Services Authorization No. 2023-021-01

for

Research Agreement dated April 18, 2023

All of the terms and conditions of the Research Agreement between the parties dated April 18, 2023 are hereby incorporated by reference.

Project Name	Central Regional Utility Service Area – Central Water Treatment Facility Process Monitoring and Performance Assessment
Scope of Services	See attached Exhibit "A"
Duration (in days)	Approximately 600 days or 20 months; This authorization shall be in full force and effect until all services identified in Exhibit "A" are complete.
Compensation (Fixed Price/Lump Sum)	$162,900
Special Contract Conditions (if any)	N/A
Budget Source/Availability	42011. 660536012.5331010 (Water Plant Operations/Treatment)

IN WITNESS WHEREOF, the parties hereto have executed this authorization on this __ day of _____, 2023.

ATTEST: Stacy M. Butterfield

By:_____
Deputy Clerk

Review as to form and legal sufficiency

County Attorney's Office Date

POLK COUNTY, a political subdivision of the State of Florida

By:_____
Chairman, Board of County Commissioners

Date signed:_____

ATTEST:

By: _____
Name: Amanda Renc
Its: Licensing Coordinator

UNIVERSITY OF CENTRAL FLORIDA,
by and on behalf of its Board of Trustees

By: _____
Name: JOEL KENNEDY
Its: Associate Director
Date Signed: 9/18/23

Exhibit A

Scope of Services
Work Authorization No. 23-021-01
Board of County Commissioners of Polk County

Central Regional Utility Service Area
Central Water Treatment Facility Process Monitoring and Performance Assessment

The University of Central Florida Board of Trustees (UCF), a public body corporate, organized under the State of Florida with an office located at 12201 Research Parkway, Suite 501, Orlando, Florida 32826 entered into a Research Agreement (AGREEMENT) with Polk County, Florida (COUNTY), a political subdivision of the State of Florida, on April 18, 2023. Pursuant to this AGREEMENT, the COUNTY has requested UCF's Department of Civil, Environmental and Construction Engineering (CECE) to perform ozone and granular activated carbon (GAC) process performance studies at the COUNTY's Central Water Treatment Facility (STUDY). The Central Water Treatment Facility (WTF) supplies the Central Region Utility Service Area (CRUSA) which is also comprised of other WTFs and interconnected systems that are not included in this STUDY.

MOTIVATION

The COUNTY owns and operates a 4 million gallons per day (MGD) Central WTF that treats groundwater through ozone addition followed by GAC treatment prior to chlorination to remove total sulfide and to meet disinfection by-products regulatory requirements. It should be noted that approximately twenty percent of the ozonated flow is by-passed around the GAC system to extend the bed useful life. The plant was first placed on-line in November 2019 (design engineer: Reiss Engineering Inc., 1016 Spring Villas Point, Winter Springs, FL 32708).

The COUNTY has requested that UCF CECE assist in an evaluation that includes the monitoring and assessment of the COUNTY's Central WTF treatment processes. The purpose of this research is to review the effectiveness of the ozone contact and destruct basin with respect to water quality, examine the condition of the activated carbon that comprises the GAC bed, assess if the beds are microbiologically active, and evaluate finished water quality and impact of blending bypass into the distribution system in terms of organic, inorganic, and microbial quality entering the water distribution system.

A. RESEARCH SCOPE

PHASE 100 – PROJECT MANAGEMENT COMPONENT

Task 101 – Project Management and Communication

Coordination of UCF research activities with the COUNTY will occur during the STUDY. Process-related data gathering activities will require COUNTY and UCF technical personnel to discuss schedule for planning purposes. This task consists of those needs required for project management for the STUDY to include scheduling and coordinating activities with the COUNTY and others (if required). UCF will communicate to COUNTY operations personnel UCF's data needs so that the appropriate means for gaining access to the appropriate sample location can be established; site-specific details regarding the differentiation between UCF-collected samples and COUNTY-collected samples will be clarified prior to any sampling activities being performed in support of STUDY.

UCF quality assurance and control methods will be implemented as the STUDY progresses. *Note: It is established herein that the COUNTY does not require a certification of the analysis for UCF's laboratories as this STUDY is applied research.*

Task 102 – Site Visits and Progress Conference Calls

This work authorization will allow UCF to perform site visits at the Central WTF for at least twelve (12) site visits. An initial effort will be for UCF to travel to the Central WTF to gain familiarity with each facility, its' process operation, and site-specific conditions for the STUDY (see Task 203 and Section E Responsibilities). In addition, a progress conference call will be held every other month to discuss project schedule and implementation needs.

PHASE 200 – RESEARCH COMPONENT

COUNTY will assist UCF in the collection of aqueous (process water streams) or solid (granular carbon media) process-related samples. UCF will provide the COUNTY with a 'script' (test plan) for the anticipated on-site sample activities, such as sample identification needs, sample bottle storage requirements and GAC sample frequency, as examples. Sample location access will vary depending on whether it is aqueous (e.g., raw supply; process stream; point-of-entry) or solid (activated carbon).

Task 201: Raw Water Supply Quarterly Sampling Events

General Water Quality. The COUNTY's Central WTF is supplied from three wells located on-site (Photo 1). These three groundwater wells will be sampled five times at quarterly intervals over the period of 17 months for the following water quality parameters: alkalinity, bromide, calcium, chlorine (residual), conductivity, iron, nitrate, oxidation reduction potential (ORP), pH, sulfate, sulfide (Total), SUVA-254, temperature, total organic carbon (as NPDOC), turbidity, and UV-254. At the time of each sampling event, process operation related information (flow, time, location) will be collected.

Photo 1. One of three Central WTF On-site Wells is shown in this photograph.

Adenosine Triphosphate. Adenosine triphosphate (ATP) will be evaluated at each of the well sites on a quarterly basis. The test will be used to monitor ATP levels in water as a quality indicator delineating the microbial activity of any sample. ATP contained within living cells and particulate matter (microbial ATP will be assessed. Dissolved ATP outside of living cells (non-microbial ATP), freely available in the water sample is not assessed. Total ATP is the sum of non-microbial, "free", ATP and microbial, bound with in a cell, or cellular, ATP. In this sampling goal, microbial ATP will be the focus. The kits used for the ATP filter the water and obtain microbial ATP directly, through a step of lysing the cells, whereas prior methods have used wands to collect both total and free ATP, where microbial ATP had to be calculated from the equation shown in Equation (1):

$$\textit{Total ATP} = \textit{Free ATP} + \textit{Microbial ATP, therefore, Microbial ATP} = \textit{Total ATP} - \textit{Free ATP} \qquad (1)$$

Task 202: Process Evaluation

UCF will evaluate the Central WTF's ozone (oxidation system) and GAC (adsorption system) unit operations as described in this Task. Key water quality of interest for the ozone and GAC system may in part or whole include adenosine triphosphate (ATP), alkalinity, bromide, calcium, chlorine (residual), conductivity, iron, nitrate, oxidation reduction potential (ORP), pH, sulfate, sulfide (Total), SUVA-254, temperature, total organic carbon (as NPDOC), turbidity, and UV-254.

Ozone System. Pre-ozonation provides many benefits to the water treatment process, in particular dissolved organics removal (natural organic matter, NOM, and organic micropollutants). Ozone oxidation breaks down long chain molecules into short chained organics such as aldehydes, ketoacids, and carboxylic acids which are more easily biodegradable with the use of a downstream granular activated carbon (GAC). The ozone treatment process consists of an ozone generator, feed-gas supply, ozone contactor, and an ozone destruct system. Operation monitoring information (flow, time, location) is necessary for STUDY as well as monitored water quality (such as the water quality listed under task 202 (above paragraph) and in addition total trihalomethanes and haloacetic acids, if such data is available). ATP will be assessed at this unit operation to assist in assessment of the two ozone destruct chambers for quality changes. The ozone process will be evaluated in terms of water quality and process-control mass transfer and performance effectiveness. **Photo 2** presents a photograph of the ozone contact and destruct chamber.

Photo 2. The ozone contact and destruct chamber.

GAC System. The activated-carbon process will be evaluated relative to its process operation performance. This will include process-control water quality evaluations (mass transfer parameter time-series comparisons), water quality, microbiological activity, and other adsorption conditions. There are two sample types which will be collected in this GAC subtask: (a) water quality samples; (b) solid GAC samples directly from the bed to be evaluated by (i) physical and (ii) microbiological means.

The Model 12-40 Adsorption System is a unit consisting of one (1) vertical pressure vessel, containing 40,000 pounds of granular activated carbon (GAC); four of the Model 12-40 containers comprise the granular activated carbon process at the Central WTF; each of the four vessels are complete with underdrain and carbon transfer piping. **Figure 1** provides an overview of the GAC process flow stream.

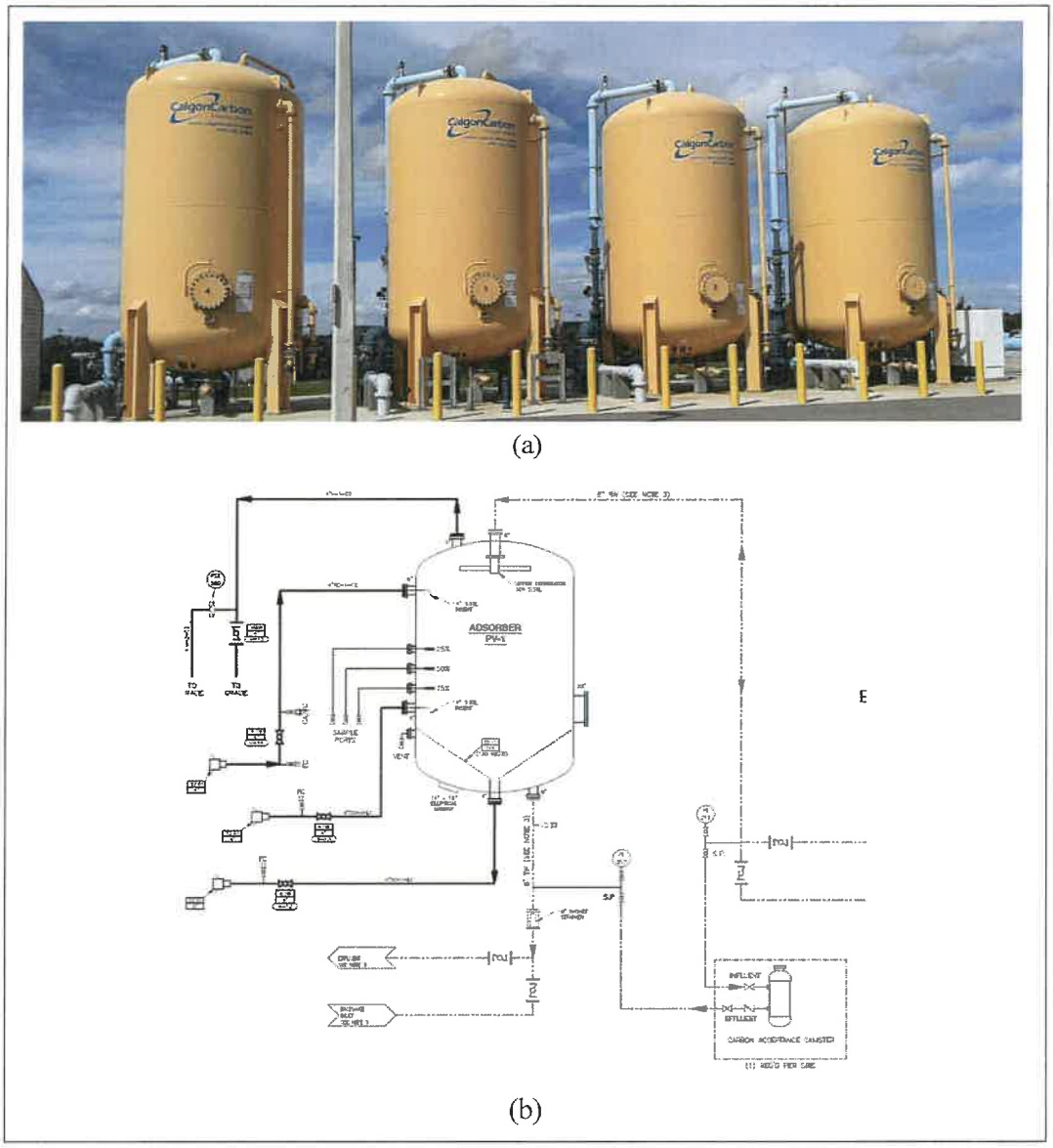

Figure 1. Central WTF Adsorber PV-1 GAC Vessels (a) Actual Installed; (b) Process Flow Diagram

a) **Water Quality and Solid GAC Sample Collection Events.** Water quality samples are to be collected from the 25%, 50% and 75% sample locations on each of the four GAC vessels. After each water quality sampling, the COUNTY will be required to remove the water sample tap covers at the 25%, 50% and 75% GAC vessel locations in order to obtain solid carbon media samples. It is planned to obtain the carbon solid samples necessary for the analysis in this component of the research via access to stainless-steel bed sampling locations, as depicted in **Figure 2**. After the water quality and solid samples are obtained by UCF, stainless-steel sample ports (once disinfected) will be reinserted/reinstalled back to the GAC vessels by the COUNTY. Parameters of critical interest are TOC, UV-254, sulfate, calcium and alkalinity. Other parameters will be assessed in the investigation as required.

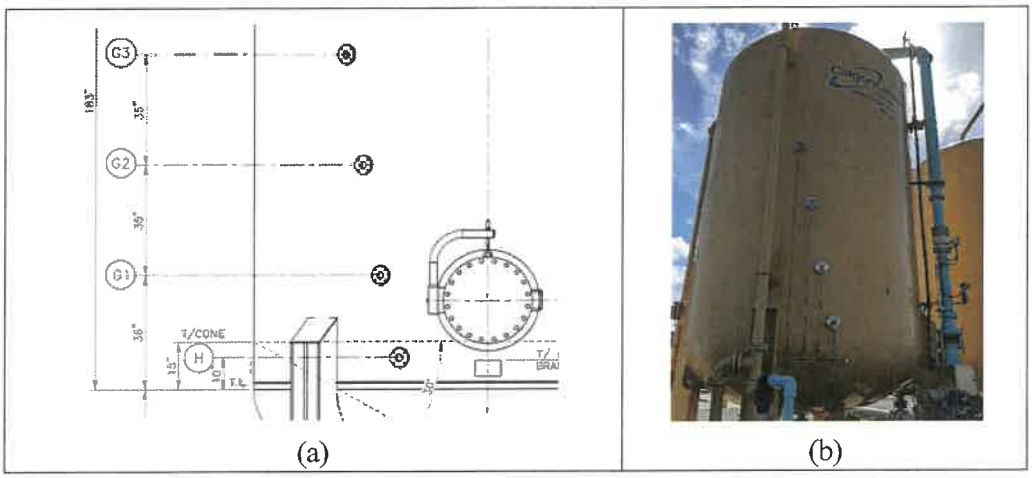

Figure 2. GAC Sample Port Detail (a) Schematic and (b) Vessel 1 Locations.

b) Solid Activated Carbon Analysis Collection Events

(i) ***Carbon integrity testing***. Approximately 100g of carbon will be collected at each of the bed depth sample ports; 25%, 50%, and 75% . This portion of the solid GAC samples will be submitted to the original manufacturer (Calgon Carbon Corporation, A Kuraray Company, 300 GSK Drive, Moon Township, PA 15108) to obtain abrasion resistance (particle integrity), particle size uniformity coefficient (effective size), ash content (inorganic quality), metals content (energy dispersive x-ray). An "Iodine" test for the carbon's surface oxide capacity will be performed (iodine number is a measure of the iodine adsorbed in the pores and, as such, is an indication of the pore volume available in the activated carbon of interest; typically, iodine numbers ranging from 600 to 1100).

(ii) ***Microbiological testing***. In treatment systems that are operated over longer periods of time, GAC surfaces can be colonized by microorganisms, which will eventually establish active biofilms, giving rise to the so-called biological activated carbon (BAC) process. While bacteria have a significant and recognized function in BAC filters, less is known about microbial community composition and dynamics in such filters. Approximately 50g of the carbon collected from the 25% and 75% bed depth sample ports will undergo microbial microbiome characterization to answer the question: which microorganisms are present? The microbial community structure will give important information about what biological and chemical reactions are occurring within filter beds. DNA will be extracted from GAC samples and sequenced on the Illumina-MiSeq platform and analyzed by the Qiime2 pipeline. Should the budget allow, a limited use of qPCR will be employed to target specific biomarkers to determine what specific enzymatic functions are occurring with the filter beds.

Task 203: Data Compilation and Analysis

UCF will compile the analytical results and data observations gained in the evaluation phase of the STUDY and perform data analysis on the collected information, considering existing COUNTY or other entity historical data and information in this Task. The analysis will focus on the following: sulfide removal effectiveness of ozone addition; the condition of the activated carbon that comprises the GAC beds and their microbiologically active status; and project a carbon replacement timeline based on water quality uptake and breakthrough information. Quality assurance and associated control charts will be developed for water quality parameters (where applicable). Precision and/or accuracy will be reported for specific parameters as needed.

PHASE 300 – REPORTING SERVICES

Task 301: Reporting Component

At the end of month 15 of the STUDY UCF will prepare an electronic version of a DRAFT REPORT and deliver to the COUNTY for their review. The COUNTY will provide to UCF one set of combined comments of COUNTY-compiled draft review comments on the DRAFT REPORT within 10 business days of receipt.

At the end of month 17 of the STUDY UCF will prepare and deliver to COUNTY a FINAL REPORT, considering COUNTY review comments of the DRAFT REPORT and report format quality requirements. A minimum of one hard copy and one electronic copy will be provided to the COUNTY at completion of the research.

Note: Additional reporting in the form "progress reports" every-other month; it is also possible that if accepted for a conference for presentation this may result in publication in Proceedings or peer-review literature (as a possibility).

B. SCHEDULE

The STUDY is anticipated to require approximately 20 months per the schedule shown in **Table 1**, Schedule by Month. UCF will proceed with the services identified herein immediately upon receipt of an executed copy of this Authorization and a formal Notice-to-Proceed from the County. This authorization shall be in full force and effect until the UCF completes all services as described herein and any subsequent modifications hereto.

Table 1. Schedule by Month

TASK	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Task 101. Project Management and Communication	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Task 102. Site Visits	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Task 201: Raw Water Supply Quarterly Sampling Event	✓			✓			✓			✓			✓							
Task 202: Process Evaluation			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
Task 203: Data Compilation and Analysis				✓	✓			✓	✓		✓	✓		✓	✓		✓	✓		
Task 301: Reporting Component (progress updates)		✓		✓		✓		✓		✓		✓		✓		✓		✓		

C. DELIVERABLES

UCF will provide STUDY findings in a reasonable manner. **Table 2** presents an anticipated schedule of deliverable dates for the STUDY.

Table 2. Deliverables Schedule (Basis: 12 months)

DELIVERABLE ITEM	DUE DATE
a. Task 301. Initial Draft Report for Review by County	End Month 17
b. Task 301: Final Report	End Month 20
c. Task 301: Every Other Month Report	Every other Month (see Table 1 – 9 events)

D. COMPENSATION

The COUNTY will compensate UCF for the services based on a lump-sum fee paid in 20 equal monthly installments of $8,145 for the duration of the project period. The cost breakdown for the STUDY is presented in **Table 3**. The cost will not exceed **$162,900** without prior mutual agreement of UCF and the COUNTY.

Table 3. UCF Research Cost for STUDY

This research STUDY is a UCF Level 1 Project.

Task	Description (See Scope for Details)	Cost ($)
101	Project Management and Communication	$2,220
102	Site Visits and Progress Conference Calls	$6,500
201	Raw Water Supply Quarterly Sampling Events	$5,750
202	Process Evaluation	$135,430
203	Data Compilation and Analysis	$8,500
301	Reporting Components	$4,500
Total STUDY		**$162,900**

E. RESPONSIBILITIES

COUNTY will provide to UCF the following information and services.

- Process-related data gathering activities will require COUNTY and UCF technical personnel to discuss schedule for planning purposes. COUNTY will assist UCF in the collection of aqueous (process water streams) or solid (granular carbon) process-related samples.
- Copies of operations data related to the ozone and GAC process, specifically any reports or analysis by the ozone manufacturer or it's representative entities.
- COUNTY will coordinate activities related to UCF's research involvement to determine site visit times and locations; the COUNTY will provide official representation at meetings where UCF is on-site; meetings with UCF will not occur without the presence of the COUNTY project manager or official designee (operations staff) unless previously agreed.
- COUNTY will provide access to the COUNTY facilities and appurtenances associated with research efforts. The COUNTY will provide personnel to assist in support of the STUDY.

F. Quality Assurance and Quality Control

A quality assurance project plan (QAPP) documents the planning, implementation, and assessment procedures for a particular project, as well as any specific quality assurance and quality control activities. It integrates the technical and quality aspects of the project to provide a "blueprint" for obtaining the type and quality of environmental data and information needed for a specific decision or use. Adherence to the UCF laboratory QAPP will provide better assurance of the reliability and accuracy of the environmental data collected, evaluated, used, or reported during the course of the STUDY.

Sample collection and water quality analyses will be performed in accordance with *Standard Methods for the Examination of Water and Wastewater* and the Environmental Protection Agency's *Methods for Chemical Analysis of Water and Wastes* and *Methods and Guidance for the Analysis of Water*. Only approved protocols will be used during the sample collection and evaluation program. This includes use of parameter specific holding times, container types, sample volumes, and preservative requirements.
Many of the activities performed by UCF will rely upon historical information such as water quality data and reports, in the implementation of this Project. UCF will follow its QAPP for field and laboratory facilities. UCF has developed its plan and is based in part on the document, Guidance for Quality Assurance Project Plans (EPA, Office of Environmental Information, EPA/240/R-02/009, December 2002). The plan has been developed to briefly describe basic activities involved with the acquisition of project information whether generated from direct measurement (laboratory or field) activities, collected from other sources, or compiled from computerized databases (should they exist). Qualitative data and information will also be relied upon in the conduct of this study.

In order to meet the objectives of the study, the QAPP will be utilized for the collection and analysis of data. Regarding the analytical testing of water samples, the appropriate portions of USEPA's Handbook of Analytical Quality Control in Water and Wastewater Laboratories and APHA-AWWA-WEF's Standard Methods for the Examination of Water and Wastewater (SM) shall be employed. In addition, the QAPP developed specifically for the project will be based on the following fundamental principles:

- The achievement of quality is the responsibility of both the person performing the work and his or her supervisor assigned to the work. The degree of application of the QAPP criteria is dependent on the impact of activity (planning, bench and pilot testing, maintenance, operation, etc.) on the objectives of the program. This is accomplished through the prudent use of "graded" quality assurance. The amount and extent of review of quality affecting activities will be commensurate with the importance of the activity to meeting the stated objectives of the overall program.
- Testing activities shall be controlled through the use of test plans, the use and adherence to test protocols and record keeping using technical notebooks and files.

Records and Data Management. The ultimate success of this project depends on the adequacy of the quality of the environmental data collected. For purposes of this project, existing and new data will be managed. Several sets of collections logs will be maintained during the field sample collection phase of the research program to document quality processes have been adhered to during implementation. Data management tasks will be used to trace the path of the data from their generation in the field or laboratory to their final use and storage. Standard-of-care record keeping, document control and approaches used for data storage and retrieval on electronic media will be maintained during project implementation. The records, forms and data control methods of importance to the project include the following formats: Field Data Collection Records; Report of Analysis (from the laboratory); Operation Data Summary (taken at time of sampling); and, Instrument and Equipment Inspection, Maintenance and Calibration Logs.

Sample Collection. Sample collection and water quality analyses will be performed. Only approved protocols will be used during the sample collection and evaluation program. This includes use of parameter specific holding times, container types, sample volumes and preservative requirements. Sampling containers (including caps) that do not contain a preservative or dechlorinating agent will be rinsed with

the water being collected prior to sample collection. The containers and caps will not be rinsed otherwise. The caps will be carefully handled during container filling to avoid sample contamination. Sufficient sample volumes as per the laboratory SOP will be collected to allow multiple measurements from the sample bottle if the results obtained in the field do not meet quality control (QC) requirements. Samples containing volatile compounds (if any) will be filled to eliminate headspace using appropriate sample containers with caps and Teflon-lined septas. The samples will be transported on the same day of sampling. Samples will be analyzed within appropriate holding times as identified with this QAPP, and proper records will be established for each water sample. Samples to be collected without headspace (to avoid aeration or constituent volatilization) will be checked for air bubbles immediately after sealing the container with the cap and septa. If air bubbles are found, the sample will be opened, filled with additional sample, and repeated until no bubbles are present.

Table A1 provides a typical summary of analytical methods for use in the field. This equipment will be calibrated in the lab or field on the same day of use, checked immediately prior to use in the field and recalibrated if necessary. Calibration will be checked approximately once every 2-hours throughout the duration of testing. These checks include the use of standard solutions (such as pH buffers and potassium iodide for conductivity) and/or blanks. Care will be taken to calibrate instruments approximating the anticipated range of measurement. Equipment calibration activities will be recorded within a field logbook. **Table A2** provides a partial listing of preservation and holding times for water quality analysis, and **Table A3** highlights the typical laboratory water quality analysis that may be performed and is tabulated in terms of the equipment used, the methodology applied, method detection limit, accuracy, precision, and sampling information including volume, container type, preservative and hold time.

G. Additional Provisions

If the research tasks required are different from those items presented herein, or if the COUNTY desires additional research, the resultant changes in scope will serve as a basis for amending the research scope as agreed to by the COUNTY and UCF. Additionally, UCF shall be entitled to rely upon the accuracy of data and information collected and provided by the COUNTY and others without independent review or evaluation. UCF is not responsible for the means, methods, sequences, techniques, or procedures of the COUNTY. Administrative and contractual points of contact for the Specific Authorization presented herein are as stated in the section, "Notices of the Research Agreement" of the Master Agreement.

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APPENDIX A

Table A-1. Summary of Analytical Methods Anticipated for Use in the Field

Test	Method Reference Number (Standard Methods); Instrument	Range / Resolution	Calibration Procedures
Chlorine, total and free	DR 890 Portable Colorimeter – SM 4500-Cl F DPD Colorimetric Method	0 – 5 mg/L Cl_2 range; 0.01 mg/L Cl_2 resolution	Use known concentrations of sodium hypochlorite into chlorine demand-free Milli-Q water (6-point calibration curve from 0 to 4 mg/L)
Conductivity	LaMotte Con 5 Field Probe (with temperature compensation)	0 – 20 mS Range 1 µS resolution	None
Dissolved Oxygen and (Oxidation Reduction Potential)	YSI 550A Sensor	0 – 50 mg/L O_2 Range	Calibrated against manufacturer's internal method and frequent membrane inspection
Hydrogen Sulfide	LaMotte 4630 Drop Count Method	0.01 mg/L S resolution	Check with samples collected for laboratory analysis using zinc acetate preservation method.
pH	LaMotte pH 5 Series Field probe (with temperature compensation)	0 – 14 Range, 0.01 resolution	Commercial pH calibration buffers, pH 4, 7, 10. Calibrated prior to analyzing any batch of samples using 2-point calibration with standard buffers
Temperature	Mercury-filled Celsius Thermometer	0 – 100 °C; 0.1 °C resolution	Calibrated against NIST-certified thermometer
Turbidity	EPA 180.1 Nephelometric Turbidity	0.01-800 NTUs 0.01	Calibrated daily with 10 NTU and full curve annually and as needed.

SM = Standard Methods; N/A = Not Applicable

Table A-2: Preservation and holding times for water quality analysis

Parameter	Collection Amount/ Vessel	Preservative	Holding Time
Alkalinity	200 mL plastic or glass	Refrigerate 4 °C	14 days
Anions	100 mL plastic or glass	Refrigerate 4 °C	28 days
Cations	100 mL plastic	HNO_3 to pH < 2	6 months
pH	50 mL plastic or glass	N/A	Analyze Immediately
TOC	100 mL glass	Refrigerate 4 °C H_3PO_4 to pH < 2	7 days
UV_{254}, Color, Turbidity	100 mL plastic or glass	N/A	Analyze Immediately

APPENDIX A

Table A-3: UCF CECE Drinking Water Laboratory Water Quality Analysis Summary Table (Preliminary)

Test	Method Reference Number (Standard Method); Instrument	Method Reporting Level (MRL)	Method Detection Level goal (MDL)	Accuracy % Recovery	Precision % RPD	Hold time (HT)	Minimum Sample Vol. (SV)	Cont. Type (CT)[1]	Preservative
Adenosine Triphosphate (ATP)	Promega GloMax® Luminometer and sample Kit	RLUs	RLUs	N/A	<20	None	24 mL	Sterile, ATP Free	24-hrs. in Lysis Solution. Keep out of sun.
Alkalinity	SM: 2320 B. Titration Method Bromocresol green/ methyl red	5 mg/L as $CaCO_3$	5 mg/L as $CaCO_3$	N/A	<20	Preferably 24 hours 14 days max.	100 mL	Glass or Plastic (filled completely and capped)	Cool, 4°C
Barium	EPA 200.7 / SM: 3120 B. Inductively Coupled Plasma (ICP) Method/Inductively Coupled Plasma Spectrometer	0.01 mg/L	0.002 mg/L	80-120	<20	180 days	250 mL	Plastic or Glass	Cool, 4°C; Acidify with 2% concentrated HNO3 to pH < 2
Bromide	EPA 300.0 / SM: 4110 B. Ion Chromatography (IC) with Chemical Suppression of Eluent Conductivity	0.01 mg/L	0.01mg/l	80-120	< 20	28 days	125 mL	Plastic	Cool, 4°C
Calcium	EPA 200.7 / SM: 3120 B. Inductively Coupled Plasma (ICP) Method/Inductively Coupled Plasma Spectrometer	0.01 mg/L	0.01 mg/L	80-120	<20	180 days	250 mL	Plastic or Glass	Cool, 4°C; Acidify with 2% concentrated HNO3 to pH < 2
Calcium Hardness	SM: 2340 C.EDTA Titrimetric Method	5.0 mg/L as Ca CO_3	0.300 mg/L as Ca CO_3	80-120	<20	180 days	250 mL	Plastic or Glass	1-mL HNO3, pH < 2
Chlorine, total and free	4500-Cl G DPD Colorimetric Method; Pocket Colorimeter II	0.10 mg/L	0.034 mg/L	80-120	< 20	analyze upon collection	250 mL	Amber Glass	Analyze immediately Cool, 4oC (Analyzed on the day of collection)
Chloride	EPA 300.0 / SM: 4110 B. Ion Chromatography (IC) with Chemical Suppression of Eluent Conductivity	0.10 mg/L	0.004 mg/L	80-120	<20	28 days	500 mL	Plastic or Glass	Cool, 4°C
Color (True)	SM: 2120 C. Single Wavelength Method (254 nm)	1 cpu	1 cpu	N/A	N/A	24 hours	100 mL	Plastic or Glass	None

Table A-3: UCF CECE Drinking Water Laboratory Water Quality Analysis Summary Table (Preliminary)

Test	Method Reference Number (Standard Method); Instrument	Method Reporting Level (MRL)	Method Detection Level goal (MDL)	Accuracy % Recovery	Precision % RPD	Hold time (HT)	Minimum Sample Vol. (SV)	Cont. Type (CT)[1]	Preservative
Conductivity	2510B. Laboratory Method; Fisher Scientific Traceable Conductivity, Resistivity and TDS Meter 2510B; HACH Conductivity Probe; Model 51975-03	N/A	N/A	N/A	<5	28 days	125 mL	Plastic or Glass	Cool, 4°C; Read at room temperature.
Fluoride	EPA 300.0 / SM: 4110 B. Ion Chromatography (IC) with Chemical Suppression of Eluent Conductivity	0.01 mg/L	0.002 mg/L	80-120	<20	28 days	500 mL	Plastic or Glass	Cool, 4°C
HAA5	SM: 5710 C. Simulated Distribution System Trihalomethanes	1-4 µg/L	3 µg/L	70-130	±30	14 days	1 L	Amber glass	Cool, 4°C
Hardness (Total)	SM: 2340 B. Hardness by Calculation	3.0 mg/L as $CaCO_3$	0.346 mg/L as $CaCO_3$	80-120	<20	180 days	250 mL	Plastic or Glass	Cool, 4°C; 1-mL HNO3, pH < 2
Iron (Total and Dissolved)	EPA 200.7 / SM: 3120 B. Inductively Coupled Plasma (ICP) Method/Inductively Coupled Plasma Spectrometer	0.005 mg/L	0.007 mg/L	80-120	<20	180 days	250 mL	Plastic or Glass	Cool, 4°C; Acidify with 2% concentrated HNO3 to pH < 2
Magnesium	EPA 200.7 / SM: 3120 B. Inductively Coupled Plasma (ICP) Method/Inductively Coupled Plasma Spectrometer	0.1 mg/L	0.03 mg/L	80-120	<20	180 days	250 mL	Plastic or Glass	Cool, 4°C; Acidify with 2% concentrated HNO3 to pH < 2
Nitrate	EPA 300.0 / SM: 4110 B. Ion Chromatography (IC) with Chemical Suppression of Eluent Conductivity	0.01 mg/L as N	0.027 mg/L as N	80-120	<20	48 hrs.	500 mL	Plastic or Glass	Cool, 4°C
pH	SM: 4500-HB. Electrometric Method / E150 HACH Platinum pH Electrode, Model 51910, HQ40d Portable pH,	0.01 units	0.01 units	N/A	±0.1 pH unit	0.25 hr.	125 mL	Plastic or Glass	Analyze immediately
Sodium	EPA 200.7 / SM: 3120 B. Inductively Coupled Plasma (ICP) Method/Inductively Coupled Plasma Spectrometer	0.03 mg/L	0.03 mg/L	80-120	<20	180 days	250 mL	Plastic or Glass	Cool, 4°C; Acidify with 2% concentrated HNO3 to pH < 2

Table A-3: UCF CECE Drinking Water Laboratory Water Quality Analysis Summary Table (Preliminary)

Test	Method Reference Number (Standard Method); Instrument	Method Reporting Level (MRL)	Method Detection Level goal (MDL)	Accuracy % Recovery	Precision % RPD	Hold time (HT)	Minimum Sample Vol. (SV)	Cont. Type (CT)[1]	Preservative
Strontium	EPA 200.7 / SM: 3120 B. Inductively Coupled Plasma (ICP) Method/Inductively Coupled Plasma Spectrometer	0.005 mg/L	0.0005 mg/L	80-120	<20	180 days	250 mL	Plastic or Glass	Cool, 4°C; Acidify with 2% concentrated HNO3 to pH < 2
Sulfide (Total)	LaMotte 4630 Drop Count Method (DR900)	0.01 mg/L	0.01 mg/L	N/A	<20	None	250 mL	Plastic or Glass	Collect without Aeration, Analyze immediately
Sulfate	EPA 300.0 / SM: 4110 B. Ion Chromatography (IC) with Chemical Suppression of Eluent Conductivity	0.01 mg/L	0.01 mg/L	80-120	<20	28 days	500 mL	Plastic or Glass	Cool, 4°C
Temperature	SM: 2550 B. Laboratory Method/ HQ40d Portable pH, Conductivity and Temperature Probe	0.1 °C	0.01 °C	N/A	NIST approved	None	125 mL	Glass / Plastic	Analyze immediately
Total Dissolved Solids (TDS)	SM: 2520 B. Electrical Conductivity Method; Fisher Scientific Traceable Conductivity, Resistivity and TDS Meter / SM: 2540C	10 mg/L / 1 mg/L	7.661 mg/L / 4 mg/L	N/A	<10	7 days	125 mL	Plastic	Cool, 4°C
Total Organic Carbon (as NPDOC)	SM: 5310 C. Persulfate-Ultaviolet Oxidation Method/Tekmarr-Dohrmann Phoenix 8000: The UV-Persulfate TOC Analyzer	0.1 mg/L	0.01 mg/L	80-120	<10	Preferred 24-hrs; limit 7-days	100 mL	Plastic	Analyze immediately; Or add HCl, H_3PO_4 or H_2SO_4 to pH<2, Cool, 4°C
TTHMs	SM: 5710 C. Simulated Distribution System Trihalomethanes	0.5-4 µg/L	1-3 µg/L	80-120	±30	14 days	1 L	Amber glass	Cool, 4°C
Turbidity	SM: 2130 B. or EPA 180.1 Nephelometric Method	0.02 - 0.05 NTU	0.012 NTU	N/A	<10	48 hrs.	100 mL	Plastic/ Glass	For best results, analyze immediately without altering sample; If storage is required, cool to 4°C.
UV-254 UV- Absorbing Organic Constituents	SM: 5910 B. Ultraviolet Absorption Method	0.009 cm^{-1}	0.001 cm^{-1}	80-120	20 (0.5 mg/L DOC)	48 hr.	125 mL	Amber glass bottle, Cap-Teflon lined	For best results, analyze samples as soon as possible. If storage is required, cool to 4°C.