Exploration Green Stormwater Wetland Water Quality Baseline Study

GLO Contract No. 23-020-005-D599

Final Report

Coastal Management Program- Cycle 27

Prepared by: Christie Taylor

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Disaster Assessment and Recovery Unit |Texas A&M AgriLife Extension Service

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Project Overview

Basins incorporating stormwater wetlands can provide ecological benefits to water quality, habitat, and recreation. This project strives to increase the collective knowledge of water quality benefits by assessing the effectiveness of stormwater treatment wetlands at Exploration Green in the lower Galveston Bay watershed. Texas A&M AgriLife Extension Service has sampled this location in the past, and this study is completing a baseline study demonstrating long-term water quality after the installation of stormwater wetlands in the area.

Texas A&M AgriLife Extension Service (AgriLife) used CMP Cycle 27 funds to develop a water sampling plan and collected 46 weekly YSI Pro Quatro handheld sampling device sample records and 23 biweekly water samples analyzed by Eastex Labs, as outlined in the QAPP, from three outfall locations of the Exploration Green Stormwater Wetland complex. The lab samples were collected by automated ISCO samplers installed onsite and bottled for analysis according to lab procedures and documented on Eastex Chain of Custody forms provided for the sample collection. Each water sample location is in a different phase of wetland establishment, allowing AgriLife to explore how the larger Exploration Green Stormwater Wetland contributes to the reduction of nonpoint source (NPS) pollution in the watershed. Routine sampling over all seasons allows stakeholders to track seasonal fluctuations and changes due to storm or drought events and to gauge needs for future stormwater wetlands. AgriLife analyzed the project results and reported their findings to stakeholders and interested parties through two presentations and a couple of onsite tours. All the lab and YSI data is available for review on the GIFT (Green Infrastructure for Texas) website. The goal in collecting and making this water quality data accessible is to provide scientific data for decision-makers on how the stormwater treatment wetlands impact long-term water quality.

Project Partners and Site Background

For this project, we have partnered with the Clear Lake City Water Authority and Exploration Green Conservancy. Exploration Green Stormwater Wetlands is a stormwater detention facility located in the Clear Lake City region of Houston at the site of the former Clear Lake Golf Course. This facility has been under construction since about 2016. It is a multiphase project in various stages of construction and establishment, which is why we chose this location. Phase 4 is the newest location available at the time of this project; it is still being actively planted by volunteers. Phase 3 outfall splits the phase in the middle, giving an interesting perspective of the differences in size and plant establishment. Phase 1 is the only fully completed and established phase, planting in this phase was completed in 2018, giving us an idea of how these projects function over time. The partners are interested in the results of this study, so we can see how modifications to the design, since the project began, are working to improve water quality while alleviating flood risks to the area.

Task 1: Develop Project Methodology/Quality Assurance

AgriLife staff developed a Quality Assurance Project Plan (QAPP) based on previous research to look at the water quality of smaller-scale projects and revised the QAPP to outline the project description and methodology, including data collection in accordance with accredited certified lab practices and hold times for samples. AgriLife contracted with Eastex Labs to supply sample collection bottles in the appropriate size for each parameter sampled and necessary preservatives for each testing method. Eastex Labs analyzed the samples and assisted with developing the protocols and methodology identified by the QAPP. The protocols were based on the ISCO 6712 sampler capabilities and software. AgriLife provided local matching funds using our automated samplers. Other local match funds came from support staff and quality assurance officer (QAO) time spent on the project. AgriLife used cycle 27 funds to replace tubing, batteries, calibration solutions, and other supplies needed to maintain the equipment properly throughout the project. To assist the PI with the sample collection and analysis for this project, AgriLife hired Kimberly Walls as our student worker for the duration of the project. After training on the equipment setup and maintenance, Kimberly collected the samples and coordinated with the Eastex lab manager and couriers. She compiled the data to upload to the website in accordance with the QAPP. The PI, Christie Taylor, quality-checked the data entry into the spreadsheet before uploading it to the website, as stated in the QAPP. Charriss York, QAO, verified receipt of lab reports in a timely manner and quality-checked 10% of samples. Two AgriLife Wetland Assistants were cross trained in sample collection, instrument maintenance, set up, and storage to assist as needed. CVs for all the staff on this project were provided to the CMP Project Manager in accordance with deliverable task 1.3, see Appendix 6 for staff CVs. See Appendix 1 for the full QAPP.

Task 2: Water Quality Sampling

Samples were collected from 3 outfall locations of Exploration Green as identified on the map.

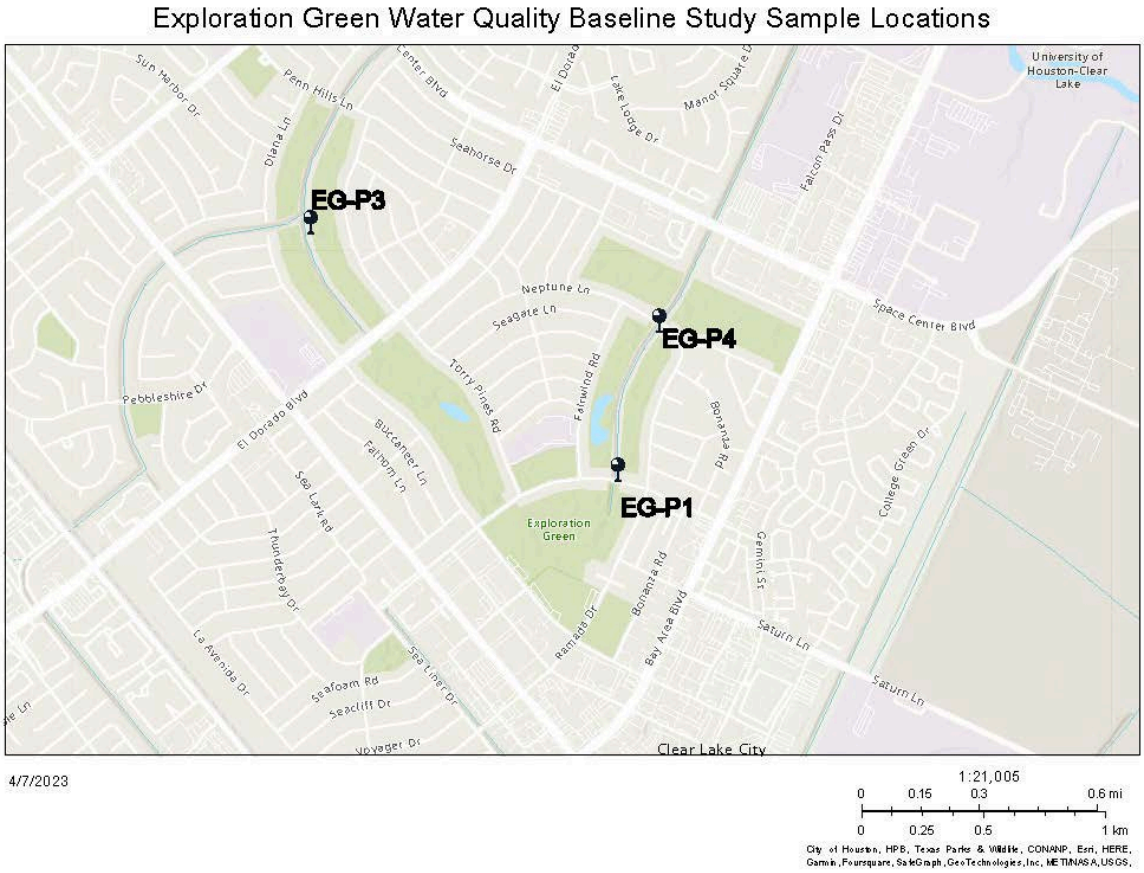


Figure 1: Map of sample locations within Exploration Green Stormwater wetland complex.

YSI Multiparameter Weekly Sampling

AgriLife collected water samples for 46 weeks from three outfall locations of Exploration Green Stormwater Wetland using hand-held YSI sampling devices as explained in the QAPP.

Figure 2: Water taken from sample collection and handheld data being recorded at Exploration Green Phase 4.

Figure 3: Handheld water sample being collected on a non-lab sample day at Phase 1 outfall.

Figure 4: Handheld YSI water sample collected at Exploration Green Phase 3 outfall.

Sample data was recorded in a field notebook with additional notes about the weather, time of day, and any changes or instrumentation errors. Individual field record sheets were also recorded in the field and then scanned to digital format in the office before they were entered into a spreadsheet to be added to the website. Scanned documents are attached in Appendix 2.

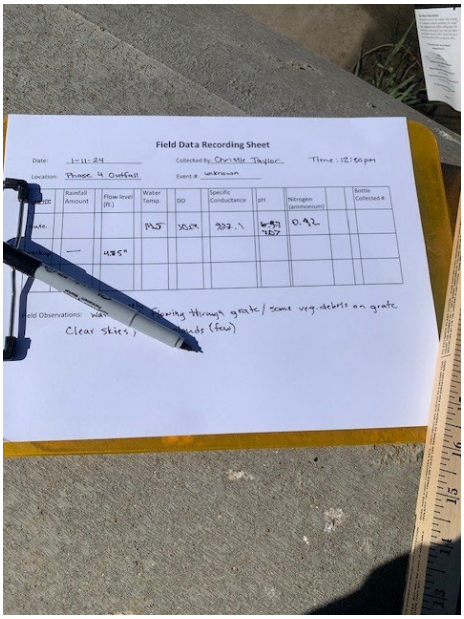


Figure 5: Field Data Recording Sheet used to record handheld device parameters at the time of the sample.

ISCO Automated Bi-Weekly Samples

AgriLife staff installed automated samplers and signage at each location.

Figure 6.Sampler and signage located at the Phase 3 outfall between sections 3a and 3b between El Dorado and Penn Hills Ln.

Figure 7Sampler and signage at Phase 1 of Exploration Green near the Reseda bridge.

Figure 8 Sampler and signage located at Phase 4 outfall of Exploration Green near the Neptune bridge

Figure 9 View of equipment inside the box, including solar array wire housing, battery, and sampler.

Each sampling station consisted of a storage box to protect the instruments from the elements, an automated sampler, an ISCO 6712, a solar array and attached battery supply, a flow meter, and a rain gauge. The signage included the project title, funding statement, project partner logos, and a QR code linked to the website for more information. Each piece of the setup was labeled and had the AgriLife project manager's contact information in case of questions or if problems arose with the sample stations. Park maintenance staff and interested stakeholders were able to contact us if they noticed anything unusual around the samplers. We did have to replace some of the tubing that was cut or nicked with lawn equipment. We also had to put suction tubing back in the outfall when curious park patrons pulled the tubes out of the water. The automated samplers collected the water samples at timed intervals as established by the QAPP. Sampling began in April of 2023 and completed at the end of February 2024. AgriLife retrieved 23 water samples from each location in bi-weekly intervals during the sampling timeframe.

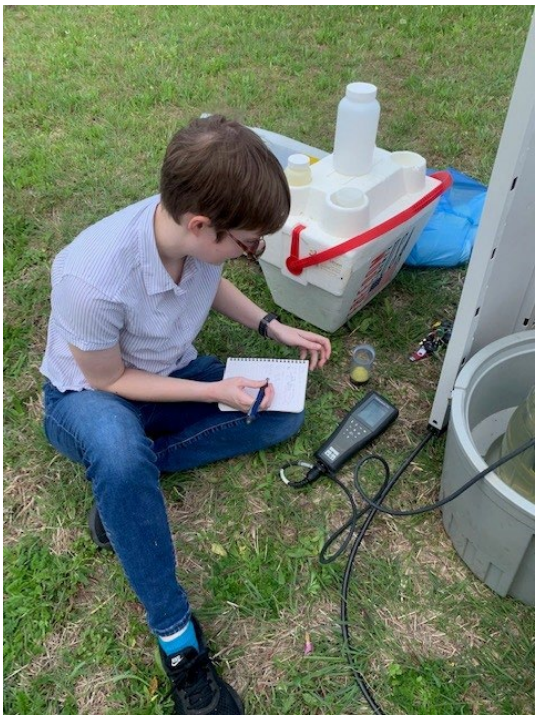


Figure 10 Kimberly is recording handheld data and preparing samples for Eastex labs in April 2023.

Figure 11 Kimberly recording hand held data and preparing lab samples in July 2023.

Figure 12 Kimberly recording field data from handheld YSI and preparing lab samples for transport in December 2023.

After samples were collected, they were stored on ice until picked up by Eastex lab couriers and analyzed by the lab.

Figure 13 Sample collection supplies include a YSI handheld probe, a DI water spray bottle to rinse probes between samples, a field journal, a clean sampling jar, lab sample bottles in secondary containment Ziplock, and a cooler of ice.

Once lab samples were analyzed, Eastex sent digital and print copies of the lab report, complete with chain of custody forms, to the project primary investigator (PI). For a full report of the lab reports, see Appendix 3. AgriLife staff then entered the data into the spreadsheet to upload to the website. Once data was ready for upload, it was verified for quality assurance by the PI, and 10% of the data was checked by the quality assurance officer (QAO)as required by the QAPP. The automated samplers also stored the rain gauge and flow meter data. The PI downloaded these data points quarterly and provided them to the staff for data entry, quality check, and graphing before adding them to the website.

Figure 14 Christie downloading passive rainfall and flow meter data from sampler after the first quarter in July 2023.

Figure 15 Christie is downloading quarterly rainfall and flow levels from ISCO samplers after third quarter in December 2023.

Figure 16 Laptop connected to ISCO data port for download at Phase 1.

Figure 17 View of ISCO data port, rain gauge port, and battery port connections(from right to left) during a sample download.

Modifications and Lessons Learned

Exposed tubing is subject to tampering. Whether it is curious patrons, bicyclists, skateboarders, maintenance crews, lawn equipment, or just the natural elements, the tubes need to be replaced at least annually. Metal pieces need to be cleaned quarterly to remove any fouling.

Due to issues with the flow meter tubing and other anomalies noticed in the data at the time of sampling, field parameters backups were added. Starting in the third quarter, we measured the flow level with a meter stick at each of the outfalls to verify that the electronic meters were working properly. Because of kinks or pinch points in the bubble tubing, some readings were elevated and removed after field verification.

At one point, we had to replace one of the sensors on the handheld sonde because it was malfunctioning. As a result, some of those parameter readings were also thrown out of the data set.

There were other gaps in the data from Phase 3 due to low or no flow at the outfall during the summer drought period.

Task 3: Data Sharing and Outreach

AgriLife openly shares the project results on a dedicated water quality webpage on the Texas Community Watershed Partners (TCWP) website hosted by the AgriLife Extension Service. This page is secondarily linked to the Green Infrastructure for Texas (GIFT) webpage's Mid-Scale Practices page, providing multiple points of access to the information.

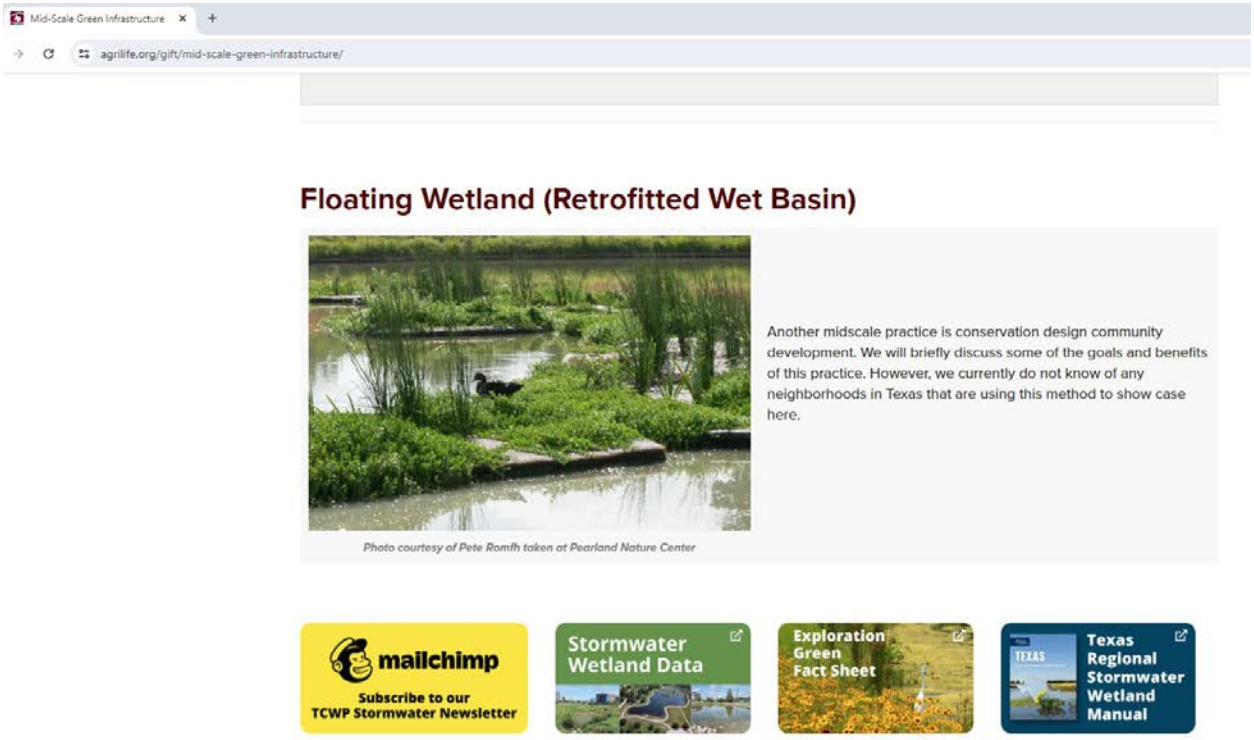


Figure 18 Screen capture of Stormwater Wetland Data thumbnail on the mid-scale green infrastructure practices tab on the GIFT website.

A QR code for the webpage was created, see below, and included on all signage and printed materials.

Figure 19 QR code link for the stormwater wetland water quality data tab on the website.

AgriLife staff developed charts and figures summarizing the project results and shared them on the website and through presentations with partners at Clear Lake City Water Authority,

Exploration Green Conservancy, and other interested stakeholders. See sample charts below in Figures 20-23.

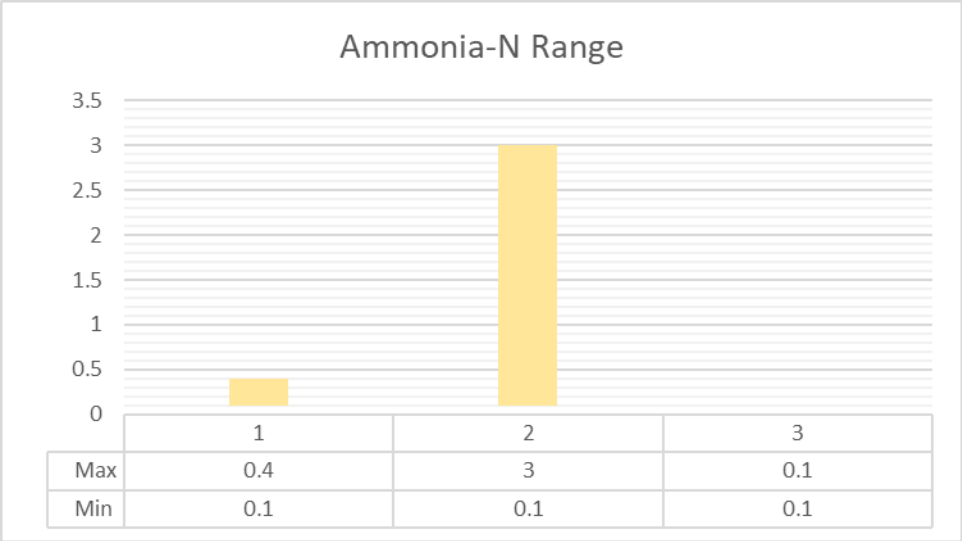


Figure 20 Summary of ammonia ranges from samples sent to Eastex Labs from April 2023 – February 2024, where 1=Phase 1, 2=Phase 3, and 3=Phase 4.

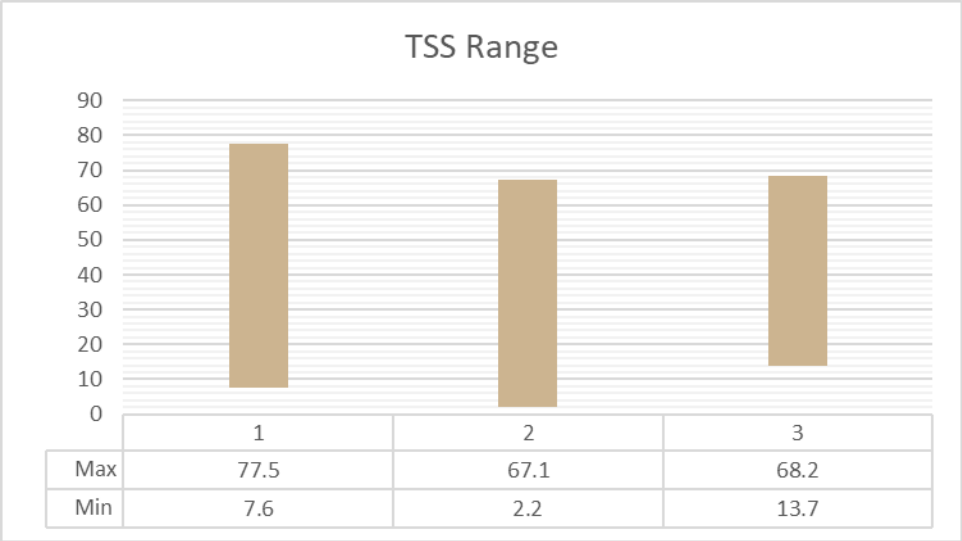


Figure 21 Summary of total suspended solids ranges measured by Eastex Labs from April 2023- February 2024, where 1=Phase 1, 2=Phase 3 and 3=Phase 4.

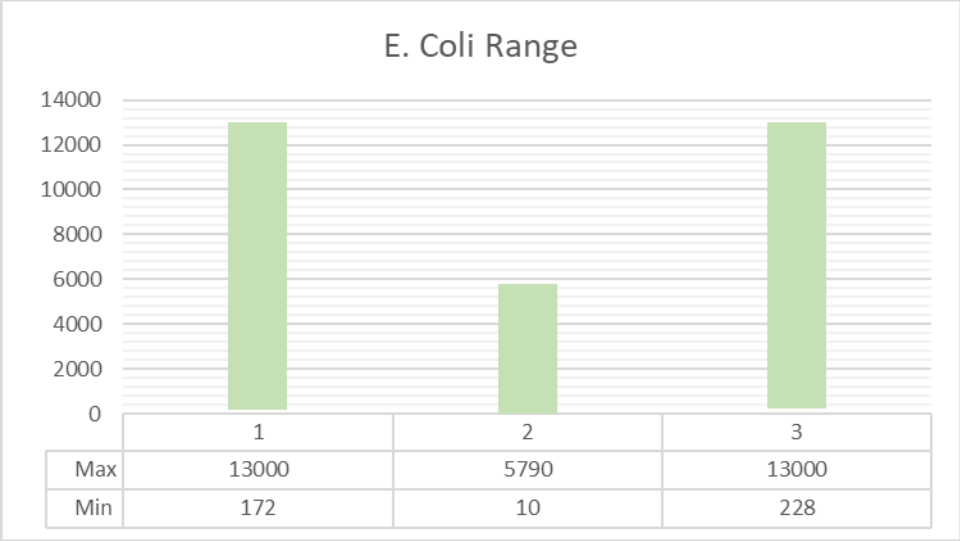


Figure 22 Summary of E.coli indicator bacteria rangse measured by Eastex Labs from April 2023 – February 2024, where 1=Phase 1, 2=Phase 3, and 3=Phase 4.

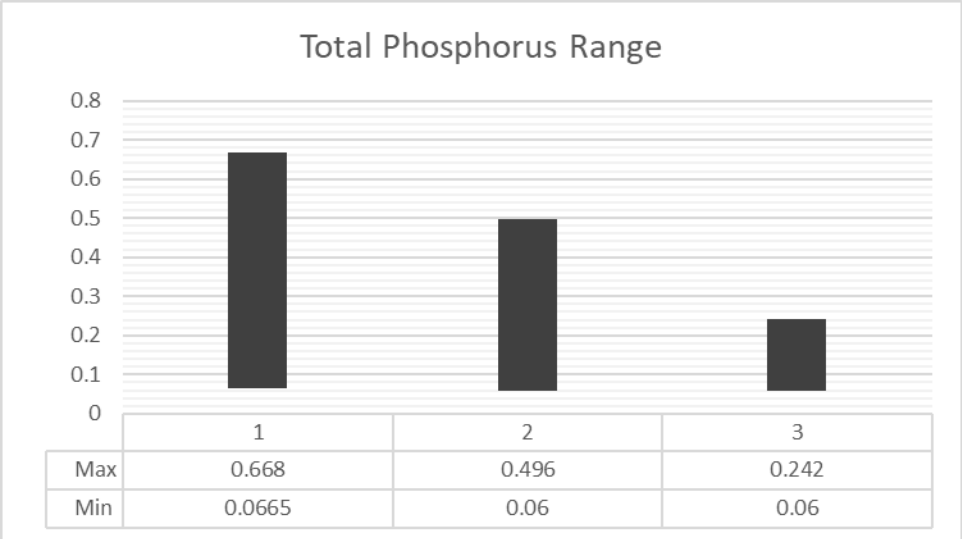


Figure 23 Summary of total phosphorus ranges measured by Eastex Labs from April 2023 – February 2024, where 1=Phase 1, 2=Phase 3, and 3=Phase 4.

Project data was added to the existing water quality page at https://tcwp.tamu.edu/stormwater/wetlands/stormwater-wetland-water-quality-monitoring-project/ on the TCWP website (tcwp.tamu.edu). This page was updated for this project by adding new sampling location photos and data. During the duration of the project the website was visited by 349 unique visitors. The newest data is located at the top of the page.

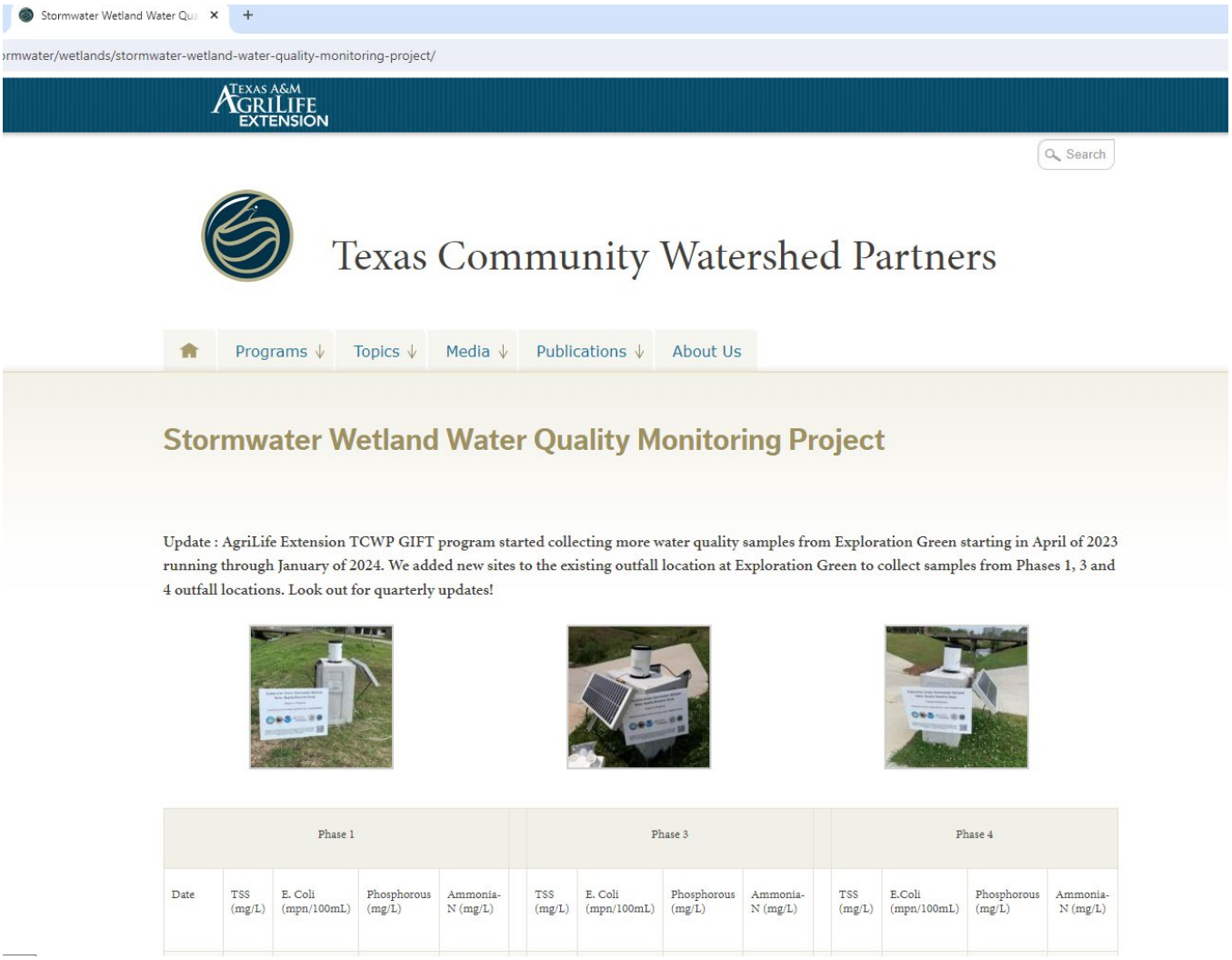


Figure 24 Screen capture of the website page on the TCWP website.

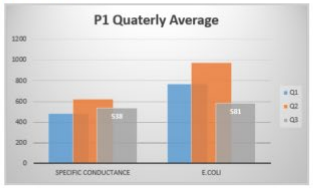
As lab reports were made available, they were added to the page as links, as depicted in Figure 25. The webpage was created in division by site, separated by a photo of each sample site set up. This was to make it easier to find information for individual sites. Site updates and tables were included under each group of site photos.

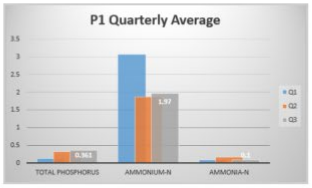
Other information included on the website included graphs created by the ISCO Flowlink software for rainfall and flow level data collected for each site, comparative charts depicting changes in parameters over time for each of the selected sites, and documents created during this project. These were followed by funding statements and logo blocks as required. The above-discussed items are depicted as screenshots in the following figures. Staff are continuing to update the newest information for the last quarter.

Exploration Green Sampler Site 1

Location #1: Exploration Green Conservation and Recreation Area , Phase 1 in the 1800 block of Reseda Dr. Houston TX, 77058. Sampling began on April 4th, 2023.

Site Data

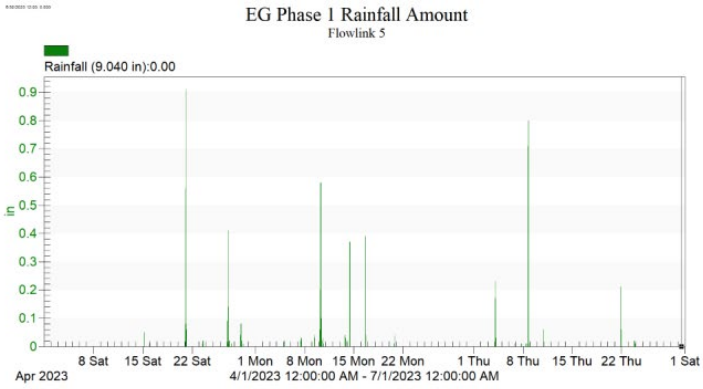


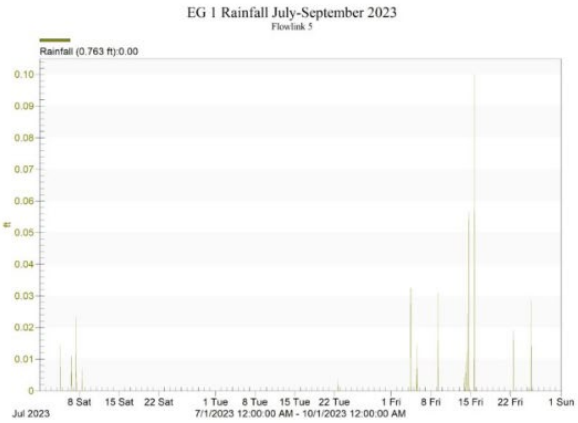


Field Data

Lab Report 4/11/23 | Lab report 4/27/23 | Lab report 5/11/23 | Lab report 5/25/23 | Lab report 6/8/23 | Lab report 6/22/23 | Lab report 7/6/23 | Lab report 7/20/23 | Lab report 8/3/23 | Lab report 8/17/23 | Lab report 8/30/23 | Lab report 9/13/23 | Lab report 9/27/23 | Lab report 10/11/23 | Lab report 10/25/23 | Lab report 11/8/23 | Lab report 11/29/23 | Lab report 12/13/23 |

Figure 25 Screen capture of the data layout for each of the sampler site locations depicting the blue links to the field data and lab report data.

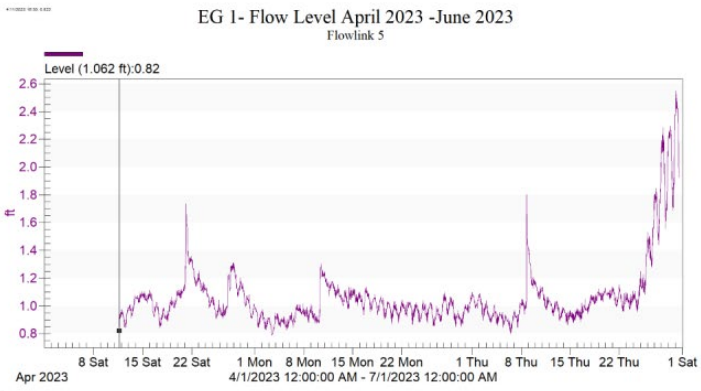


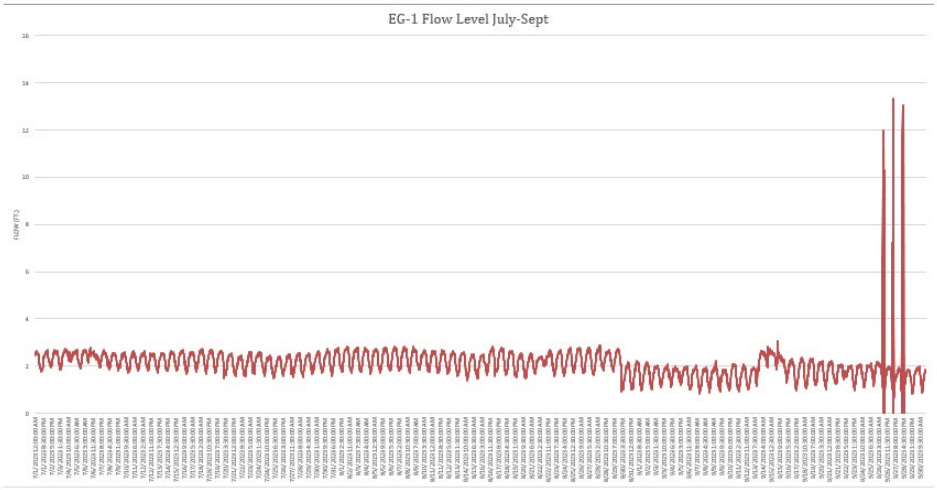


EG1-Rainfall April-June23 | EG 1 Rainfall July -September 2023

Figure 26 Screen capture of the rainfall data for the first 2 quarters graphs and table links depicting the layout of the information shared on the website.

Flow





EG 1 Flow Level July- September 2023

Figure 27 Screen capture of the flow level data recorded by the ISCO sampler and depicted on the website. Associated tables of data are shown as the blue links under the graphics.

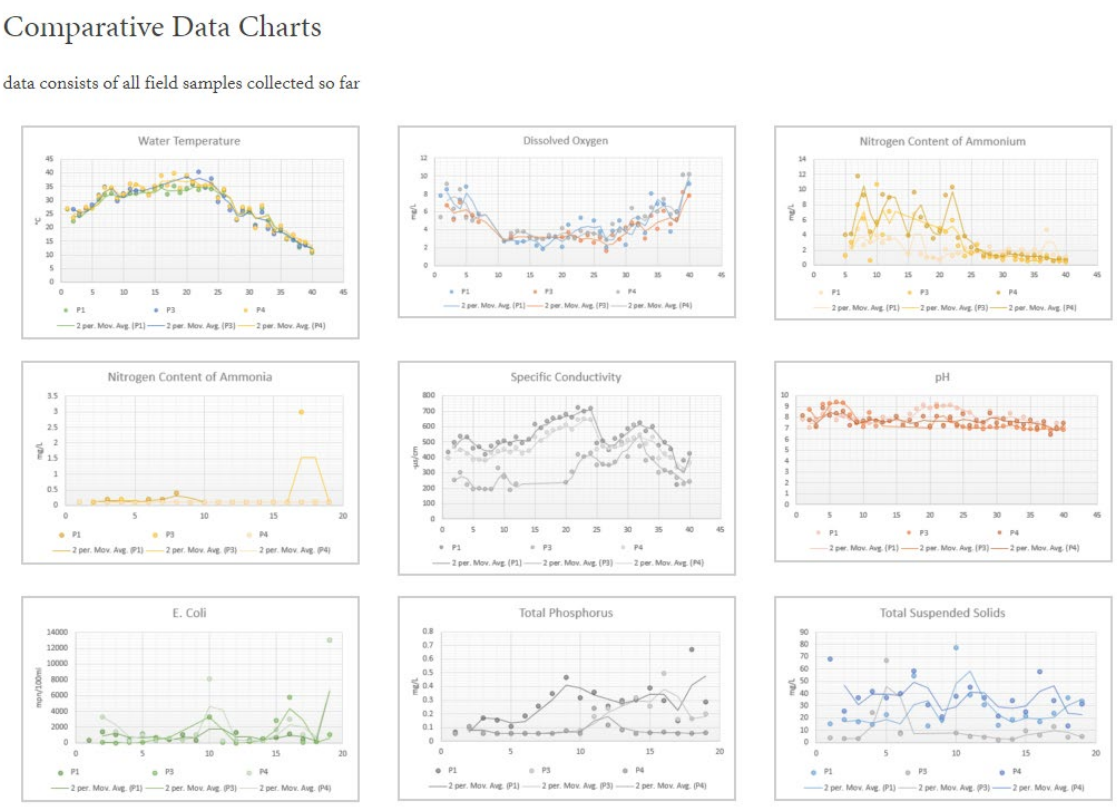


Figure 28 Screen capture of initial comparison charts depicting trends in the data.

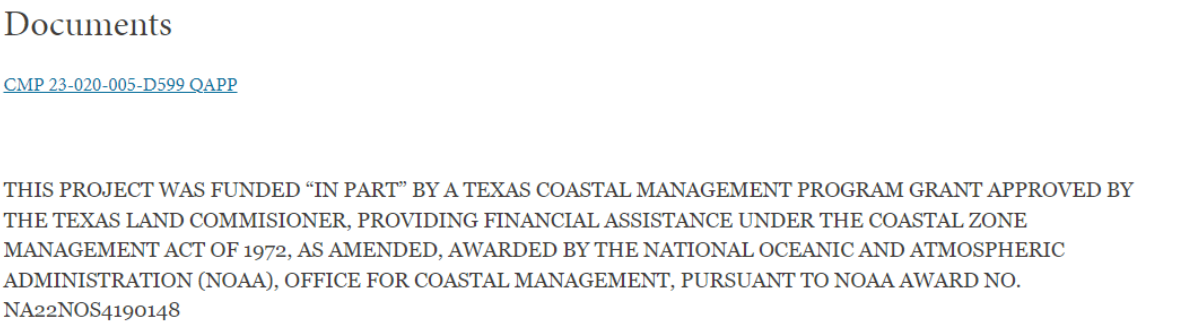


Figure 29 Screen capture of the Documents section and required funding statement. All documents are linked to the website as pdfs.

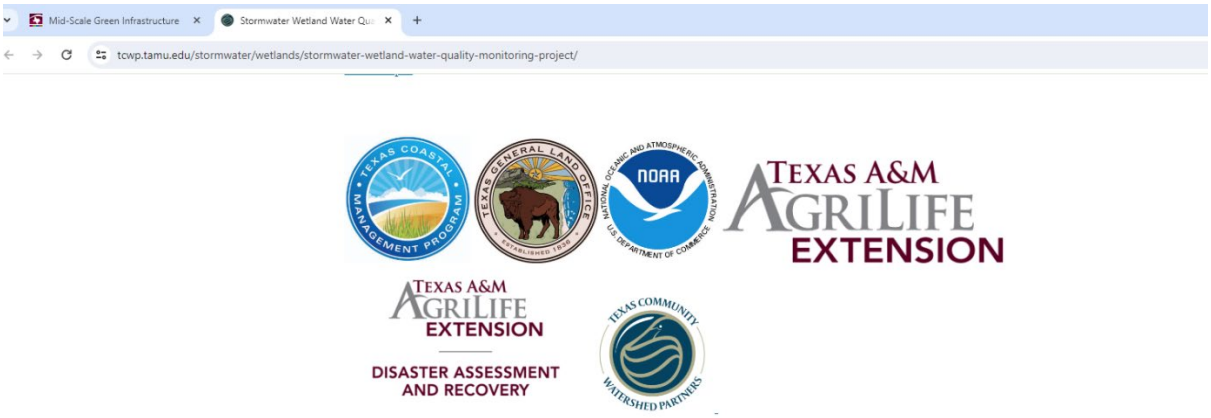


Figure 30 Screen capture of the required logo block from the website.

Christie discussed the ongoing sampling project during the Watershed Coordinators Roundtable field trip to Exploration Green as part of the TWRI (Texas Water Resource Institute) fall roundtable meeting hosted on October 9, 2023.

Figure 31 Christie and Charriss leading a tour of Exploration Green for the TWRI Watershed Coordinators Roundtable Meeting group in October 2023.

Staff presented the findings and the webpage at two presentations in the first quarter of 2024. Kimberly presented the sampling results to the Clear Lake City Water Authority and Exploration Green Boards at the Monthly Board Meeting on February 6, 2024. The meeting notes and presentation slides are included in the appendices. Christie presented the results and

comparative data as part of the Mid-Scale Green Infrastructure Practices presentation at the Port Lavaca Gift Workshop hosted by Clean Coast Texas on February 7, 2024.

Figure 32 Christie presenting the methodology and parameters for the study at the Clean Coast Texas GIFT workshop in Port Lavaca on February 7, 2024.

Figure 33 Christie is depicting some of the initial results of the data in multiple charts on the slide at the Clean Coast Texas GIFT workshop in Port Lavaca, Texas on February 7, 2024.

Figure 34 Christie shared the website QR to all the water quality data as part of her mid-scale green infrastructure stormwater wetland presentation at the Clean Coast Texas GIFT workshop in Port Lavaca on February 7, 2024.

Abstract proposals were submitted to the Galveston Bay Symposium to present the results of this project. Unfortunately, the symposium was postponed until January 2025. A poster is being printed to be able to be presented at the future symposium.

AgriLife is publishing a white paper describing the project results and lessons learned for future sampling endeavors. Once final edits are completed, the paper will be linked to the webpage under the documents section.

Future Recommendations

AgriLife Extension has created two posters to be presented at future conferences and meetings to continue the education about stormwater wetland water quality benefits. Our hope is to present this current data at the rescheduled State of the Bay Conference for the Galveston Bay Estuary Program in 2025.

Figure 35 Study poster presentation created for future outreach at local symposia.

Our recommendations include continued monitoring, benefits analysis of the currently available data, the addition of similar sites and practices data for comparison, and regular monitoring both upstream and downstream of the installed practices. To address some of the comparison site recommendations, we have proposed continued and expanded sampling at this and multiple other site locations in the Galveston Bay watershed in upcoming EPA funding opportunities. Exploration Green Conservancy Board members have also discussed requesting to be added as a regular Texas Stream Team sampling location. Finally, we would suggest a benefit analysis run on the existing data, possibly as part of a future report comparing the benefits of multiple practices or locations in Texas.

Appendix 1: Quality Assurance Project Plan (QAPP)

QUALITY ASSURANCE PROJECT PLAN (QAPP)

Exploration Green Stormwater Wetland Water Quality Baseline Study

GLO Contract No. 23-020-005-DD599 Coastal Management Program Grant Cycle 27

Prepared by:
Texas A&M AgriLife Extension Service
Texas Community Watershed Partners
Stormwater Wetland Program

Prepared for:
Texas General Land Office
Texas Coastal Management Program

Effective Period: One year from date of final approval

Questions concerning this quality assurance project plan should be directed to:

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Contents

Distribution List

Organizations and individuals which will receive copies of the approved QAPP and any subsequent revisions include:

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Houston, TX 77058
Name: Jennifer Morrow
Title: General Manager
Name: John Branch
Title: Board President

Exploration Green Conservancy Board

2323 Clear Lake City Blvd. Suite 180, Box 265
Houston, TX 77062
Name: David Sharp
Title: President

TAMU AgriLife Extension

1335 Regents Park Drive, Ste 260
Houston, TX 77058
Name: Christie Taylor
Title: Extension Program PM
Name: Charriss York
Title: Extension Program QA Officer

List of Abbreviations

CMP……... Coastal Management Program
DO…….. Dissolved Oxygen
EPA…… Environmental Protection Agency
Extension……...Texas A&M AgriLife Extension Services
GLO……General Land Office
NOAA…… National Oceanic and Atmospheric Association
NPS……Nonpoint Source
PM……..Project Manager
QA……..Quality Assurance
QAO……...Quality Assurance Officer
QAPP…….Quality Assurance Project Plan
SOP……Standard Operating Procedure
TCWP…… Texas Community Watershed Partners
TSS…….Total Suspended Solids

Project / Task Organization

The following is a list of organizations and individuals participating in the project with their specific roles and responsibilities:

GLO Coastal Management Program (CMP)

Jessica Chappell, CMP PM
Provides the primary point of contact between the Extension and CMP. Tracks and reviews deliverables to ensure that tasks in the workplan are completed as specified in the contract.

TAMU AgriLife Extension

Christie Taylor, Extension Program PM
The PM is the primary contact between the CMP and the Extension. The PM oversees the creation of all deliverables including the QAPP, any QAPP revisions as needed, progress reports, signage, reports, and web posts for the project. The PM oversees the collection of samples, reporting and analysis of data as outlined in the QAPP. Ensures that all staff involved in collections have been trained in collection procedure, programming of ISCO 6712 samplers, and use of YSI multiprobe for sample data collection. As well as ensuring all field documentation is handled properly and reported back to the PM.

Charriss York, Extension Program QAO
The QAO reviews the chain of custody forms a makes sure the transfers to the lab happen as specified in the QAPP. The QAO verifies the successful transfer of data from the lab to the Extension Program PM. The QAO enforces any corrective action, as required. Assures that all staff involved in the collection of samples are competent on ISCO 6712 and YSI multiprobe.

Kimberly Walls, Water Quality Student Intern
Student intern will calibrate and maintain all sampling equipment (both handheld and automated), label and collect samples from all three locations, contact lab courier and arrange for sample transport to the lab for analysis, including a documentation of chain of custody. The student intern will also ensure supplies (sample jars, ice, cooler, calibration solutions, field data sheets, etc.) are readily available for timely sample collection.
Student intern will assist with reviewing sample data and uploading lab reports to the webpage quarterly.

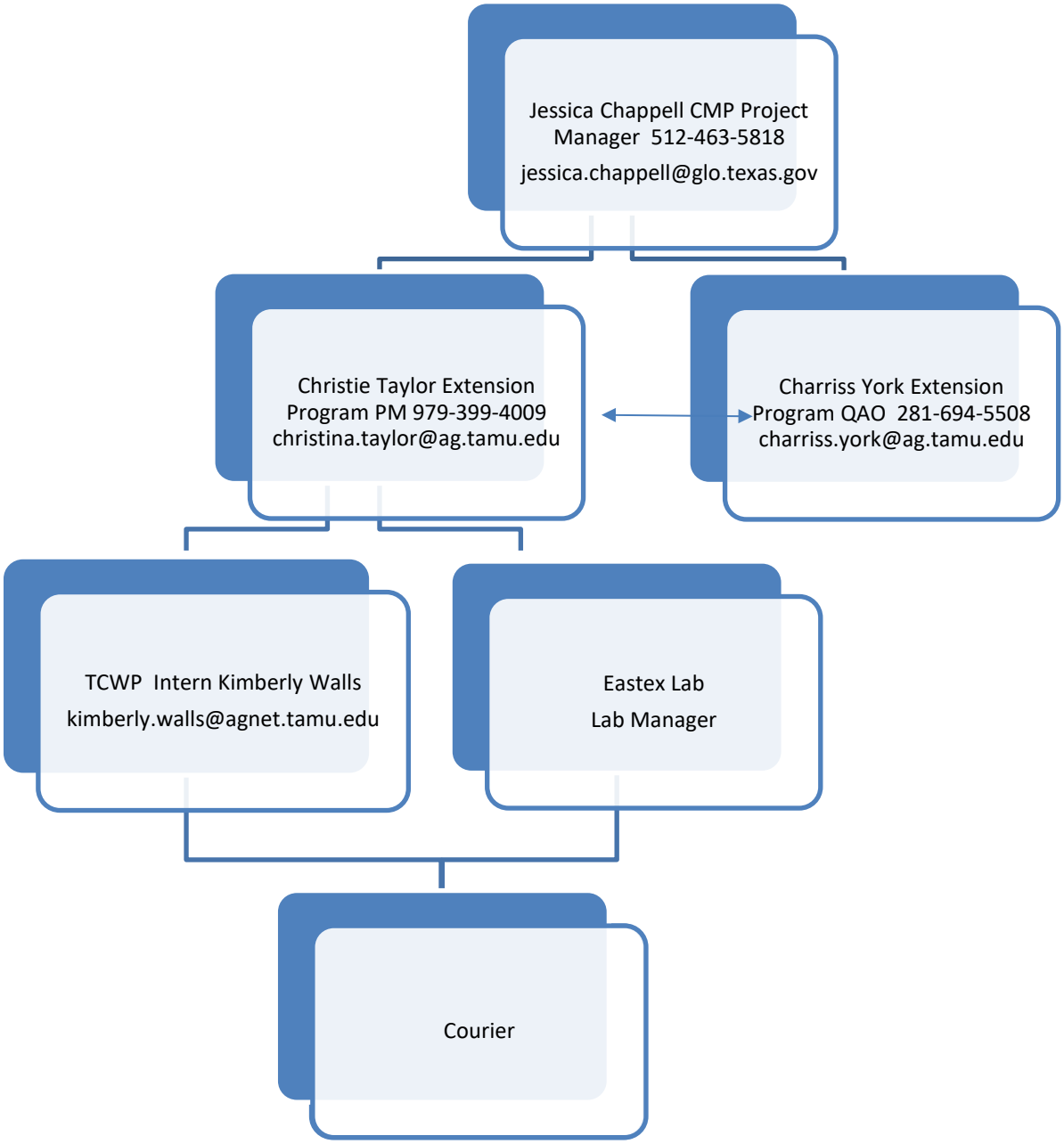
LAB

Lab Manager
Responsible for supervision of laboratory personnel involved in generating analytical data for this project. Responsible for ensuring that laboratory personnel involved in generating analytical data have adequate training and a thorough knowledge of all SOPs specific to the analyses or task performed and/or supervised. Responsible for oversight of all laboratory operations, ensuring that all QA/QC requirements are met, and documentation related to the analysis is completely and accurately reported. Responsible for ensuring laboratory corrective actions are implemented, documented, reported, and verified. Enforces corrective action, as needed.

Courier

Couriers are employed by the lab to collect and transport samples for analysis. Courier will schedule sample pick up and prepped reagent bottle deliveries with student intern or PM. Courier will provide chain of custody forms for each transfer of samples. Courier will deliver samples to the lab on ice within the specified hold times for each analysis to be run.

Figure 1.1 Project Organizational Chart- Lines of Communication



Approval Signatures

CMP PM Date

Extension PM Date

Extension QAO Date

PROJECT TITLE

Exploration Green Stormwater Wetland Water Quality Baseline Study

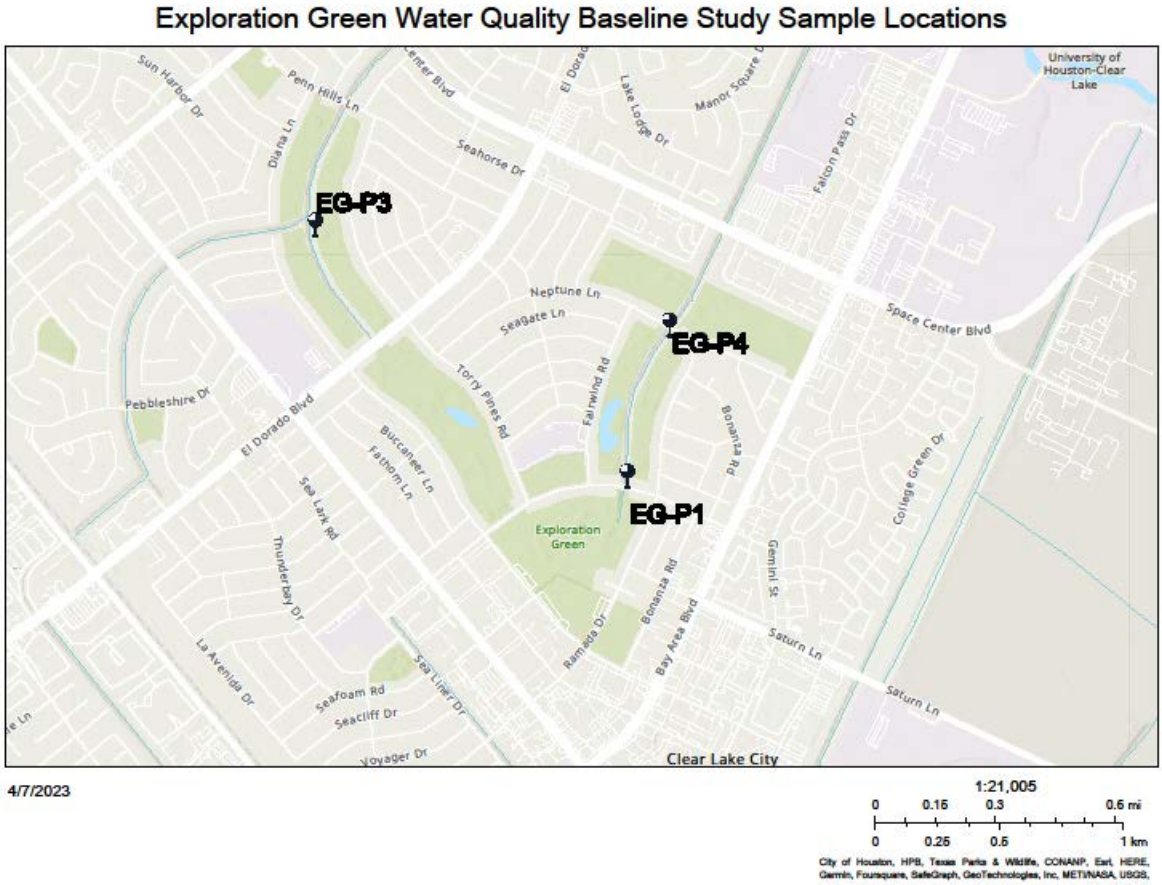
A. GENERAL DESCRIPTION OF STUDY:

A1. Problem:

Basins that incorporate stormwater wetlands can provide ecological benefits to water quality, habitat, and recreation. Currently, water quality data to assess the effectiveness of this type of stormwater treatment wetland is limited in the lower Galveston Bay watershed. Texas A&M AgriLife Extension Service has recently completed a study to test water quality treatment of storm events in three demonstration projects; however, there has not been a long-term or baseline study of water quality post-installation of stormwater wetlands in the area.

Texas Community Watershed Partners (TCWP) as part of the TAMU AgriLife Extension proposes to develop this QAPP as a standard water quality monitoring protocol and sample three stormwater wetland segments designed by LAN and CLCWA with technical assistance from TCWP within Exploration Green. Exploration Green Conservation and Recreation Area is transforming the defunct Clear Lake Golf Course into a stormwater detention facility with five segments ("Phases") each containing an open water feature, wetland shelves, habitat island, and walking trails. The 200-acre site receives stormwater runoff from an approximately 2000-acre predominantly suburban watershed, which is itself in the Armand Bayou watershed, 303 (d) listed as impaired by the US EPA. Water quality sampling will occur at Phases 1, 3, and 4 to represent water quality at various levels of phase completion. Phase 1 is a 14-acre lake containing 6 acres of wetlands planted from 2016-2018. Phase 3 is connected to Phase 2 and is split into Phases 3A and 3B. Phase 3A is a 16.6-acre detention pond that has completed construction as of 2021 with ongoing planting planned throughout the summer of 2023. Phase 3B is an 11.3-acre pond with construction at 95% completion. Phase 4 is a 22.5-acre pond connected to Phase 1 that has completed construction as of 2021. Wetland planting on the phase is ongoing with a total of 1,500 plants planted as of the date of this document.

Figure A1.1 Sampling Location



A2. Background:

Extension and project partners are designing and implementing stormwater wetland demonstration projects in various basin types and watersheds. In contrast to the standard detention basin, basins that incorporate stormwater wetlands can provide a multiplicity of benefits: water quality, wildlife habitat, aesthetics, and recreation. The stormwater wetlands are designed to retain water for about 48-72 hours (about 3 days) post-storm event to allow them to remove debris, sediments and harmful chemicals and bacteria before the water is released downstream and into Galveston Bay. However, there have not been enough studies of these designs' effectiveness on improving water quality.

For example, in one study of Mason Park marsh, the region's first constructed treatment wetland in Houston, TX results were inconclusive due to extreme drought [Guillen UHCL 2012]. The other study of this site was conducted by citizen science, but there are limited other studies of this type of constructed wetland in our area which to compare the data.

In a similar study of this BMP design from Pine Lake, Georgia, research shows that using wetlands and bioretention features reduce the amount of total coliform, E. coli, and conductivity thus improving the quality of water discharged from the stormwater wetland. This study collected water samples after storm events that occurred after a 48-hour antecedent dry period. They also collected influent and effluent samples at the same time [Styes, Zarus, and Ryan April 2015 Stormwater- Magazine].

As development increases, so does the requirement for drainage infrastructure, but currently, standard stormwater basins are ecologically and aesthetically bleak. Stormwater wetlands provide a method of combining multiple functions into a single site. Gaining data on the stormwater wetland practice is necessary as the technique is promoted for its multiplicity of benefits. The project will look at the water quality data aspect of the stormwater wetland BMP and provide quality and comparable data of common NPS parameters measured at the outflow sites of Exploration Green. The goal is to have a complete annual baseline through all seasons and rainfall conditions that can be compared to other water quality testing sites from BMP and non-BMP sites to gauge the effectiveness of the practice. Secondarily we would like to look at variations of data through establishment of the wetland shelves at the three sample locations and try to determine if there is any compounding effects as stormwater moves between the Phases before outfall into the natural receiving body of water.

All data from both field and lab analysis will be available on the TCWP website at the link provided https://tcwp.tamu.edu/stormwater/wetlands/stormwater-wetland-water-quality-monitoring-project/ and thus accessible for decision makers effecting change in drainage infrastructure planning. Stormwater wetland effects on water quality are documented in other areas of the U.S. and internationally, [Center for Watershed Protections' National Pollutant Removal Database for Stormwater Treatment Practices] but there is less documentation of Houston regional stormwater wetlands. Data from local demonstration projects can result in better buy-in by local decision makers.

A3. Project Task Description:

Project Objective:

The project will generate data of known and acceptable quality to accurately depict the amount of water quality improvements provided by the stormwater wetland of Exploration Green in Clear Lake.

Each of the three outfall locations at Exploration Green will be sampled through all seasons to provide data in variable weather and conditions. There will be one portable ISCO 6712 sampler at each of the three selected effluent sites within the phases of Exploration Green to collect samples. Handheld YSI multiparameter samples will be collected at each site. A total of 66 samples will be lab analyzed. One sample for each lab analyzed parameter will be collected biweekly from each of the three outfall locations, and each sample will be given a distinct number based on location and sample week. Parameters to be tested in biweekly lab samples include TSS, phosphate, ammonium, and bacteria levels. Samples will be collected by TCWP staff and transferred by courier to Eastex labs for analysis. Lab results will be delivered as both electronic and hard copies to the extension program PM and the extension program QAO. The lab results and analysis will be compiled by the extension program PM. Lab results and graphic representation of water quality changes will be uploaded to the designated webpage on the TCWP website (https://tcwp.tamu.edu/stormwater/wetlands/stormwater-wetland-water-quality-monitoring-project/) by the extension staff.

Handheld YSI samples will be collected weekly from April 2023 to February 2024. Parameters measured with the handheld unit will include water temperature, DO, conductivity, pH, and ammonium levels. The YSI will be calibrated weekly using the calibration technique described in the unit manual. All data will be recorded on the field data sheets. Rainfall events and flow levels will be recorded by the automated samplers and downloaded monthly by the PM. Rainfall amounts and flow levels will be updated to the website quarterly. Rainfall amounts and flow level data will be included on data sheets for corresponding sample dates.

Each parameter will be graphed as linear trend analysis.

To produce results in a timely manner, the water quality sampling project will follow the timeline described in Table A3.1

Table A3.1

Task	**Project Milestones**	**Start**	**End**
1.1	Develop QAPP	M1	M3
2.6	Begin sampling	M3	M13
3.3	Data reports posted to TCWP webpage and provided to GLO and partners quarterly	M6	M13
3.4	Present data	M13	M14
4.3	Final Report	M14	M14

A4. Quality Objectives and Criteria

The project objective is to evaluate and quantify the effectiveness of constructed stormwater wetlands on water quality. The purpose of collecting effluent samples biweekly is to verify that the water is being treated to a measurable degree during long-term capture by the wetland basin. This method is comparable to other studies of stormwater wetlands as best management practices.

Table A4.1: Quality Objectives

Procedure	Completeness	Precision	Representativeness	Comparability
Collect water quality samples using automated sampling equipment ISCO 6712 and YSI multiprobe in the field	It is the goal of this project to have 90% of all potential data available for use in reporting and analysis.	Adhering to the same protocols for each site demonstrated during each repetition.	Ensure the number of samples taken at each site is enough to accurately characterize the water quality conditions of corresponding site in each seasonal period at during representative rainfall and flow conditions.	Dedication to using approved sampling and analysis methods. Report data in standard units; according to known laboratory practices so data can be compared to other local SWQM data and national projects of similar BMPs.

A5. Special Training / Certifications

TCWP staff involved in the collection of samples will be trained in the ISCO 6712 set up and collection procedures, rain gauge, flow loggers and chain of custody procedures. Sample collecting staff will be trained in YSI sonde calibration protocols according to manufacturer's manual for calibration procedures. A list of trained TCWP staff will be maintained by the Extension QAO.

A6. Documents and Records

Records produced by this project will consist of data collection, monitoring, and analysis results. Progress reports on data collection, processing and analysis will be submitted quarterly.

Laboratory Test Reports must document the test results clearly and accurately. The data reports should include information necessary for the interpretation and validation of data. The requirements for reporting data are as follows:

- Name of client
- Sample name
- Sample matrix
- Date and time of collection
- Units of measure
- Date and time of sample receipt
- Date and time of sample analysis
- Indication of Method used for analysis
- Identification of samples that did not meet QA requirements and reason for removal

Data will be reported on the dedicated project webpage (https://tcwp.tamu.edu/stormwater/wetlands/stormwater-wetland-water-quality-monitoring-project/) on the TCWP website. Tabular and graphical representation of the data will be reported on the webpage quarterly as available for each of the three locations.

Data validation and QA checks will be conducted by the Extension QAO. Copies of data documentation generated by the Extension program project personnel will be stored in the GIFT Program One Drive cloud. Extension will ensure against catastrophic loss of data (e.g. physical damage/data loss due to fire or storm damage) by storing data backups at a secure location. The data report and web-based products will be organized according to sample site location. Hard copies will be kept in a waterproof/ fireproof safe.

The final assessment data report will be produced electronically and as a hard copy, and all files used to produce the report will be saved electronically by TAMU for at least five years and will be available for transfer to the CMP PM.

Table A6.1: Project Quality Assurance Documents and Records

Document/Record	Location	Retention	Form
QAPP, amendments, and appendices	TAMU	5 years	Electronic/ Paper
Chain of Custody Forms, Field Notes, and Sample Results	TAMU	5 years	Electronic/ Paper
Quarterly Progress Reports, data collection, data monitoring, data analysis	TAMU	5 years	Electronic/ Paper
Presentations and white paper	TAMU	5 years	Electronic/ Paper
Final report	TAMU	5 years	Electronic/ Paper
All Backups	TAMU	1 year	Electronic

B. MEASUREMENT AND DATA ACQUISITION

B1. EXPERIMENTAL DESIGN

This project's experimental design aims to show the effectiveness of constructed stormwater wetlands as a BMP for improved water quality in stormwater detention. The three sites at Exploration Green are of varied sizes and at various stages of completion. The Phase 1 stormwater wetland was completed in Fall 2018, Phase 3A completed construction in Fall 2021planting is 95% completion as of the date of this document, and Phase 4 completed construction in Fall 2022, and wetland planting activities are ongoing at this time. These sites are in the sub-watershed of the Armand Bayou Watershed in Clear Lake.

TableB1.1 Location Description

Location	Site	Latitude Longitude	Sample code	Start Date	End Date	Mode of Sampling	Sample Matrix	Monitoring Frequency
Exploration Green Park Phase 1	Effluent	**To Be Recorded at Time of Install**	EG-P1-#	Apr. 2023	Feb. 2024	Automatic and handheld	water	Weekly-Biweekly
Exploration Green Park Phase 3	Effluent	**To Be Recorded at Time of Install**	EG-P3-#	Apr. 2023	Feb. 2024	Automatic and handheld	water	Weekly-Biweekly
Exploration Green Park Phase 4	Effluent	**To Be Recorded at Time of Install**	EG-P4-#	Apr. 2023	Feb. 2024	Automatic and handheld	water	Weekly-Biweekly

This experiment will monitor water quality parameters at the effluent sites of each basin location. Automated samplers will be located at the effluent sites and sample biweekly for one year according to

the schedule provided in Table B1.1. Up to 22 samples for lab analysis will be collected at each site biweekly with additional parameters measured from a handheld sampling device weekly. Rainfall amounts will be measured using an ISCO 674 tipping bucket rain gauge and water flow levels measured with an ISCO 730 bubble flow meter. Rainfall amount and flow amount will be recorded on the field collection data form at time of sample collection. ISCO 6712 automated sampler data logs will be downloaded monthly on the last Friday of each month by the Extension PM.

B1.2 Experimental Method Summary by Location

Location	**Outflow Volume**	**Outflow Pollutant Concentration**
Exploration Green Nature Park Phase 1	Measured with ISCO 6712 automated sampler triggered to collect weekly. A composite sample will be taken every week in a 9L bottle. Flow volume will be recorded from the ISCO 730 bubble flow meter. Rainfall amount will be measured from the ISCO 674 tipping bucket rain gauge.	Direct laboratory measurements of composite samples analyzed biweekly. A YSI ProQuatro handheld multiparameter meter will be used to measure additional parameters onsite weekly with a YSI Professional Plus being used as needed.
Exploration Green Nature Park Phase 3	Measured with ISCO 6712 automated sampler triggered to collect weekly. A composite sample will be taken every week in a 9L bottle. Flow volume will be recorded from the ISCO 730 bubble flow meter. Rainfall amount will be measured from the ISCO 674 tipping bucket rain gauge.	Direct laboratory measurements of composite samples analyzed biweekly. A YSI ProQuatro handheld multiparameter meter will be used to measure additional parameters onsite weekly with a YSI Professional Plus being used as needed.
Exploration Green Nature Park Phase 4	Measured with ISCO 6712 automated sampler triggered to collect weekly. A composite sample will be taken every week in a 9L bottle. Flow volume will be recorded from the ISCO 730 bubble flow meter. Rainfall amount will be measured from the ISCO 674 tipping bucket rain gauge.	Direct laboratory measurements of composite samples analyzed biweekly. A YSI ProQuatro handheld multiparameter meter will be used to measure additional parameters onsite weekly with a YSI Professional Plus being used as needed.

B2. SAMPLING METHODS

Field Sampling Procedures

Field sampling data will be documented on Field Data Reporting Form (Appendix B). For all sampling visits, location id, sampling time, sampling date, sample collector's name and signature, rainfall amount, sample volumes, preservatives added to samples are recorded. A YSI Professional Series multiprobe will be used to measure dissolved oxygen (DO), specific conductance, pH, and water temperature and ammonium levels in standard measurements. Measurements will be saved in the device log and downloaded monthly. This data will be recorded on the field data reporting form weekly as a backup. Values for measured field parameters are recorded on the Field Data Reporting Form and the field data notebook (Rite in the Rain All-Weather Journal) should also include any visual observations, and time since the last recorded rainfall event, etc. Basic rules for recording information for this project are:

1. Legible writing in indelible, waterproof ink with no write-overs,
2. Changes should be made by crossing out original entry with 1 single line, entering the change and initial and date corrections,
3. Closeouts on incomplete pages with an initialed and dated diagonal line.
4. Paper copies are collected in the water quality sampling binder and reviewed by PM and QAO before being scanned.
5. All forms are scanned for electronic backup and uploaded to the website.

Automated Sampling Procedures

Automated samplers will be programmed in accordance with manufacturer user guides for automatic sampler data collection. Sample bottles and coolers for sample storage and sample pick up will be provided by the lab. Sample types, container types, minimum sample volume, preservation requirements and hold times are specified in Table B2.1. Samples will be collected in one large composite sample and separated into the appropriate sample containers for transport to the lab. Samples will be bagged by sample site for secondary containment and ease of transport. Then the courier will be contacted to pick up samples.

Table B2.1 Sampling Protocol

Parameter	Matrix	Sample Type	Container	Preservation	Sample Volume	Hold Time
E. coli	water	composite	Sterile, plastic	Sodium Thiosulfate <60 C	100ml	32 hours*
TSS	water	composite	Plastic or glass	<60C	1000ml	7 days
Total Phosphorus	water	composite	Plastic or glass	Sulfuric acid <60 C	500ml	28 days
Ammonia as N	water	composite	Plastic or glass	Sulfuric acid <60 C	500ml	28 days

- Bacteria hold time for storm water runoff samples in automated samplers collected for non-EPA regulatory purposes.(Daren Harmel, et al, Environ Monit Assess 2016)

B3. SAMPLE HANDLING AND CUSTODY

Sample Labeling

Samples from the field are labelled on the container with an indelible marker. Label includes:

1. Site identification
2. Date and time collected
3. Preservative added, if applicable
4. Sample type (i.e. analysis) to be performed

Sample Handling

Samples are collected at the field site by AgriLife Extension staff and then labeled and appropriately preserved for laboratory analysis. Once preserved, the samples will be packaged in coolers by field staff according to laboratory specifications.

Samples will be transferred from TCWP to Eastex lab by courier. Samples analyzed by the laboratory will be documented on a chain of custody (COC) from that laboratory. A copy of the COC and custody procedures from the participating laboratory is found in Appendix C.

Upon receipt, the condition of the samples, including any abnormalities or departures from the standard condition will be recorded. All samples will have a traceable COC. Every sample accepted will be logged into a secure electronic database. Each sample is given a unique Lab ID number listed on the report. Samples that do not meet volume, preservation, hold time, and temperature requirements will be qualified, and the Extension PM will be contacted for guidance. All samples requiring thermal preservation are considered acceptable if the arrival temperature is within +/- 20 C of required temperature of the method specified range. Where applicable the lab verifies chemical preservation using readily available techniques prior to or during sample preparation or analysis. Samples are handled and prepared as directed in the lab's analytical SOP for each analysis. Laboratory SOPs will be provided as an appendix to this QAPP.

B4. ANALYTICAL METHODS

Analytical methods are provided as an appendix to this document. The following tables summarizes the parameters, with appropriate codes, to be analyzed and the party responsible for the analysis. Method of analysis and limits of quantification and appropriate precision percentages and specified in Table B4.1.

Table B4.1 Measurement Performance Specifications

Parameter	Units	Matrix	Method	PAREMETER CODE	AWRL	Limit of Quantitation (LOQ	PRECISION (RPD of LCS/LCSD)	BIAS (%Rec. of LCS)	LOQ CHECK STANDARD %Rec	Lab
Field Parameters (Water Column)										
Rainfall	Inches	Water	gauge	46529	NA	NA	NA	NA	NA	Field
pH	pH. units	water	YSI multiprobe	00400	NA	NA	NA	NA	NA	Field
DO	mg/L	water	YSI multiprobe	00300	NA	NA	NA	NA	NA	Field
Conductivity	uS/cm	water	YSI multiprobe	00094	NA	NA	NA	NA	NA	Field
Flow	Gallons	water	ISCO flow meter		NA	NA	NA	NA	NA	Field
Temperature	^{0}C	Water	YSI multiprobe		NA	NA	NA	NA	NA	Field
Conventional Parameters (Water)										
Ammonia-N	mg/L	water	SM 4500-N G	00610	0.1	0.02	20	80-120	70-130	Eastex
T-PO4-P	mg/L	water	SM 4500-P E	00665	0.06	0.06	20	80-120	70-130	Eastex
E. coli		water	Idexx Laboratories Colilert 18	31699	1	NA	0.5	NA	NA	Eastex
TSS	mg/L	water	SM2540 D	00530	4	1	20	80-120	NA	Eastex

B5. QUALITY CONTROL

B5.1 Instrument/ Equipment testing, inspection and maintenance

Automated sampler testing and maintenance are reference at the following locations:
ISCO 6712: http://www.isco.com/manuals/UP001DT6.pdf

ISCO 730 Bubble Module: http://www.isco.com/manuals/UP001ATF.pdf

YSI ProQuatro handheld multiparameter meter:
https://www.ysi.com/File%20Library/Documents/Manuals/606962-ProQuatro-User-Manual-English.pdf

YSI Professional Plus handheld multiprobe:
http://www.ysi.com/File%20Library/Documents/Manuals/605596-YSI-ProPlus-User-Manual-RevD.pdf

Equipment records are kept on all field equipment and a supply of critical spare parts is maintained by the AgriLife Extension Field Supervisor.

All laboratory tools, gauges, instruments, equipment testing, and maintenance requirements are contained within the laboratory QAMs. Testing and maintenance records are maintained and available.

B5.2 Instrument Calibration and Frequency

All instruments and devices used in obtaining environmental data will be calibrated prior to use. Calibration methods are contained in the manufacturer's instruction manuals referenced above. YSI multiprobes will be calibrated before sampling, following protocols outlined in the YSI manual.

Calibration procedures for laboratory equipment will be kept by the Eastex labs.

B5.3 Inspection / Acceptance of Supplies and Consumables

The laboratory QA officer and laboratory technical director oversee all required checks of supplies and chemicals and assure all records are complete. These include all routine and non-routine maintenance activities and reference material verifications.

Field sampling equipment is tested by extension staff before use; any changes or calibrations are noted in the field notebook and field data reporting sheets.

All sample bottles are provided by Eastex and undergo inspection before they are delivered to the Extension office.

Probe calibration solutions are maintained per manufacturer suggestions. The reagents are catalogued as they are received and used.

B6. Data Management

Field staff will visit sites biweekly to collect samples. On each visit notes will be made on the field data recording sheets and the field notebook. If no samples are collected or there is a problem with their collection, the visit will be recorded into the field notebook. If visits are made to calibrate, maintenance, or otherwise check the equipment these site visits will also be recorded in the field notebook.

Samples collected on-site will be labelled for transportation to the laboratory. Site name, time of collection, comments and other data will be copied from field notebook to COC. The COC and sample bottles will be submitted to laboratory analyst with relinquishing and receiving signatures on COC filled out by the field researcher.

All field data sheets will be scanned into electronic format. Field data will be transferred or manually entered into an electronic spreadsheet. The spreadsheet will be created using Microsoft Excel software. The spreadsheet will be stored in the GIFT One Drive file and shared with the Extension PM and QAO. All files will be backed up monthly to an external hard drive. The QAO will check 10 percent of all the manually recorded spreadsheet entries to the field records to ensure there were no transcription errors. The tables, charts and graphs created from the data analysis will be uploaded to the dedicated webpage quarterly.

All paper records and electronic files will be stored for at least five years by the Extension office.

.C. Assessments and Oversight

C1. Assessments and Response Actions

The following table identifies the types of assessments and response actions for project activities applicable to this QAPP.

Deficiencies are any deviations from the QAPP or equipment manual protocols. Deficiencies may invalidate resulting data and may require corrective action. Corrective action may include samples being discarded and recollected. Deficiencies are documented in the field logbook, field data sheets, etc. by field or laboratory staff. The Extension PM is responsible, in consultation with the Extension QAO, for ensuring that the corrective actions and resolutions to the problems are documented and records maintained in accordance with the QAPP. In addition, these actions and resolutions are reported to the CMP PM in writing in email, quarterly progress reports and by completion of CAP (Corrective Action Plan).

Table C1.1 Assessments and Response Requirements

Assessment Activity	**Schedule**	**Responsible Party**	**Scope**	**Response Requirement**
Status Monitoring	Continuous	Extension PM	Monitor project status and records to ensure requirements are being fulfilled.	Quarterly reports to CMP PM
Monitoring Systems Audit	Dates to be determined by CMP PM/ Extension QAO	CMP PM Extension QAO	To ensure field sampling, handling, and measurements are happening in accordance with the QAPP. Review data management as it relates to this project.	Quarterly Progress Reports and/or timely response to CMP PM. Complete any CAP provided by QAO or CMP PM.

C2. Reports to Management

All the reports in this section are contract deliverables for the AgriLife Extension and are transferred to the CMP PM in accordance with contract requirements.

The QAPP, associated appendices and amendments detail the sample handling and data reporting for this project.

Quarterly Progress Reports summarize activities for each task; reports monitoring status, problems, delays, corrective actions; and describes the status of each deliverable task.
Final Project Report summarizes the activities for the entire project period including a description and documentation of major project activities, evaluation of project results and environmental benefits and a conclusion drawn from the research.

D. Data Validation and Usability

D1. Data Review, Verification, and Validation

For this document's purpose, data verification is a systematic process for evaluating performance and compliance of a set of data to ascertain its completeness, correctness, and consistency using the methods and criteria defined in the QAPP. Validation means the processes taken independently of data generation to evaluate the technical usability of verified data with respect to the project's objectives or intention. All data obtained from the field and laboratory measurements will be reviewed and verified for conformance to project requirements and validated against the data quality criteria in section A4 of this QAPP. Data supported by these verification and validation controls will be considered acceptable and reported on the webpage.

D2. Verification and Validation Methods

All data will be verified by Extension PM to ensure they are representative of the samples analyzed and the locations where the measurements were made and that the data and quality control measures were made accurately in accordance with the project specifications.
The staff and management of the respective field, laboratory, and analysis and data management tasks are responsible for the integrity, verification, and validation of the data each task generates or handles throughout each project process.
The data to be verified (listed in Table D2.1) are evaluated for against performance specifications (section B4) and are checked for errors in transcription, calculations, and data input. If an error is found the person who entered the data will be notified to address the issue. Issues that can be corrected are corrected and documented electronically or by initialing and dating the appropriate paperwork. If the error cannot be corrected the data associated with the error will be rejected and not reported.

Table D2.1 Data Verification Procedures

Data to be Verified	Field Task	Laboratory Task	Extension Data Management Task
Sample documentation complete, sample labeled, site id	Y	Y	
Field samples collected	Y		
Standards and reagents traceable	Y	Y	
Sample preservation and handling acceptable	Y	Y	
COC Complete	Y	Y	
Hold times not exceeded	Y	Y	
Collection, Preparation, Analysis consistent with SOPs and QAPP	Y	Y	Y
Field Documentation	Y		Y
Instrument calibration	Y	Y	
QC samples analyzed at required frequency	Y	Y	Y
QC results meet performance specifications	Y	Y	Y

Analytical Sensitivity consistent with QAPP		Y	Y
Results, calculations, transcriptions checked	Y	Y	Y
Laboratory samples analyzed for all parameters		Y	
Nonconforming activities documented	Y	Y	Y
Outliers confirmed and documented; reasonableness checked			Y
Results reported in standard measures and formats			Y
Sampling and data gaps documented and checked	Y	Y	Y
10 % data manually reviewed			Y
Data, Analysis, Results reported on webpage quarterly			Y

D3. Reconciliation with User Requirements

Data collected from this project will be analyzed and reported on the dedicated webpage located on the TCWP website and in a final white paper to the CMP to show the performance of stormwater wetlands as a BMP. The purpose is to show the reduction in NPS loadings of water that has passed through the stormwater wetland. The paper will discuss the limitations of the data collected. The results will be used by local officials as they review ordinances and design standards for future stormwater retention in their communities. Data will also be used in AgriLife Extension outreach programs to provide unbiased, science- based, quality assured data on the effectiveness of stormwater wetlands for reducing NPS loadings on the Texas Gulf Coast.

Appendix A: Contract Scope of Work

Contract Number: 23-020-005-D599

Project Name: Exploration Green Stormwater Wetland Water Quality Baseline Study.

Subrecipient: Texas A&M AgriLife Extension Service.

Reporting Frequency: Quarterly.

Contact: Christie Taylor, Texas A&M AgriLife Extension Program Specialist.

Project Description:

Basins that incorporate stormwater wetlands can provide ecological benefits to water quality, habitat, and recreation. Currently, water quality data to assess the effectiveness of this type of stormwater treatment wetland is limited in the lower Galveston Bay watershed. Texas A&M AgriLife Extension Service has recently completed a study to test water quality treatment of storm events in three demonstration projects; however, there has not been a long-term or baseline study of water quality post-installation of stormwater wetlands in the area.

Texas A&M AgriLife Extension Service ("AgriLife" or "Subrecipient") will use Coastal Management Program ("CMP") Grant Cycle 27 funds to develop a water sampling plan and collect 50-60 weekly (or biweekly as determined in the QAPP) water samples from three outfall locations of Exploration Green Stormwater Wetland (the "Project"). As part of the Project, AgriLife will collect the samples through automated samplers installed by AgriLife onsite. AgriLife staff will retrieve the samples weekly and measure additional water quality parameters onsite using a handheld multiparameter sampling device. AgriLife will detail the parameters sampled in the sampling plan. AgriLife will send the water samples to a laboratory to test for nutrient levels and bacteria indicator species. Each water sample location is in a different phase of wetland establishment, allowing AgriLife to explore how the larger Exploration Green Stormwater Wetland is contributing to the reduction of nonpoint source ("NPS") pollution in the watershed. AgriLife will analyze the project results and report their findings to stakeholders.

This Project will provide more water quality data to assess the effectiveness of stormwater wetlands at reducing NPS pollution in associated waterbodies. Routine sampling over all seasons will allow AgriLife to track seasonal fluctuations, changes due to storm or drought events, and to gauge needs for future stormwater wetlands. Additionally, the Project will provide scientific data for decision makers at Exploration Green Conservancy and Clear Lake City Water Authority on how the stormwater treatment wetlands being created at Exploration Green in the Clear Creek watershed are impacting long-term water quality.

Project Budget:

	CMP	**Subrecipient**	**Third Party**	**Project Totals**
Salaries	$44,641.00	$3,926.00	$0.00	$48,567.00
Fringe	$11,305.00	$1,159.00	$0.00	$12,464.00
Travel	$1,334.00	$0.00	$0.00	$1,334.00
Supplies	$7,783.00	$0.00	$0.00	$7,783.00
Equipment	$0.00	$0.00	$0.00	$0.00
Contractual	$5,400.00	$0.00	$0.00	$5,400.00
Other	$620.00	$22,500.00	$0.00	$23,120.00
Subtotal	**$71,083.00**	**$27,585.00**	**$0.00**	**$98,668.00**
Indirect	$0.00	$19,805.00	$0.00	$19,805.00
Total	**$71,083.00**	**$47,390.00**	**$0.00**	**$118,473.00**

Special Award Conditions ("SAC"):

1. Subrecipient must complete Project as described in this Work Plan.
2. The GLO and/or NOAA must approve any changes to the scope of work or budget requests that change the total Project cost.
3. Subrecipient must print CMP and NOAA logos, including appropriate acknowledgment statement, on education/outreach materials, signs, final reports and/or publications.
4. Subrecipient must share data in the appropriate manner as specified in the Contract.
5. Subrecipient must coordinate with the GLO prior to issuing press releases, conducting media events, or otherwise engaging in media related communications for Project.

Task 1: Methodology and Quality Assurance Protocols

AgriLife will develop a Quality Assurance Project Plan ("QAPP") that includes detailed methodology for sample collection, recording, laboratory transfer, hold times and analysis. AgriLife will develop the QAPP in accordance with National Environmental Laboratory Accreditation Program ("NELAP") procedures, Environmental Protection Agency ("EPA") standards, and Texas Commission on Environmental Quality ("TCEQ") guidelines. AgriLife will train and hire a graduate student, or student workers, to collect the water samples and the onsite measurements.

Task 1 Deliverables:

1. Draft Quality Assurance Project Plan (QAPP)
   Due Date: 3/31/2023
2. Final Quality Assurance Project Plan (QAPP)
   Due Date: 4/10/2023
3. CV of Graduate Student or Student Worker(s)
   Due Date: 3/31/2023

Travel: No travel funds requested for this task.

Task 2: Water Sampling

AgriLife will collect water samples for 50-60 weeks from three outfall locations of Exploration Green Stormwater Wetland. AgriLife will install automated samplers and signage at each location. AgriLife shall program the automated samplers to collect the water samples at timed intervals as established by the QAPP. AgriLife will submit draft signage to the GLO for review and approval before installation. AgriLife will retrieve the water samples from all three solar-powered automated samplers and record the rainfall amount measured by the rain gauge attached to the samplers.

While onsite retrieving the samples, AgriLife will measure water quality parameters using handheld multiparameter sampling devices and measure light intensity using a photometer. AgriLife will send the water samples to a certified lab to test for bacteria and nutrient levels.

Task 2 Deliverables:

1. Map of sample locations
   Due Date: 4/10/2023
2. Draft signage
   Due Date: 2/10/2023
3. Executed contract with lab
   Due Date: 3/15/2023
4. Final signage
   Due Date: 3/25/2023
5. Photos of automated samplers and signage at all locations
   Due Date: 3/25/2023
6. Photos of water sampling efforts
   Due Date: Quarterly until 3/31/2024

Travel: Travel to sites for set up and sample collection using both personal and AgriLife fleet vehicles.

Task 3: Data Sharing and Outreach

AgriLife will share the Project results on a dedicated water quality webpage linked to one of the AgriLife Texas Community Watershed Partners ("TCWP") websites, most likely the Green Infrastructure for Texas ("GIFT") webpage. AgriLife will include a QR code to the webpage on all signage and printed materials. AgriLife will develop figures that summarize the project results and share them with partners at Clear Lake City Water Authority, Exploration Green Conservancy, Galveston Bay Foundation, Galveston Bay Estuary Program ("GBEP") Water and Sediment Quality subcommittee, and Harris County Flood Control District. AgriLife will publish a white paper describing the Project results. AgriLife will present the white paper at a local or state conference such as GBEP State of the Bay or the State Stormwater Conference.

Task 3 Deliverables:

1. Project webpage link
   Due Date: 2/10/2023
2. QR code linking to webpage
   Due Date: 2/10/2023

3. Quarterly data reports posted to a TCWP or GIFT website and links provided to GLO and project partners
   Due Date: 3/31/2024
4. Presentation agendas, power point slides, or poster presentation and photos
   Due Date: 2/16/2024
5. White paper
   Due Date: 3/15/2024

Travel: Two people to attend a local or state conference.

Task 4: Project Monitoring & Reporting

AgriLife will prepare and submit all reports, deliverables, and requests for reimbursement as required in the Contract, to CMPReceipts@GLO.TEXAS.GOV. Quarterly progress reports and requests for reimbursement are due to CMPReceipts@GLO.TEXAS.GOV on the 10th day of every quarter of the year starting with January 10, 2023. AgriLife will summarize the methods and results of the Project, as well as provide a discussion of the Project's findings and future recommendations in the final report. AgriLife will include photos of water sampling efforts in the report.

Task 4 Deliverables:

1. Quarterly progress reports and requests for reimbursement
   Due Date: Ongoing until 3/31/2024
2. Draft final report
   Due Date: 3/15/2024
3. Final report
   Due Date: 3/31/2024
4. Project closeout form
   Due Date: 3/31/2024

Travel: No travel funds requested for this task

Performance Evaluations

CMP staff will conduct quarterly performance evaluations of subrecipients to examine project progress and adherence to the 18-month completion timeline. Evaluations will be conducted under the following terms.

- **3-Month Evaluation (January 15, 2023)**
  - Subrecipients that did not submit the initial progress report and reimbursement request and do not show progress toward establishing the framework of their project will be identified by the CMP project manager ("PM").
- **6-Month Evaluation (April 15, 2023)**
  - If the CMP PM determines the Project is behind schedule or is making insufficient progress, i.e. Deliverables and reporting are late, the CMP PM will contact

Subrecipient via phone or email to revise Deliverable due dates and determine a method for getting the Project completed within the remaining Contract period.

- Subrecipients working on 306A projects with NOAA SAC requirements must provide the required SAC documentation at this time.
  - If the SAC documentation is not available, CMP staff may request a one- time SAC extension from NOAA. This extension is for a maximum of three (1) additional months.

- **9-Month Evaluation (July 15, 2023)**
  - If the Project had late reporting or Deliverables at the previous two (2) evaluations, the Project will be placed on a Performance Improvement Plan (PIP).
    - This will include more frequent check-ins with the CMP PM and a revised Deliverable schedule with Deliverables broken down into smaller pieces.
  - Reimbursement request will be held for payment until the PIP is in place.
  - **Subrecipients performing 306A projects with SACs must provide all required SAC documentation at this time. If the SAC documentation is unavailable, the Project may be terminated.**
- **12-Month Evaluation (October 15, 2023)**
  - If the Project is not adhering to the PIP and not demonstrating significant efforts to correct compliance issues, the GLO will consider the Project for termination and will issue a Notice of Deficiency to the project's Authorizing Official.
  - **Subrecipients can request a one (1) time extension.**
  - GLO will withhold payment on Subrecipient's reimbursement requests until GLO receives all outstanding documents and Deliverables.
- **15-Month Evaluation (January 15, 2024)**
  - GLO will closely examine projects with PIPs to ensure the PIP is being adhered to and the project is on track.
  - GLO may terminate the Project if the Project has significantly failed to adhere to the PIP.
  - GLO will withhold payment on Subrecipient's reimbursement requests until GLO receives all outstanding documents and Deliverables.
- **18-Month Evaluation (March 31, 2024)**
  - The Project must be complete. Incomplete projects may be terminated.

Appendix B: Field Data Recording Sheet

Field Data Recording Sheet

Date: _____ Collected By: _____

Location: _____ Event #: _____

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:

Field Observations:

Appendix C: Chain of Custody

EASTEX ENVIRONMENTAL LABORATORY, INC.

P. O. Box 1089 * Coldspring, TX 77331 (800) 525-0508 * FAX (936) 653-3172

P. O. Box 631375 * Nacogdoches, TX 75963-1375 (936) 569-8879 * FAX (936) 569-8951

www.eastexlab.com

REPORT TO:

(1) Company

Address

Attn.

Phone #

Fax #

INVOICE TO:

(2) Company

Address

Attn.

Phone #

Fax #

P.O. #

Sampler's Name (please print)

Sampler's Signature

Project Number

(3) Project Name

Remarks:

(7) Containers

(8) ANALYSIS REQUESTE

Order ID	(4) Sample ID	Date	Time	(5) C/G	DO	PH	Cl2	Flow	Temp	(6) Matrix	#Con	Size	Type	Pres

Relinquished By: (Signature) Received By: (Signature) Date Time Received Iced: Yes / No

Relinquished By: (Signature) Received By: (Signature) Date Time Received Iced: Yes / No

Relinquished By: (Signature) Received and/or Checked In By: (Signature) Date Time Received Iced: Yes / No

LAB USE ONLY Sample Condition Acceptable Yes / No Temp °C: * Therm ID Logged In By: (Signature) Date Time

Alternate Check In (Signature) Date Time

White Copy-Follows Samples
Yellow Copy-Laboratory
Pink copy-Client Copy

SEE BACK FOR INSTRUCTIONS

Chain of Custody Revision 2: 03/24/17

*Thermometer has 0.0 factor and recorded temperature is actual temperature.

Eastex Environmental Laboratory, Inc.

INSTRUCTIONS

Please be complete and accurate when filling out the Chain-of-Custody sheet, as all information will be printed on the final lab report.

1 REPORT TO: Name of company, address, #'s, and where you want the report sent.

2 INVOICE TO: Name of company, address, #'s, and where you want the report sent.

3 PROJECT NAME: What you will call this sample.

4 SAMPLE ID: How you will refer to this sample.

5 SAMPLE TYPE: C3=3pt Comp. C6=6pt Comp. C12=12hr Comp. C24=24hr Comp. G=Grab

6 MATRIX: DW=Drinking Water WW=Wastewater SO=Soil/Sludge OL=Oils
FL=Filter LE=Leachate SD=Solid RE=Resin OT=Other

7 CONTAINER(S)

SIZE: 1=Gallon 2=1/2 Gallon 3=Quart/Liter 4=Pint 5=1/2 pt (250 ml)
6=125 ml/4 oz. 7=60 mls/2 oz 8-Vial 9=Other

TYPE: P=Plastic G=Glass T=Teflon S=Sterile

PRESERVATIVE: C=Chilled S=Sulfuric Acid N=Nitric Acid B=Base/Caustic Z=Zn Acetate
H=Hydrochloric Acid ST=Sodium Thiosulfate O=Other

8 ANALYSIS REQUESTED Please be as specific as possible when listing which samples get what results.

Water Quality Sample Collection Training Log

Staff	ISCO Setup Procedure	ISCO Programming	YSI Calibration	Rain Gauge Calibration	Sample Collection	COC Procedures	Date Completed
Christie Taylor	x	x	x	x	x	x	9/27/2019
Kimberly Walls	x	x	x	x	x	x	4/13/2023
Elena Espinoza	x						
Gabrielle Scott			x		x	x	10/18/2023

Appendix 2: Field Data Recording Sheets

Field Data Recording Sheet

Date: 4/4/23 Collected By: Kimberly Walls

Location: _____ Event #: F.1

Site ID:		Rainfall Amount		Air Temp.		Water Temp.		DO		Specific Conductance		pH	Nitrogen (ammonium)			Bottle Collected #:
4						27.0°C		5.4 mg/L		395.6 µS/cm		8.16	7.0 mg/L			
~~3 4/4/23~~ X ~~Nitrate Nitrite~~						26.6°C		7.8 mg/L		435.1 µS/cm		7.82	15.6 mg/L			

1
4/4/23

Field Observations:

Field Data Recording Sheet

Date: 4/11/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: L.1

Site ID:	Rainfall Amount	Air Temp.	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1			22.3°C	8.5 $\frac{mg}{L}$	496.4 $\frac{us}{cm}$	7.06	56.2 $\frac{mg}{L}$	4
3			26.6°C	6.7 $\frac{mg}{L}$	253.5 $\frac{us}{cm}$	8.71	72.6 $\frac{mg}{L}$	3
4			23.6°C	9.1 $\frac{mg}{L}$	467.8 $\frac{us}{cm}$	7.75	73.9 $\frac{mg}{L}$	3

Field Observations:

Field Data Recording Sheet

Date: 4/25/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: F.2

Site ID:	Rainfall Amount	Air Temp.	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1			24.9°C	5.23 $\frac{mg}{L}$	537 $\frac{uS}{cm}$	7.82	111.92 $\frac{mg}{L}$	
3			24.5°C	5.07 $\frac{mg}{L}$	300.5 $\frac{uS}{cm}$	7.09	100.60 $\frac{mg}{L}$	
4			25.7°C	6.31 $\frac{mg}{L}$	445.9 $\frac{uS}{cm}$	7.21	66.85 $\frac{mg}{L}$	

Field Observations:

At Site #3, the water was very low at a flow of 0.059ft. Because of this, some soil and organisms were mixed in the sample when attempting to collect ~~enos~~ enough of a sample to submerge the probes.

Field Data Recording Sheet

Date: 4/27/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: L.2

Site ID:	Rainfall Amount	Air Temp.	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		~~26.9°C~~	26.9°C	7.34 mg/L	530 µS/cm	8.25	50.99 mg/L	4
3			27.0°C	7.05 mg/L	221.2 µS/cm	9.18	110.66 mg/L	4
4			27.5°C	8.47 mg/L	423.2 µS/cm	8.81	69.54 mg/L	3

Field Observations:

Field Data Recording Sheet

Date: 5/4/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: F.3

Site ID:	Rainfall Amount	Air Temp.	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1			27.2°C	8.78 mg/L	456.1 µS/cm	8.72	1.19 mg/L	
3			28.3°C	5.43 mg/L	191.0 µS/cm	9.26	1.24 mg/L	
4			26.9°C	5.30 mg/L	385.8 µS/cm	8.15	4.00 mg/L	

Field Observations:

The flow level at site 3 again made collection difficult, but the steady and fast flow allowed for fairly pure capture at the concrete edge.

Field Data Recording Sheet

Date: 5/11/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: 2.3

Site ID:	Rainfall Amount	Air Temp.	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1			30.2°C	5.57 $\frac{mg}{L}$	467 $\frac{\mu S}{cm}$	7.70	2.46 $\frac{mg}{L}$	4
3			31.8°C	5.65 $\frac{mg}{L}$	148.8 $\frac{\mu S}{cm}$	9.36	3.03 $\frac{mg}{L}$	4
4			31.4°C	5.01 $\frac{mg}{L}$	382.6 $\frac{\mu S}{cm}$	8.33	4.09 $\frac{mg}{L}$	4

Field Observations:

Field Data Recording Sheet

Date: 5/18/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: F.4

Site ID:	Rainfall Amount	Air Temp.	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1			32.2°C	5.71 $\frac{mg}{L}$	418.3 $\frac{uS}{cm}$	8.13	4.72 $\frac{mg}{L}$	
3			34.7°C	4.82 $\frac{mg}{L}$	193.4 $\frac{uS}{cm}$	9.32	7.93 $\frac{mg}{L}$	
4			34.6°C	5.74 $\frac{mg}{L}$	377.1 $\frac{uS}{cm}$	8.56	11.77 mg/L	

Field Observations:

For Site #4, the amounts of DO and NH_4^+ fluctuated enough that an exact reading was difficult. This especially applied to the ammonium specifically.

Field Data Recording Sheet

Date: 5/25/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: 2.4

Site ID:	Rainfall Amount	Air Temp.	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1			32.3°C	5.27 $\frac{mg}{L}$	471.1 $\frac{uS}{cm}$	7.88	2.63 $\frac{mg}{L}$	4
3			34.2°C	188.1 $\frac{mg}{L}$	195.1 $\frac{uS}{cm}$	8.21	6.17 $\frac{mg}{L}$	4
4			34.6°C	26.5 $\frac{mg}{L}$	425.8 $\frac{uS}{cm}$	7.28	9.26 $\frac{mg}{L}$	4

Field Observations:

The data for DO and ammonium fluctuated rapidly ~~and~~ for Sites 3 and 4. The ~~best~~ estimates for both values were recorded. On the same day, it was discovered that the probe for DO was cracked and nonfunctional. The data from the probe on this day may be flawed.

Field Data Recording Sheet

Date: 6/1/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: F.S

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1	~~30.2°C~~	0.971	30.2°C	—	495.0 $\frac{-us}{cm}$	7.74	3.06 $\frac{mg}{L}$	
3		0.072	29.6°C	—	329.7 $\frac{-us}{cm}$	7.46	0.60 $\frac{mg}{L}$	
4		0.896	30.8°C	—	436.9 $\frac{-us}{cm}$	7.56	4.42 $\frac{mg}{L}$	

Field Observations:

Field Data Recording Sheet

Date: 6/8/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: L.5

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		1.017	31.5°C	—	506 $\frac{-us}{cm}$	7.56	3.87 $\frac{mg}{L}$	4
3		0.115	32.3°C	—	272.1 $\frac{-us}{cm}$	7.12	10.68 $\frac{mg}{L}$	4
4		0.568	32.1°C	—	450.2 $\frac{-us}{cm}$	7.64	5.65 $\frac{mg}{L}$	4

Field Observations:

Low water levels ~~made~~ in the sampling jar made data collection difficult.

Field Data Recording Sheet

Date: 6/15/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: F.6

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		0.774	32.4°C	2.70 mg/L	488.3 µS/cm	7.43	2.46 mg/L	
3		0.321	34.0°C	2.80 mg/L	188.3 µS/cm	8.44	3.95 mg/L	
4		0.558	35.9°C	2.80 mg/L	435.2 µS/cm	7.87	9.37 mg/L	

Field Observations:

Field Data Recording Sheet

Date: 6/22/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: L.6

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		0.974	32.3 °C	2.98 mg/L	532 µS/cm	7.65	3.64 mg/L	41
3		0.157	33.4 °C	3.23 mg/L	225.0 µS/cm	7.20	7.05 mg/L	41
4		—	35.7 °C	3.60 mg/L	463 µS/cm	7.69	8.97 mg/L	41

Field Observations:

There was not enough calibration solution for conductance and ammonium. Flow level for phase 4 was not recorded because the sampler showed a negative number. Ammonium levels are the main data set holding back sampling timing as it can be unclear when levels have stabilized.

Field Data Recording Sheet

Date: 6/29/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: F.7

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		1.611	33.4°C	2.54 mg/L	494 µS/cm	8.02	—	
3		—	—	—	—	—	—	
4		0.420	34.1°C	3.84 mg/L ~~34.1°C~~	424.2 µS/cm	7.54	—	

Field Observations:

Nitrogen was inaccurately calibrated, only showing 0.
Site 3 had no water at the outflow location for collection.

Field Data Recording Sheet

Date: 7/6/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: L.7

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		2.152	31.9°C	2.71 mg/L	518 µS/cm	7.66		4
4		0.453	31.8°C	3.76 mg/L	444.3 µS/cm	7.69		4

Field Observations:

ammonium was not appropriately calibrated. No flow from phase 3

Field Data Recording Sheet

Date: 7/13/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: F.8

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		1.786	33.9 °C	3.18 mg/L	613 $\frac{\mu S}{cm}$	7.87	1.47 $\frac{mg}{L}$	
4		0.075	35.0 °C	3.17 $\frac{mg}{L}$	532 $\frac{\mu S}{cm}$	8.11	3.91 $\frac{mg}{L}$	

Field Observations:

Field Data Recording Sheet

Date: 7/20/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: L.8

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		1.939	35.1°C	2.21 mg/L	592 µS/cm	7.49	6.68 mg/L	4
4		0.082	38.8°C	2.17 mg/L	507 µS/cm	7.25	9.65 mg/L	4

Field Observations:

Field Data Recording Sheet

Date: 7/27/23 Collected By: Cimberly Walls

Location: Exploration Green Event #: F.9

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		1.909	32.0°C	1.85 mg/L	634 us/cm	8.25	1.48 mg/L	
4		0.262	35.4°C	2.90 mg/L	559 us/cm	7.72	6.30 mg/L	

Field Observations:

Field Data Recording Sheet

Date: 8/3/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: 2.9

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		1.539	35.0°C	3.12 mg/L	652 $\frac{-us}{cm}$	8.77	0.96 mg/L	4
4		0.639	39.8°C	3.40 mg/L	577 $\frac{-us}{cm}$	7.35	5.11 mg/L	4

Field Observations:

Field Data Recording Sheet

Date: 8/10/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: F.10

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		2.234	~~32.6~~ 8/10/23 °C 32.5	3.26	660 $\frac{\mu s}{cm}$	9.10	0.96 $\frac{mg}{L}$	
4		0.391	34.3 °C	3.12 $\frac{mg}{L}$	589 $\frac{\mu s}{cm}$	8.10	3.53 $\frac{mg}{L}$	

Field Observations:

Field Data Recording Sheet

Date: 8/17/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: L.10

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		1.306	34.2 °C	8/17/23 ~~3.26~~ 2.07 mg/L	677 µS/cm	8.86	0.65 mg/L	4
3		0.321	38.7 °C	8/17/23 ~~3.12~~ 3.13 mg/L	235.8 µS/cm	7.08	4.84 mg/L	4
4		0.49	38.9 °C	4.14 mg/L	607 µS/cm	7.17	4.48 mg/L	4

Field Observations:

Field Data Recording Sheet

Date: 8/23/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: F.11

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		1.551	35.6 °C	4.56 mg/L	658 µS/cm	9.15	2.07 mg/L	
3		0.420	36.1 °C	3.68 mg/L	303.1 µS/cm	8.98	4.34 mg/L	
4		0.374	36.4 °C	3.05 mg/L	581 µS/cm	8.11	9.18 mg/L	

Field Observations:

Field Data Recording Sheet

Date: 8/30/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: L.M

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		8/30/23 ~~1.551~~ 1.077	33.8 °C	3.10 mg/L	721 $\frac{\mu S}{cm}$	9.02	1.18 $\frac{mg}{L}$	4
3		8/30/23 ~~0.420~~ 0.984	40.3 °C	3.13 mg/L	416.9 $\frac{\mu S}{cm}$	7.26	5.88 $\frac{mg}{L}$	4
4		8/30/23 ~~0.374~~	35.1 °C	2.96 mg/L	643 $\frac{\mu S}{cm}$	7.18	10.30 $\frac{mg}{L}$	4

Field Observations:

Field Data Recording Sheet

Date: 9/6/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: F.12

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		0.764	35.2 °C	5.30 mg/L	697 $\frac{\mu S}{cm}$	9.13	1.61 $\frac{mg}{L}$	
3		0.475	34.4 °C	2.77 mg/L	401.4 $\frac{\mu S}{cm}$	7.75	2.53 $\frac{mg}{L}$	
4		0.476	35.4 °C	3.85 mg/L	648 $\frac{\mu S}{cm}$	8.03	3.61 $\frac{mg}{L}$	

Field Observations:

First time sampling with a new Ammoium-N probe. Sampling concludes ahead of schedule.

Field Data Recording Sheet

Date: 9/13/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: L.12

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1	~~0.674~~	0.674	34.1 °C	3.47 mg/L	718 us/cm	8.81	2.25 mg/L	4
3		0.236	37.9 °C	3.35 mg/L	429.5 us/cm	7.15	1.13 mg/L	4
4		0.229	36.0 °C	3.63 mg/L	644 us/cm	7.33	3.84 mg/L	4

Field Observations:

Field Data Recording Sheet

Date: 9/20/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: F.13

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		0.778	30.4 °C	5.00 mg/L	443 µs/cm	8.51	1.46 mg/L	
3		0.502	29.3 °C	2.51 mg/L	347.4 µs/cm	7.13	1.63 mg/L	
4		0.771	30.7 °C	3.56 mg/L	454.3 µs/cm	8.26	2.33 mg/L	

Field Observations:

Vegetation has steadily increased at the P4 outflow site.

Field Data Recording Sheet

Date: 9/27/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: L.13

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		5.302 ft	33.4 °C	3.76 mg/L	508 $\frac{-us}{cm}$	8.44	1.78 $\frac{mg}{L}$	4
3		0.338 ft	31.5 °C	3.04 mg/L	353.5 $\frac{-us}{cm}$	6.98	2.76 $\frac{mg}{L}$	4
4		0.003 ft	34.0 °C	3.28 mg/L	473 $\frac{-us}{cm}$	7.27	1.94 $\frac{mg}{L}$	4

Field Observations:

Battery from phase 1 was accidentally disconnected. Flow level seemed off on both phase 1 and phase 4.

Field Data Recording Sheet

Date: 10/4/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: F.14

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		1.171	27.8	1.97	445.4	7.26	1.35	
3		0.846	26.2	1.57	349.4	7.11	1.11	
4		0.484	27.7	2.98	458.0	7.73	1.31	

Field Observations:

Tubing for flow module was readjusted for site 4.

Field Data Recording Sheet

Date: 10/11/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: L.14

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		1.490	22.8	3.85	523	7.28	2.41	
3		0.482	22.7	3.37	368.7	6.93	1.06	
4		0.062	23.0	4.65	468.9	7.50	1.51	

Field Observations:

Tubing for flow module at site 4 had to be readjusted. non-negative number was recorded.

Field Data Recording Sheet

Date: 10/25/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: L.15

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
		1.188	25.6 °C	2.34 mg/L	585 µS/cm	7.77	1.74 mg/L	4
		0.331	26.3 °C	4.23 mg/L	404.5 µS/cm	7.08	0.69 mg/L	4
		0.359	27.0 °C	4.05 mg/L	511 µS/cm	7.49	1.30 mg/L	4

Field Observations:

Site 4 continued to display negative flow values. The non-negative value was recorded. This sampling was done without calibration solution for nitrogen of ammonium available.

Field Data Recording Sheet

Date: 11/1/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: F.16

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		0.741	20.8 °C	4.53 mg/L	608 µS/cm	7.80	2.11 mg/L	
3		0.452	20.7 °C	4.71 mg/L	608 µS/cm	7.19	1.62 mg/L	
4		—	19.8 °C	6.38 mg/L	525 µS/cm	7.90	1.66 mg/L	

Field Observations:

The bubbler line for site 4 was cut and the level was not recorded.

Field Data Recording Sheet

Date: 11/8/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: Lab

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		1.158	26.4 °C	5.30 mg/L	622 µs/cm	8.35	1.41 mg/L	4
3		0.244	25.6 °C	4.71 mg/L	473 µs/cm	7.41	0.65 mg/L	4
4		0.289	28.0 °C	4.50 mg/L	545 µs/cm	7.46	1.24 mg/L	4

Field Observations:

The bubbler line for site 4 was replaced. Ammonium was able to be recalibrated however conductivity remained unable to be calibrated.

Field Data Recording Sheet

Date: 11/15/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: F.17

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		~~t~~	22.6 °C	3.65 mg/L	564 ~~uS~~/cm	7.44	2.06 ~~mg~~/L	
3		0.787	19.4 °C	3.03 mg/L	381.1 ~~uS~~/cm	7.02	0.66 ~~mg~~/L	
4		0.203	20.7 °C	5.45 mg/L	486 ~~uS~~/cm	7.65	1.37 ~~mg~~/L	

Field Observations:

There was not enough time for calibration to be performed. The flow measurement for site 1 (10.00ft) appeared faulty and was not officially recorded. DO ~~seem~~ seemed low considering ~~faith~~ the rain earlier in the week.

Field Data Recording Sheet

Date: 11/29/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: 2.17

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		0.696	18.6 °C	8.00 mg/L	600 µs/cm	8.03	1.26 mg/L	4
3		0.206	17.5 °C	5.58 mg/L	391.8 µs/cm	6.92	0.52 mg/L	4
4		—	18.3 °C	6.45 mg/L	529 µs/cm	7.35	1.01 mg/L	4

Field Observations:

Site 4 bubbler line was cut.

Field Data Recording Sheet

Date: 12/6/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: F.18

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		—	18.6°C	6.87 mg/L	478.3 µS/cm	7.36	2.04 mg/L	
3		0.344	14.3°C	4.10 mg/L	302.6 µS/cm	6.89	0.77 mg/L	
4		—	20.6°C	6.00 mg/L	342.8 µS/cm	7.75	1.29 mg/L	

Field Observations:

Field Data Recording Sheet

Date: 12/13/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: L.18

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		—	15.6 °C	6.88 mg/L	497 µS/cm	7.44	1.48 mg/L	
3		0.249	15.8 °C	6.10 mg/L	316.1 µS/cm	6.86	0.48 mg/L	
4		0.274	16.0 °C	7.39 mg/L	422.2 µS/cm	7.08	1.02 mg/L	

Field Observations:

Calibration did not occur between lack of time and distilled water. Site 1 samples were contaminated with ants. Site 4 bubbler line was replaced.

Field Data Recording Sheet

Date: 12/20/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: F.19

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		1.371ft or 6 in.	15.3°C	8.74	451.4	7.29	4.67	
3		0.305ft or 4 in	15.3°C	4.62	302.5	7.07	1.27	
4		0.033ft or ~3 inch	17.2°C	5.67	397.2	7.61	0.42	

Field Observations:

Ran out of distilled water. Accurate calibration could not be completed.

Field Data Recording Sheet

Date: 1/3/24 Collected By: Kimberly Walls

Location: Exploration Green Event #: 2.19

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		1.467 or 13 in.	12.7	6.00	222.9	6.34	1.38	4
3		2.745 or 13 in.	13.1	5.13	264.7	6.80	0.45	4
4		1.027 or 14.5 in.	14.4	5.96	335.8	6.45	0.64	4

Field Observations:

The rain ~~gauges~~ gauges were discovered to be clogged and the bubbler line for site 3 was replaced.

Field Data Recording Sheet

Date: 1/11/24 Collected By: Christie Taylor

Location: Exploration Green Event #: F.20

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		0.781 or 10.5 in.	14.4	10.09	381.3	7.47	0.91	
3		0.220 or 5.5 in.	13.4	8.21	225.2	6.90	0.46	
4		-0.05 or 4.75 in.	14.5	10.13	322.1	7.07	0.92	

Field Observations:

Clear skies with high clouds. Air temperature of 67°F. Some debris on site 4 grate. All rain ~~gra~~ gauges but the one at site 1 was clogged

Field Data Recording Sheet

Date: 1/18/24 Collected By: Kimberly Walls

Location: Exploration Green Event #: 1.20

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		0.732 or 9.5 in.	10.7	9.09	422.7	7.10	1.11	4
3		0.239 or 3.5 in.	11.5	7.82	241.5	6.87	0.44	4
4		0.335 or 2.5 in.	11.6	10.19	364.6	7.45	0.70	4

Field Observations:

Mildly windy with cloudy skies. Air temperature roughly 64°F. Water was running steady and clear except ~~of~~ for site 1 which was slightly cloudy.

Field Data Recording Sheet

Date: 10/18/23 Collected By: Kimberly Walls

Location: Exploration Green Event #: F.15

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		0.830	26.5 °C	5.00 mg/L	539 µs/cm	8.58	1.17 mg/L	
3		0.311	25.8 °C	2.94 mg/L	497.8 µs/cm	7.13	1.19 mg/L	
4		—	27.5 °C	3.86 mg/L	483.5 µs/cm	8.35	1.08 mg/L	

Field Observations:

The flow from Site 4 was not recorded as only a negative number was displayed. Observation showed this number to be inaccurate.

Field Data Recording Sheet

Date: 1/24/24 Collected By: Kimberly Walls

Location: Exploration Green Event #: F.21

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		1.04	13.9°C	8.58 mg/L	326.7 uS/cm	6.69	1.33 mg/L	
3		0.879	15.2°C	8.38 mg/L	172.2 uS/cm	6.68	0.71 mg/L	
4		2.04	13.4°C	8.44 mg/L	276.3 uS/cm	6.98	0.91 mg/L	

Field Observations:

Fast moving and clear water. Cloudy skies with ambient temperature of 64°F and ~~tight~~ rain.

Field Data Recording Sheet

Date: 1/31/24 Collected By: Kimberly Walls

Location: Exploration Green Event #: ~~F~~ L.21

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		1.13	16.5°C	6.58 mg/L	338.3 us/cm	6.81	1.63 mg/L	3
3		0.210	15.3°C	7.80 mg/L	173.0 us/cm	6.84	0.44 mg/L	4
4		0.917	16.1°C	7.94 mg/L	280.5 us/cm	7.21	0.92 mg/L	41

Field Observations:

P1: Slightly cloudy fast moving water. P3: Clear water running quickly with evidence of algal blooms & plant debris.
P4: Somewhat cloudy fast moving water.
Thin clouds with an ambient temperature of 73°F

Field Data Recording Sheet

Date: 2/7/24 Collected By: Kimberly Walls

Location: Exploration Green Event #: F.22

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		0.945	17.3°C	6.91 mg/L	355.2 $\frac{us}{cm}$	6.70	1.84 $\frac{mg}{L}$	
3		0.313	15.7°C	8.05 mg/L	143.4 $\frac{us}{cm}$	6.69	0.45 $\frac{mg}{L}$	
4		0.426	17.5°C	8.39 mg/L	301.4 $\frac{us}{cm}$	7.10	0.95 $\frac{mg}{L}$	

Field Observations:

P1: Slightly cloudy water. P3: mostly clear water. P4: somewhat cloudy. windy.

Field Data Recording Sheet

Date: 2/14/24 Collected By: Kimberly Walls

Location: Exploration Green Event #: L.22

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		0.79	18.6°C	6.99 mg/L	374.7 $\frac{us}{cm}$	7.09	2.44 $\frac{mg}{L}$	4
3		0.164	16.9°C	7.26 mg/L	206.5 $\frac{us}{cm}$	6.87	0.54 $\frac{mg}{L}$	4
4		0.397	17.4°C	8.70 mg/L	335.9 $\frac{us}{cm}$	7.51	0.82 $\frac{mg}{L}$	4

Field Observations:

P1: water somewhat cloudy and flowing rapidly.

P4: water somewhat cloudy and moving steadily.

lightly cloudy with an ambient temperature of 64°F

Field Data Recording Sheet

Date: 2/21/24 Collected By: Kimberly Walls

Location: Exploration Green Event #: F.23

Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		0.63	21.3°C	7.36 mg/L	398.3 uS/cm	6.89	1.25	
3		0.21	20.3°C	6.43 mg/L	223.6 uS/cm	6.85	0.44	
4		0.14	20.7°C	9.35 mg/L	353.2 uS/cm	8.12	0.60	

Field Observations:

All water sources except for Site 3 was cloudy in appearance. The weather was lightly cloudy with wind. Ambient temperature of 74°F.

Field Data Recording Sheet

Date: 2/28/24 Collected By: Kimberly Walls

Location: Exploration Green Event #: L.23

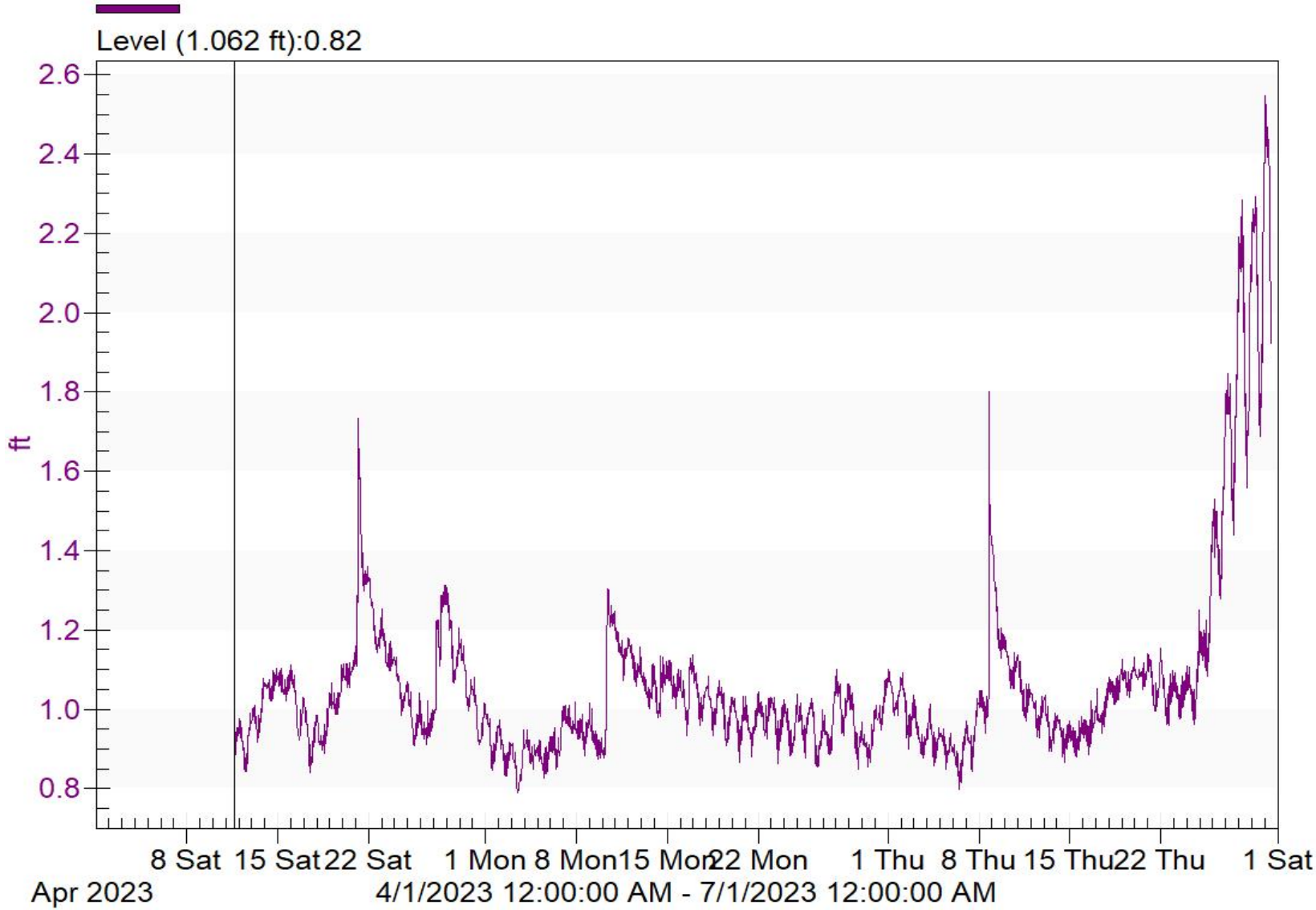
Site ID:	Rainfall Amount	Flow level (ft.)	Water Temp.	DO	Specific Conductance	pH	Nitrogen (ammonium)	Bottle Collected #:
1		0.58	21.6°C	6.85 $\frac{mg}{L}$	416.2 $\frac{uS}{cm}$	7.14	1.55 $\frac{mg}{L}$	4
3		0.17	19.0°C	4.63 $\frac{mg}{L}$	274.8 $\frac{uS}{cm}$	6.91	0.58 $\frac{mg}{L}$	4
4		0.800	21.2°C	7.15 $\frac{mg}{L}$	375.9 $\frac{uS}{cm}$	7.92	0.63 $\frac{mg}{L}$	4

Field Observations:

Water was cloudy and running steady save for site 3 which had little to no flow occurring. The weather was very windy and cloudy with an ambient temperature of 67°F.

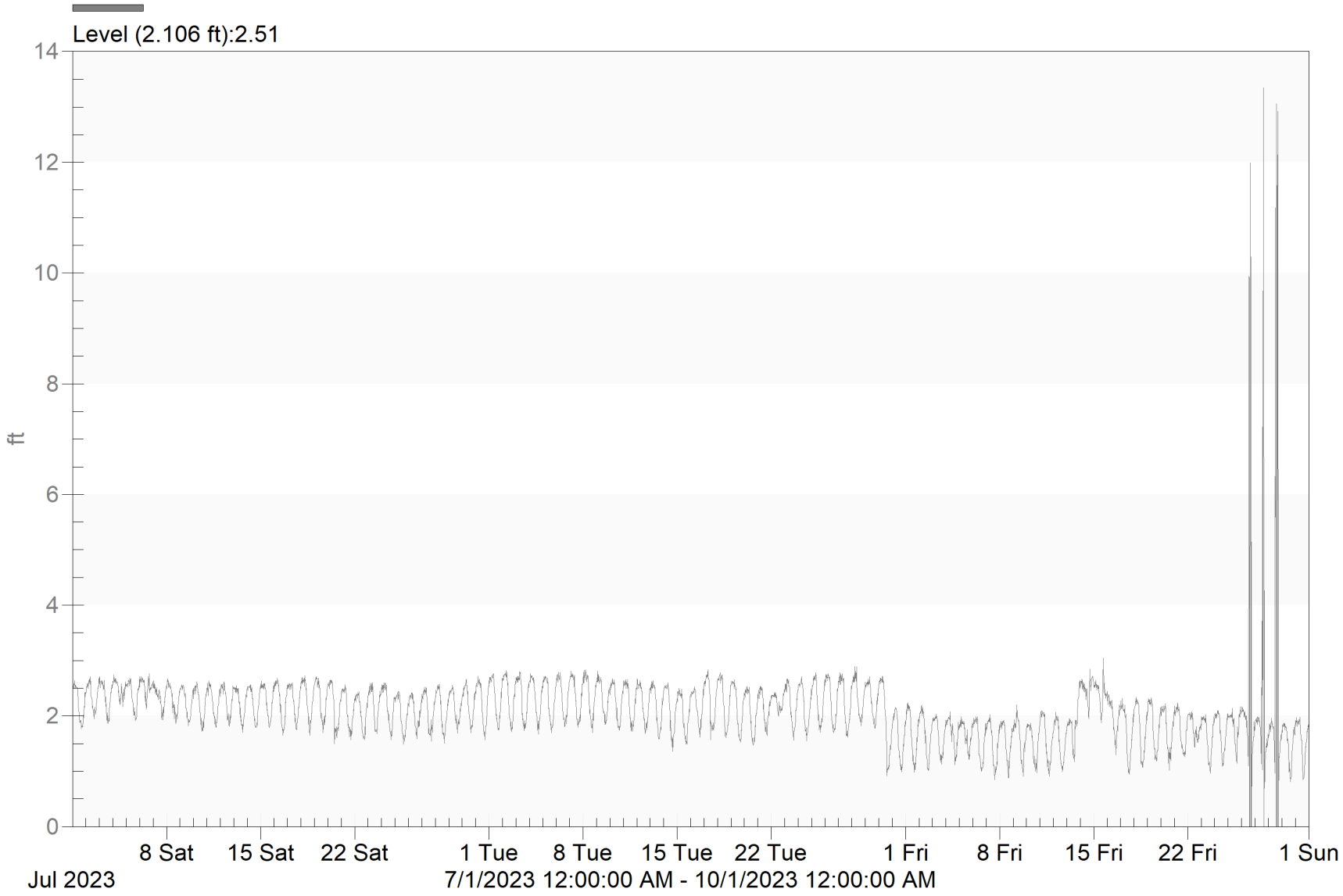
EG 1- Flow Level April 2023 -June 2023

Flowlink 5



EG 1 Flow Level July - September 2023

Flowlink 5

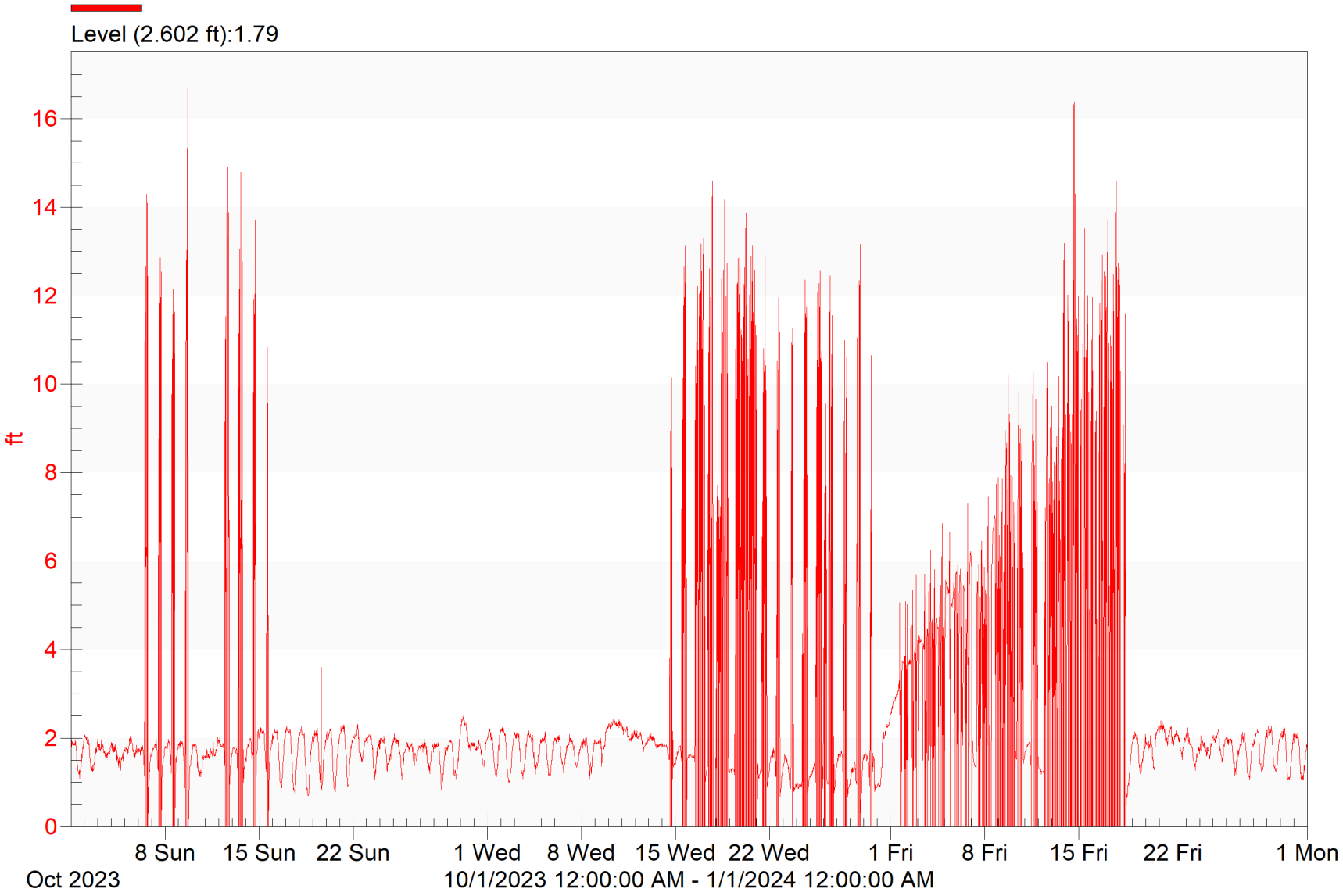


EG 1 Flow Level in Ft.

January 2024 -February 2024

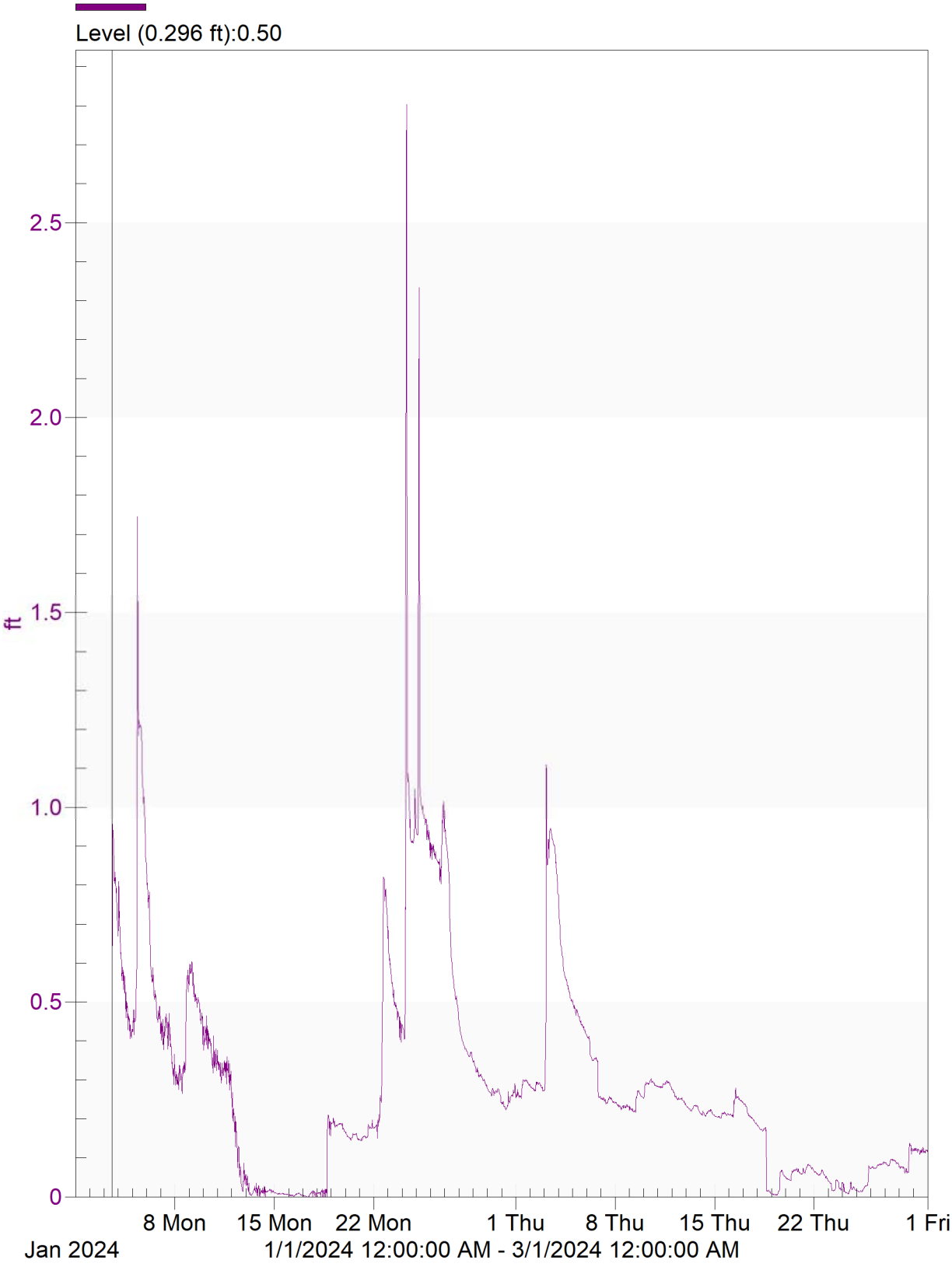
EG 1 Flow Level in Ft.

October 2023 - December 2023



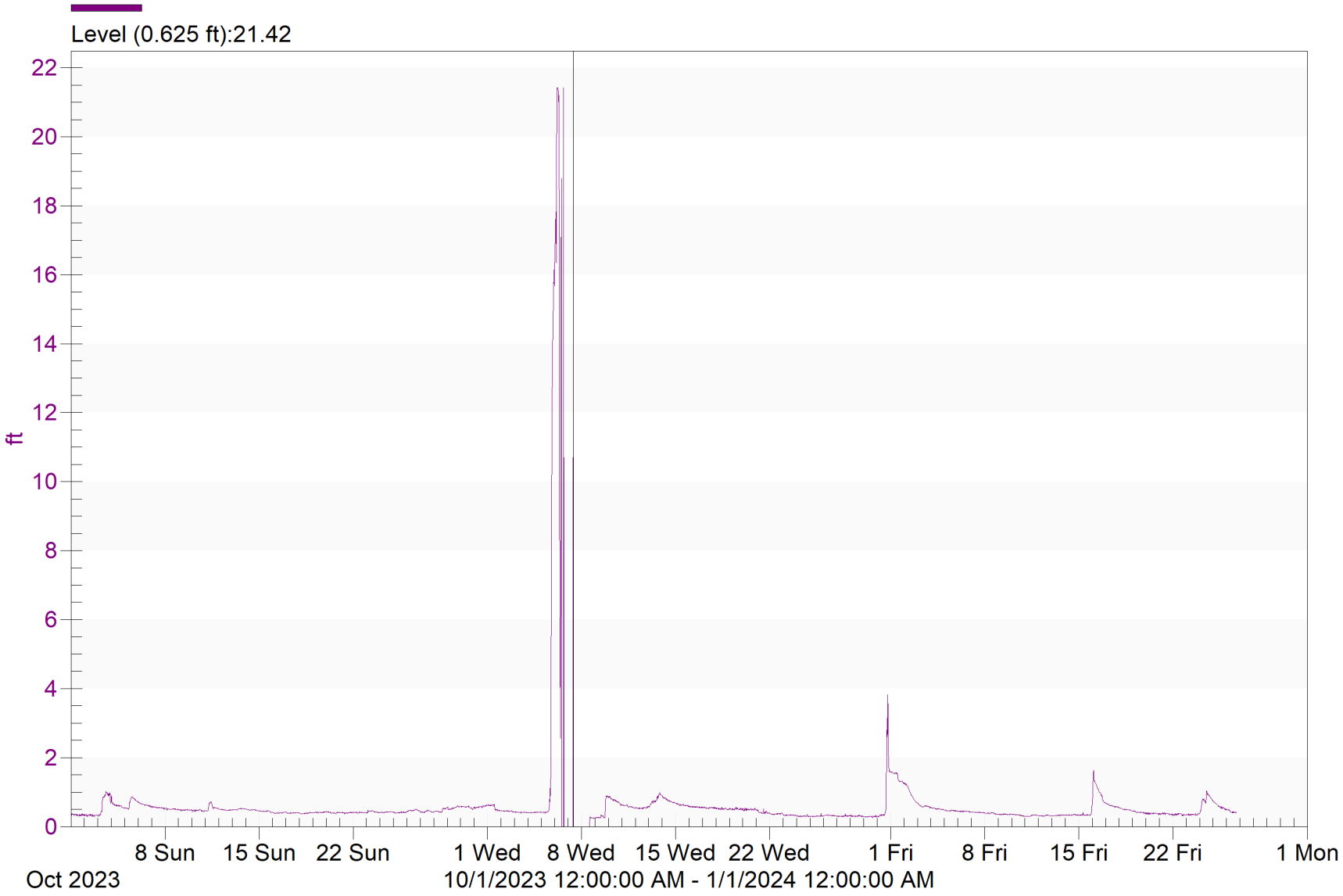
EG Phase 3 Flow Level in FT

January 2024 - February 2024



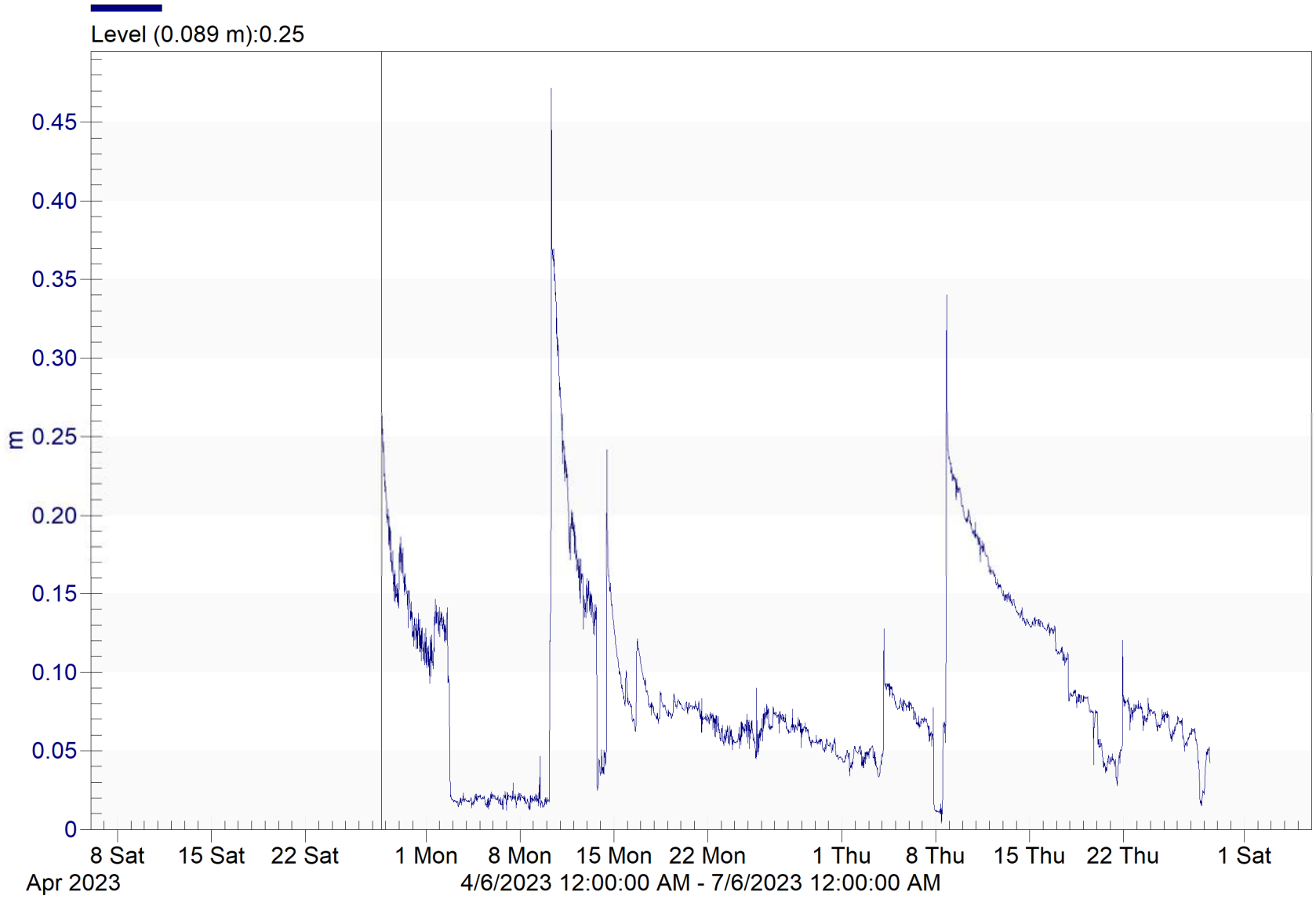
EG Phase 3 Flow Level in FT

October 2023 - December 2023



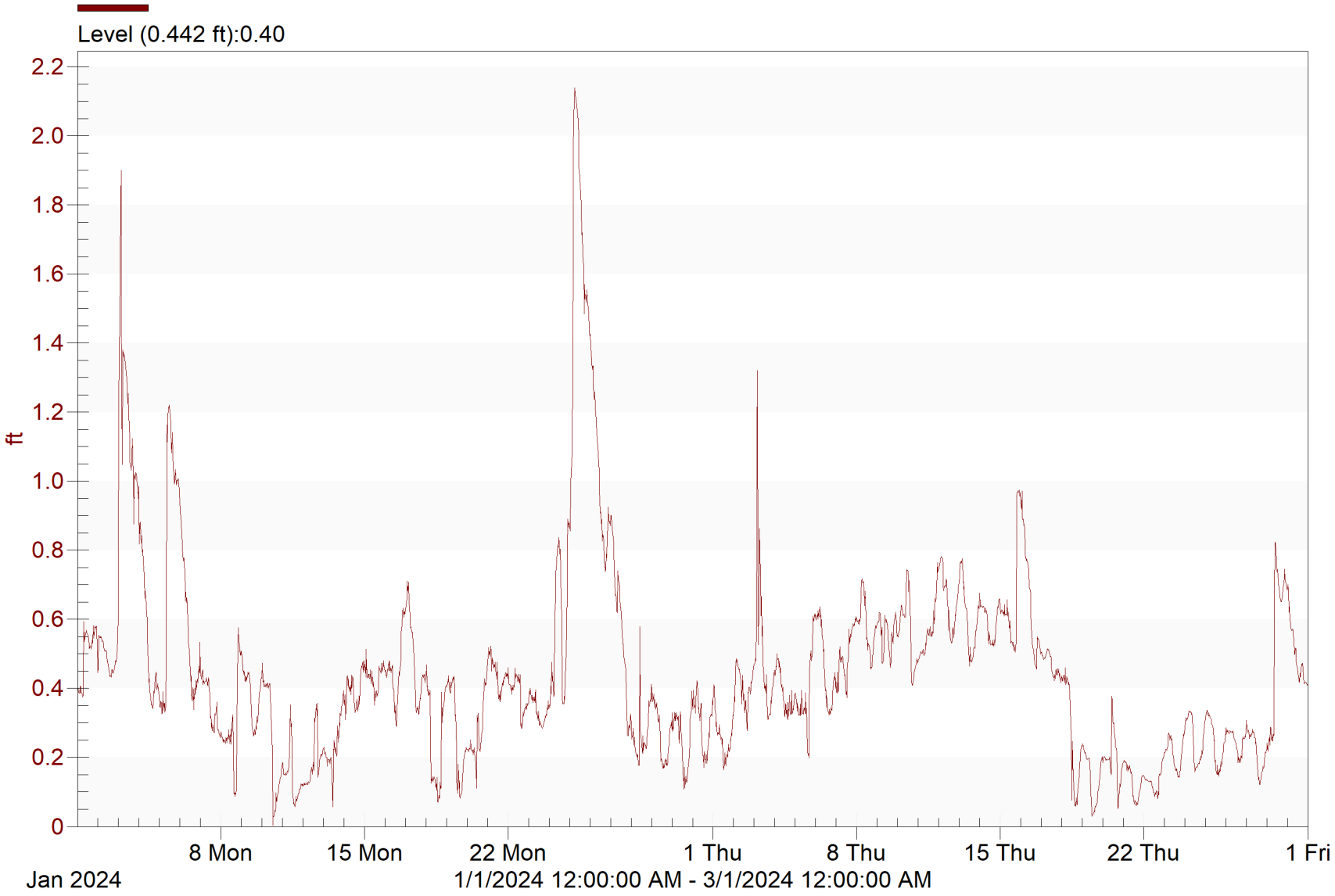
EG Phase 3

Flowlink 5



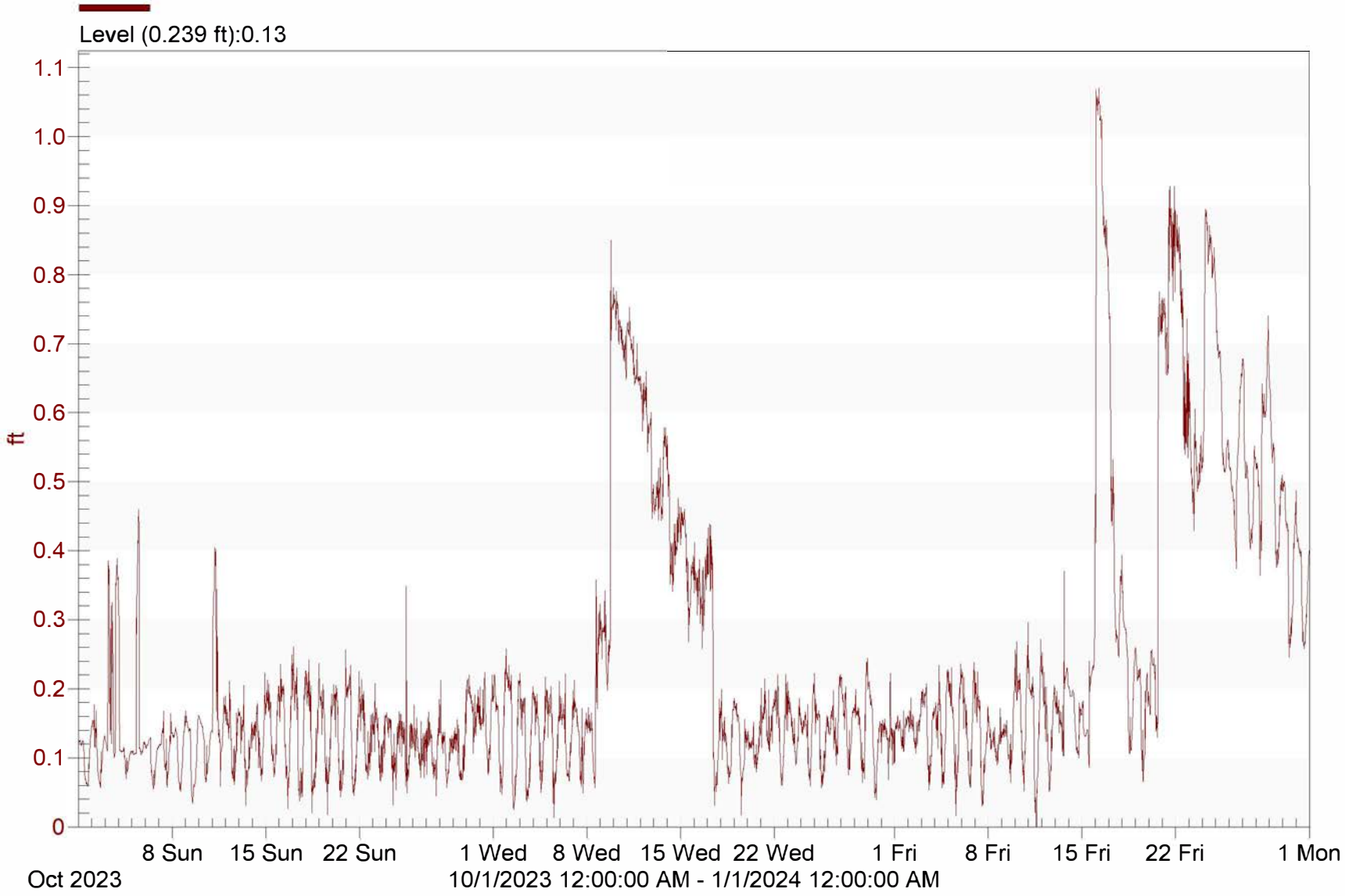
Phase 4 Flow Level in ft.

January -February 2024



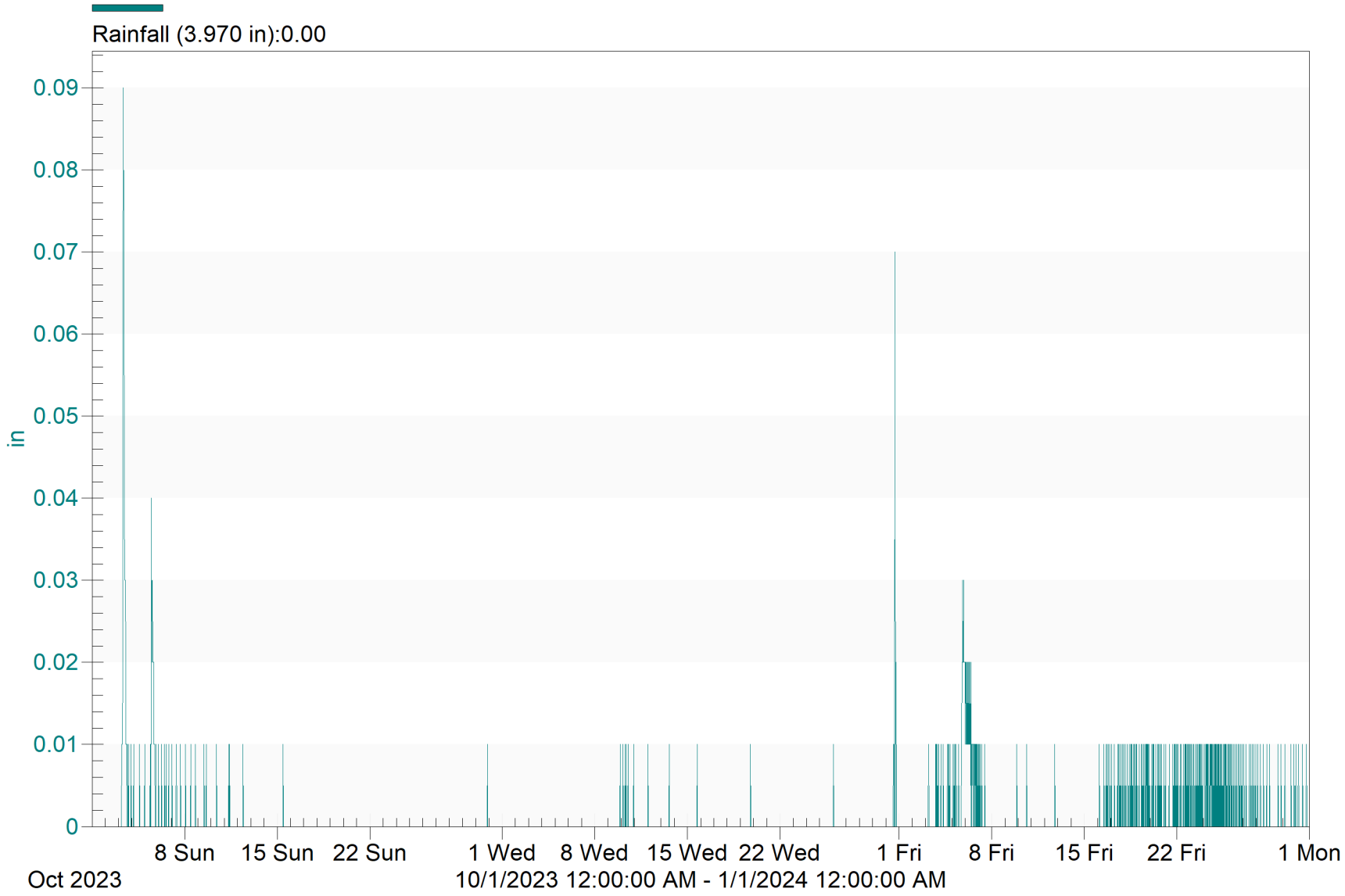
Phase 4 Flow Level in ft.

October 2023 - December 2023



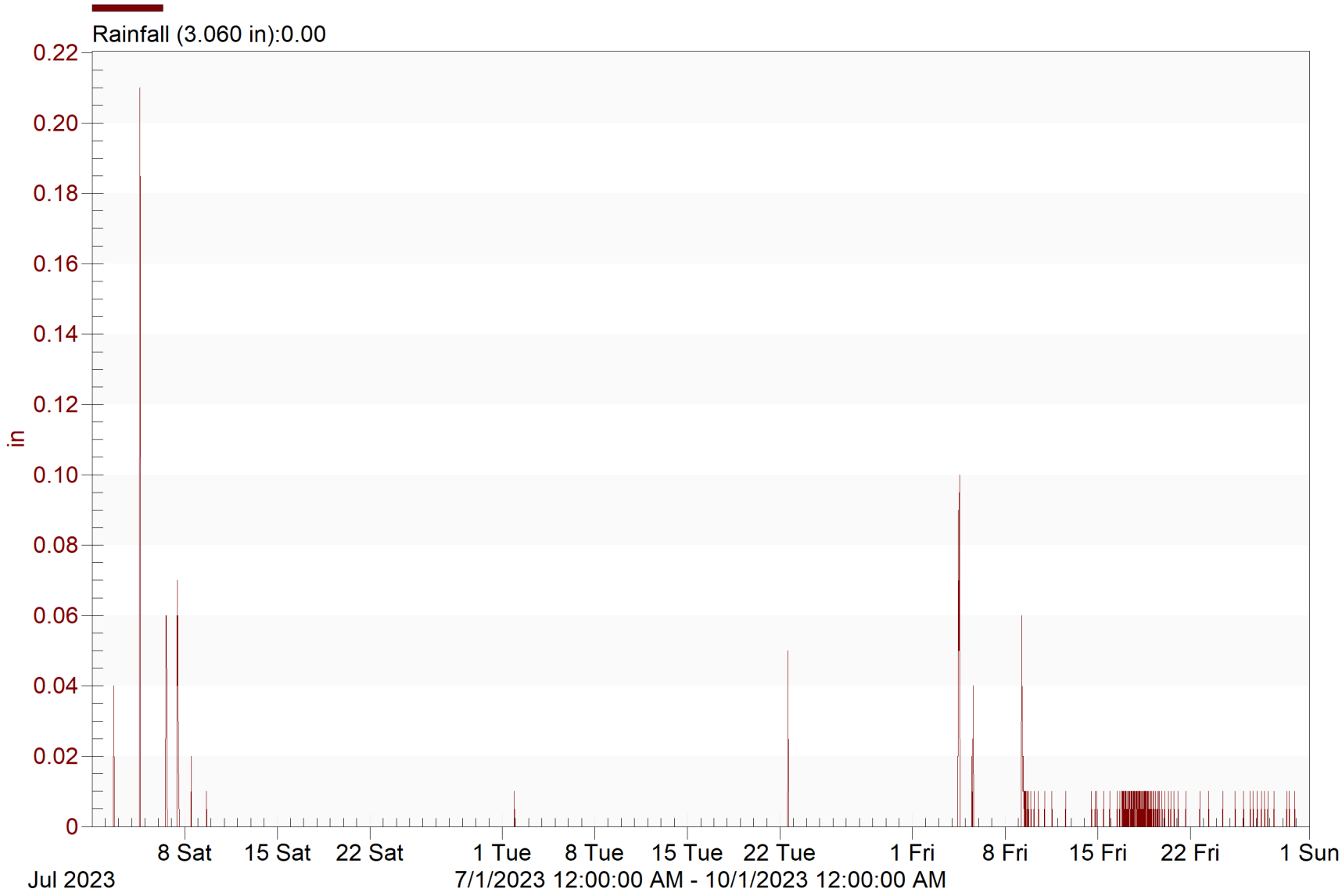
Phase 4 Rainfall in Inches

October 2023 to December 2023



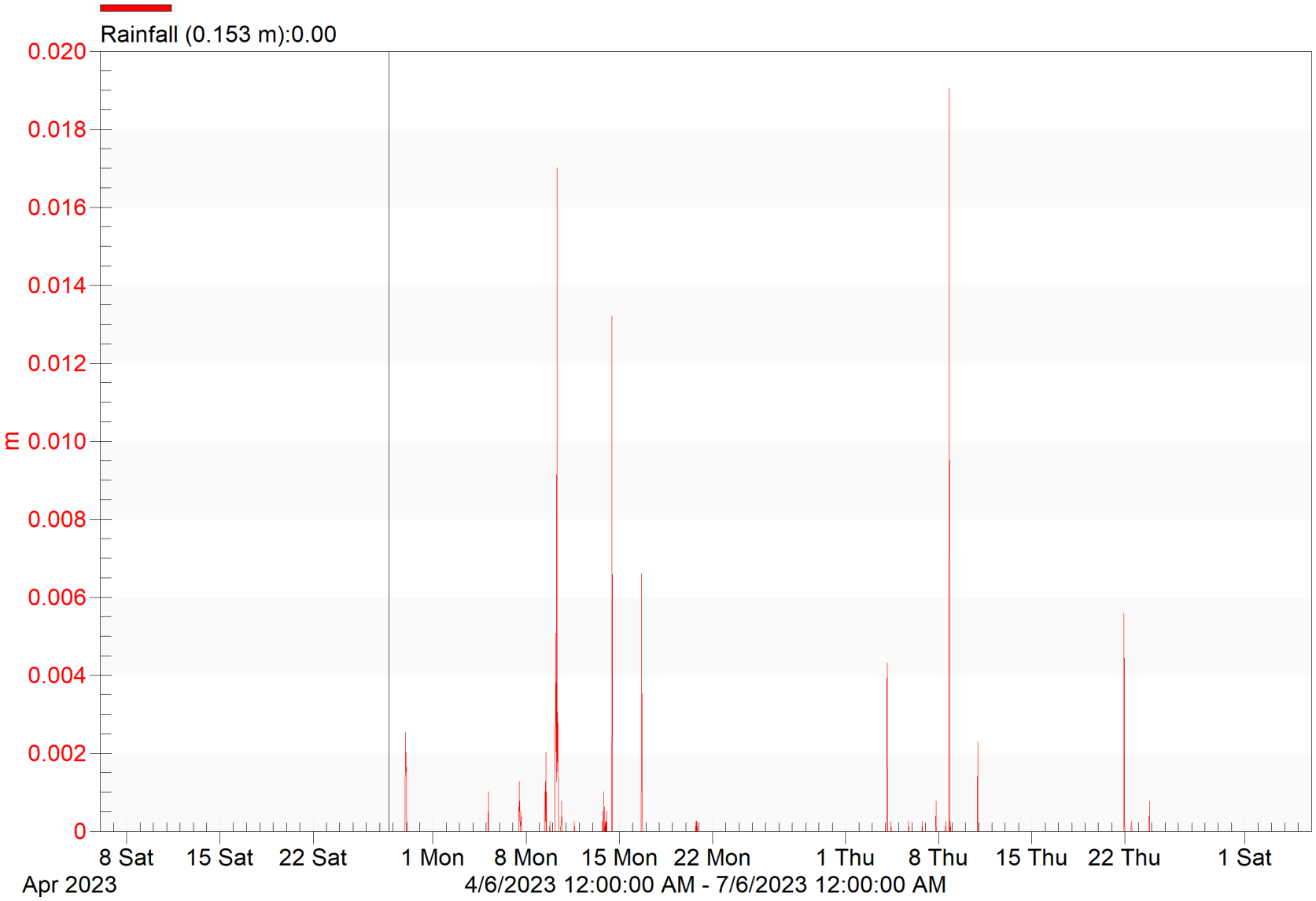
EG 3 Rainfall Data July - September 2023

Flowlink 5



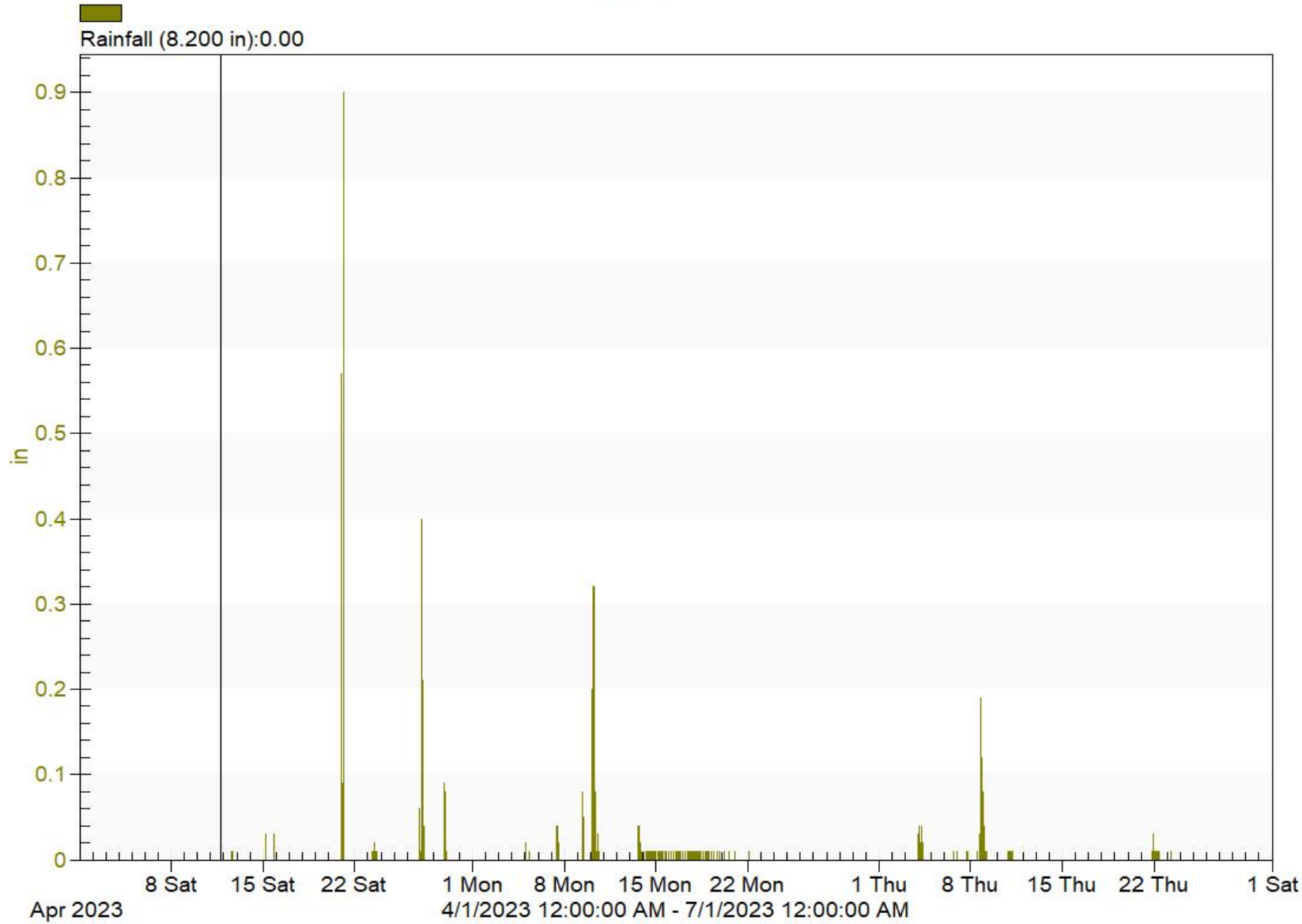
EG Phase 3

Flowlink 5



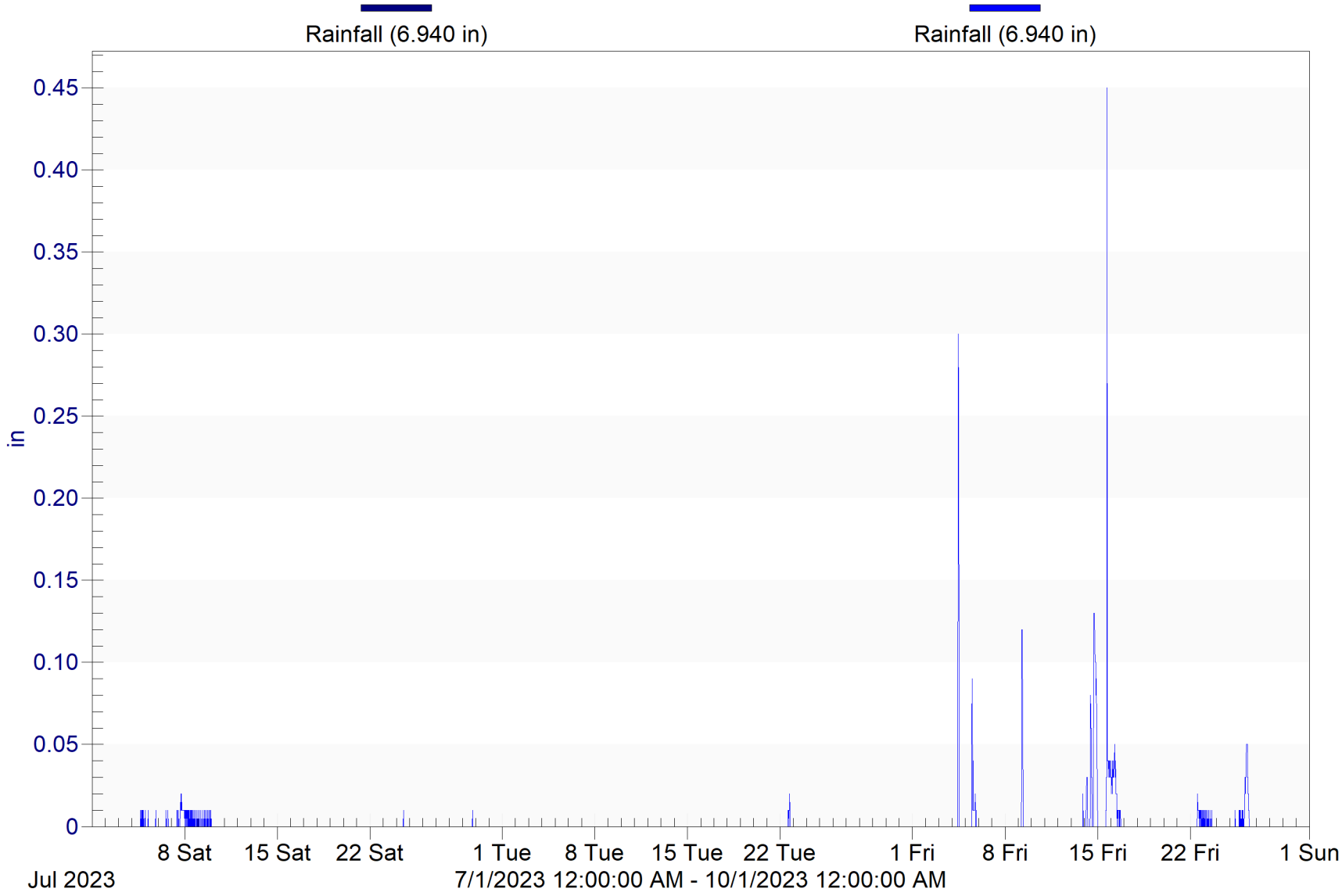
EG4- Rainfall April 2023 - June 2023

Flowlink 5



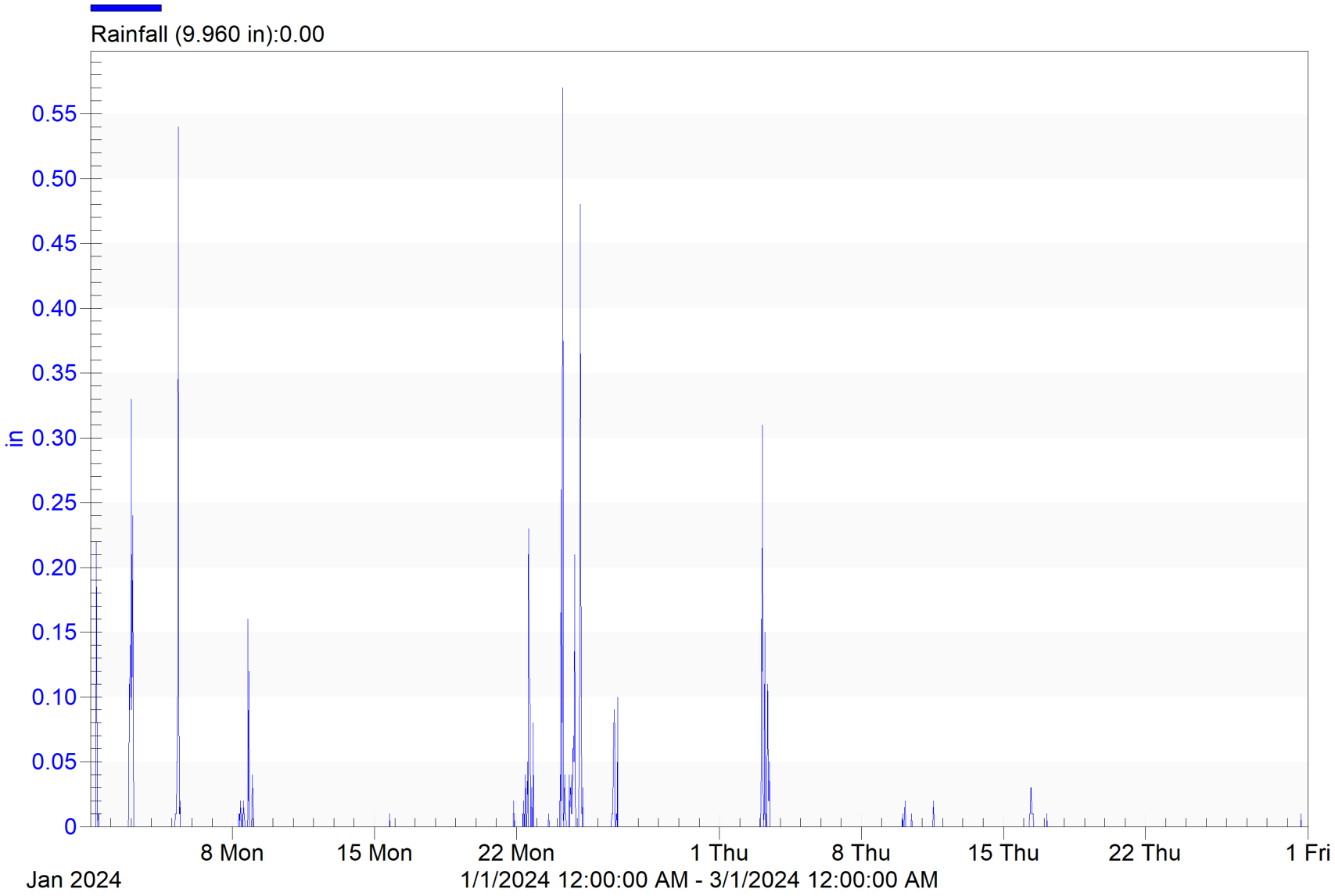
Phase 4 Rainfall Data July - September 2023

Flowlink 5



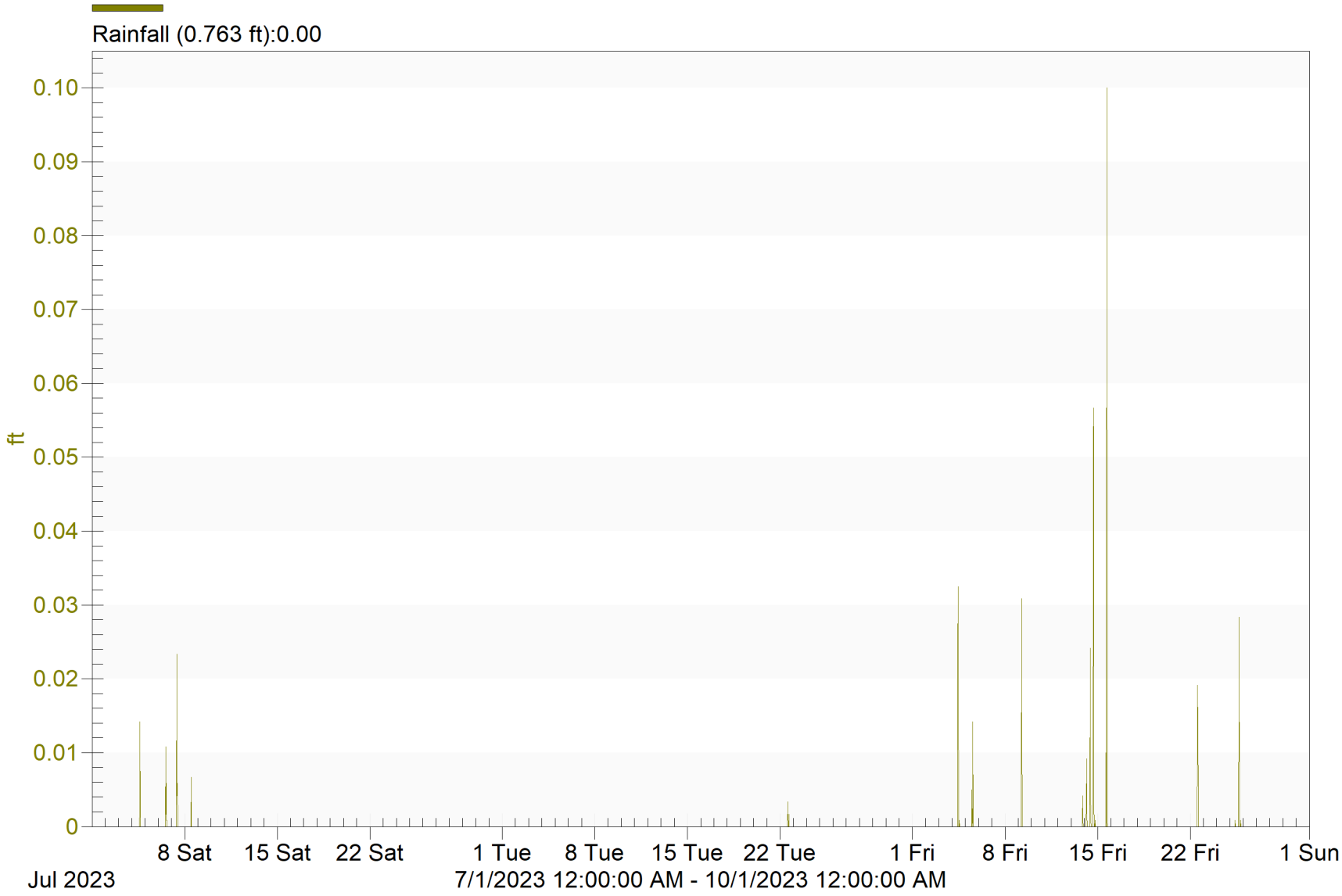
EG Phase 1 Rainfall in Inches

January 2024 - February 2024



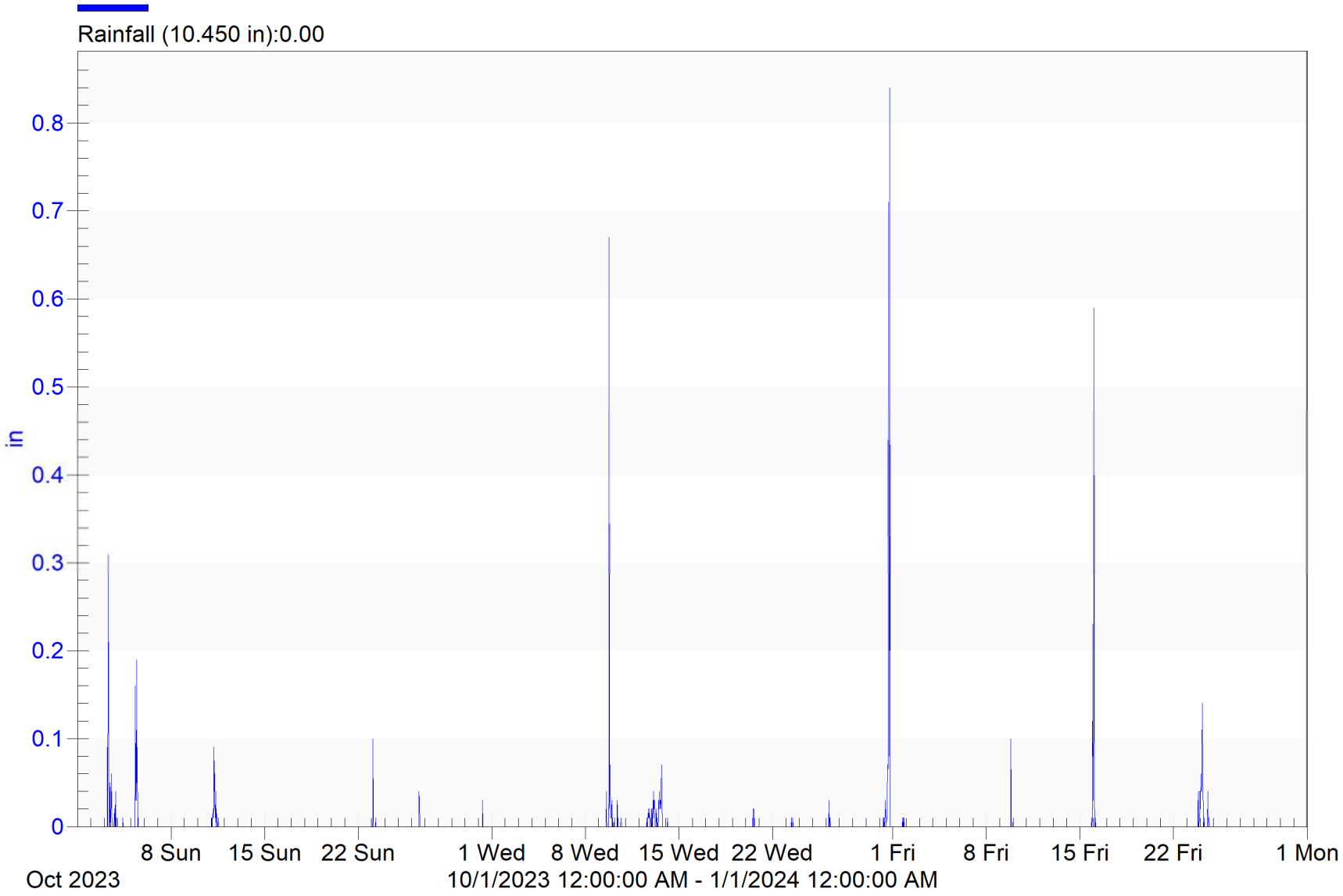
EG 1 Rainfall July-September 2023

Flowlink 5



EG Phase 1 Rainfall in Inches

October 2023 - December 2023



Appendix 3: Lab Reports

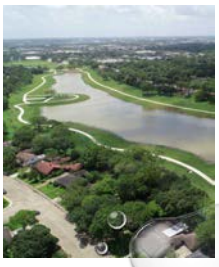
Follow link to view linked lab reports. All reports are available on the website.

https://tcwp.tamu.edu/stormwater/wetlands/stormwater-wetland-water-quality-monitoring-project/

Appendix 4: Presentations

A POINT-BY-POINT ANALYSIS OF EXPLORATION GREEN

EVALUATING WATER QUALITY AND ITS EFFECTS



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BACKGROUND

- FUNDING APPROVED 2022
- PARTNERED WITH EASTEX LABS
- SAMPLING BEGAN IN APRIL 2023
- QAPP FINALIZED IN JULY 2023
- SAMPLING FINISHES ON FEBRUARY 28TH
- GRANT ENDS AFTER MARCH

DISCLAIMER:
- Not a specialist

CHECK OUT OUR WEBSITE

- HTTPS://TCWP.TAMU.EDU/STORMWATER/WETLANDS/STORMWATER-WETLAND-WATER-QUALITY-MONITORING-PROJECT/
- QUARTERLY WATER QUALITY UPDATES
- LAB REPORTS
- DATA TABLES
- QAPP
- ARCHIVE

EQUIPMENT

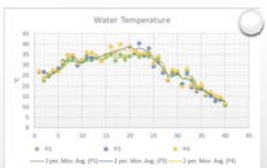
- SOLAR POWERED ISCO AUTOMATED SAMPLER WITH ATTACHMENTS
- YSI PRO QUATRO MULTIPROBE
- STYROFOAM COOLER
- LAB PROVIDED BOTTLES WITH PRESERVATIVES
- 6 GLASS JARS
- CALIBRATION STATION WITH SOLUTIONS

PARAMETERS

Bi-Weekly Lab Data	Weekly Field Data	Passive collection
• AMMONIA-N (mg/L) • TOTAL SUSPENDED SOLIDS (TSS) (mg/L) • TOTAL PHOSPHORUS (mg/L) • E. COLI (mpn/100mL)	• DISSOLVED OXYGEN (DO) (mg/L) • WATER TEMPERATURE (°C) • SPECIFIC CONDUCTANCE (µs/cm) • AMMONIUM-N (mg/L) • pH	• FLOW LEVEL (ft.) • RAINFALL AMOUNT (in.)

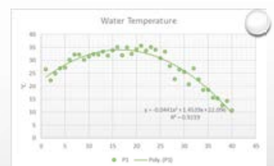
OVERALL TRENDS

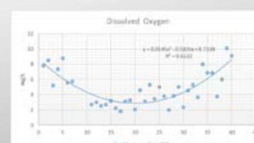
- TEMPERATURE & DISSOLVED OXYGEN



OVERALL TRENDS

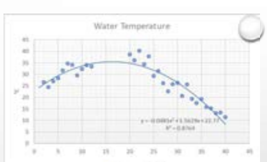
- TEMPERATURE & DISSOLVED OXYGEN
- STRONG QUADRATIC CORRELATION

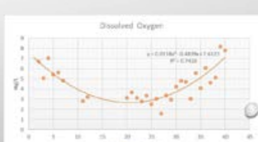




OVERALL TRENDS

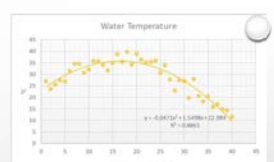
- TEMPERATURE & DISSOLVED OXYGEN
- STRONG QUADRATIC CORRELATION

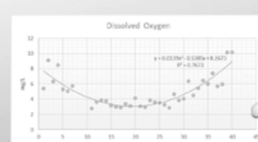




OVERALL TRENDS

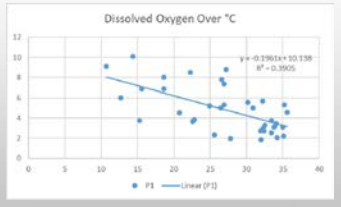
- TEMPERATURE & DISSOLVED OXYGEN
- STRONG QUADRATIC CORRELATION
- R VALUE RANGE OF ~0.8-0.96





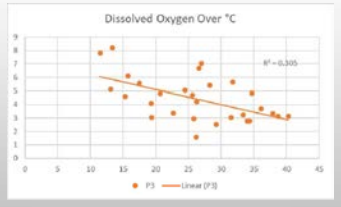
OVERALL TRENDS

- TEMPERATURE & DISSOLVED OXYGEN
- STRONG QUADRATIC CORRELATION
- R VALUE RANGE OF ~0.8-0.96
- MODERATE NEGATIVE CORRELATION



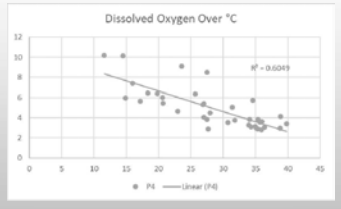
OVERALL TRENDS

- TEMPERATURE & DISSOLVED OXYGEN
- STRONG QUADRATIC CORRELATION
- R VALUE RANGE OF ~0.8-0.96
- MODERATE NEGATIVE CORRELATION



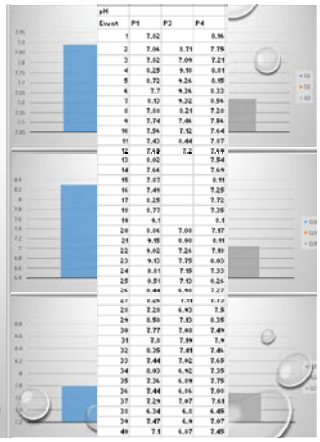
OVERALL TRENDS

- TEMPERATURE & DISSOLVED OXYGEN
- STRONG QUADRATIC CORRELATION
- R VALUE RANGE OF ~0.8-0.96
- MODERATE NEGATIVE CORRELATION
- R VALUE RANGE OF ~0.5-0.7



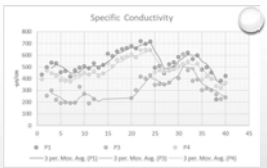
OVERALL TRENDS

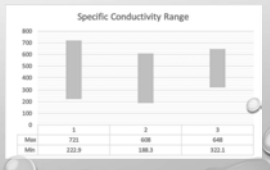
- TEMPERATURE & DISSOLVED OXYGEN
- STRONG QUADRATIC CORRELATION
- R VALUE RANGE OF ~0.8-0.96
- MODERATE NEGATIVE CORRELATION
- R VALUE RANGE OF ~0.5-0.7
- AVERAGE PH SEASONALLY AFFECTED



SITE COMPARISONS

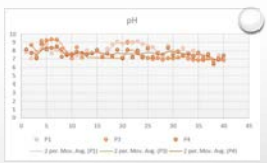
- OVERALL RANGE OF ~190-720 µs/cm
- TDS RANGE OF ~123-468 mg/L (C = 0.65)
- MEDIAN VALUES: 520.5, 302.85, 302.85
- HORSEPEN BAYOU COMPARISON (6/21/23 - 6/22/23):
  - P1: 532
  - P3: 225
  - P4: 463
  - BAY AREA BOULEVARD: 896 (0.3), 1050 (1.3), 2670 (2.2)
  - MIDDLEBROOK: 1290, 5610, 1730, 5400
- DETERMINATION:
- POTENTIAL PARAMETER UNDER TREATMENT
  - WITHIN NORMAL RANGE

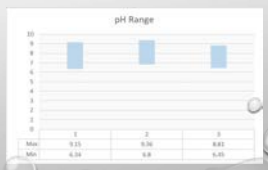




SITE COMPARISONS

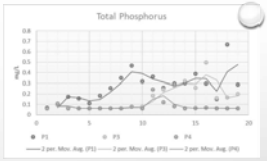
- OVERALL RANGE OF ~6.4 - 9.4
- MEDIAN VALUES: 7.82, 7.13, 7.645
- HORSEPEN BAYOU COMPARISON (6/21/23 - 6/22/23):
  - P1: 7.65
  - P3: 7.2
  - P4: 7.69
  - BAY AREA BOULEVARD: 7.9 (0.3), 7.8 (1.3), 7.4 (2.2)
  - MIDDLEBROOK: 7.7, 8.5, 8.1
- DETERMINATION:
  - TREATMENT INCONCLUSIVE, SLIGHTLY NEUTRAL
  - AVERAGES ALKALINE, SPIKES OUTSIDE RECOMMENDED RANGE (6.5-9)

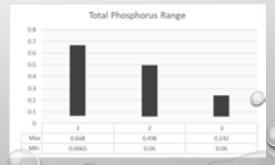




SITE COMPARISONS

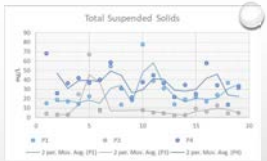
- OVERALL RANGE OF ~0.06 - 0.67 mg/L
- MEDIAN VALUES: 0.291, 0.163, 0.06
- HORSEPEN BAYOU COMPARISON (6/21/23 - 6/22/23):
  - P1: 0.183
  - P3: <0.0600
  - P4: <0.0600
  - BAY AREA BOULEVARD: 0.6 (0.3)
  - MIDDLEBROOK: 0.855
- DETERMINATION:
  - POTENTIAL PARAMETER UNDER TREATMENT, SITE 4 LOWEST
  - WITHIN TYPICAL STORMWATER LEVELS. NO CONCRETE STANDARD. EXCESS CAN ENCOURAGE ALGAL BLOOMS.

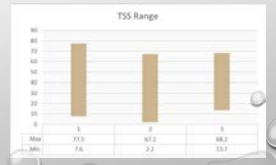




SITE COMPARISONS

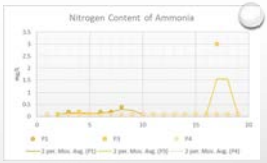
- OVERALL RANGE OF ~2 – 78 mg/L
- MEDIAN VALUES: 19, 5.1, 36.3
- NO COMPARISON. SECCHI DISK AND NARRATIVE DESCRIPTIONS.
- DETERMINATION:
  - SOMEWHAT INCONCLUSIVE, SITE 3 LOWEST, 4 HIGHEST.
  - RECOMMENDED VALUE SITE DEPENDENT, WITHIN EXPECTED RANGE FOR STORMWATER.
  - SOME TSS RECOMMENDED.
  - EPA LIMITS BASED ON PHOTOSYNTHESIS AND PRESENCE OF TOXINS.

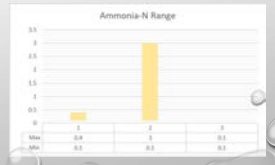




SITE COMPARISONS

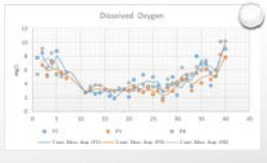
- OVERALL RANGE OF <0.1 - 3 mg/L
- MEDIAN VALUES: 0.1 ACROSS ALL SITES
- HORSEPEN BAYOU COMPARISON (6/21/23 - 6/22/23):
  - P1: 0.2
  - P3: <0.1
  - P4: <0.1
  - MIDDLEBROOK: 0.242
- DETERMINATION:
  - POTENTIAL PARAMETER UNDER TREATMENT
  - USUALLY WITHIN NORMAL LEVELS. SITE 3 SPIKES.

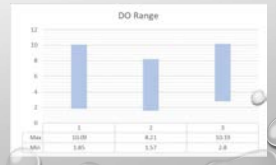




SITE COMPARISONS

- OVERALL RANGE OF ~1.5 - 10.1 mg/L
- MEDIAN VALUES: 4.53, 4.23, 4.14
- HORSEPEN BAYOU COMPARISON (6/21/23 - 6/22/23):
  - P1: 2.98
  - P3: 3.23
  - P4: 3.60
  - BAY AREA BOULEVARD: 0.3 (2.2), 4 (1.3), 5.3 (0.3)
  - MIDDLEBROOK: 7.5, 5.2, 0.2
- DETERMINATION:
  - TREATMENT INCONCLUSIVE. DIFFERENCE IN METHOD.
  - AVERAGES LOW OXYGEN. REFLECTED IN FISH PRESENT.



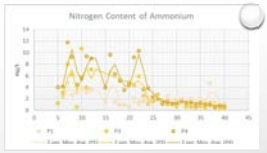


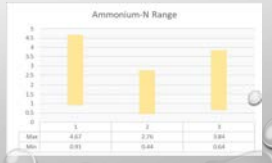
SITE COMPARISONS

- OVERALL RANGE OF <10 – 13,000 MPN/100L
- MEDIAN VALUES: 480, 145, 835
- NO DIRECT COMPARISONS, ENTEROCOCCI.
- 3B YEAR BEFORE (FEB.-SEPT.): 410, 20, 31, 180, 180, 85
- DETERMINATION:
  - TREATMENT INCONCLUSIVE/POSSIBLY NOT TREATED
  - AVERAGES ABOVE PRIMARY AND SECONDARY. HIGHLY VARIABLE.

SITE COMPARISONS

- CORRECTED RANGE OF ~0.4 - 4 mg/L
- MEDIAN VALUES: 1.91, 1.445, 3.875
- NO DIRECT COMPARISONS
- DETERMINATION:
  - TREATMENT INCONCLUSIVE.
  - FAVORABLE RATIO





SITE COMPARISONS

- OTHER PARAMETER OBSERVATIONS
  - FLOW LEVEL:
    - <1IN-2FT.
    - P3 LOWEST
  - TEMPERATURE:
    - ~10-40°C
    - SAMPLED DURING MIDDAY/AFTERNOON
    - STRESSED AQUATIC ECOSYSTEM
  - RAINFALL:
    - SUMMER DROUGHT
    - CLOGGED EQUIPMENT

CHALLENGES

- PROBE FAILURES
- BUBBLER LINE
- RAIN GAUGE
- INTRUDERS

SUMMARY

PROMISING PARAMETERS:

- SPECIFIC CONDUCTIVITY
- TOTAL PHOSPHORUS
- AMMONIA-N

MORE DATA?

- AMMONIUM-N
- PH
- DO
- TSS

LEAST PROMISING:

- E. COLI

SPECIAL THANKS:

- EGC BOARD
- CLEAR LAKE WATER AUTHORITY
- EASTEX LABS
- TEXAS COMMUNITY WATERSHED PARTNERS
- NOAA
- TEXAS COASTAL MANAGEMENT PROGRAM
- TCEQ

CONTACT

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- MORE ABOUT TCWP: HTTPS://TCWP.TAMU.EDU/

Exploration Green Conservancy
Board of Directors
Meeting Minutes – February 6, 2024

The Exploration Green Conservancy Board Meeting was called to order by Board Chair David Sharp at 7:05 p.m., on Tuesday, February 6, 2024, in the Clear Lake City Water Authority Board Room located at 900 Bay Area Boulevard in Houston, Texas. The draft agenda was approved with two changes which were (1) to move New Business to the first item of business after Determination of a Quorum and (2) to move the Communication/Events Committee report the first position under Reports.

Executive Board Members in Attendance

Dave Sharp	Gene Fisseler	Mike Pryor
Rich Sommer	Anthea Guest	Thomas Morrow
Jose Moguel	Lisa Martinez	Liz VanOrstrand

Executive Board Members Absent

Allen Brown	Christie Taylor

Advisory Board Members Present

Matt Forster	Frank Weary

Advisory Board Members Absent

Mary Carol Edwards	Kim Gushanas	Matt Singer
Kenton Fisher	Susan Parker	Barry Ward
George Guillen	Doug Peterson	

Others in Attendance

Tiffany Deshler – Community member	Chris Smith – Communications/Events Team
Mara Savely – Fundraising Team	Kimberly Walls – Water Quality & Wetland Intern, Texas Community Watershed Partners
Gabrielle Scott – AgriLife	

Quorum – the Secretary confirmed that a quorum was present.

New Business – Tiffany Deschler, whose condo backs up to Exploration Green Phase 5, requested permission to site and construct a coastal tall grass pocket prairie on Exploration Green property near her home. She was thanked for her proposal and it was explained that several committees will need to review the request in the context of their ongoing work and that no response would be forthcoming until after the 2024 planting season.

Minutes – The Secretary had distributed the draft meeting minutes of the January 9, 2024, Board meeting to the Board members prior to this meeting. Rich Sommer moved that the minutes be approved and Mike Pryor provided a second. The motion passed and the minutes were approved.

Treasurer's Report – Treasurer Jose Moguel presented the Treasurer's Report. Income during January totaled $7,037.39, all from donations. On the spending side, miscellaneous reimbursements and software fees resulted in total monthly expenses of $1,573.48. The net increase yielded a total fund balance of $228,869.77 at the end of the month. Rich Sommer made a motion to accept the Treasurer's Report. The motion was seconded by Lisa Martinez. The motion passed.

Reports

- Communication/Events/Volunteers – Liz VanOrstrand explained that only a small percentage of the capabilities of Donor Perfect are being utilized. Data regarding donations, donors, volunteers, and events can all be linked to produce invaluable reports and useful Constant Contact communications. But to do so will require that all pertinent data is routinely entered by the various users. In addition, historic data contained in various spreadsheets can be uploaded once it has been reviewed and cleaned up. The options to accomplish the historical data clean-up include paying Donor Perfect for the fort, using volunteers, or going to a third party. We currently pay for the basic Donor Perfect plan with limited record capacity which, in turn, runs up the per contact cost each month. We can upgrade to higher Donor Perfect plan and eliminate both our separate Constant Contact subscription and the per contact charges for an annual increase of about $1,000. That figure will be refined. With the upgrade comes user training. Rich Sommer moved that we upgrade our current subscription to Donor Perfect Plus for an amount not to exceed $1,500. Mike Pryor provided a second and the motion passed.

  Liz reiterated her request for descriptions of events and activities for the website. She also pointed out that information included in the newsletter continues to be inconsistent with that on the website. We have to get this straightened out. We all need to work harder on this so that guests and volunteers can know where and when to go.

  In order for Liz to successfully post event information, folks must supply her with accurate and timely input – dates, times, and meet-up locations. Accurate street addresses are necessary to get folks to the correct locations – we have to get them right in our communications.

  Outreach opportunities are increasing, and outreach volunteers are needed. Upcoming outreach dates include February 10 (Clear Lake City Elementary Annual Family Fun Day), March 7 (Seabrook Intermediate STEM Night), April 20 (EGC Stewardship Day/Earth Day weekend), and April 27 (Armand Bayou Nature Center Earth Day event). Importantly, our outreach representatives must have an "elevator speech" that they can deliver. That elevator speech must be common to everyone; i.e., one set of talking points that everyone can use and everyone sticks to. More to come on this topic.

  Liz and Matt Forster are working together to enlist even more Texas Master Naturalists for Exploration Green volunteer work.

- Fundraising Team – Mara Savely continues to work on a grant request for submittal to Port Houston. A Letter of Intent will be submitted before the end of February and, depending on Port Houston's feedback, the full request will be submitted in March. Next up is the HEB grant request.

- Capital Campaign Team – David Sharp reported that the capital campaign remains idle for the time being and, before it is restarted, there will need to be some alignment between Exploration Conservancy and CLCWA. David and Thomas Morrow will set up a meeting to discuss. David further reported that work on the website continues and reminded Board members to submit their brief biographical summaries. The Conservancy is now successfully registered with the Combined Federal Campaign which yielded $5,000 in EGC donations last year.

- Tree Nursery Team – Lisa Martinez and Rich Sommer have conducted a tree replacement survey with the following findings: 46 replacement trees to be planted on the Phase 4 island; 38 trees to be planted in Phase 3A; and 17 trees to be planted near the parking lot. Phase 5 new tree planting will be split evenly between 2024 and 2025.

  Wetland Plant Nursery Team – Gabrielle Scott announced that the February 17 Stewardship Saturday activities will include trash pick-up and general clean-up. March 2 will be a Boy Scout Day.

  Kimberly Walls presented the results of the water parameter measurement and water quality sampling and analysis program conducted at three distinct points in Exploration Green. The field program was initiated April 2023 and was concluded February 2024. Parameters observed, measured and analyzed include rainfall, flow rate, water temperature, total suspended solids, specific conductivity, pH, dissolved oxygen, ammonia-N, ammonium-N, total phosphorus, and e.coli. The results of the analysis performed were compared against data available from downstream Horsepen Bayou. Many of the findings were not surprising but there will be some follow-up regarding low warm weather DO and e. coli spikes.

- Project (Amenities) Committee – Mike Pryor reported he had met with Big Boy Concrete regarding installation of benches in Phase 1 and in Phase 3B. He has also completed installation of dedication plaques on seven more trees.

- Land Steward – Matt Forster advised that two portable toilets have been set up in Exploration Green for public use, one in Phase 2 and Phase 4. Recent wildlife observations in the Green include bats in a downed tree, brown pelicans, and a river otter.

Old Business – The Visioning Team will be returning to work on the land use plan. Phase 5 construction is complete; however, the grass is not taking root and reseeding is likely.

Next Meeting – The next meeting of the Board will be convened on Tuesday, March 12, 2024.

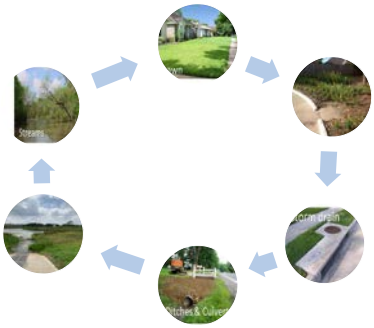
Adjournment – Lisa Martinez moved to adjourn the meeting. Liz VanOrstrand provided a second and the motion passed. The meeting was adjourned at 9:10 p.m.

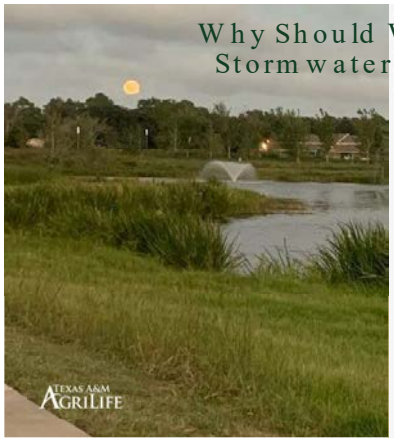
TEXAS A&M AGRILIFE

GIFT Mid-scale Projects: Stormwater Wetlands and Conservation Neighborhood Planning

Christie Taylor, Program Specialist
Stormwater Wetland Program
Texas Community Watershed Partners
cctaylor@tamu.edu

The Path of Runoff and Pollution





Why Should We Consider Stormwater Wetlands?

Benefits to Wildlife

- Habitat Creation
- Nesting sites
- Food and water source
- Increase in Pollinators
- Biodiversity

Benefits to People

- Flood Control
- Improved Water Quality
- Recreational & Health Benefits
- Educational Benefits
- Economic Benefits

How Do We Claim These Benefits?

Planning

Research

Partnerships

What is a Stormwater Wetland?

Construct for the purpose of flood control and water quality improvement

Not part of mitigation for permitted activity

Medium or Neighborhood scale stormwater detention area connected to larger waterbody

EPA: Maintaining only 15% of the area of a watershed in wetlands can reduce flooding peaks by 60%.

How do we begin?

Study
What is the issue? Where does the water come from and where does it flow? Surfaces, Soil, Size, Coverage Area

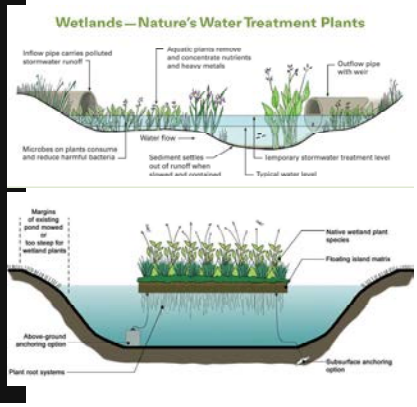
Design
What do we want? Outreach to community, depth, ratio of water to wetland, microtopography, planting type, cost evaluation, control structure, hold time

Construction
Excavation, Testing, Planting, Seeding

Maintenance and Monitoring
It takes time for the plants to fully establish (1-3 years), will need to remove sediment occasionally, mowing schedule, what to do about nuisance animals or undesirable plants.

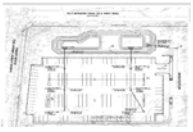
Communication is the key.

Two Basic styles of Storm water Wetlands



Sample Demonstration Projects

City: Houston
Watershed: Brays Bayou
Size: 0.25 ac



City: Houston
Watershed: Brays Bayou
Size: 0.62 ac

Mix of Green in between Grey Infrastructure can still create benefits.

Sample Demonstration Projects

Floating Wetland Retrofit at Pearland Nature Center

City: Pearland
Watershed: Clear Creek
Size (pond): 26 acres

Houston Botanic Garden

City: Houston
Watershed: Sims Bayou
Size: ~ 3 Acres

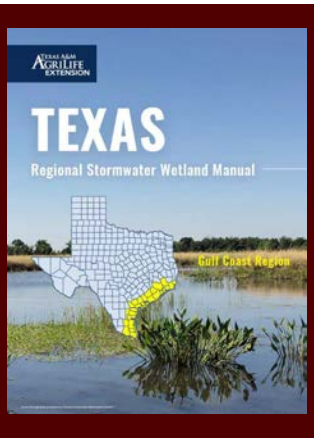
Sample Demonstration Projects

City: Houston (Clear Lake City)
Watershed: Clear Creek
Size at completion: 40 acres wetland within 200 acres parkland
Project Partners:
- **Exploration Green Conservancy**
- **Clear Lake City Water Authority**
- **Texas Master Naturalist Program**
- **Galveston Bay Foundation**
- **Texas Parks and Wildlife**
- **Galveston Bay Estuary Program TCEQ**
- **Coastal Management Program GLO**
- **NOAA**
- **County Commissioner's Office**

Project Nursery

Can't remember all the things we discussed today?

Pick up the newest resource on our publication table.



Parameters Monitored at Exploration Green

Bi-Weekly Lab Data

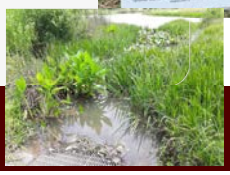
- AMMONIA-N (mg/L)
- TOTAL SUSPENDED SOLIDS (TSS) (mg/L)
- TOTAL PHOSPHORUS (mg/L)
- E. COLI (mpn/100mL)

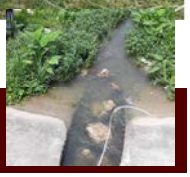
Weekly Field Data

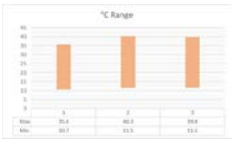
- DISSOLVED OXYGEN (DO) (mg/L)
- WATER TEMPERATURE (°C)
- SPECIFIC CONDUCTANCE (µs/cm)
- AMMONIUM-N (mg/L)
- pH

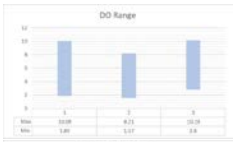
Passive collection

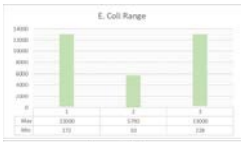
- FLOW LEVEL (ft.)
- RAINFALL AMOUNT (in.)

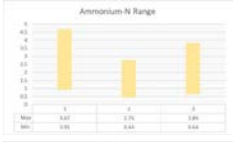


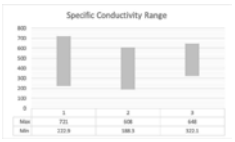


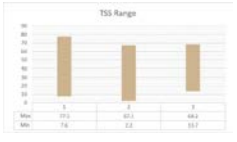


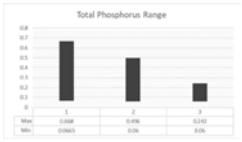


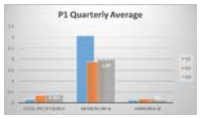


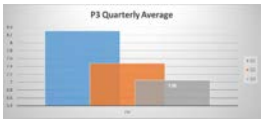


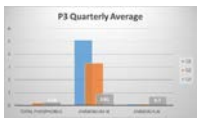


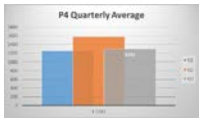












Check out our website

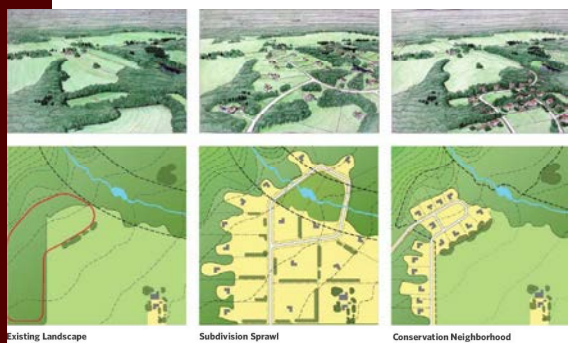
https://tcwp.tamu.edu/stormwater/wetlands/stormwater-wetland-water-quality-monitoring-project/

Quarterly Water quality updates
Lab reports
Data Tables
QAPP
Archive

Charts & Graphs provided by Kimberly Walls

What if wetlands aren't right for an area?

A **conservation development** is usually defined as a project that dedicates a minimum of 50 percent of the total development parcel as open space.



http://www.designyourtown.org/design_detail/conservation-subdivisions/

Not one size fits all...

Conservation development refers to an approach that combines new residential construction and land protection and generates revenue while accomplishing conservation goals. Although often discussed in terms of clustered, high-density housing – as opposed to sprawl – conservation development can include many other types of projects, depending on their particular conservation goals and outcomes.

Contact Us

We'd love to talk about all things Wetlands and Watersheds.

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Respectfully submitted,

Gene Fisseler, Secretary

Appendix 5: White paper

Exploration Green Water Quality Baseline Study

GLO Contract No. 23-020-005-DD599
Coastal Management Program - Cycle 27

March 2024

THIS PROJECT WAS FUNDED "IN PART" BY A TEXAS COASTAL MANAGEMENT PROGRAM GRANT APPROVED BY THE TEXAS LAND COMMISSIONER, PROVIDING FINANCIAL ASSISTANCE UNDER THE COASTAL ZONE MANAGEMENT ACT OF 1972, AS AMENDED, AWARDED BY THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA), OFFICE FOR COASTAL MANAGEMENT, PURSUANT TO NOAA AWARD NO. NA22NOS4190148.

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Project Manager

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Texas A&M AgriLife Extension Services

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Quality Assurance Officer

EASTEX LABS

Coldspring, TX 77331

ABBREVIATIONS

°C - Degrees Celsius

µS/cm - Micro Siemens per Centimeter

mg/L - Milligrams per Liter

mL – Milliliter

mpn/100mL - Most Probable Number per 100 Milliliters

EPA – Environmental Protection Agency

NELAP – National Environmental Laboratory Accreditation Program

TCEQ – Texas Commission on Environmental Quality

TCWP – Texas Community Watershed Partners

TSS – Total Suspended Solids

TABLE OF CONTENTS

INTRODUCTION

Beginning in 2015, the community organizations involved in the Exploration Green project, including Texas Community Watershed Partners (TCWP), undertook the ambitious plan of turning a 178-acre Clear Lake golf course into a series of stormwater detention ponds. With the primary goal of providing up to 500 million gallons of storage in stormwater, the project aims to restore wetland habitat with native vegetation and act as a natural form of stormwater treatment [1][2]. Exploration Green's detention ponds are surrounded by urban residential and heavily commuted roadways dotted with commercial and office buildings. Feeding into Horsepen Bayou, Exploration Green is potentially a significant drainage source into the Armand Bayou subwatershed. These qualities make Exploration Green an excellent candidate for testing the effectiveness of stormwater wetlands on water quality and urban runoff, yet a baseline study for this project does not yet exist for comparative data analysis. This research aims to fulfill that need and provide a basis for future decision-making and analysis as it pertains to water quality within constructed detention ponds such as the ones present at Exploration Green.

METHODOLOGY

Three outflow locations of three different construction phases were chosen to compare constructed wetlands with varied amounts of the desired vegetation. Water quality testing began in April of 2023 and continued weekly through February of 2024. Using a combination of handheld and composite lab sampling, data parameters were maximized under the specified budget. Parameters included ammonium nitrogen levels, dissolved oxygen, specific conductivity, water temperature, pH, flow level, and rainfall amount. Handheld sampling equipment was calibrated immediately before weekly arrival on site and represented water quality at midday and afternoon. Automatic biweekly composite samples were distributed into plastic containers, on ice, with the proper preservation solutions. These samples were handed off to a courier to be tested for ammonia nitrogen level, E. coli counts, total phosphorus, and total suspended solids at a NELAP accredited lab. The table below details the specific equipment and methodology.

Location	**Outflow Volume**	**Outflow Concentration**
Exploration Green Nature Park Phase 1 (Site 1)	Measured with ISCO 6712 automated sampler triggered to collect a biweekly composite sample in a 9L bottle. Flow volume recorded from the ISCO 730 bubble flow meter. Rainfall amount measured from the ISCO 674 tipping bucket rain gauge. A pasture stick was used as a flow reference.	Direct laboratory measurements of composite samples analyzed biweekly. A YSI ProQuatro handheld multiparameter meter measures additional parameters onsite weekly with a YSI Professional Plus being used as needed.

Exploration Green Nature Park Phase 3 (Site 3)	Measured with ISCO 6712 automated sampler triggered to collect a biweekly composite sample in a 9L bottle. Flow volume recorded from the ISCO 730 bubble flow meter. Rainfall amount measured from the ISCO 674 tipping bucket rain gauge. A pasture stick was used as a flow reference.	Direct laboratory measurements of composite samples analyzed biweekly. A YSI ProQuatro handheld multiparameter meter measures additional parameters onsite weekly with a YSI Professional Plus being used as needed.
Exploration Green Nature Park Phase 4 (Site 4)	Measured with ISCO 6712 automated sampler triggered to collect a biweekly composite sample in a 9L bottle. Flow volume recorded from the ISCO 730 bubble flow meter. Rainfall amount measured from the ISCO 674 tipping bucket rain gauge. A pasture stick was used as a flow reference.	Direct laboratory measurements of composite samples analyzed biweekly. A YSI ProQuatro handheld multiparameter meter measures additional parameters onsite weekly with a YSI Professional Plus being used as needed.

Each lab sampling event was timed so that the courier handling the samples would reach the lab in the appropriate hold time. The storage methods and hold time of each lab parameter is listed in the table below.

Parameter	**Matrix**	**Sample Type**	**Container**	**Preservation**	**Sample Volume**	**Hold Time**
E. coli	water	composite	Sterile, plastic	Sodium Thiosulfate <60 C	125mL	24 hours*
TSS	water	composite	Plastic	<60C	1000mL	7 days
Total Phosphorus	water	composite	Plastic	Nitric acid <60 C	250mL	28 days
Ammonia as Nitrogen	water	composite	Plastic	Sulfuric acid <60 C	500mL	28 days

KEY FINDINGS

BASE FINDINGS

The range of each parameter was analyzed and recorded. Instead of mean, median values were selected as being representative of the dataset. This was done to more accurately reflect the typical water quality present, independent of specific events and outliers.

Specific conductance measured with an overall range of 172.2 to 648 µS/cm. In terms of specific sites, Site 1 had a range of 222.9 to 721 µS/cm, Site 3 a range of 172.2 to 608 µS/cm, and Site 4 a range of 276.3 to 648 µS/cm. Median values of 501.5, 287.65, and 448.05 µS/cm were present for Site 1, 3, and 4 respectively.

E. coli measured with an overall range of 10 to 13,000 mpn/100mL. In terms of specific sites, Site 1 had a range of 86 to 13,000 mpn/100mL, Site 3 a range of 10 to 5,790 mpn/100mL, and Site 4 a range of 47 to 13,000 mpn/100mL. Median values of 394, 110, and 427.5 mpn/100mL were present for Site 1, 3, and 4 respectively.

Total phosphorus measured with an overall range of 0.0600 to 0.688 mg/L. In terms of specific sites, Site 1 had a range of 0.0665 to 0.688 mg/L, Site 3 a range of 0.0600 to 0.496 mg/L, and Site 4 a range of 0.0600 to 0.269 mg/L. Median values of 0.2995, 0.163, and 0.0624 mg/L were present for Site 1, 3, and 4 respectively.

Total suspended solids measured with an overall range of 1 to 77.5 mg/L. In terms of specific sites, Site 1 had a range of 7.6 to 77.5 mg/L, Site 3 a range of 1 to 67.1 mg/L, and Site 4 a range of 13.7 to 68.2 mg/L. Median values of 19, 4.35, and 34.5 mg/L were present for Site 1, 3, and 4 respectively.

Dissolved oxygen measured with an overall range of 1.57 to 10.19 mg/L. In terms of specific sites, Site 1 had a range of 1.85 to 10.09 mg/L, Site 3 a range of 1.57 to 8.38 mg/L, and Site 4 a range of 2.8 to 10.19 mg/L. Median values of 5, 4.71, and 5.04 mg/L were present for Site 1, 3, and 4 respectively.

The water temperature measured with an overall range of 10.7 to 40.3°C. In terms of specific sites, Site 1 had a range of 10.7 to 35.6°C, Site 3 a range of 11.5 to 40.3°C, and Site 4 a range of 11.6 to 39.8°C. Median values of 27.05, 26, and 27.6°C were present for Site 1, 3, and 4 respectively.

pH measured with an overall range of 6.34 to 9.36. In terms of specific sites, Site 1 had a range of 6.34 to 9.15, Site 3 a range of 6.68 to 9.36, and Site 4 a range of 6.45 to 8.81. Median values of 7.755, 7.1, and 7.625 were present for Site 1, 3, and 4 respectively.

Nitrogen of ammonia had an overall range of 0.1 to 3 mg/L. In terms of specific sites, Site 1 had a range of 0.1 to 0.9 mg/L, Site 3 a range of 0.1 to 3 mg/L, and Site 4 a range of 0.1 to 1.4 mg/L. A median value of 0.1 mg/L was present for all sites.

Nitrogen of ammonium measured with an overall range of 0.44 to 4.67 mg/L. In terms of specific sites, Site 1 had a range of 0.91 to 4.67 mg/L, Site 3 a range of 0.44 to 2.76 mg/L, and Site 4 a range of 0.6 and 3.84 mg/L. Median values of 1.76, 1.16, and 2.93 mg/L were present for Site 1, 3, and 4 respectively.

Flow Level had an overall range of 0 to 2.234 feet. In terms of specific sites, Site 1 had a range of 0 to 2.85, Site 3 a range of blank to blank, and Site 4 a range of blank to blank. Median values of 1.017, 0.321, and 0.42 were present for Site 1, 3, and 4 respectively.

Total rainfall over the sampling period was calculated to be 49.22 inches. The rain gauge measuring the data rarely displayed a 30-minute rainfall event above 1.0 inches. In terms of specific sites, Sites 1 and 4 tended to collect the most amount of rain while Site 3 collected the least. The average amount of rainfall every 30 minutes ranged from 0 to 0.003 inches.

LOCAL COMPARISON

To find a comparative baseline, data from two different sampling sites were referenced along Horsepen Bayou in as close proximity to Exploration Green as possible. One near bay area boulevard and the other near Middlebrook. Sampling sites further downstream were not used due to increases in salinity level and the vicinity to other types of outflow or runoff sources. Upstream, the water body is thinned into residential drainage and did not have any available water quality data in the TCEQ Texas Clean Rivers database referenced [3]. The data selected indicated water quality snapshots within the time frame of June 21st to June 22nd of 2023. Regular long-term sampling data from the comparative sources was not available. Methodology differed slightly; the selected sources having been measured at different depths in the water source. Only some of the tested parameters were able to be compared using this method. For example, most local sampling efforts test for Enterococci instead of E. coli. This is most likely because Enterococci can be used for a wider variety of water sources [4]. Secchi disks and narrative descriptions also seem to be the preferred method of determining the turbidity of water in the area rather than testing for total suspended solids.

For specific conductance, Exploration Green was measured to have nearly less than half to as much as half of the level of conductance reported in Horsepen Bayou. Site 1, 3, and 4 measured with values of 532, 225, and 463 µS/cm respectively. The site at bay area boulevard measured with values ranging from 896 to 2670 µS/cm while the site at Middlebrook measured with values ranging from 1290 to 5610 µS/cm.

For pH, Exploration Green was measured to have values similar to Horsepen Bayou, presenting as slightly more acidic than downstream. Site 1, 3, and 4 measured with values of 7.65, 7.2, and 7.69 respectively. The site at bay area boulevard measured with values ranging from 7.4 to 7.9 while the site at Middlebrook measured with values ranging from 7.7 to 8.5.

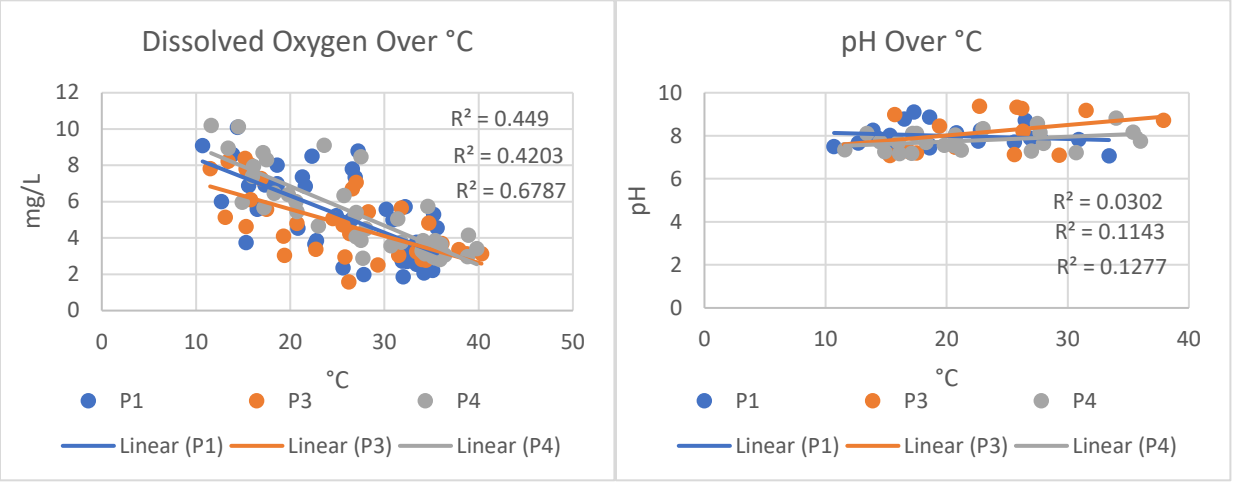
For total phosphorus, Exploration Green was tested to have values less than half of what was present in Horsepen Bayou. Site 1, 3, and 4 measured with values of 0.183 mg/L and less than 0.0600 mg/L respectively. The site at bay area boulevard was tested to have a value of 0.6 mg/L while the site at Middlebrook tested to have a value of 0.855 mg/L.

For nitrogen content of ammonia, Exploration Green was tested to have values similar to Horsepen Bayou. Sites 1, 3, and 4 were measured to have values of 0.2 mg/L and less than 0.1 mg/L respectively while the Middlebrook site measured to have 0.242 mg/L. The site at Bay Area Boulevard did not test for this parameter.

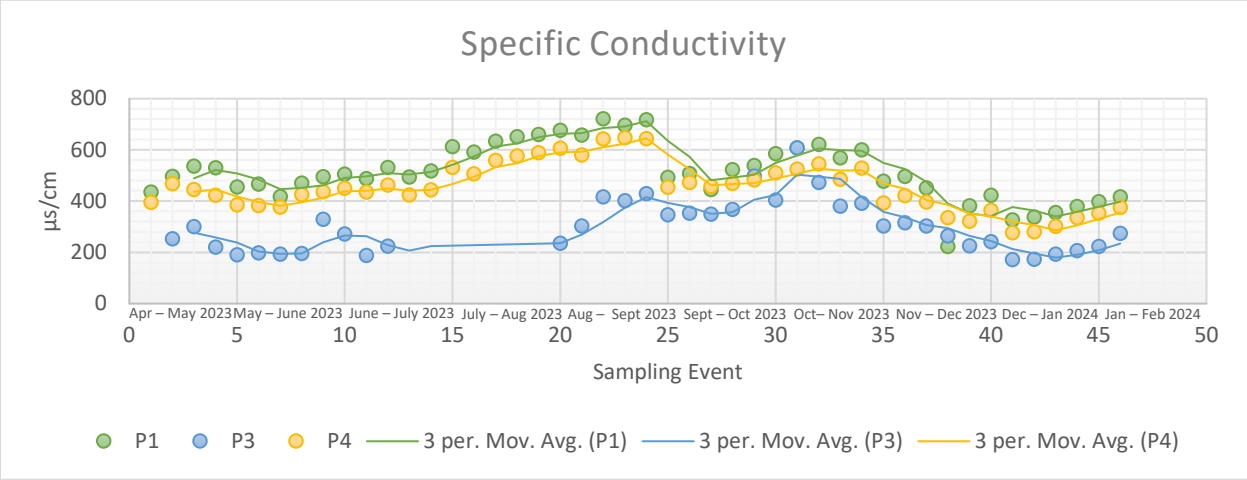
For dissolved oxygen, Exploration Green was measured to have slightly lower values than Horsepen Bayou. Sites 1, 3, and 4 were measured to have values of 2.98, 3.23, and 3.60 mg/L respectively. The site at Bay Area Boulevard was measured to have a gradient of 0.3 to 5.3 mg/L while the site at Middlebrook had a gradient of 0.2 to 7.5 mg/L.

TRENDS

There were several observable trends that occurred both between the different phases and between different seasonal conditions. In warmer months, the pH increased in the frequency of values over 9.0, while the colder months increased the frequency of values below 7.0. When graphically compared to temperature, there existed little correlation between the two parameters, having a maximum R value rounded to 0.37. The change in dissolved oxygen accompanied the change in temperature closely with an R value rounded to 0.66.



There existed a clear difference in specific conductance between the different outflow sites throughout the testing period. Site 1 consistently displayed the highest values followed by Site 4 and Site 3, with Site 1 and 4 displaying trend lines of highly similar shape to one another.



After data correction, nitrogen of ammonium displayed a similar trend of Site 1 with the highest values followed by Site 4 and Site 3.

Figure before correction

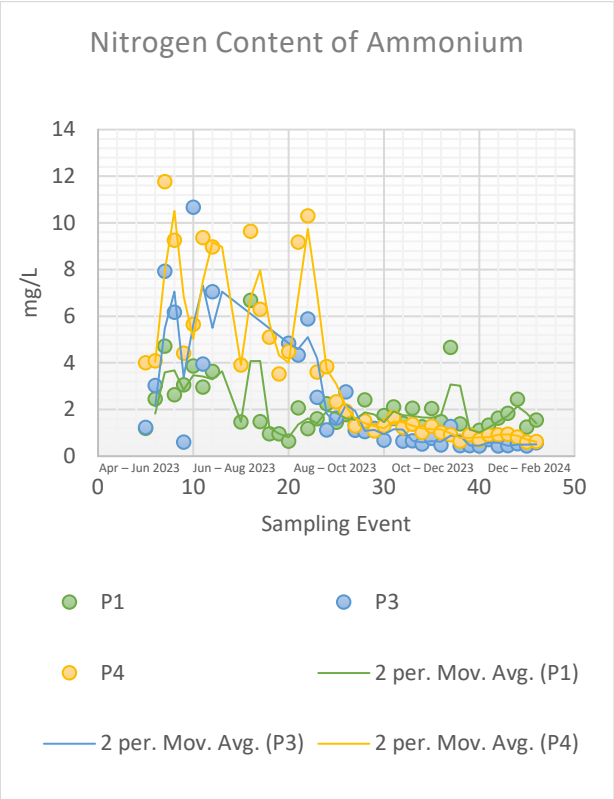
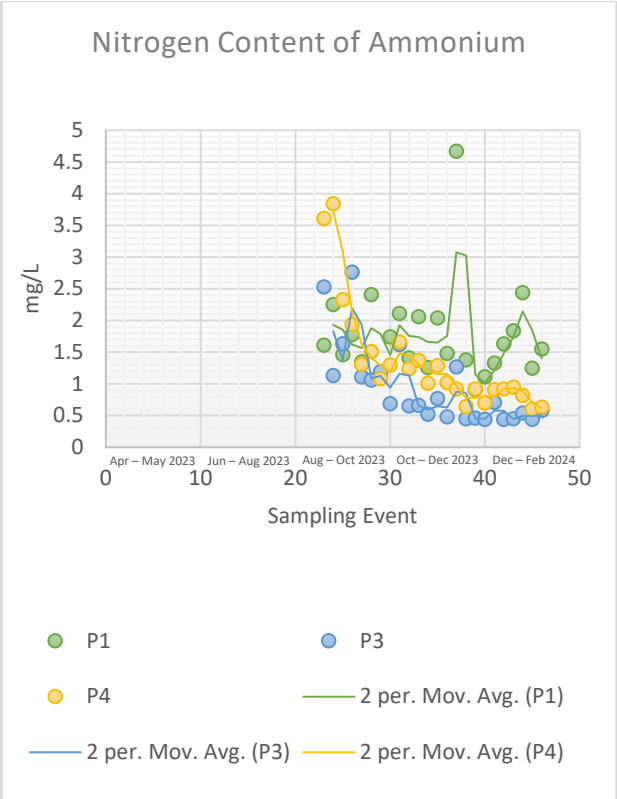
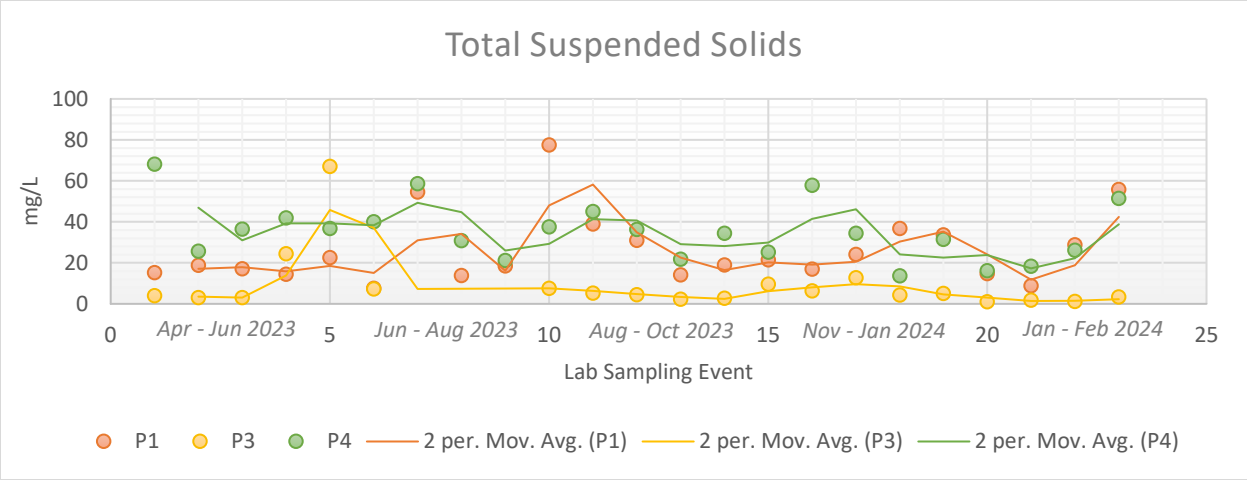


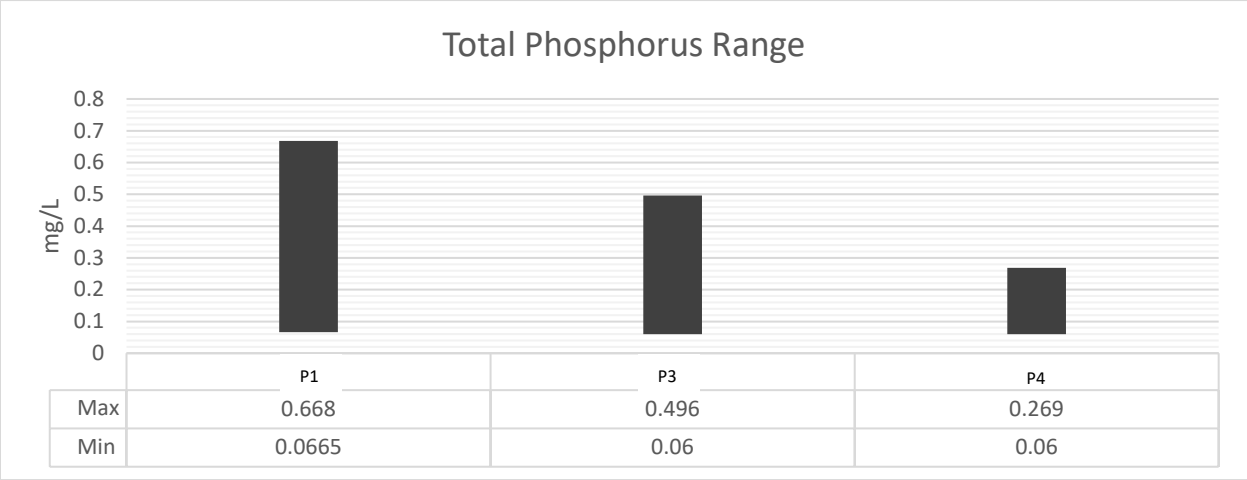
Figure After correction



The clear difference in median values between the different sites in terms of total suspended solids displays a general difference in turbidity levels between the different detention ponds. Site 4 contained the most amount of total suspended solids more often while Site 3 contained the least amount of total suspended solids the most often. The difference is slightly visible when displayed graphically.



Total phosphorus also appeared to have distinct differences in average water quality between the different phases, having clear differences in maximum values. When ordered from highest to lowest in both median and maximum values, Site 1 ranks as having the highest phosphorus levels while Site 4 had the lowest values.



	P1	P3	P4
Max	0.668	0.496	0.269
Min	0.0665	0.06	0.06

Conclusion

Exploration Green's subcategory for aquatic life based off TCEQ standards appears to fall under the intermediate category for most of the year, varying in oxygen levels from minimal to exceptional [5]. This is reflected in the observed fish life that reside in the detention ponds, only containing abundance of low-oxygen tolerant species.

The geometric mean of each site's E. coli levels was calculated to be 542.97, 166.45, and 353.9 mpn/100mL for Site 1, 3, and 4 respectively. This places Site 3 in the second category for primary contact recreation and Site 1 and 4 in the first category of secondary contact recreation [6]. However, single spikes in E. coli levels routinely measured above the levels recommended for secondary contact recreation. One spike in two sites simultaneously measured over 10,000 units above the level for noncontact recreation.

Most other parameters were within expected levels for stormwater, going outside of expected ranges on rare occasions. Nitrogen of ammonia experienced a prolonged spike in values shortly before the end of this study after nearly an entire year of Site 4 having not experienced a single spike in levels.

Overall, Exploration Green shows promise in its ability to act as a filtration method, displaying improved comparative levels with parameters such as specific conductance and total phosphorus. However, more research is needed to concretely confirm the method's effect on water quality. There also still exists parameters that the detention ponds could improve upon, such as stabilizing E. coli and dissolved oxygen levels.

The areas in which this study could improve include better equipment and maintenance, the use of parameters that allow for better comparison to local sampling efforts, and the ability to sample from different levels within the water body. More extensive state water quality standards are recommended to more easily deduce whether certain parameters are outside of expected levels.

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6. RULE §307.7: Site Specific Uses and Criteria. Texas Administrative Code. 2022. https://texreg.sos.state.tx.us/public/readtac$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=30&pt=1&ch=307&rl=7

Appendix 6: Project Staff Curriculum Vitas

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ELENA ESPINOZA

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EXPERIENCE

JANUARY 17TH 2023– CURRENT

WETLAND EXTENSION ASSISTANT, TEXAS A&M AGRILIFE

Maintain two wetland plant nurseries. Organize planting events at various wetland sites and assist on volunteer workdays. Aid in a high school career development program and other community outreach events.

FEBRUARY 2021 – DECEMBER 17TH 2022

COMMUNITY LEADER, TEXAS A&M UNIVERSITY AT GALVESTON

Establish a productive and comfortable living environment for freshman engineers. Plan activities for them to assimilate into their new community. Provide resources for students and offer solutions to problems they may face. Administer individual counseling sessions with each resident.

JANUARY 2021 – MAY 2022

CHEMISTRY LAB TECHNICIAN, TEXAS A&M UNIVERISTY AT GALVESTON

Prepare necessary chemicals and glassware needed by students for the Organic Chemistry lab. Administer two labs per week for two Organic Chemistry classes.

EDUCATION

DECEMBER 2022

BACHELOR OF SCIENCE IN MARINE BIOLOGY, TEXAS A&M UNIVERISTY AT GALVESTON

Bachelor of science in Marine Biology, with a minor in Chemistry. GPA 3.6 and graduated with Honors. Relevant coursework includes Coastal Plant Ecology, Elasmobranch Ecology, Biology of Marine Mammals, Ichthyology, and Chemistry of Environmental Pollution.

MAY 2018

HIGHSCHOOL DIPLOMA, EDWARD S MARCUS HIGHSCHOOL

GPA 4.5. Member of the National Honor Society. Awarded Outstanding Student Award and awarded National Hispanic Scholar.

SKILLS

- Proficient communicator with people from diverse backgrounds
- Team collaboration office
- Time management
- Proficient in both lab and field work
- Computer proficiency, especially Microsoft

ACTIVITIES

MAY 2022 – DECEMBER 2022

TEXAS A&M AT GALVESTON WOMEN'S SOCCER CLUB PRESIDENT

Organize games with other universities in our league. Plan and conduct weekly practices. Manage the club's budget and logistics. Represent the club at events on campus and in public.

JANUARY 2019 – DECEMBER 2022

LAMDA KAPPA ALPHA HONOR'S ASSOCIATION

Volunteer for events around campus and the community. Maintain a GPA of 3.5 or higher.

SEPTEMBER 2022 – DECEMBER 2022

EDUCATIONAL OUTREACH INTERACTIVE DISPLAY AT TAMUG SEA CAMP

Researched, planned, built, and installed an educational art piece for Texas A&M University at Galveston's Educational outreach program, Sea Camp, featuring six different species of sharks native to the Gulf of Mexico.

SEPTEMBER 2021 – DECEMBER 2021

GALVESTON BAY FOUNDATION OYSTER FARMS

Volunteered with Galveston Bay Foundation and the Seafood Safety Lab. Maintained the health of an oyster farm. Counted the spat (baby oysters), documented any organisms in or on the reef, and took water quality readings.

Christina C. C. Taylor
1335 Regents Park Dr. Suite 260, Houston, Texas 77058 979-399-4009 • christina.taylor@ag.tamu.edu

EDUCATION

M.S. in Rangeland Ecology and Management - May 2008 – Texas A&M University

B.S. in Marine Biology - December 1999 – Texas A&M University

EXPERIENCE

2018-present Extension Program Specialist Level 1, Texas A&M AgriLife Extension Service, Houston, Texas

2005-2018 Wetland Environmental Consultant, SMC Consulting, Inc. Pearland, Texas

2007 Wetland Environmental Consultant, Blanton Associates Austin, Texas

2006 Wetland Environmental Consultant, DESCO Magnolia, Texas

2004-2005 Research Assistant, Texas A&M University Galveston, Texas

2003-2005 Graduate Teaching Assistant, Texas A&M University Galveston, Texas

2000-2003 Research Technician Genome Sequencing Project, Baylor College of Medicine Houston, Texas

PUBLICATIONS

Henry, Jessica and **Christie Taylor** 2020.Houston Botanic Garden Stormwater Wetlands Final Report.

Taylor, Christie 2020. Initiating Water Quality Sampling of Stormwater Treatment Wetlands in Galveston Bay Watershed.

Ulibarri, C, R Kline, A Rydzak, P Roling, M Llosa, **C Taylor**, and C York. 2020. Monitoring Vegetation Indicators to Assess the Success of Wetland Restoration.

Taylor, C.C.C. 2020. Wildlife Management Plan for Sedona Lakes

Taylor, C. 2018. Wildlife Management Plan for Spekbug

Taylor, C. C. 2008. Thesis

PRESENTATIONS

2021-22 Taylor, C.C.C. GIFT Mid-scale Projects: Stormwater Wetlands. Clean Coast Texas Green Infrastructure Workshops. Aransas Pass and Kingsville, Texas

2021 Taylor, C.C.C. Stormwater Wetlands as Green Infrastructure: Nature Based Solutions for Stormwater Issues. Zoom Baffin Bay Webinar

2020 Taylor, C.C.C. Exploration Green: A Stormwater Wetland Project. Zoom Presentation. Dr. Feagin's Wetland and Riparian Restoration Class

2020 Taylor, C.C.C. Initiating Water Quality Sampling of Stormwater Treatment Wetlands in Galveston Bay Watershed. Zoom Meetings. CMP, MD Anderson and Exploration Green

2020 Taylor, C.C.C. We All Live in a Watershed. 4-H2O Ambassadors Presentation. Zoom Webinar

2020 Taylor, C. C. C. Texas Master Naturalist Wetland Training Class. Gulf Coast Master Naturalist Chapter Sheldon Lake State Park Sheldon, TX.

2020 Taylor, C.C.C. GIFT-Stormwater Wetlands Where We Stand and What's Next. Clear Lake City, Houston, Texas. WSQ Subcommittee Meeting

2020 Taylor, C. C. C. Constructed Stormwater Wetlands: What have we learned? State of the Bay Symposium. Galveston, TX.

2019 Taylor, C. C. C. Exploration Green Town Hall Presentation. Clear Lake City, Houston, TX 2019

Taylor, C. C. C. Exploration Green Field Day. Clear Lake City, Houston, TX.

2019 Taylor, C. C. C. Managing Our Stormwater Gutter to Stream Constructed Stormwater Wetlands. Corpus Christi, Arlington, Beaumont, Austin, Pearland, Brownsville, TX.

2019 Taylor, C. C. C. Texas Master Naturalist Wetland Training Class. Gulf Coast Master Naturalist Chapter Sheldon Lake State Park Sheldon, TX.

GRANTS / PROPOSALS

2021 Green Infrastructure for Texas High School Intern Program. EPA STEM Career Development RFA (EPA-GM-2021-HSCD) Requested $297,079 (Awarded)

2021 Promoting Healthy Soils and Green Infrastructure for Improved Water Quality in the Lower Galveston Bay Watershed. GBEP FY2023 WSQ Subcommittee Proposal Requested $92,309 (not awarded)

2021 Exploring Education Connections at Exploration Green. GBEP FY2023 PPE Subcommittee Proposal Requested $98,942 (not awarded)

2021 Exploration Green Stormwater Wetland Water Quality Baseline Study. CMP Cycle 27 Proposal Accepted Total Project Cost $118,473. (Awarded)

2020 Innovative Comprehensive Approach to Riparian Restorations: Sims Bayou Pilot Program. Joint Proposal with Houston Botanic Garden CMP Cycle 26 (not awarded)

2019 Green Infrastructure from Planning to Action: Keys to Healthy Resilient Watershed Communities. NOAA Office of Education Environmental Literacy Program FY 2021 PreProposal Requested $470,364 (not awarded)

2019 Green Infrastructure for Texas: Expanding Stormwater Wetlands in Brazoria County. Galveston Bay Estuary Program FY2021 Project Proposal Requested $40,000 (not awarded)

PROJECTS

- Exploration Green Stormwater Wetland Water Quality Study
- GIFT High School Intern Program
- Regional Stormwater Wetland Manual
- Exploration Green Stormwater Wetland
- MDA Proton Therapy Parking Lot Expansion Stormwater Wetland
- Pearland Nature Center Floating Wetlands Maintenance
- Sheldon Lake State Park Vegetation Monitoring Project
- Stormwater Wetland Water Quality Sampling Project

MEMBERSHIPS / AFFILIATIONS / COMMITTEES

- Exploration Green Conservancy Executive Board
- Exploration Green Conservancy Advisory Board
- Texas Extension Specialists Association member
- Galveston Bay Estuary Program Water and Sediment Quality Subcommittee
- Gamma Sigma Delta

CERTIFICATIONS

2022 Texas Riparian and Stream Ecosystem Course

2017 Wetland Delineation & Regional Supplement Training

2003 Wetland Delineator Certification Program

Gabrielle Scott

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EDUCATION

Texas A&M University College Station, TX
Plant and Environmental Soil Science w/ Soil and Water Emphasis Graduation: 05/2023
Geology and Agronomy Minor Cumulative GPA: 3.2/4.0

WORK EXPERIENCE

Texas A&M Extension- Rosenberg Rosenberg, TX
Pesticide Intern (Summer Intern) *5/9/18 – 8/15/18*

- As a Texas A&M intern my duties were to aid my supervisor John Gordy in his research under the A&M research efforts under the Agriculture/Natural Resource branch of Texas A&M. The project which my supervisor and colleagues aimed to accomplish were to see what pesticides would produc optimal growth and protection for various crops such as cotton, sorghum, rice, and soy.

HTeaO- Sugarland Sugarland, TX
Sales Associate *5/14/20 – 7/20/20*

- My duties as a sales associate/cashier at HTeaO were to assist customers with making the best purc that best suited their taste of tea. In addition to assisting customers with their purchases of teas I al brewed tea (brewer) for customers to either take home in gallon sized jugs or pint-sized cups.

Texas A&M AgriLife Extension – College Station College Station, TX
Waters Program (Summer Intern) *5/31/22 – 8/9/22*

- My duties as a summer intern in the Waters Program ranged from workshop planning, environmen remediation, water quality management, regulations, and informing the public about best managem practices for local waters.

Texas A&M AgriLife Extension – College Station College Station, TX
Weed science (Intern) *6/13/22 – 6/6/23*

- My duties as an intern in the Weed science Program range from data entry, weed identification, assi extension agents with pesticide applications, and informing the public about best management prac local pasture regarding weed control.

Texas A&M AgriLife Extension – College Station College Station, TX
Soil Research Assistant (Intern) *1/19/23– 6/5/23*

- My duties as an intern in the Soil science Program range from data entry, soil sampling assisting ext agents and graduates with research, and informing the public about best management practices for health.