES	0.2	0.051	1	Dissolved	J	lq
400-220081-2	Effluent	Water	Total Nitrogen	Nitrogen, Total	mg/L	0.37	YES	0.5	0.26	1	Total	J	lq
400-220081-2	Effluent	Water	Total Nitrogen	Nitrogen, Total Dissolved	mg/L	0.3	YES	0.5	0.26	1	Dissolved	J	lq
400-220468-1	Influent	Water	350.1	Ammonia (undistilled)	mg/L	2.9	YES	5	2.4	100	Total	J	lq
400-220468-1	Influent	Water	353.2	Nitrate-Nitrite, Dissolved	mg/L	0.032	YES	0.05	0.018	1	Dissolved	J	lq
400-220468-1	Influent	Water	365.1	Phosphorus, Dissolved	mg/L	0.02	YES	0.02	0.0096	1	Dissolved	J+	m
400-220468-1	Influent	Water	365.1	Total Phosphorus as P	mg/L	0.051	YES	0.02	0.0096	1	Total	J+	m
400-220468-2	Effluent	Water	353.2	Nitrate-Nitrite, Dissolved	mg/L	0.026	YES	0.05	0.018	1	Dissolved	J	lq
400-220468-2	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 Limit
PQL	Practical Quantitation Limit

Qualifiers

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

Reason Codes

bl	Laboratory Blank Contamination
ht	Holding Time

Attachment A: Summary of Qualified Data
ARP Pond - May 2022

LAB ID	SAMPLE	MATRIX	METHOD	ANALYTE	UNITS	RESULT	DETECTED	PQL	MDL	DILUTION	FRACTION	QUALIFIERS	REASON CODE
ld	Laboratory Duplicate RPDs												
lq	Result Detected Between the MDL and PQL												
m	Matrix Spike Recovery												

ARP Pond
Data Review Summary

Sample Delivery Group: 400-220849-1, 400-221567-1, 400-221913-1, and 400-222081-1
Sampling Date: June 2nd, 16th, 23rd and 28th, 2022
Data Reviewer: Jamie Herman Date Completed: November 11, 2022
Peer Reviewer: Katie Abbott Date Completed: November 14, 2022

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

Field Identification	Sample Type	Laboratory Identification	Matrix	Analyses			
				Total Recoverable Metals (200.7)	Dissolved Metals (200.7)	General Chemistry – Total	General Chemistry - Dissolved
Data Package 400-220849-1							
Influent	N	400-220849-1	Water	X[1]	X[1]	X[m1]	X[m1]
Effluent	N	400-220849-2	Water	X[1]	X[1]	X[1]	X[1]
Data Package 400-221567-1							
Influent	N	400-221567-1	Water	X	X	X[m]	X
Effluent	N	400-221567-2	Water	X	X	X	X
Data Package 400-221913-1							
Influent	N	400-221913-1	Water	X	X[m]	X[m]	X[m]
Effluent	N	400-221913-2	Water	X	X	X	X
Dup-1	FD	400-221913-3	Water	X	X	X	X
Field Blank	FB	400-221913-4	Water	X	X	X	X
Data Package 400-222081-1							
Influent	N	400-222081-1	Water	X[m]	X	X[m]	X[m]
Effluent	N	400-222081-2	Water	X	X	X[m]	X

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 (353.2/354.1), Total Phosphorous (365.1), Orthophosphate (365.1), Ammonia as N (350.1), Total Organic Carbon (5310B), Total Alkalinity (SM2320B), Chlorophyll a (SM10200)
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)
[1] – Only 365.1 total and dissolved phosphorus, SM10200 chlorophyll a, and 365.1 low level orthophosphate were performed due to temperatures at the time of sample receipt.

This report contains the final results of the data validation conducted for water samples collected in June 2022 for the ARP Pond 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 (detailed 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 addressed 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	With the exception noted below, the samples were received by Eurofins TestAmerica Pensacola, Eurofins TestAmerica Houston, 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 400-220849-1** Due to a FedEX shipping delay, the samples were received at Eurofins TestAmerica Pensacola at an elevated temperature (8.9°C). The associated analyses received outside of temperature criteria and/or outside their method required holding times were cancelled. The following analyses were within the recommended ≤6 °C temperature range and the laboratory proceeded with analysis: Method 365.1 total and dissolved phosphorus, Method 365.1 low level orthophosphate, and Standard Method (SM)10200 chlorophyll a.
Report	NA	**Data Package 400-220849-1** The laboratory revised and reissued the data package to include the original chain of custody associated with the sample volume submitted to the Eurofins TestAmerica Pensacola laboratory. No further action was considered necessary.
Holding Times	No	With the exceptions noted below, the analyses were conducted within the method required holding time. **Data Package 400-221567-1** Due to laboratory error, the nitrite as nitrogen (N) and nitrate as N analysis for samples Influent and Effluent were performed 102-103 hours outside the method holding time of 48 hours. The associated detected results were qualified as estimated (J- ht), and the non-detected results were qualified as unusable (R ht). **Data Package 400-221913-1** The total suspended solids and total volatile suspended solids re-analyses for samples Influent and Dup-1 were performed 6 days outside the method holding time of 7 days per laboratory analytical procedures associated with field duplicates. The laboratory noted if all analytical results confirm in two samples, then those analytes are rerun for confirmation on those two samples. The associated detected results were qualified as estimated (J ht). The laboratory reported both hold and out of hold results, results were selected for reporting using the following criteria: • If both results were reported as detected, the higher detected result was selected for reporting. • If one result was reported as non-detect and the other

Review Parameter	Criteria Met?	Comments
		result was reported as detected, the detected result was selected for reporting. • If both results were reported as detected and one result was qualified as estimated because the sample was analyzed outside the method required holding time, the associated result analyzed within the method required holding time was selected for reporting. The results not selected for reporting were qualified as "Do not report" (DNR).
Laboratory Blanks • Method Blank (MB)	No	With the exceptions listed in Table 1, the target analytes were not detected within the method blanks.
Matrix Quality Control • Matrix Spike/ Matrix Spike Duplicate **400-220849-1** Influent (Total/Dissolved Phosphorus, Orthophosphate) **400-221567-1** Influent (Total Ammonia, Nitrite as N) **400-221913-1** Influent (Dissolved Aluminum, Nitrite as N, Total/Dissolved Phosphorus, TOC) **400-222081-1** Influent (Total Aluminum, Dissolved Nitrate-Nitrite Total/Dissolved Phosphorus) Effluent (Orthophosphate as P) • Laboratory Duplicate **400-220849-1** None **400-221567-1** Influent (DOC) Effluent (Alkalinity) **400-221913-1** Influent (VSS, TSS, DOC) Effluent (Alkalinity, TOC) **400-222081-1** Influent (DOC) • 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 and total/dissolved Kjeldahl nitrogen. Therefore, there is no measure of accuracy and precision as it pertains to the sample matrix for these parameters. **Laboratory Duplicate** With the exception noted below, 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. **Data Package 400-221913-1** The total suspended solids (TSS) duplicate performed on sample Influent is associated with an analytical run that was not reported by the laboratory for the parent sample; therefore, qualification based on the laboratory duplicate result variability was not considered necessary. **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.
Field Quality Control • Trip Blank/Field Blank **400-221913-1** Field Blank • Field Duplicate **400-221913-1** Influent/Dup-1	No	**Trip Blank/Field Blank** A trip blank was not applicable for the methods performed. With the exception listed in Table 3, no target analytes reported in the associated field blank. **Field Duplicate** 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.
Package Completeness	No	With the exception of the nitrite as n results for samples Influent and Effluent which were qualified as unusable (R) as the samples were analyzed after the method holding time had been grossly exceeded, and the nitrite as n result for sample Influent which was qualified as unusable (R) as the matrix spike recoveries were below the rejection point, the data are considered greater than 98% complete.

ºC – Degrees Celsius
% – Percent
≤ – Less Than or Equal To
> – Greater Than
± – Plus or Minus
COC – Chain of Custody
DOC – Dissolved Organic Carbon
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
RPD – Relative Percent Difference
TOC – Total Organic Carbon
TSS – Total Suspended Solids
TVS – Total Volatile Solids

Qualifiers
DNR – Do Not Report
J- - Estimated, Low Bias
J – Estimated
R – Unusable

Reason Codes
DNR – Do Not Report
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 400-221913-1			
MB 400-582847/1-A Influent Effluent Dup-1 Field Blank	Dissolved Aluminum	0.0873 mg/L	The associated sample results reported at concentrations <5x the concentration of the blank contamination were qualified as non-detect (U bl).
MB 400-583423/23 Influent Effluent Dup-1 Field Blank	Ammonia	0.0290 mg/L	
MB 400-583534/37 Influent Effluent Dup-1 Field Blank	Total Organic Carbon	0.516 mg/L	None. The associated results were reported as non-detect or at concentrations >5x the concentration of the blank contamination.
Data Package 400-222081-1			
MB 400-583972/34 Influent Effluent	Total Organic Carbon	0.742 mg/L	None. The associated results were reported at concentrations >5x the concentration of the blank contamination.

> - Greater Than
< - Less Than
MB – Method Blank
mg/L – Milligrams per Liter

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 400-220849-1				
Influent	Orthophosphate as P	**73/77** (90-110)	2 (20)	As the potential bias was considered to be low, the associated detected result was qualified as estimated (J- m).
Data Package 400-221913-1				
Influent	Nitrite as N	**0/0** (90-110)	0 (20)	As the potential bias was considered to be low, and the percent recoveries were below the rejection point, the associated non-detect results were qualified as unusable (R m).
Data Package 400-222081-1				
Influent	Total Phosphorus as P	**112/112** (90-110)	0 (20)	As the potential bias was considered to be high, the associated detected results were qualified as estimated (J+ m).
	Phosphorus, Dissolved	**112/112** (90-110)	0 (20)	

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

Qualifiers
J+ – Estimated, bias high
J- – Estimated, bias low
R – Unusable
Reason Codes
m – Matrix Spike Recovery

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

Blank/ Associated Samples	Analyte	Concentration	Qualification
Data Package 400-221913-1			
Field Blank Influent Effluent Dup-1	Phosphorus, Dissolved	0.019 mg/L	The associated Influent sample result was reported at concentrations <5x the concentration of the blank contamination and was qualified as non-detect (U bf).

< - Less Than
mg/L – Milligrams per Liter

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

Attachment A: Summary of Qualified Data
Eurofins TestAmerica Pensacola - ARP Pond - June 2022

LAB ID	SAMPLE	MATRIX	METHOD	ANALYTE	UNITS	RESULT	DETECTED	PQL	MDL	DILUTION	FRACTION	QUALIFIERS	REASON CODE
400-220849-1	Influent	Water	365.1	Phosphorus, Dissolved	mg/L	0.014	YES	0.02	0.0096	1	Dissolved	J	lq
400-220849-1	Influent	Water	365.1/LL	Orthophosphate as P	mg/L	0.016	YES	0.005	0.005	1	Total	J-	m
400-221567-1	Influent	Water	200.7	Aluminum	mg/L	0.13	YES	0.2	0.051	1	Total	J	lq
400-221567-1	Influent	Water	351.2	Nitrogen, Kjeldahl	mg/L	0.44	YES	0.5	0.26	1	Total	J	lq
400-221567-1	Influent	Water	353.2	Nitrate Nitrite as N	mg/L	0.048	YES	0.05	0.018	1	Total	J	lq
400-221567-1	Influent	Water	354.1	Nitrite as N	mg/L	< 0.018	NO	0.1	0.018	1	Total	R	ht
400-221567-1	Influent	Water	Nitrate by calc	Nitrate as N	mg/L	0.048	YES	0.05	0.018	1	Total	J-	ht,lq
400-221567-1	Influent	Water	Total Nitrogen	Nitrogen, Total	mg/L	0.49	YES	0.5	0.26	1	Total	J	lq
400-221567-2	Effluent	Water	200.7	Aluminum	mg/L	0.12	YES	0.2	0.051	1	Total	J	lq
400-221567-2	Effluent	Water	353.2	Nitrate Nitrite as N	mg/L	0.044	YES	0.05	0.018	1	Total	J	lq
400-221567-2	Effluent	Water	353.2	Nitrate-Nitrite, Dissolved	mg/L	0.048	YES	0.05	0.018	1	Dissolved	J	lq
400-221567-2	Effluent	Water	354.1	Nitrite as N	mg/L	< 0.018	NO	0.1	0.018	1	Total	R	ht
400-221567-2	Effluent	Water	Nitrate by calc	Nitrate as N	mg/L	0.044	YES	0.05	0.018	1	Total	J-	ht,lq
400-221913-1	Influent	Water	200.7	Aluminum	mg/L	0.064	YES	0.2	0.051	1	Total	J	lq
400-221913-1	Influent	Water	200.7	Dissolved Aluminum	mg/L	< 0.1	NO	0.2	0.1	1	Dissolved	U	bl
400-221913-1	Influent	Water	350.1	Ammonia (undistilled)	mg/L	< 0.033	NO	0.05	0.033	1	Total	U	bl
400-221913-1	Influent	Water	354.1	Nitrite as N	mg/L	< 0.018	NO	0.1	0.018	1	Total	R	m
400-221913-1	Influent	Water	365.1	Phosphorus, Dissolved	mg/L	< 0.019	NO	0.02	0.019	1	Dissolved	U	bf
400-221913-1	Influent	Water	SM2540D	Total Suspended Solids	mg/L	< 5	NO	5	5	1	Total	DNR	DNR
400-221913-1	Influent	Water	SM2540D	Total Suspended Solids	mg/L	12	YES	2.5	2.5	1	Total	J	ht
400-221913-1	Influent	Water	SM2540E	Total Volatile Suspended Solids	mg/L	< 5	NO	5	5	1	Total	DNR	DNR
400-221913-1	Influent	Water	SM2540E	Total Volatile Suspended Solids	mg/L	7.5	YES	2.5	2.5	1	Total	J	ht
400-221913-2	Effluent	Water	200.7	Dissolved Aluminum	mg/L	< 0.35	NO	0.35	0.35	1	Dissolved	U	bl
400-221913-2	Effluent	Water	350.1	Ammonia (undistilled)	mg/L	< 0.035	NO	0.05	0.035	1	Total	U	bl
400-221913-3	Dup-1	Water	200.7	Aluminum	mg/L	0.15	YES	0.2	0.051	1	Total	J	lq
400-221913-3	Dup-1	Water	200.7	Dissolved Aluminum	mg/L	< 0.055	NO	0.2	0.055	1	Dissolved	U	bl
400-221913-3	Dup-1	Water	350.1	Ammonia (undistilled)	mg/L	< 0.029	NO	0.05	0.029	1	Total	U	bl
400-221913-3	Dup-1	Water	351.2	Total Kjeldahl Nitrogen, Dissolved	mg/L	0.44	YES	0.5	0.26	1	Dissolved	J	lq
400-221913-3	Dup-1	Water	SM2540D	Total Suspended Solids	mg/L	10	YES	5	5	1	Total	DNR	DNR
400-221913-3	Dup-1	Water	SM2540D	Total Suspended Solids	mg/L	12	YES	2.5	2.5	1	Total	J	ht
400-221913-3	Dup-1	Water	SM2540E	Total Volatile Suspended Solids	mg/L	8	YES	5	5	1	Total	DNR	DNR
400-221913-3	Dup-1	Water	SM2540E	Total Volatile Suspended Solids	mg/L	9	YES	2.5	2.5	1	Total	J	ht
400-221913-3	Dup-1	Water	Total Nitrogen	Nitrogen, Total Dissolved	mg/L	0.44	YES	0.5	0.26	1	Dissolved	J	lq
400-221913-4	Field Blank	Water	200.7	Dissolved Aluminum	mg/L	< 0.1	NO	0.2	0.1	1	Dissolved	U	bl
400-221913-4	Field Blank	Water	350.1	Ammonia (undistilled)	mg/L	< 0.025	NO	0.05	0.025	1	Total	U	bl
400-221913-4	Field Blank	Water	365.1	Phosphorus, Dissolved	mg/L	0.019	YES	0.02	0.0096	1	Dissolved	J	lq
400-222081-1	Influent	Water	200.7	Aluminum	mg/L	0.092	YES	0.2	0.051	1	TARGET	J	lq
400-222081-1	Influent	Water	353.2	Nitrate Nitrite as N	mg/L	0.027	YES	0.05	0.018	1	TARGET	J	lq
400-222081-1	Influent	Water	365.1	Phosphorus, Dissolved	mg/L	0.023	YES	0.02	0.0096	1	TARGET	J+	m
400-222081-1	Influent	Water	365.1	Total Phosphorus as P	mg/L	0.059	YES	0.02	0.0096	1	TARGET	J+	m
400-222081-1	Influent	Water	Nitrate by calc	Nitrate as N	mg/L	0.027	YES	0.05	0.018	1	TARGET	J	lq
400-222081-2	Effluent	Water	353.2	Nitrate Nitrite as N	mg/L	0.02	YES	0.05	0.018	1	TARGET	J	lq
400-222081-2	Effluent	Water	365.1	Total Phosphorus as P	mg/L	0.013	YES	0.02	0.0096	1	TARGET	J	lq
400-222081-2	Effluent	Water	Nitrate by calc	Nitrate as N	mg/L	0.02	YES	0.05	0.018	1	TARGET	J	lq

Attachment A: Summary of Qualified Data
Eurofins TestAmerica Pensacola - ARP Pond - June 2022

LAB ID	SAMPLE	MATRIX	METHOD	ANALYTE	UNITS	RESULT	DETECTED	PQL	MDL	DILUTION	FRACTION	QUALIFIERS	REASON CODE

Definitions

<	Less Than
DNR	Do Not Report
ID	Identification
mg/L	Milligrams per Liter
MDL	Method Detection Limit
P	Phosphorus
PQL	Practical Quantitation Limit

Qualifiers

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

Reason Codes

bf	Field Blank Contamination
bl	Laboratory Blank Contamination
ht	Holding Time
lq	Result Detected Between the MDL and PQL
m	Matrix Spike Recovery

Appendix C Analysis of Reversals

Appendix C
Laboratory Water Quality Reversals

Analyte (mg/L)	Method Detection Limit (MDL)	11/18/2021						11/22/2021						12/7/2021						12/14/2021				
		Influent			Effluent			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)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)
Aluminum	0.024-0.051	0.094	J		0.64			0.100	J		1.20			0.15	J		3.7			0.240			2.3	
Aluminum, Dissolved	0.024	0.025	J		0.024	U		0.025	J		0.024	U		0.063	J		0.024	U		0.055	J		0.034	J
% dissolved		27%			4%			25%			2%			42%			1%			23%			1%	
Total Volatile Suspended Solids	Varies	10	U		10	U		5.0	U		20	U		6.7	U		20	U		10.0	U		10	U
Total Suspended Solids	Varies	7.4			5	U		6.5			10	U		4.0			13			7.8			9.0	
% Volatile		Cannot be computed due to variable MDL																						
Organic Carbon, Total	0.50	6.8			4.2			7.0			5.5			6.9			6.0			6.9		Rw	4.6	
Organic Carbon, Dissolved	0.50	7.2			3.8			7.8			4.1			6.8			3.7			8.7		Rw	4.4	
% dissolved		106%			90%			111%			75%			99%			62%			126%			96%	
Nitrogen, Kjeldahl	0.10 - 0.26	0.96			0.57			1.3			0.89			1.4			1.5			1.1			0.97	
Nitrogen, Kjeldahl, Dissolved	0.10 - 0.26	0.85			0.40			0.89			0.91			1.2			0.72			0.92			1.1	
% dissolved		89%			70%			68%			102%			86%			48%			84%			113%	
Nitrogen, Kjeldahl, Dissolved	0.10 - 0.26	0.85			0.40			0.89			0.91			1.2			0.72			0.92			1.1	
Ammonia	0.024 - 0.10	0.10	U		0.10	U		0.10	U		0.10	U		0.21	J		0.20	J		0.29			0.30	
% ammonia		12%			25%			11%			11%			18%			28%			32%			27%	
Nitrate Nitrite as N	0.010 - 0.018	0.016	J-		0.012	J		0.016	J		0.010	U	Rw	0.035	J-		0.048	J		0.068			0.078	
Nitrate Nitrite as N, Dissolved	0.010 - 0.018	0.010	U		0.010	U		0.010	U		0.016	J-	Rw	0.042	J		0.041	J		0.069			0.069	
% dissolved		63%			83%			63%			160%			120%			85%			101%			88%	
Nitrate Nitrite as N, Dissolved	0.010 - 0.018	0.010	U		0.010	U		0.010	U		0.016	J-	Rw	0.042	J		0.041	J		0.069			0.069	
Nitrite as N	0.010 - 0.018	--	R		0.010	U		0.010	U Q		--	R		0.012	J		0.013	J		0.010	U		--	R
% nitrite		#VALUE!			100%			100%			#VALUE!			29%			32%			14%			#VALUE!	
Nitrate as N	0.010 - 0.018	0.016	J		0.012	J		0.016	J-		0.016	J-	Rp	0.023	J		0.035	J		0.068			0.078	
Missing Part (NO3NO2, NO2)?											Y													
Nitrogen, Total	0.11 - 0.26	0.976	C		0.582	C		1.3			0.91		Rp	1.4			1.5			1.2			1.0	
Nitrogen, Total Dissolved	0.11	0.85			0.40			0.89			0.93		Rp	1.2			0.76			0.99			1.2	
% dissolved		87%			69%			68%			102%			86%			51%			83%			120%	
Missing Part (KN, NO3NO2, NO2)?											Y													
Phosphorus as P, Total	0.0096	0.066			0.0096	U		0.072			0.0096	U J3		0.0096	U		0.0096	U		0.096			0.0096	U
Phosphorus as P, Total Dissolved	0.0096	0.0096	U		0.0096	U		0.027			0.0096	U		0.0096	U		0.0096	U		0.031			0.0096	U
% dissolved		15%			100%			38%			100%			100%			100%			32%			100%	
Phosphorus as P, Total	0.0096	0.066			0.0096	U		0.072			0.0096	U J3		0.0096	U		0.0096	U		0.096			0.0096	U
Orthophosphate as P	0.0050	--	R		--	R		0.0060	J-		0.0077	J-		0.0050	U		0.0050	U		0.0050	U		0.0050	U
% dissolved		#VALUE!			#VALUE!			8%			80%			52%			52%			5%			52%	

Legend

I: Reported value is between the method detection limit and the practical quantitation limit
J: Estimated value
J-: Esimated value, low bias
J3: Estimated value; value may not be accurate. Spike recovery or RPD outside of criteria
Q: Sample held beyond the accepted holding time
U: Not detected
V: Detected at or above the method detection limit in the sample and the associated method blank
C: Calculated by AECOM as sum of TKN and Nitrate+Nitrite as N
R: Unusable Data
R (U): Unusable data due to elevated MDL (see Appendix D, pages 25-31)
NC: Cannot Calculate
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 C
Laboratory Water Quality Reversals

Analyte (mg/L)	Method Detection Limit (MDL)		1/20/2022						1/27/2022						2/3/2022						2/8/2022			
			Influent			Effluent			Influent			Effluent			Influent			Effluent			Influent			
		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)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result
Aluminum	0.024-0.051		0.37			1.1			0.12	J		0.19	J		0.051	U		0.051	U		0.13	J		0.190
Aluminum, Dissolved	0.024		0.089	J		0.024	U		0.054	U		0.054	U		0.051	U		0.051	U		0.051	U		0.051
% dissolved			24%			2%			45%			28%			100%			100%			39%			27%
Total Volatile Suspended Solids	Varies		13.0	U		20	U		10.0	U		13	U		2.5	U		4.0			6.5			3.0
Total Suspended Solids	Varies		11.0			10	U		7.8			6.3	U		5.5			4.5			11			5.0
% Volatile																								
Organic Carbon, Total	0.50		3.9		Rw	6.7			6.8			4.6			7.8			7.0			6.4	J+		7.1
Organic Carbon, Dissolved	0.50		4.7		Rw	6.1			6.8			3.7			6.5			6.0			5.9			5.3
% dissolved			121%			91%			100%			80%			83%			86%			92%			75%
Nitrogen, Kjeldahl	0.10 - 0.26		NR			NR			1.5			1.4			0.80			0.53		Rw	1.6			0.75
Nitrogen, Kjeldahl, Dissolved	0.10 - 0.26		0.76			0.55			1.4			0.90			0.51			0.74		Rw	1.1			0.79
% dissolved			#VALUE!			#VALUE!			93%			64%			64%			140%			69%			105%
Nitrogen, Kjeldahl, Dissolved	0.10 - 0.26		0.76			0.55			1.4			0.90			0.51			0.74		Rw	1.1			0.79
Ammonia	0.024 - 0.10		0.10	U		0.10	U		0.10	U		0.10	U		0.024	U		0.024	U		0.024	U		0.053
% ammonia			13%			18%			7%			11%			5%			3%			2%			7%
Nitrate Nitrite as N	0.010 - 0.018		NR			NR			0.13			0.13			0.018	U		0.018	U		0.027	J-	Rw	0.027
Nitrate Nitrite as N, Dissolved	0.010 - 0.018		0.060			0.065			0.12			0.13			0.018	UJ		0.018	U		0.075	U	Rw	0.082
% dissolved			#VALUE!			#VALUE!			92%			100%			100%			100%			278%			304%
Nitrate Nitrite as N, Dissolved	0.010 - 0.018		0.060			0.065			0.12			0.13			0.018	UJ		0.018	U		0.075	U	Rw	0.082
Nitrite as N	0.010 - 0.018		0.010	U		0.010	U		0.010	U		0.010	U		0.018	U		0.018	U		0.018	U		0.018
% nitrite			17%			15%			8%			8%			100%			100%			24%			22%
Nitrate as N	0.010 - 0.018		NR			NR			0.13			0.13			0.018	U		0.018	U		0.027	J	Rp	0.027
Missing Part (NO3NO2, NO2)?																					Y			Y
Nitrogen, Total	0.11 - 0.26		0.82			0.62			1.6			1.5			0.80			0.53		Rp	1.6		Rp	0.78
Nitrogen, Total Dissolved	0.11		NC			NC			1.5			1.0			0.51			0.74	S	Rp	1.2		Rp	0.87
% dissolved			#VALUE!			#VALUE!			94%			67%			64%			140%			75%			112%
Missing Part (KN, NO3NO2, NO2)?																		Y			Y			Y
Phosphorus as P, Total	0.0096		0.094			0.0096	U		0.11			0.0096	U		0.079			0.030			0.064			0.037
Phosphorus as P, Total Dissolved	0.0096		0.023			0.0096	U		0.019	J		0.0096	U		0.015	J		0.010	J		0.012	J		0.095
% dissolved			24%			100%			17%			100%			19%			33%			19%			257%
Phosphorus as P, Total	0.0096		0.094			0.0096	U		0.11			0.0096	U		0.079			0.030		Rw	0.064			0.037
Orthophosphate as P	0.0050		0.024			0.0068			0.017			0.0062			0.039	U		0.039	U	Rw	0.0050	U		0.0050
% dissolved			26%			71%			15%			65%			49%			130%			8%			14%

Appendix C
Laboratory Water Quality Reversals

Analyte (mg/L)	Method Detection Limit (MDL)			2/15/2022						2/24/2022						3/1/2022						3/10/		
		Effluent		Influent			Effluent			Influent			Effluent			Influent			Effluent			Influent		
		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)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)
Aluminum	0.024-0.051	U		0.072	J		0.051	U		0.190	J		0.051	U		0.140	J		0.051	U	Rw	0.280		
Aluminum, Dissolved	0.024	U		0.051	U		0.051	U		0.073	U		0.051	U		0.076	J		0.440		Rw	0.130	U	
% dissolved				71%			100%			38%			100%			54%			863%			46%		
Total Volatile Suspended Solids	Varies			6.5			2.5	U		13.0			5.0	U		7.0			2.5	U		13.0		
Total Suspended Solids	Varies	U		7.0			5.0	U		14.0			5.0	U		12.0			5.0	U		20.0		
% Volatile																								
Organic Carbon, Total	0.50			6.9			6.4			6.6			5.9		Rw	7.5			6.9			8.4		
Organic Carbon, Dissolved	0.50			6.6			6.0			6.2			7.7		Rw	6.8			5.7			6.7		
% dissolved				96%			94%			94%			131%			91%			83%			80%		
Nitrogen, Kjeldahl	0.10 - 0.26			0.83			0.55			2.00			0.56			0.52			0.55			2.00		
Nitrogen, Kjeldahl, Dissolved	0.10 - 0.26			0.34	J		0.45	J		0.59	U		0.47	U		0.44	J		0.53			0.44	J	
% dissolved				41%			82%			30%			84%			85%			96%			22%		
Nitrogen, Kjeldahl, Dissolved	0.10 - 0.26			0.34	J		0.45	J		0.59	U		0.47	U		0.44	J		0.53			0.44	J	
Ammonia	0.024 - 0.10			0.58		Rw	0.099			0.024	U		0.032	J		0.110			0.150			0.160		
% ammonia				171%			22%			4%			7%			25%			28%			36%		
Nitrate Nitrite as N	0.010 - 0.018	J	Rw	0.043	J		0.018	U		0.018	U		0.018	U		0.018	J+		0.018	U		0.031	J	
Nitrate Nitrite as N, Dissolved	0.010 - 0.018	U	Rw	0.038	J		0.018	U		0.018	U		0.018	U		0.019	J+		0.020	J		0.023	J	
% dissolved				88%			100%			100%			100%			106%			111%			74%		
Nitrate Nitrite as N, Dissolved	0.010 - 0.018	U	Rw	0.038	J		0.018	U		0.018	U		0.018	U		0.019	J+		0.020	J		0.023	J	
Nitrite as N	0.010 - 0.018	U		0.018	U		0.018	U		--	R		0.018	U		0.018	U		0.018	U		0.018	U J3	
% nitrite				47%			100%			#VALUE!			100%			95%			90%			78%		
Nitrate as N	0.010 - 0.018	J	Rp	0.043	J		0.018	U		0.018	U		0.018	U		0.018	J		0.018	U		0.031	J	
Missing Part (NO3NO2, NO2)?																								
Nitrogen, Total	0.11 - 0.26		Rp	0.87			0.55			2.00			0.56			0.54			0.55			2.00		
Nitrogen, Total Dissolved	0.11	S	Rp	0.38	J		0.45	J		0.59	U		0.47	U		0.46	J		0.55			0.46	J	
% dissolved				44%			82%			30%			84%			85%			100%			23%		
Missing Part (KN, NO3NO2, NO2)?																								
Phosphorus as P, Total	0.0096	J	Rw	0.044	J+		0.0096	U		0.061			0.0096	U		0.10			0.0140	J		0.11		
Phosphorus as P, Total Dissolved	0.0096	J	Rw	0.0096	U		0.0096	U		0.0096	U		0.0096	U		0.0096	U		0.0096	U		0.0260		
% dissolved				22%			100%			16%			100%			10%			69%			24%		
Phosphorus as P, Total	0.0096	J		0.044	J+		0.0096	U		0.061			0.0096	U		0.10			0.0140	J		0.11		
Orthophosphate as P	0.0050	U		0.015	J-		--	R		0.018	J-		0.0064	J-		0.0050	U		0.0050	U		0.0050	U	
% dissolved				34%			#VALUE!			30%			67%			5%			36%			5%		

Appendix C
Laboratory Water Quality Reversals

Analyte (mg/L)	Method Detection Limit (MDL)	/2022			3/17/2022						4/14/2022						4/20/2022							
		Effluent			Influent			Effluent			Influent			Effluent			Influent			Effluent			Influent	
		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)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)
Aluminum	0.024-0.051	0.130	J		0.051	U		0.051	U		0.051	U		0.43			0.12	J		0.28			0.051	U
Aluminum, Dissolved	0.024	0.070	U		0.051	U		0.051	U		0.051	U		0.13	J		0.051	U		0.051	U		0.051	U
% dissolved		54%			100%			100%			100%			30%			43%			18%			100%	
Total Volatile Suspended Solids	Varies	7.0			27.0			9.0			6.5			8.0			4.0			2.5	U		6.5	
Total Suspended Solids	Varies	8.0			28.0			14.0			13.0			12.0			4.5	J		4.0			16.0	
% Volatile																								
Organic Carbon, Total	0.50	7.6			9.4			8.1			7.9			6.9			7.9			5.9			7.9	
Organic Carbon, Dissolved	0.50	6.4			6.7			6.1			7.7			6.1			7.1			5.3			7.3	
% dissolved		84%			71%			75%			97%			88%			90%			90%			92%	
Nitrogen, Kjeldahl	0.10 - 0.26	1.5			0.94			0.9			1.0			0.75			0.69	U	Rw	0.58	U		0.78	
Nitrogen, Kjeldahl, Dissolved	0.10 - 0.26	0.60			0.50			0.30	J		0.62			0.48	I		1.1		Rw	0.38	J		0.49	J3
% dissolved		40%			53%			33%			62%			64%			159%			66%			63%	
Nitrogen, Kjeldahl, Dissolved	0.10 - 0.26	0.60			0.50			0.30	J		0.62			0.48	I		1.1		Rw	0.38	J		0.49	J3
Ammonia	0.024 - 0.10	0.140			0.024	U		0.024	U		0.024	U		0.024	U		0.024	U		0.024	U		0.024	U
% ammonia		23%			5%			8%			4%			5%			2%			6%			5%	
Nitrate Nitrite as N	0.010 - 0.018	0.023	J		0.026	J		0.018	U		0.030	J		0.018	U		0.018	U		0.018	U		0.018	U
Nitrate Nitrite as N, Dissolved	0.010 - 0.018	0.022	J		0.018	U		0.018	U		0.018	U		0.018	U		0.018	U J3		0.018	U		0.420	
% dissolved		96%			69%			100%			60%			100%			100%			100%			2333%	
Nitrate Nitrite as N, Dissolved	0.010 - 0.018	0.022	J		0.018	U		0.018	U		0.018	U		0.018	U		0.018	U J3		0.018	U		0.420	
Nitrite as N	0.010 - 0.018	0.018	U		0.018	U		0.018	U		0.018	U		0.018	U		0.018	U		0.018	U		0.018	U
% nitrite		82%			100%			100%			100%			100%			100%			100%			4%	
Nitrate as N	0.010 - 0.018	0.023	J		0.026	J		0.018	U		0.030	J		0.018	U		0.18	U		0.018	U		0.018	U
Missing Part (NO3NO2, NO2)?																							Y	
Nitrogen, Total	0.11 - 0.26	1.50			0.97			0.90			1.00			0.75			0.69	U	Rp	0.58	U		0.78	
Nitrogen, Total Dissolved	0.11	0.62			0.50			0.30	J		0.62			0.48	J		1.1		Rp	0.38	J		0.91	
% dissolved		41%			52%			33%			62%			64%			159%			66%			117%	
Missing Part (KN, NO3NO2, NO2)?																	Y						Y	
Phosphorus as P, Total	0.0096	0.0096	U	Rw	0.18			0.0580			0.062			0.046			0.24	R (U)		0.17	R (U)		0.024	
Phosphorus as P, Total Dissolved	0.0096	0.0550		Rw	0.0220			0.0096	U		0.023			0.0096	U		0.22	R (U)		0.15	R (U)		0.028	
% dissolved		573%			12%			17%			37%			21%			92%			88%			117%	
Phosphorus as P, Total	0.0096	0.0096	U	Rw	0.18			0.0580			0.062			0.046			0.24	R (U)		0.17	R (U)		0.024	
Orthophosphate as P	0.0050	0.0140	J-	Rw	0.0540			0.0250			0.021	J-		0.013	J-		0.026			0.0066			0.026	J-
% dissolved		146%			30%			43%			34%			28%			11%			4%			108%	

Appendix C
Laboratory Water Quality Reversals

Analyte (mg/L)	Method Detection Limit (MDL)	4/27/2022				5/4/2022						5/12/2022						5/18/2022						
			Effluent			Influent			Effluent			Influent			Effluent			Influent			Effluent			
		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)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)	Result
Aluminum	0.024-0.051		0.28			0.051	U		0.32			0.170	J		0.27			0.051	U		0.19	J		0.051
Aluminum, Dissolved	0.024		0.051	U		0.051	U		0.051	U		0.051	U		0.051	U		0.054	J		0.140	J		0.051
% dissolved			18%			100%			16%			30%			19%			106%			74%			100%
Total Volatile Suspended Solids	Varies		5.5			8.0			5.5			7.0			2.5	U		5.0	U		2.5	U		7.0
Total Suspended Solids	Varies		5.5			17.0			7.0			10.0			3.0			11.0			2.5	U		11.0
% Volatile																								
Organic Carbon, Total	0.50		6.4			9.6			7.1			8.5			6.5			9.2			5.8			9.4
Organic Carbon, Dissolved	0.50		6.1			8.1			6.8			7.2			6.2			7.9			6.2	S		7.6
% dissolved			95%			84%			96%			85%			95%			86%			107%			81%
Nitrogen, Kjeldahl	0.10 - 0.26		0.72			0.74			0.71			1.30			0.54			0.97			0.32	J		1.40
Nitrogen, Kjeldahl, Dissolved	0.10 - 0.26		0.37	J		0.65			0.83			0.68			0.28	J		0.61			0.30	J		0.74
% dissolved			51%			88%			117%			52%			52%			63%			94%			53%
Nitrogen, Kjeldahl, Dissolved	0.10 - 0.26		0.37	J		0.65			0.83			0.68			0.28	J		0.61			0.30	J		0.74
Ammonia	0.024 - 0.10		0.024	U		0.17			0.099			0.036	J		0.024	U		0.037	J		0.034	J		2.9
% ammonia			6%			26%			12%			5%			9%			6%			11%			392%
Nitrate Nitrite as N	0.010 - 0.018	Rw	0.018	U	Rw	0.018	U		0.018	U		0.018	R		0.018	U		0.074			0.046	J		0.480
Nitrate Nitrite as N, Dissolved	0.010 - 0.018	Rw	0.063		Rw	0.018	U J3		0.018	U		0.018	R		0.018	U		0.018	U		0.018	U		0.032
% dissolved			350%			100%			100%			100%			100%			24%			39%			7%
Nitrate Nitrite as N, Dissolved	0.010 - 0.018	Rw	0.063		Rw	0.018	U J3		0.018	U		0.018	R		0.018	U		0.018	U		0.018	U		0.032
Nitrite as N	0.010 - 0.018		0.018	U		0.018	U		0.018	U		0.018	U		0.018	U		0.018	U		0.018	U		0.018
% nitrite			29%			100%			100%			100%			100%			100%			100%			56%
Nitrate as N	0.010 - 0.018	Rp	0.018	U	Rp	0.018	U		0.018	U		0.018	U		0.018	U		0.018	U		0.018	U		0.480
Missing Part (NO3NO2, NO2)?			Y																					
Nitrogen, Total	0.11 - 0.26	Rp	0.72		Rp	0.74			0.71			1.30			0.54			1.00			0.37	J		1.90
Nitrogen, Total Dissolved	0.11	Rp	0.43	J	Rp	0.65			0.83			0.68			0.28	J		0.61			0.30	J		0.77
% dissolved			60%			88%			117%			52%			52%			61%			81%			41%
Missing Part (KN, NO3NO2, NO2)?			Y																					
Phosphorus as P, Total	0.0096		0.026		Rw	0.110	V		0.038	V		0.066			0.011	J		0.090	J-		0.021			0.051
Phosphorus as P, Total Dissolved	0.0096		0.032		Rw	0.021			0.011	J		0.022			0.0096	U		0.019	J-		0.0096	U		0.020
% dissolved			123%			19%			29%			33%			87%			21%			46%			39%
Phosphorus as P, Total	0.0096		0.026			0.110	V		0.038	U		0.066			0.011	J		0.090	J-		0.021			0.051
Orthophosphate as P	0.0050		0.0089			0.018	J-		0.0050	U		0.020	J-		0.0055			0.026			0.0050	U		0.210
% dissolved			34%			16%			13%			30%			50%			29%			24%			412%

Appendix C
Laboratory Water Quality Reversals

Analyte (mg/L)	Method Detection Limit (MDL)	5/25/2022					6/2/2022						6/16/2022						6/23/2022					
		Influent		Effluent			Influent			Effluent			Influent			Effluent			Influent			Effluent		
		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)	Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)
Aluminum	0.024-0.051	U		0.051	U		NA			NA			0.130	J		0.120	J		0.064	J	Rw	0.480		
Aluminum, Dissolved	0.024	U		0.051	U		NA			NA			0.051	U		0.051	U		0.100	U	Rw	0.350	U	
% dissolved				100%			#VALUE!			#VALUE!			39%			43%			156%			73%		
Total Volatile Suspended Solids	Varies			2.5	U		NA			NA			5.0	U		5.0	U		7.5	J		5.0	U	
Total Suspended Solids	Varies			3.5			NA			NA			5.0	U		5.0	U		12.0	J		5.0	U	
% Volatile																								
Organic Carbon, Total	0.50			7.6			NA			NA			7.7			5.5			7.5			5.1		
Organic Carbon, Dissolved	0.50			6.6			NA			NA			6.9			4.8			6.5			4.4		
% dissolved				87%			#VALUE!			#VALUE!			90%			87%			87%			86%		
Nitrogen, Kjeldahl	0.10 - 0.26			0.72			NA			NA			0.440	J		0.260	U		1.30			0.260	U	
Nitrogen, Kjeldahl, Dissolved	0.10 - 0.26			0.26	U		NA			NA			0.260	U		0.260	U		0.50			0.260	U	
% dissolved				36%			#VALUE!			#VALUE!			59%			100%			38%			100%		
Nitrogen, Kjeldahl, Dissolved	0.10 - 0.26			0.26	U		NA			NA			0.260	U		0.260	U		0.50			0.260	U	
Ammonia	0.024 - 0.10	J	Rw	0.150			NA			NA			0.120			0.150			0.033	U		0.035	U	
% ammonia				58%			#VALUE!			#VALUE!			46%			58%			7%			13%		
Nitrate Nitrite as N	0.010 - 0.018			0.097			NA			NA			0.048	J		0.044	J		0.018	U		0.018	U	
Nitrate Nitrite as N, Dissolved	0.010 - 0.018	J		0.026	J		NA			NA			0.050			0.048	J		0.018	U		0.018	U	
% dissolved				27%			#VALUE!			#VALUE!			104%			109%			100%			100%		
Nitrate Nitrite as N, Dissolved	0.010 - 0.018	J		0.026	J		NA			NA			0.050			0.048	J		0.018	U		0.018	U	
Nitrite as N	0.010 - 0.018	U		0.018	U		NA			NA			0.018	R		0.018	R		0.018	R		0.018	U	
% nitrite				69%			#VALUE!			#VALUE!			36%			38%			100%			100%		
Nitrate as N	0.010 - 0.018			0.097			NA			NA			0.048	J-	Rp	0.044	J-	Rp	0.018	U	Rp	0.018	U	
Missing Part (NO3NO2, NO2)?													Y			Y			Y					
Nitrogen, Total	0.11 - 0.26	S		0.82			NA			NA			0.49	J	Rp	0.26	U S	Rp	1.30		Rp	0.26	U	
Nitrogen, Total Dissolved	0.11			0.26	U S		NA			NA			0.26	U	Rp	0.26	U S	Rp	0.50		Rp	0.26	U	
% dissolved				32%			#VALUE!			#VALUE!			53%			100%			38%			100%		
Missing Part (KN, NO3NO2, NO2)?													Y			Y			Y					
Phosphorus as P, Total	0.0096	J+		0.035			0.051			0.0096	U		0.100			0.0096	U		0.0350			0.0096	U	
Phosphorus as P, Total Dissolved	0.0096	J+		0.0330	S		0.014	J		0.0096	U		0.0096	U		0.0096	U		0.0190	U		0.0096	U	
% dissolved				94%			27%			100%			10%			100%			54%			100%		
Phosphorus as P, Total	0.0096	J+	Rw	0.035			0.051			0.0096	U		0.100			0.0096	U		0.0350			0.0096	U	
Orthophosphate as P	0.0050		Rw	0.0050	R		0.016	J-		0.0050	U		0.0100			0.0050	U		0.0200			0.0050	U	
% dissolved				14%			31%			52%			10%			52%			57%			52%		

Analyte (mg/L)	Method Detection Limit (MDL)	6/28/2022					
		Influent			Effluent		
		Result	Qualifier (lab)	Qualifier (reversal)	Result	Qualifier (lab)	Qualifier (reversal)
Aluminum	0.024-0.051	0.092	J		0.210		
Aluminum, Dissolved	0.024	0.051	U		0.051	U	
% dissolved		55%			24%		
Total Volatile Suspended Solids	Varies	10.0			5.0	U	
Total Suspended Solids	Varies	11.0			2.5	U	
% Volatile							
Organic Carbon, Total	0.50	7.4	V		5.2	V	
Organic Carbon, Dissolved	0.50	6.4			4.9		
% dissolved		86%			94%		
Nitrogen, Kjeldahl	0.10 - 0.26	1.10			0.520		Rw
Nitrogen, Kjeldahl, Dissolved	0.10 - 0.26	0.58			0.650	S	Rw
% dissolved		53%			125%		
Nitrogen, Kjeldahl, Dissolved	0.10 - 0.26	0.58			0.650	S	Rw
Ammonia	0.024 - 0.10	0.024	U		0.024	U	
% ammonia		4%			4%		
Nitrate Nitrite as N	0.010 - 0.018	0.027	J		0.020	J	
Nitrate Nitrite as N, Dissolved	0.010 - 0.018	0.018	U		0.018	U	
% dissolved		67%			90%		
Nitrate Nitrite as N, Dissolved	0.010 - 0.018	0.018	U		0.018	U	
Nitrite as N	0.010 - 0.018	0.018	U		0.018	U	
% nitrite		100%			100%		
Nitrate as N	0.010 - 0.018	0.027	J		0.020	J	
Missing Part (NO3NO2, NO2)?							
Nitrogen, Total	0.11 - 0.26	1.10			0.54	S	Rp
Nitrogen, Total Dissolved	0.11	0.58			0.65	S	Rp
% dissolved		53%			120%		
Missing Part (KN, NO3NO2, NO2)?					Y		
Phosphorus as P, Total	0.0096	0.0590	J+		0.0130	J	
Phosphorus as P, Total Dissolved	0.0096	0.0230	J+		0.0096	U	
% dissolved		39%			74%		
Phosphorus as P, Total	0.0096	0.0590	J+		0.0130	J	
Orthophosphate as P	0.0050	0.0100			0.0050	U	
% dissolved		17%			38%		

Appendix D Laboratory Water Quality Results

Date	Method Detection Limit (mg/L)	11/18/2021				11/22/2021				12/7/2021				12/14/2021				1/19/2022			
Time		1100		1130		1200		1230		1200		1230		1200		1230		1200		1230	
Analyte (mg/L)		Influent		Effluent		Influent		Effluent		Influent		Effluent		Influent		Effluent		Influent		Effluent	
Aluminum	0.024-0.051	**0.094**	J	**0.64**		**0.100**	J	**1.20**		**0.15**	J	**3.7**		**0.240**		**2.3**		**0.37**		**1.1**	
Aluminum, Dissolved	0.024	**0.025**	J	0.024	U	**0.025**	J	0.024	U	**0.063**	J	0.024	U	**0.055**	J	**0.034**	J	**0.089**	J	0.024	U
Total Volatile Suspended Solids	Varies	10	U	10	U	5.0	U	20	U	6.7	U	20	U	10.0	U	10	U	13.0	U	20	U
Total Suspended Solids	Varies	**7.4**		5	U	**6.5**		10	U	**4.0**		**13**		**7.8**		**9.0**		**11.0**		10	U
Alkalinity, Total	5.0	**55**		**50**		**55**		**51**		**55**		**49**		**55**		**51**		**41**	J-	**36**	J-
Organic Carbon, Total	0.50	**6.8**		**4.2**		**7.0**		**5.5**		**6.9**		**6.0**		**6.9**		**4.6**		**3.9**		**6.7**	
Organic Carbon, Dissolved	0.50	**7.2**		**3.8**		**7.8**		**4.1**		**6.8**		**3.7**		**8.7**		**4.4**		**4.7**		**6.1**	
Chlorophyll a (mg/m3)	0.50	**35**		**1.9**		**25**		**3.8**		**11**		**13**		**35**		**3.0**		**31**		1.0	U
Nitrogen, Kjeldahl	0.10 - 0.26	**0.96**		**0.57**		**1.3**		**0.89**		**1.4**		**1.5**		**1.1**		**0.97**		NR		NR	
Nitrogen, Kjeldahl, Dissolved	0.10 - 0.26	**0.85**		**0.40**		**0.89**		**0.91**		**1.2**		**0.72**		**0.92**		**1.1**		**0.76**		**0.55**	
Nitrate as N	0.010 - 0.018	**0.016**	J	**0.012**	J	**0.016**	J-	**0.016**	J-	**0.023**	J	**0.035**	J	**0.068**		**0.078**		NR		NR	
Nitrate Nitrite as N	0.010 - 0.018	**0.016**	J-	**0.012**	J	**0.016**	J	0.010	U	**0.035**	J-	**0.048**	J	**0.068**		**0.078**		NR		NR	
Nitrate Nitrite as N, Dissolved	0.010 - 0.018	0.010	U	0.010	U	0.010	U	**0.016**	J-	**0.042**	J	**0.041**	J	**0.069**		**0.069**		**0.060**		**0.065**	
Nitrite as N	0.010 - 0.018	--	R	0.010	U	0.010	U Q	--	R	**0.012**	J	**0.013**	J	0.010	U	--	R	0.010	U	0.010	U
Ammonia	0.024 - 0.10	0.10	U	0.10	U	0.10	U	0.10	U	**0.21**	J	**0.20**	J	**0.29**		**0.30**		0.10	U	0.10	U
Nitrogen, Total	0.11 - 0.26	**0.976**	C	**0.582**	C	**1.3**		**0.91**		**1.4**		**1.5**		**1.2**		**1.0**		**0.82**		**0.62**	
Nitrogen, Total Dissolved	0.11	**0.85**		**0.40**		**0.89**		**0.93**		**1.2**		**0.76**		**0.99**		**1.2**		NC		NC	
Phosphorus as P, Total	0.0096	**0.066**		0.0096	U	**0.072**		0.0096	U J3	0.0096	U	0.0096	U	**0.096**		0.0096	U	**0.094**		0.0096	U
Phosphorus as P, Total Dissolved	0.0096	0.0096	U	0.0096	U	**0.027**		0.0096	U	0.0096	U	0.0096	U	**0.031**		0.0096	U	**0.023**		0.0096	U
Orthophosphate as P	0.0050	--	R	--	R	**0.0060**	J-	**0.0077**	J-	0.0050	U	0.0050	U	0.0050	U	0.0050	U	**0.024**		**0.0068**	

I: The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
J: Estimated value
J-: Esimated value, low bias
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
C: Calculated by AECOM as sum of TKN and Nitrate+Nitrite as N
R: Unusable Data
R (U): Unusable data due to elevated MDL (see Appendix D, pages 25-31)
NC: Cannot Calculate
+: Polymer only operations
Bold: Result above Method Detection Limit

Date	Method Detection Limit (mg/L)	1/27/2022				2/3/2022+				2/8/2022+				2/15/2022+				2/24/2022+			
Time		1200		1230		1200		1230		1200		1230		12:00		12:30		12:00		12:30	
Analyte (mg/L)		Influent		Effluent		Influent		Effluent		Influent		Effluent		Influent		Effluent		Influent		Effluent	
Aluminum	0.024-0.051	**0.12**	J	**0.19**	J	0.051	U	0.051	U	**0.13**	J	0.190	U	**0.072**	J	0.051	U	**0.190**	J	0.051	U
Aluminum, Dissolved	0.024	0.054	U	0.054	U	0.051	U	0.051	U	0.051	U	0.051	U	0.051	U	0.051	U	0.073	U	0.051	U
Total Volatile Suspended Solids	Varies	10.0	U	13	U	2.5	U	**4.0**		**6.5**		**3.0**		**6.5**		2.5	U	**13.0**		5.0	U
Total Suspended Solids	Varies	**7.8**		6.3	U	**5.5**		**4.5**		**11**		5.0	U	**7.0**		5.0	U	**14.0**		5.0	U
Alkalinity, Total	5.0	**41**		**42**		**42**		**42**		**41**		**44**		**40**		**28**		**43**		**43**	
Organic Carbon, Total	0.50	**6.8**		**4.6**		**7.8**		**7.0**		**6.4**	J+	**7.1**		**6.9**		**6.4**		**6.6**		**5.9**	
Organic Carbon, Dissolved	0.50	**6.8**		**3.7**		**6.5**		**6.0**		**5.9**		**5.3**		**6.6**		**6.0**		**6.2**		**7.7**	
Chlorophyll a (mg/m3)	0.50	**56**		**2.3**		**34**		**17**		**86**		**16**		**75**		**7.2**		**88**		**7.2**	
Nitrogen, Kjeldahl	0.10 - 0.26	**1.5**		**1.4**		**0.80**		**0.53**		**1.6**		**0.75**		**0.83**		**0.55**		**2.00**		**0.56**	
Nitrogen, Kjeldahl, Dissolved	0.10 - 0.26	**1.4**		**0.90**		**0.51**		**0.74**		**1.1**		**0.79**		**0.34**	J	**0.45**	J	0.59	U	0.47	U
Nitrate as N	0.010 - 0.018	**0.13**		**0.13**		0.018	U	0.018	U	**0.027**	J	**0.027**	J	**0.043**	J	0.018	U	0.018	U	0.018	U
Nitrate Nitrite as N	0.010 - 0.018	**0.13**		**0.13**		0.018	U	0.018	U	**0.027**	J-	**0.027**	J	**0.043**	J	0.018	U	0.018	U	0.018	U
Nitrate Nitrite as N, Dissolved	0.010 - 0.018	**0.12**		**0.13**		0.018	UJ	0.018	U	0.075	U	0.082	U	**0.038**	J	0.018	U	0.018	U	0.018	U
Nitrite as N	0.010 - 0.018	0.010	U	0.010	U	0.018	U	0.018	U	0.018	U	0.018	U	0.018	U	0.018	U	--	R	0.018	U
Ammonia	0.024 - 0.10	0.10	U	0.10	U	0.024	U	0.024	U	0.024	U	**0.053**		**0.58**		**0.099**		0.024	U	**0.032**	J
Nitrogen, Total	0.11 - 0.26	**1.6**		**1.5**		**0.80**		**0.53**		**1.6**		**0.78**		**0.87**		**0.55**		**2.00**		**0.56**	
Nitrogen, Total Dissolved	0.11	**1.5**		**1.0**		**0.51**		**0.74**		**1.2**		**0.87**		**0.38**	J	**0.45**	J	0.59	U	0.47	U
Phosphorus as P, Total	0.0096	**0.11**		0.0096	U	**0.079**		**0.030**		**0.064**		**0.037**	J	**0.044**	J+	0.0096	U	**0.061**		0.0096	U
Phosphorus as P, Total Dissolved	0.0096	**0.019**	J	0.0096	U	**0.015**	J	**0.010**	J	**0.012**	J	**0.095**	J	0.0096	U	0.0096	U	0.0096	U	0.0096	U
Orthophosphate as P	0.0050	**0.017**		**0.0062**		0.039	U	0.039	U	0.0050	U	0.0050	U	**0.015**	J-	--	R	**0.018**	J-	**0.0064**	J-

I: The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
J: Estimated value
J-: Esimated value, low bias
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 r
C: Calculated by AECOM as sum of TKN and Nitrate+Nitrite as N
R: Unusable Data
R (U): Unusable data due to elevated MDL (see Appendix D, pages 25-31)
NC: Cannot Calculate
+: Polymer only operations
Bold: Result above Method Detection Limit

Date	Method Detection Limit (mg/L)	3/1/2022+				3/10/2022+				3/17/2022+				4/14/2022				4/20/2022			
Time		12:00		12:30		12:00		12:30		12:00		12:30		12:00		12:30		12:00		12:30	
Analyte (mg/L)		Influent		Effluent		Influent		Effluent		Influent		Effluent		Influent		Effluent		Influent		Effluent	
Aluminum	0.024-0.051	**0.140**	J	0.051	U	**0.280**		**0.130**	J	0.051	U	0.051	U	0.051	U	**0.43**		**0.12**	J	**0.28**	
Aluminum, Dissolved	0.024	**0.076**	J	**0.440**		0.130	U	0.070	U	0.051	U	0.051	U	0.051	U	**0.13**	J	0.051	U	0.051	U
Total Volatile Suspended Solids	Varies	**7.0**		2.5	U	**13.0**		**7.0**		**27.0**		**9.0**		**6.5**		**8.0**		**4.0**		2.5	U
Total Suspended Solids	Varies	**12.0**		5.0	U	**20.0**		**8.0**		**28.0**		**14.0**		**13.0**		**12.0**		**4.5**	J	**4.0**	
Alkalinity, Total	5.0	**52**		**40**		**50**		**43**		**45**		**44**		**55**		**48**		**47**		**44**	
Organic Carbon, Total	0.50	**7.5**		**6.9**		**8.4**		**7.6**		**9.4**		**8.1**		**7.9**		**6.9**		**7.9**		**5.9**	
Organic Carbon, Dissolved	0.50	**6.8**		**5.7**		**6.7**		**6.4**		**6.7**		**6.1**		**7.7**		**6.1**		**7.1**		**5.3**	
Chlorophyll a (mg/m3)	0.50	**100**		**18.0**		**160**		**69.0**		**220**		**76.0**		**55**		**34**		**58**		**7.9**	
Nitrogen, Kjeldahl	0.10 - 0.26	**0.52**		**0.55**		**2.00**		**1.5**		**0.94**		**0.9**		**1.0**		**0.75**		0.69	U	0.58	U
Nitrogen, Kjeldahl, Dissolved	0.10 - 0.26	**0.44**	J	**0.53**		**0.44**	J	**0.60**		**0.50**		**0.30**	J	**0.62**		**0.48**	I	**1.1**		**0.38**	J
Nitrate as N	0.010 - 0.018	**0.018**	J	0.018	U	**0.031**	J	**0.023**	J	**0.026**	J	0.018	U	**0.030**	J	0.018	U	0.18	U	0.018	U
Nitrate Nitrite as N	0.010 - 0.018	**0.018**	J+	0.018	U	**0.031**	J	**0.023**	J	**0.026**	J	0.018	U	**0.030**	J	0.018	U	0.018	U	0.018	U
Nitrate Nitrite as N, Dissolved	0.010 - 0.018	**0.019**	J+	**0.020**	J	**0.023**	J	**0.022**	J	0.018	U	0.018	U	0.018	U	0.018	U	0.018	U J3	0.018	U
Nitrite as N	0.010 - 0.018	0.018	U	0.018	U	0.018	U J3	0.018	U	0.018	U	0.018	U	0.018	U	0.018	U	0.018	U	0.018	U
Ammonia	0.024 - 0.10	**0.110**		**0.150**		**0.160**		**0.140**		0.024	U	0.024	U	0.024	U	0.024	U	0.024	U	0.024	U
Nitrogen, Total	0.11 - 0.26	**0.54**		**0.55**		**2.00**		**1.50**		**0.97**		**0.90**		**1.00**		**0.75**		0.69	U	0.58	U
Nitrogen, Total Dissolved	0.11	**0.46**	J	**0.55**		**0.46**	J	**0.62**		**0.50**		**0.30**	J	**0.62**		**0.48**	J	**1.1**		**0.38**	J
Phosphorus as P, Total	0.0096	**0.10**		**0.0140**	J	**0.11**		0.0096	U	**0.18**		**0.0580**		**0.062**		**0.046**		0.24	R (U)	0.17	R (U)
Phosphorus as P, Total Dissolved	0.0096	0.0096	U	0.0096	U	**0.0260**		**0.0550**		**0.0220**		0.0096	U	**0.023**		0.0096	U	0.22	R (U)	0.15	R (U)
Orthophosphate as P	0.0050	0.0050	U	0.0050	U	0.0050	U	**0.0140**	J-	**0.0540**		**0.0250**		**0.021**	J-	**0.013**	J-	**0.026**		**0.0066**	

I: The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
J: Estimated value
J-: Esimated value, low bias
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 r
C: Calculated by AECOM as sum of TKN and Nitrate+Nitrite as N
R: Unusable Data
R (U): Unusable data due to elevated MDL (see Appendix D, pages 25-31)
NC: Cannot Calculate
+: Polymer only operations
Bold: Result above Method Detection Limit

Date	Method Detection Limit (mg/L)	4/27/2022				5/4/2022				5/12/2022				5/18/2022				5/25/2022			
Time		12:00		12:30		12:00		12:30		10:00		10:30		12:00		12:30		10:00		10:30	
Analyte (mg/L)		Influent		Effluent		Influent		Effluent		Influent		Effluent		Influent		Effluent		Influent		Effluent	
Aluminum	0.024-0.051	0.051	U	**0.28**		0.051	U	**0.32**		**0.170**	J	**0.27**		0.051	U	**0.19**	J	0.051	U	0.051	U
Aluminum, Dissolved	0.024	0.051	U	0.051	U	0.051	U	0.051	U	0.051	U	0.051	U	**0.054**	J	**0.140**	J	0.051	U	0.051	U
Total Volatile Suspended Solids	Varies	**6.5**		**5.5**		**8.0**		**5.5**		**7.0**		2.5	U	5.0	U	2.5	U	**7.0**		2.5	U
Total Suspended Solids	Varies	**16.0**		**5.5**		**17.0**		**7.0**		**10.0**		**3.0**		**11.0**		2.5	U	**11.0**		**3.5**	
Alkalinity, Total	5.0	**47**		**87**		**58**	J	**44**		**54**		**55**		**48**		**55**		**70**		**51**	
Organic Carbon, Total	0.50	**7.9**		**6.4**		**9.6**		**7.1**		**8.5**		**6.5**		**9.2**		**5.8**		**9.4**		**7.6**	
Organic Carbon, Dissolved	0.50	**7.3**		**6.1**		**8.1**		**6.8**		**7.2**		**6.2**		**7.9**		**6.2**		**7.6**		**6.6**	
Chlorophyll a (mg/m3)	0.50	**80**		**17**		**44**		**53**		**74**		**27**		**98**		**16**		**110**		**22**	
Nitrogen, Kjeldahl	0.10 - 0.26	**0.78**		**0.72**		**0.74**		**0.71**		**1.30**		**0.54**		**0.97**		**0.32**	J	**1.40**		**0.72**	
Nitrogen, Kjeldahl, Dissolved	0.10 - 0.26	**0.49**	J3	**0.37**	J	**0.65**		**0.83**		**0.68**		**0.28**	J	**0.61**		**0.30**	J	**0.74**		0.26	U
Nitrate as N	0.010 - 0.018	0.018	U	0.018	U	0.018	U	0.018	U	0.018	U	0.018	U	0.018	U	0.018	U	**0.480**		**0.097**	
Nitrate Nitrite as N	0.010 - 0.018	0.018	U	0.018	U	0.018	U	0.018	U	0.018	R	0.018	U	**0.074**		**0.046**	J	**0.480**		**0.097**	
Nitrate Nitrite as N, Dissolved	0.010 - 0.018	**0.420**		**0.063**		0.018	U J3	0.018	U	0.018	R	0.018	U	0.018	U	0.018	U	**0.032**	J	**0.026**	J
Nitrite as N	0.010 - 0.018	0.018	U	0.018	U	0.018	U	0.018	U	0.018	U	0.018	U	0.018	U	0.018	U	0.018	U	0.018	U
Ammonia	0.024 - 0.10	0.024	U	0.024	U	**0.17**		**0.099**		**0.036**	J	0.024	U	**0.037**	J	**0.034**	J	**2.9**	J	**0.150**	
Nitrogen, Total	0.11 - 0.26	**0.78**		**0.72**		**0.74**		**0.71**		**1.30**		**0.54**		**1.00**		**0.37**	J	**1.90**		**0.82**	
Nitrogen, Total Dissolved	0.11	**0.91**		**0.43**	J	**0.65**		**0.83**		**0.68**		**0.28**	J	**0.61**		**0.30**	J	**0.77**		0.26	U
Phosphorus as P, Total	0.0096	**0.024**		**0.026**		**0.110**	V	0.038	V	**0.066**		**0.011**	J	**0.090**	J-	**0.021**		**0.051**	J+	**0.035**	
Phosphorus as P, Total Dissolved	0.0096	**0.028**		**0.032**		**0.021**		**0.011**	J	**0.022**		0.0096	U	**0.019**	J-	0.0096	U	**0.020**	J+	**0.0330**	
Orthophosphate as P	0.0050	**0.026**	J-	**0.0089**		**0.018**	J-	0.0050	U	**0.020**	J-	**0.0055**		**0.026**		0.0050	U	**0.210**		0.0050	R

I: The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
J: Estimated value
J-: Esimated value, low bias
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 r
C: Calculated by AECOM as sum of TKN and Nitrate+Nitrite as N
R: Unusable Data
R (U): Unusable data due to elevated MDL (see Appendix D, pages 25-31)
NC: Cannot Calculate
+: Polymer only operations
Bold: Result above Method Detection Limit

Date	Method Detection Limit (mg/L)	6/2/2022				6/16/2022				6/23/2022				6/28/2022			
Time		11:00		11:30		11:00		11:30		11:00		11:30		12:00		12:30	
Analyte (mg/L)		Influent		Effluent		Influent		Effluent		Influent		Effluent		Influent		Effluent	
Aluminum	0.024-0.051	NA		NA		**0.130**	J	**0.120**	J	**0.064**	J	**0.480**		**0.092**	J	**0.210**	
Aluminum, Dissolved	0.024	NA		NA		0.051	U	0.051	U	0.100	U	0.350	U	0.051	U	0.051	U
Total Volatile Suspended Solids	Varies	NA		NA		5.0	U	5.0	U	**7.5**	J	5.0	U	**10.0**		5.0	U
Total Suspended Solids	Varies	NA		NA		5.0	U	5.0	U	**12.0**	J	5.0	U	**11.0**		2.5	U
Alkalinity, Total	5.0	NA		NA		**43.0**		**43.0**		**47.0**		**45.0**		**45.0**		**42.0**	
Organic Carbon, Total	0.50	NA		NA		**7.7**		**5.5**		**7.5**		**5.1**		**7.4**	V	**5.2**	V
Organic Carbon, Dissolved	0.50	NA		NA		**6.9**		**4.8**		**6.5**		**4.4**		**6.4**		**4.9**	
Chlorophyll a (mg/m3)	0.50	**79.0**		**3.6**		39.0		1.0	U	**50.0**		1.0	U	**38.0**		**1.2**	
Nitrogen, Kjeldahl	0.10 - 0.26	NA		NA		**0.440**	J	0.260	U	**1.30**		0.260	U	**1.10**		**0.520**	
Nitrogen, Kjeldahl, Dissolved	0.10 - 0.26	NA		NA		0.260	U	0.260	U	**0.50**		0.260	U	**0.58**		**0.650**	
Nitrate as N	0.010 - 0.018	NA		NA		**0.048**	J-	**0.044**	J-	0.018	U	0.018	U	**0.027**	J	**0.020**	J
Nitrate Nitrite as N	0.010 - 0.018	NA		NA		**0.048**	J	**0.044**	J	0.018	U	0.018	U	**0.027**	J	**0.020**	J
Nitrate Nitrite as N, Dissolved	0.010 - 0.018	NA		NA		**0.050**		**0.048**	J	0.018	U	0.018	U	0.018	U	0.018	U
Nitrite as N	0.010 - 0.018	NA		NA		0.018	R	0.018	R	0.018	R	0.018	U	0.018	U	0.018	U
Ammonia	0.024 - 0.10	NA		NA		**0.120**		**0.150**		0.033	U	0.035	U	0.024	U	0.024	U
Nitrogen, Total	0.11 - 0.26	NA		NA		**0.49**	J	0.26	U	**1.30**		0.26	U	**1.10**		**0.54**	
Nitrogen, Total Dissolved	0.11	NA		NA		0.26	U	0.26	U	**0.50**		0.26	U	**0.58**		**0.65**	
Phosphorus as P, Total	0.0096	**0.051**		0.0096	U	**0.100**		0.0096	U	**0.0350**		0.0096	U	**0.0590**	J+	**0.0130**	J
Phosphorus as P, Total Dissolved	0.0096	**0.014**	J	0.0096	U	0.0096	U	0.0096	U	0.0190	U	0.0096	U	**0.0230**	J+	0.0096	U
Orthophosphate as P	0.0050	**0.016**	J-	0.0050	U	**0.0100**		0.0050	U	**0.0200**		0.0050	U	**0.0100**		0.0050	U

I: The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
J: Estimated value
J-: Esimated value, low bias
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 r
C: Calculated by AECOM as sum of TKN and Nitrate+Nitrite as N
R: Unusable Data
R (U): Unusable data due to elevated MDL (see Appendix D, pages 25-31)
NC: Cannot Calculate
+: Polymer only operations
Bold: Result above Method Detection Limit

AECOM
1625 Summit Lake Drive
Tallahassee, FL 32317
aecom.com