Sankofa Wetland Park Monitoring Report

January – March 2024

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Sankofa Wetland Park Monitoring Report
Summary of Activities: January-March 2024

Monitoring Sampling Design

A monitoring sampling design was developed, shown below, consisting of five monitoring sites (S1 through S5) set approximately equidistant and in the planned path of the linear pond of the Sankofa Wetland Park. The St. Bernard drainage ditch at the bridge to the Viola wastewater treatment plant is also being monitored (site SB), as well as a site in the Bayou Bienvenue Wetland Triangle (site T1).

Location of sampling sites at the Sankofa Wetland Park (S1-S5), the St. Bernard drainage ditch (SB), and the Bayou Bienvenue Wetland Triangle (site T1) .

Site visits

January 24, 2024: Jason day traveled to the Sankofa wetland park to carry out monthly monitoring. Dissolved oxygen, conductivity, temperature, salinity and pH were measured at monitoring sites S1 through S5, SB, and at boardwalk on the wetland triangle (T2), using a handheld probe. An avian census was carried out by sight and sound. The staff gauge was at 66.0 cm at 11:00 am.

Mr. Day met with Rashida Ferdinand to visit the cypress nursery. Ms. Ferdinand was concerned that some of the trees were dead, but Mr. Day felt the tips of the seedlings and almost all were flexible, suggesting that they are alive.

Water levels were very high in the park with water overflowing near the gazebo, but was intercepted by the drainage ditch parallel to Florida Avenue, so no flood waters reached the road. The staff gauge was at 66.0 cm, while it was 41.5 cm in December 2023, an increase of 24.5 cm (9.6 inches). This indicates that water levels in the park were at a maximum and that to increase capacity, which is needed in order for the park to retain water during major storms, material will need to be deposited at the low spot near the gazebo.

Flooding of the St. Bernard drainage channel on January 24, 2024.

Dissolved oxygen was 2.2 mg/L at the SB site, ranged from 4.6 to 9.3 mg/L in the wetland park sites, with increasing oxygen availability going westward. DO was 1.9 mg/L at the wetland triangle site (T2). Conductivity was ~820 mS at the SB site, and ranged from ~730 mS to ~1200 mS at the wetland park sites. The wetland triangle site (T2) had a conductivity reading of ~3400 mS. Salinity was 0.45 ppt at the SB site, ranged from 0.61 to 0.73 ppt at the wetland park sites, and was 2.21 ppt at site T2. Water temperature was 19.8˚C at the SB site, ranged from 15.2 to 17.4˚C at the wetland park sites, and was 14.5˚C at site T2. pH was 7.1 at site SB, ranged from 7.4 to 7.9 at the wetland park sites, and was 7.1 at site T2. Total dissolved solids (TDS) was 0.60 mg/L at the bridge (SB), ranged from 0.57 to 0.94 mg/L at the wetland park, and was 2.71 mg/L at site T2.

Discrete water quality data from January 24, 2024.

Site	Date	DO (mg/l)	Cond. (mS)	Salinity (ppt)	Temp. (˚C)	pH	TDS (mg/L)
SB	01/24/24	2.2	820.5	0.45	19.8	7.1	0.60
S1	01/24/24	4.6	977.7	0.61	15.2	7.4	0.80
S2	01/24/24	5.7	1162.7	0.69	17.4	7.5	0.90
S3	01/24/24	8.5	1216.0	0.73	17.0	7.9	0.94
S4	01/24/24	8.7	1027.4	0.63	15.5	7.8	0.82
S5	01/24/24	9.3	729.0	0.43	16.2	7.8	0.57
T2	01/24/24	1.9	3412.7	2.21	14.5	7.1	2.71

February 6, 2024: Jason Day carried out monthly monitoring at the wetland park. Dissolved oxygen, conductivity, temperature, salinity and pH were measured at monitoring sites S1 through S5, SB and T2 using a handheld probe. An avian census was carried out by sight and sound. The staff gauge was 63.0 cm at 12:25.

Discrete water quality data from February 6, 2024.

Site	Date	DO (mg/l)	Cond. (mS)	Salinity (ppt)	Temp. (˚C)	pH	TDS (mg/L)
SB	02/06/24	2.1	922.6	0.56	15.6	6.7	0.73
S1	02/06/24	4.8	670.1	0.41	14.7	7.0	0.54
S2	02/06/24	11.0	662.9	0.39	16.3	7.5	0.52
S3	02/06/24	9.6	748.5	0.44	16.3	7.5	0.58
S4	02/06/24	9.9	765.5	0.45	16.8	7.4	0.59
S5	02/06/24	9.2	526.4	0.31	15.7	7.6	0.42
T2	02/06/24	4.8	1110.2	0.66	17.2	7.1	0.85

Dissolved oxygen was 2.1 mg/L at the bridge (SB), 4.8 mg/L at site S1, 11.0 mg/L at site S2, ~9.5 mg/L at sites S3, S4 and S5, and 4.8 mg/L at the wetland triangle site (T2). Conductivity was ~922 mS at the SB site, ranged from ~525 mS to ~765 mS in the wetland park, and ~1110 mS at site T2. Salinity was <1.0 ppt at all sites. Water temperature ranged from 15˚C to 17˚C, and pH ranged from 6.7 to 7.5. Total dissolved solids (TDS) was 0.73 mg/L at the bridge (SB), ranged from 0.42 to 0.59 mg/L, in the wetland park, and was 0.85 mg/L at site T2.

Water quality results from February 6, 2024.

Site	Date	NO_x (mg/L)	NH_3 (mg/L)	TN (mg/L)	PO_4 (mg/L)	TP (mg/L)	TSS (mg/L)	BOD_5 (mg/L)
SB	02/06/24	0.087	3.6	3.89	0.54	0.60	7.2	7.5
S1	02/06/24	0.25	<0.10	1.05	0.087	0.10	<5.0	4.5
S2	02/06/24	0.11	<0.10	0.55	<0.050	<0.10	9.8	4.2
S3	02/06/24	0.40	<0.10	1.18	<0.050	<0.10	13.2	4.9
S4	02/06/24	0.26	<0.10	0.96	<0.050	<0.10	20.8	4.6
S5	02/06/24	0.050	<0.10	0.43	<0.050	<0.10	10.0	3.7
T2	02/06/24	<0.050	0.22	0.93	0.37	0.49	<5.0	5.3

Nitrate+nitrite (NO_x) concentrations were 0.087 mg/L at site SB, ranged from 0.05 to 0.40 mg/L at the wetland park sites, and was below detection (0.05 mg/L) at site T2. Ammonia (NH_3) concentrations were 3.6 mg/L at site SB, below detection (<0.10 mg/L) at the wetland park sites, and 0.22 mg/L at site T2. Total nitrogen (TN) concentrations were 3.89 mg/L at the bridge site (SB), ranged from 0.43 to 1.18 mg/L at the wetland park sites, and 0.93 mg/L at site T2. Phosphate (PO_4) concentrations were 0.54 mg/L at the bridge site (SB), 0.87 mg/L at site S1, below detection (<0.05 mg/L) at sites S2-S5, and 0.37 mg/L at site T2. Total phosphorus (TP) concentrations were 0.60 mg/L at site SB, 0.10 mg/L at site S1, below detection (<0.10 mg/L) at sites S2-S5, and 0.49 mg/L at site T2. Total suspended solids (TSS) concentrations were 7.2 mg/L at site SB, ranged from below detection (<5.0 mg/L) to 20.8 mg/L at the wetland park sites, and was below detection (<5.0 mg/L) at site T2. Five-day biological oxygen demand (BOD_5) was 7.5 mg/L at site SB, ranged from 3.7 to 4.8 mg/L at the wetland park sites, and was 5.3 mg/L at site T2.

Water quality samples on February 6th, 2024.

March 12, 2024: Dr. Robert Lane and Mr. Jason Day visited the Sankofa Wetland Park to carry out monthly monitoring. Dissolved oxygen, conductivity, temperature, salinity and pH were measured at monitoring sites S1 through S5, SB, as well as at the boardwalk on the wetland triangle (T2) using a handheld probe. There was a major flooding event at the park. The staff gauge was 89.0 cm at 10:37am.

Discrete water quality data from March 12, 2024.

Site	Date	DO (mg/l)	Cond. (mS)	Salinity (ppt)	Temp. (˚C)	pH	TDS (mg/L)
SB	03/12/24	6.9	772.0	0.48	16.5	7.2	0.62
S1	03/12/24	1.8	677.6	0.39	16.5	7.2	0.52
S2	03/12/24	2.2	747.1	0.42	18.1	7.3	0.56
S3	03/12/24	7.5	760.1	0.45	16.6	7.7	0.59
S4	03/12/24	8.0	760.8	0.44	17.1	7.4	0.58
S5	03/12/24	10.3	654.5	0.38	17.2	7.5	0.50
T2	03/12/24	3.8	1475.1	0.93	15.3	7.1	1.18

Dissolved oxygen was 6.9 mg/L at the bridge site (SB), ranged from 1.8 to 10.3 mg/L at the wetland park sites with increasing concentrations going west, and 3.8 mg/L at site T2. Conductivity was 772.0 mS at the bridge, ranged from 654.5 mS to 760.8 mS at the wetland park sites, and 1475.1 mS at site T2. Salinity was 0.48 ppt at site SB, ranged from 0.38 to 0.45 ppt at the wetland park sites, and 0.93 ppt at site T2. Water temperature was 16.5˚C at site SB, ranged from 16.5 to 18.1˚C at the wetland park sites, and was 15.3˚C at site T2. pH was 7.2 at the bridge (SB), ranged from 7.2 to 7.7 at the wetland park sites, and was 7.1 at site T2. Total dissolved solids (TDS) were 0.62 mg/L at site SB, ranged from 0.50 to 0.59 mg/L at the wetland park sites, and was 1.18 mg/L at site T2.

Flooding between sites S1 and S2 on March 12, 2024.

Avian Survey

A total of 24 bird species were observed in January, 26 species in February, and 30 species in March. A total of 42 species were sighted this quarter.

Bird species observed at the Sankofa Wetland Park for Q1 2024.

Common Name	Scientific Name	1/24/24	2/6/24	3/12/24
American Coot	*Fulica americana*		X	X
American Crow	*Corvus brachyrhynchos*	X	X	X
American Goldfinch	*Spinus tristis*	X		
Anhinga	*Anhinga anhinga*			X
Bald Eagle	*Haliaeetus leucocephalus*		X	
Black Vulture	*Coragyps atratus*		X	X
Black-Bellied Whistling-Duck	*Dendrocygna autumnalis*			X
Blue Jay	*Cyanocitta cristata*	X	X	X
Blue-Grey Gnatcatcher	*Polioptila caerulea*			X
Carolina Chicadee	*Poecile carolinensis*	X	X	X
Carolina Wren	*Thryothorus ludovicianus*	X	X	X
Cattle Egret	*Bubulcus ibis*		X	
Common Grackel	*Quiscalus quiscula*	X	X	X
Common Moorhen	*Gallinula chloropus*		X	X
Double Crested Cormorant	*Phalacrocorax auritus*			X
Downy Woodpecker	*Dryobates pubescens*	X	X	
Eastern Kingbird	*Tyrannus tyrannus*			X
Eastern Phoebe	*Sayornis phoebe*		X	
European Starling	*Sturnus Vulgaris*	X	X	X
Fish Crow	*Corvus ossifragus*			X
Great Blue Heron	*Ardea herodias*		X	X
Great Erget	*Ardea alba*	X	X	X
Green Heron	*Butorides virescens*			X
Laughing Gull	*Larus atricilla*	X	X	X
Limpkin	*Aramus guarauna*	X		
Little Blue Heron	*Egretta caerlea*			X
Mockingbird	*Mimus polyglottos*	X	X	X
Mourning Dove	*Zenaida macroura*	X	X	X
Northern Cardinal	*Cardinalis cardinalis*	X	X	X
Northern Parula Warbler	*Setophaga americana*			X
Red Shouldered Hawk	*Buteo lineatus*	X	X	X
Red Winged Blackbird	*Agelaius phoeniceus*	X	X	X
Ruby-Crowned Kinglet	*Corthylio calendula*	X	X	
Snowy Egret	*Egretta thula*	X	X	X
Song Sparrow	*Melospiza melodia*	X		
Swamp Sparrow	*Melospiza georgiana*			X
Tree Swallow	*Tachycineta bicolor*	X		
Tricolor Egret	*Egretta tricolor*		X	
Tuffted Titmouse	*Baeolophus bicolor*	X		
Turkey Vulture	*Cathartes aura*	X	X	
White Ibis	*Eudocimus albus*	X	X	X
Yellow-Rumped Warbler	*Setophaga coronata*	X		X

Miscellaneous Activities

January 15, 2024: Rashida Ferdinand reached out in regards to precautions for safeguarding their cypress nursery plants during freezing conditions. The following is what was conveyed:

First and foremost, it is imperative to ensure adequate watering for all plants, as this serves as their primary defense against the cold.

To enhance protection, priority is given to seedlings, the most vulnerable to adverse weather conditions. This involves covering them with tarps, particularly focusing on the recently potted plants, the youngest specimens, which typically possess a smaller hardiness zone.

An additional precautionary measure is mulching the plants, effectively shielding the soil from sudden temperature shifts. This comprehensive approach aims to fortify the nursery against potential freeze-related challenges.

Louisiana native plants, inherently accustomed to brief freezing temperatures, can withstand such conditions as long as they receive sufficient water and nutrients to carry them through the freeze.

January 16, 2024: A virtual meeting was held with Michael Paulot, a teacher at the International School of Louisiana. The main topic of discussion was the agenda for two class field trips to the wetland park on January 24th and 25th. Below is what was provided by Mr. Paulot (highlights made by Dr. Lane). Unfortunately, this event was cancelled.

4-LS1-1: We aim to help students construct arguments showing how plants and animals possess internal and external structures that aid in survival, growth, behavior, and reproduction. This includes identifying both external macroscopic structures (LC-4-LS1-1a) and internal structures (LC-4-LS1-1b).

LC-4-ESS2-2: The students will use maps to locate different land and water features on Earth, including identifying areas of earthquake and volcano occurrences (LC-4-ESS2-2a & LC-4-ESS2-2b).

4-LS1-2: We'll focus on explaining how animals receive and process information through their senses, and how they respond to this information in various ways. This covers identifying different types of sense receptors (LC-4-LS1-2a), their uses (LC-4-LS1-2b), and the role of memory in animals (LC-4-LS1-2c).

To make the most of our field experience, here are three activity ideas:

Exploration Trek: A guided walk through different parts of the wetlands, focusing on observing and identifying external and internal structures of local flora and fauna.

Map-Reading Session: An interactive activity where students use maps to locate and discuss various geographical features of the Sankofa Wetlands, with a special focus on understanding the landscape's geological aspects.

Sensory Workshops: Engaging exercises where students can learn about animal senses, perhaps even including a blindfolded 'sensory walk' or games that emphasize the use of different senses.

January 16, 2024: Dr. Lane attended an interview of a job candidate for a horticulturalist position. Sydney Lister seemed very competent in many different areas, including GIS, however, her horticulture experience was limited.

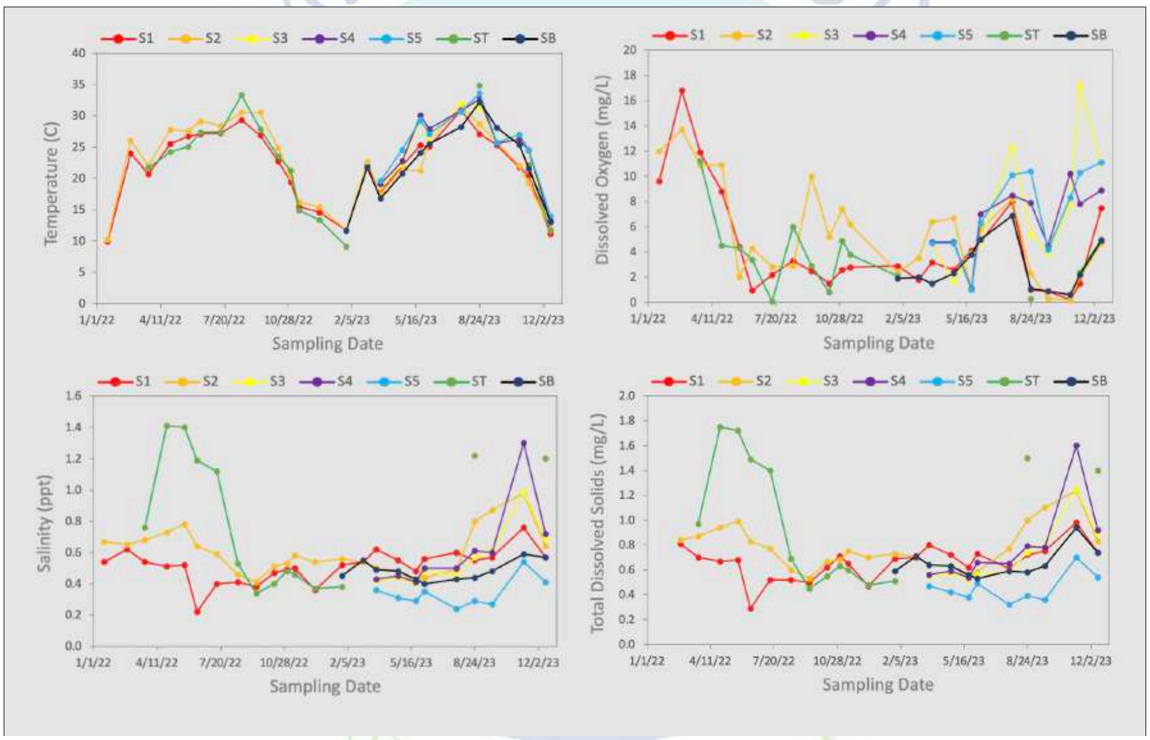
Sydney Lister during interview.

January 26, 2024: Dr. Lane attended an interview of with Caroline Scalzo for a horticulturalist position at Sankofa. Ms. Scalzo has extensive horticultural experience from several positions in Cincinnati, Ohio. She also has identified Sankofa as the organization she would like to work, has visited the park previously, She is prepared to relocate to New Orleans by end of March.

Caroline Scalzo during interview.

January 28, 2024: Dr. Lane was asked to provide information for a progress report to NFWF. Specifically, he was asked to put together text 'on some of the monitoring and research data that Comite performed. [A]lso include the work we did with Silverjackets with Tom'. Below is what was submitted.

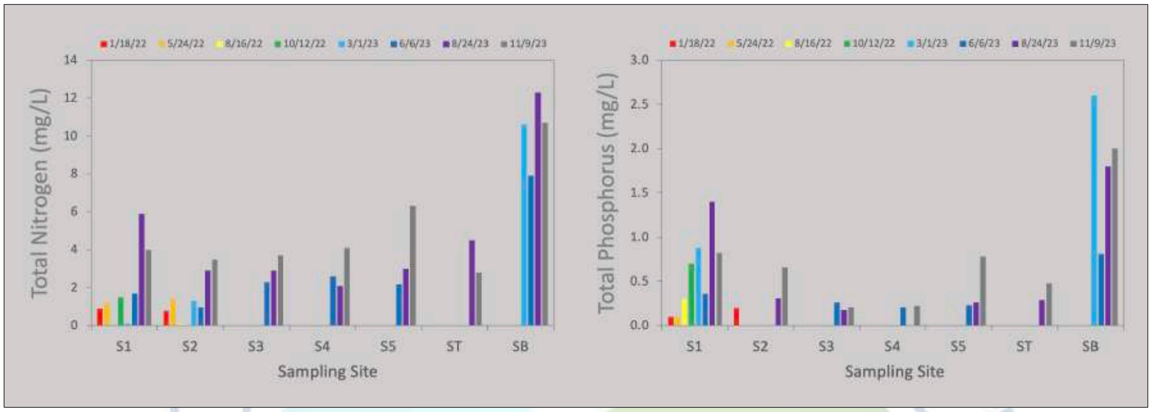
Comite Resources field technicians have been carrying out monthly monitoring of the Sankofa Wetland Park since January 2022. Five monitoring sites (S1 through S5) have been located approximately equidistant in the linear pond of the Sankofa Wetland Park. The St. Bernard drainage ditch at the bridge to the Viola Water treatment plant is also being monitored (site SB), as well as a site in the Bayou Bienvenue Wetland Triangle (site T1). Dissolved oxygen, conductivity, temperature, salinity and pH are being measured monthly at monitoring described above using a handheld probe, and water samples are collected every three months for nutrient (NOx, NH3, TN, PO4, TP), BOD5 and sediment (TSS) analysis. These parameters offer crucial insights into the overall health and ecological balance of aquatic environments. Collectively, monitoring these parameters enables the detection of changes in water quality, helping to identify potential pollution sources, mitigate environmental impacts, and implement effective conservation measures to preserve aquatic ecosystems and safeguard water resources.



Water temperature, dissolved oxygen, salinity and TDS data from the Sankofa Wetland Park.

Water temperatures fluctuated throughout the years, with a low during the winter of ∼10°C (50.0°F) during the winter to ∼33°C (91.4°F) during the summer, with very little variation between sites. Water temperature plays a crucial role in the ecology of aquatic ecosystems, influencing various biological, chemical, and physical processes. Dissolved oxygen concentrations ranged from 0.1 to 17.3 mg/L. Sites S3-S5 had higher concentrations than the rest of the sites during the summer and fall of 2023. Dissolved oxygen (DO) is of paramount ecological importance in aquatic systems as it serves as a life-sustaining factor for a diverse array of organisms. Salinity concentrations ranged from 0.2 to 1.4 ppt, with the highest concentrations occurring at site T1. In the wetland park, salinity never rose above 1 ppt.

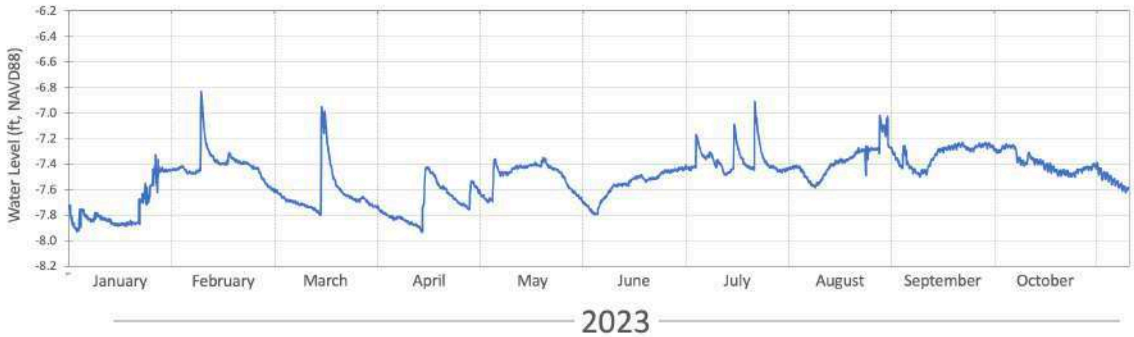
Salinity, or the concentration of dissolved salts in water, is a critical environmental factor that significantly influences the ecology of aquatic systems. Total dissolved solids concentrations ranged from 0.29 to 1.75 mg/L. TDS represents the sum of inorganic and organic substances dissolved in water, encompassing ions, minerals, and dissolved organic matter. Total Dissolved Solids (TDS) play a significant role in the ecological dynamics of aquatic systems.



Total nitrogen and total phosphorus concentration data from the Sankofa Wetland Park.

Total nitrogen concentrations ranged from below detection (<0.16 mg/L) to 12.3 mg/L, with the highest concentrations at site SB. The SB site (at the bridge) was generally a source of nitrogen pollution to the wetland park. Total nitrogen is the sum of nitrate, nitrite, ammonia and organically bonded nitrogen, such as contained in plants and animals. Total phosphorus concentrations ranged from below detection (<0.04 mg/L) to 2.6 mg/L, with (like phosphate) the highest concentrations at site SB followed by site S1 and generally decreasing going west into the wetland park. Total phosphorus is the sum of phosphate and organically bonded phosphorus, or organic phosphorus. Total phosphorus in aquatic systems is a critical factor influencing nutrient dynamics and ecological processes. Monitoring nutrient concentrations in natural aquatic habitats is essential for assessing ecosystem health and water quality, serving as a key indicator of potential issues such as eutrophication. This monitoring provides valuable data for the early detection and prevention of nutrient-related problems, safeguarding both the environment and human health.

A water level probe and a barometric compensation probe were installed on February 23rd, 2022 in the wetland park between sites #1 and #2. A staff gauge was also installed and has been read monthly. Comite Resources personnel carried out an elevation survey at key locations on the eastern end of the Sankofa Wetland Park in December 2022 that facilitated the calculation of the water level gauge data to be in NAVD 88. Data from January through November 2023 indicate that water level fluctuated from a low of nearly -8.0 ft to a high of nearly -6.8 ft. Interestingly, water levels during the summer drought of 2023 were higher than the wet spring, exemplifying how water levels in the wetland park are controlled by the St. Bernard drainage district, which most likely kept water levels lower during the rainy period to prevent flooding, but allowed levels to rise during the drought.



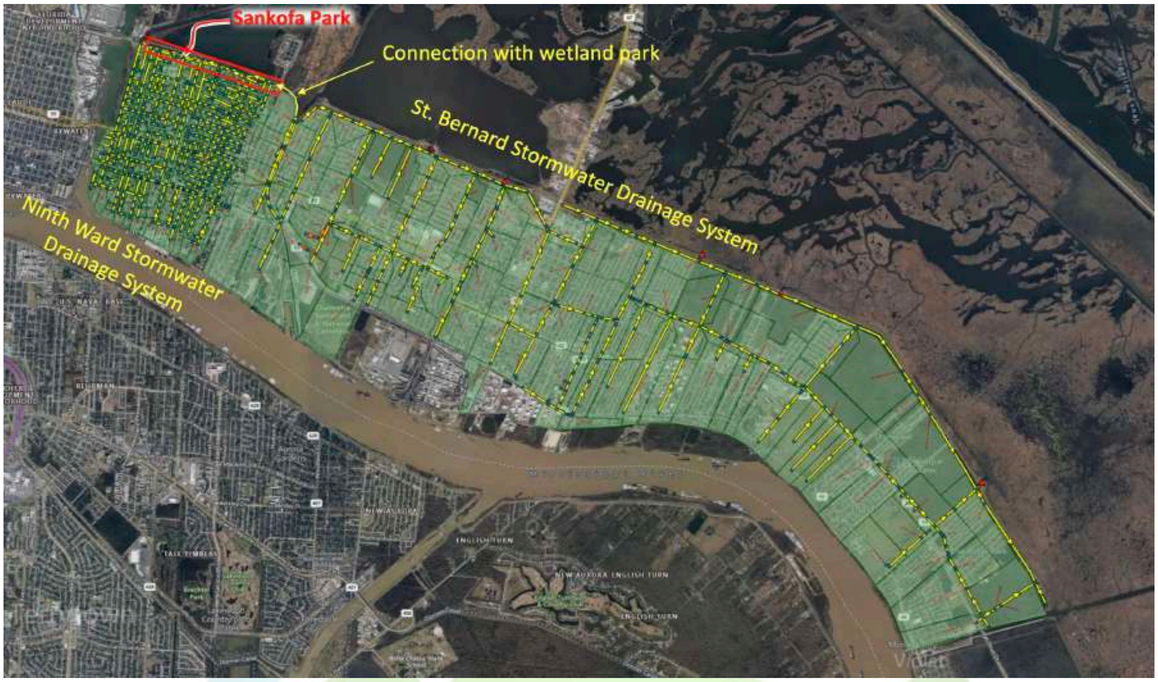
Water level in the Sankofa Wetland Park in 2023.

Hydrologic modelling of the Sankofa Wetland Park has been ongoing since the spring of 2022 with the Silver Jackets program by the Corps of Engineers. The modeling has been carried out using variations of the EPA Storm Water Management Model (SWMM) with the goal of developing plans for hydraulic load measurements to ensure stormwater retention capacity of the 40-acre wetland park with drainage infrastructure systems in the Lower Ninth Ward area of New Orleans. To this end, MSMM technical professional, Tom Willis, assisted in investigating factors related to keeping the pond water surface at desirable levels.

The technical assessment of the wetland Park project is informed by development of a geographic information systems (GIS) model and analysis of an EPA SWMM model developed by the New Orleans sewerage and water board. The geographic information systems model allows information from sources such as the USGS, the federal emergency management agency, and other federal, state, and commercial entities to be layered and analyzed comprehensively. The EPA SWMM model provides a means and methodology for analysis of hydrologic and hydraulic parameters consequential to the hydraulic loading of the Sankofa wetland Park.

During the course of the Phase I Assessment, it was discovered that water levels in the Sankofa wetland pond are directly tied to the St. Bernard storm drainage canal system at the east end of the wetland pond. It was initially thought that water level in the wetland pond was only influenced by the Lower Ninth Ward storm drainage canal system and thus the SWMM modeling done so far only includes the Lower Ninth Ward storm drainage canal system and not the St. Bernard storm drainage canal system, which actually controls water levels in the wetland park. Since the wetland park is directly connected to the St. Bernard storm drainage canal system, during large storms when water levels are elevated in the St. Bernard storm drainage canal system, the wetland park acts as a retention pond, holding water during peak storm discharge and then releasing it back into the drainage system. The St. Bernard and the Lower Ninth Ward storm drainage canal systems intersect near the wetland park, however, the Lower Ninth Ward canal system water level is maintained at -15 ft and the St. Bernard system is kept above -7ft. Thus during large storms water flows into the wetland park from the St. Bernard canal system and flows out of the park mostly through the Lower Ninth Ward canal system. It is for this reason that another round of modelling will be carried out in 2024.

Unfortunately, Mr. Willis recently died, and so another Corps of Engineers representative will be involved in this effort.



SWMM model configuration for the Lower Ninth Ward and the St. Bernard stormwater drainage systems.

February 5, 2024: Rob Lane traveled to downtown New Orleans to assist Rashida Ferdinand with a presentation to the Economic Development & Special Development Projects Committee. Overall, the talk went well, though there were several comments submitted online that were surprisingly negative. One said that the park was being constructed too slowly and without regard to its impacts on animal populations. Another cited the platform and lack of access due to the construction of the wetland. There was a comment of how trees were cut down to make way for small seedlings. Pretty much nonsense.

February 7, 2024: Rob Lane met with Rashida Ferdinand to discuss future plans for the park ("Theory of Change"). Afterwards, Rashida and Rob met with Maya Kocian and Olivia Molden of Earth Economics to discuss updating their valuation report.

February 12, 2024: Rashida Ferdinand sent Dr. Lane a 'Theory of Change' document she started along with a blog post about such documents, with a request to work on it. Below is what was submitted.

1. *Who* are you seeking to influence or benefit (target population)?

We are seeking to influence the New Orleans Department of Public Works and Sewerage and Water Board. The project will benefit the residents of the Lower Ninth Ward that have been impacted by subsiding land surface levels, flooding and higher flood insurance rates.

2. *What* benefits are you seeking to achieve (results)?

A decrease or halt of land subsidence in the Lower Ninth Ward. Corollary benefits will include improved infrastructure and flood mitigation. The roads in the Lower Ninth Ward, in particular, have been badly damaged by sinking land elevation over the last several decades, with many broken and undulating sections. Green infrastructure initiatives include the usage of a bioretention pond to store stormwater generated in Lower Ninth Ward until it can be discharged by pumping station #5.

3. *When* will you achieve them (time period)?

We will be able to achieve these benefits within 3 years.

4. *How* will you and others make this happen (activities, strategies, resources, etc.)?

1) Work with USACE – Silver Jackets program for a second phase of work to continue a hydrological study of the drainage system servicing the Lower Ninth Ward and St. Bernard Parish. The first phase of work included a SWMM hydrological model of the Lower Ninth Ward drainage network to assess the effectiveness of the Sankofa Wetland Park as a stormwater retention pond. The second phase of work will include to the SWMM model the drainage network for Arabi and Chalmette, which are connected to the Lower Ninth Ward drainage system and to the Sankofa Wetland Park.

2) Obtain Lidar and other relevant land surface elevation data of New Orleans, Arabi and Chalmette over time to determine land subsidence rates for the various drainage networks. Obtain data of the depth that groundwater has been artificially maintained at by pumping for the various drainage networks.
3) Statistically determine if there is a correlation between groundwater levels and land surface subsistence.
4) Determine at what depth groundwater should be maintained at to prevent future land subsidence from occurring.

5) Provide this information to the New Orleans Department of Public Works and Sewerage and Water Board. Once implemented, land subsidence rates will decrease immediately.
6) Determine the maximum amount of stormwater that can be stored in the Sankofa Wetland Park.
7) Study grounds of areas adjacent to and around bioretention ponds by SWB Wastewater treatment facility for any seepage that may flow from and to Bayou area.

5. *Where* and under what circumstances will you do your work (context)?

The Lower Ninth Ward and the Sankofa Wetland Park are the focus of this work. Sankofa CDC is located in the Lower Ninth Ward, but has assistance from the USACE Silver Jackets program and environmental consultants from across the state.

6. *Why* do you believe your theory will bear out (assumptions)

There is substantial evidence that there is correlation between artificially low groundwater levels and decreases in land elevation. Artificially low groundwater levels lead to oxidation of soil organic matter, which causes land subsidence. As the ground sinks over time, streets break and building foundations become unstable. The community also becomes more vulnerable to flooding and dependent on pumps. Groundwater levels in the Lower Ninth Ward are currently kept 8 to 9ft below the surface at all times, which has caused massive subsidence over the last half a century, leaving much of the Lower Ninth Ward below sea level. We have developed the assumption that if groundwater levels are raised there will be less soil oxidation and thus less land subsidence. In addition, if the groundwater level is raised in the Lower Ninth Ward, the Sankofa Wetland Park will perform as a bioretention pond, which has additional environmental benefits.

February 14, 2024: Rashida Ferdinand asked Dr. Lane to produce a white paper describing lowered groundwater and regional subsidence. Below is what was submitted.

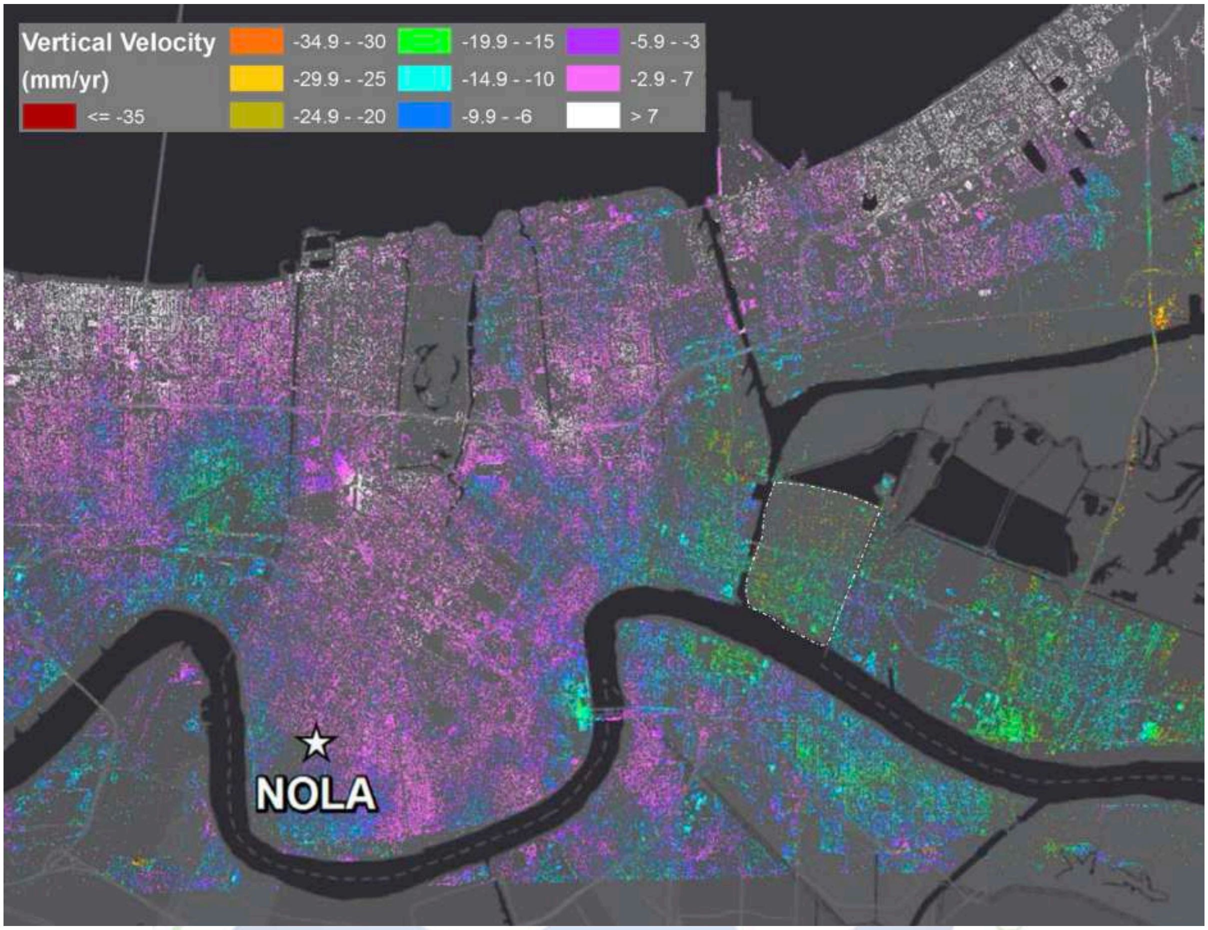
Artificial Lowering of Groundwater Water Levels & Decreasing Land Elevations in the Lower Ninth Ward

The southeastern Louisiana region, encompassing the Mississippi River Delta and New Orleans, experiences high land subsidence rates. This subsidence primarily stems from factors such as the drainage and oxidation of organic soils, compaction of aquifer systems due to groundwater extraction, natural compaction processes, and dewatering of surface sediments (Asselen et al. 2024). Furthermore, flood-protection measures and alterations to natural drainage pathways exacerbate the issue by diminishing sediment accumulation.

Subsidence in southeastern Louisiana has ranged from 6 to 20 inches (15-50 cm) over the past two decades, varying by location, with structures lacking deep pilings experiencing differential settling and structural cracking (Jones et al. 2016). This phenomenon not only lowers ground elevations and exacerbates flooding, but also poses several other risks including compromising elements within the hurricane protection system, diminishing levee and flood control structure heights that increases the likelihood of surge overtopping, lowering coastal elevations, reducing surge attenuation effects and potentially extending the reach of surges inland. Land subsidence can also compromise the integrity of levees, potentially leading to failures. In New Orleans, it has caused extensive damage to roads and drainage systems, amplifying flood risks and raising long-term infrastructure maintenance expenses (Asselen et al. 2024).

In New Orleans, areas that were once marshland and subsequently developed into buildings, roads, and levee causeways exhibit higher rates of subsidence than marshes without structures. Satellite radar data have revealed subsidence rates from 2002 to 2005 of 0.2 inches +/- 0.1 inches/yr (5.6 mm +/- 2.5 mm/yr) across the city (Dixon et al. 2006). Another study identified the Lower Ninth Ward as having a subsidence rate of 0.4-0.8 inches/yr (10-20 mm/yr), the second highest found in the greater New Orleans region, only surpassed by that in New Orleans East of 0.6-1.2 inches/yr (15-30 mm/yr; Jones et al. 2016). Both studies correlated areas with the highest rates of subsidence with several levee breaches that occurred during Hurricane Katrin, including in the Lower Ninth Ward.

Subsidence in the New Orleans region has been greatly amplified by the artificial decrease in groundwater water levels by stormwater pumping. For example, groundwater water levels in the Lower Ninth Ward are currently kept 8 to 9 ft (2.4-2.7 m) below the surface at all times, which has caused massive subsidence over the last half a century, leaving much of the Lower Ninth Ward below sea level. There is substantial evidence that there is a correlation between artificially lowered groundwater levels and decreases in land elevation (Asselen et al. 2024; Jones et al. 2016; Waltham 2005). Artificially low groundwater water levels cause increased land subsidence due to soft soil processes such as compaction and increased aerobic oxidation of organic-rich soils (Day et al. 2021). The correlation between subsidence and soft soil processes is evidenced by significant subsidence in the Lower Ninth Ward that extends eastward along the levees, corresponding with increases in peat deposit thicknesses (Jones et al. 2016). This increase is particularly pronounced in Bayou Bienvenue, where peat thickness transitions from approximately 4 ft (1.2 m) in New Orleans west of the Upper 9th Ward to over 14 ft (4.3 m) north of the Lower Ninth Ward.



Subsidence rates in the greater New Orleans region (modified from Jones et al. 2016). Notice that the Lower Ninth Ward (white dashed line) has some of the highest subsidence rates in the region.

The Greater New Orleans Urban Water Plan advocates for the storage of stormwater in the landscape, thereby promoting soil infiltration to deter soil oxidation and compaction. In addition, the plan calls for a groundwater monitoring network with real-time controls to manage surface water levels for subsidence control. Responsibility to execute this plan lies jointly with the City of New Orleans and Sewerage and Water Board of New Orleans. However, groundwater water levels in the Lower Ninth Ward, and elsewhere in the greater New Orleans region, have not been raised since the release of the Urban Water Plan in 2013 (Asselen et al. 2024).

LITERATURE CITED

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Dixon, T.H., F. Amelung, A. Ferretti, F. Novali, F. Rocca, R. Dokka, G. Sella, S.-W. Kim, S. Wdowinski, and D. Whitman. 2006. Subsidence and flooding in New Orleans. Nature 441, no. 7093: 587-588.

Jones, C.E., Karen An, R.G. Blom, J.D. Kent, E.R. Ivins, and D. Bekaert. 2016. Anthropogenic and geologic influences on subsidence in the vicinity of New Orleans, Louisiana. Journal of Geophysical Research: Solid Earth 121, no. 5: 3867-3887.

Waltham, T. 2005. The flooding of New Orleans. Geology Today 21:6 : 225-231.

February 14, 2024: Rashida Ferdinand sent Dr. Lane another 'Theory of Change' document she started concerning pollinator habitat, with a request to work on it. Below is what was submitted.

1. *Who* are you seeking to influence or benefit (target population)?

We are seeking to influence the city of New Orleans Parks and Parkways, New Public Schools, Department of Infrastructure, City Office of Economic Development, Louisiana Department of Education, Louisiana Department of Wildlife, USDA, and City Planning Commission. The project will directly benefit the residents of the Lower Ninth Ward with access to nature-based spaces and the Sankofa Wetland Park, and bring an opportunity for education on the ecosystems and their benefits to environmental health, mental health, and overall community health. The project will also provide an example of how ecosystem enhancement can restore wildlife habitats and increase wildlife species diversity.

2. *What* benefits are you seeking to achieve (results)?

An increase in nature-based spaces in currently blighted and vacant lots of the Lower Ninth Ward that will increase habitat for pollinator insects, migratory birds, macroinvertebrates, as well as mammals and reptiles. The development of an ecosystem model that demonstrates the importance of such restoration for wildlife species. Data that can be used to quantify benefits of ecosystem restoration to the Lower Ninth Ward community.

3. *When* will you achieve them (time period)?

We will be able to achieve these benefits within 3 years.

4. *How* will you and others make this happen (activities, strategies, resources, etc.)?

1) Measure the increase restored of habitat in the Sankofa Wetland Park.

2) Carry out a literature review of the methods and benefits of integrated ecosystems on the health and wellness of neighborhood residents.

3) Map the current vacant and blighted lots in the Lower Ninth Ward and determine the best locations for work to be carried out.

4) Purchase or obtain permission to create nature-based spaces at locations identified above.

5) Create nature-based spaces at locations in the Lower Ninth Ward.

6) Develop an environmental impact analysis with Earth Economics on ecosystem enhancement values to the economic development of the Lower Ninth Ward.

7) Work with the Louisiana Department of Education on standards for guided tours to educate students and the public on ecosystem enhancement

5. *Where* and under what circumstances will you do your work (context)?

The Lower Ninth Ward and the Sankofa Wetland Park are the focus of this work. Sankofa CDC is located in the Lower Ninth Ward, but has assistance from the Comite Resources and other environmental consultants from across the state.

6. *Why* do you believe your theory will bear out (assumptions)

There is a direct correlation between pollinator habitat area and number and species diversity of pollinators as well as cohabitators, such as birds, small mammals and reptiles. There is substantial evidence on the correlation between nature-based spaces and overall community health and well-being.

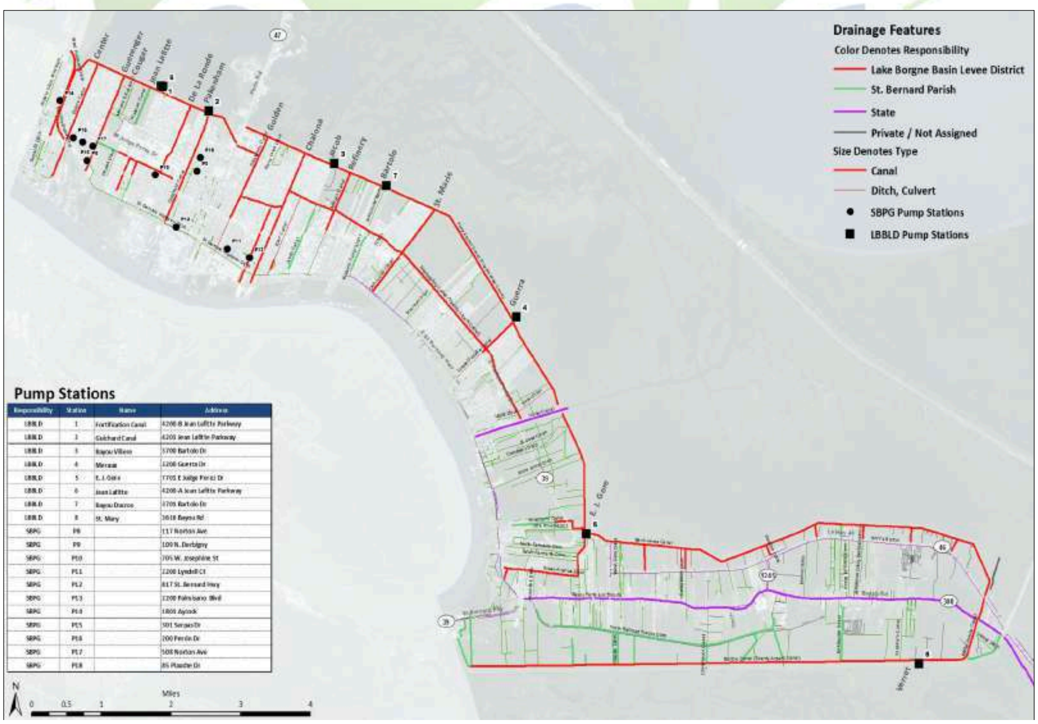
February 22, 2024: Rashida Ferdinand requested Dr. Lane to fill out the Entergy questionnaire below. The acres of wetland and forest restored was estimated based on what was actually excavated and planted in 2023, estimated to total 7.2 acres. Carbon sequestered was based on the mature wetland space, which is about 7 acres, and that freshwater wetlands generally sequester approximately 176 g C/m^2/yr (Villa and Bernal 2018), we can estimate that approximately 10,991 pounds of carbon were sequestered by the park in 2023.

Activity/Measure	2023 Data (enter NA if not applicable)
Number of trees planted	Dr. Shaffer has answer
Number of trees distributed	Dr. Shaffer has answer
Acres of wetlands restored	2.2
Acres of forest restored	5.0
Acres of wetlands preserved or placed into conservation	NA
Acres of forest restored or placed into conservation	NA
Number of rain barrels installed	NA
Gallons of rain water absorbed	NA
Lbs of CO2 stored	10,990
MW of Solar Capacity Installed	NA
Lbs of waste avoided or recycled	NA
Miles of streams restored or enhanced	NA

March 12, 2024: Dr. Lane and Mr. Day participated in the NOEW event. Dr. Lane prepared a series of graphics, which included copies of the 2023 Annual Report and Park Maintenance Plan, as well as props that were presented at the event. Graphics and reports were given to Rashida F. after the event. Mr. Day gave nature walks to several groups.

Station setup at the NOEW event (left) and participants (right) on March 12, 2024.

March 14, 2024: Dr. Lane called Hillary Nunez with Public Works at 504-278-4315 to determine if the pumping stations located closest to the wetland park in St. Bernard Parish (i.e., pumping station #1 at Fortification Canal & #6 at Jean Lafitte) is shut down, causing flooding in the park. Dr. Lane left a message.



The St. Bernard pumping station map.

March 19, 2024: Dr. Lane emailed Dennis Bradley (dbradley@sbpg.net) with St. Bernard Parish concerning the water level issue. Mr. Bradley responded that we could meet on 3/26@1pm to discuss the issue.

March 20, 2024: Dr. Lane developed a cypress seedling planting guide and sent to Devin Theobold, the Director of Operations at Sankofa as well as Rashida F. The guide can be found appended to the end of this report.

Rashida Ferdinand sent Dr. Lane the following text for editing for correctness:

We began planning the Wetland Park during 2014 to restore 40 acres of blighted land into a vibrant green infrastructure project. We planted 1,500 trees and wetland plants, which filter stormwater and support the growth of flora, fauna, and macroinvertebrates as a primary component of a healthy ecosystem.

Creation of a space for animal habitats to thrive as a home for beavers, river otters, perch, bass, swamp rabbits, turtles, crawfish, and other Louisiana wildlife. Over 80 bird species, including Black-bellied Whistling-Ducks, White Ibis, Great Egrets, Yellow-crowned Nights, Anhingas, and Red-shouldered hawks live in the Wetland Park.

Dr. Lane returned the following:

In 2014, the visionary initiative to transform 40 acres of neglected land into the flourishing Sankofa Wetland Park was set into motion. This ambitious project aimed not only to revitalize the area but also to establish a robust green infrastructure. The park's transformation involved massive earthworks to create a linear wetland pond stretching nearly a mile, and the strategic planting of 1,500 trees and a variety of wetland plants. These plants play a crucial role in filtering stormwater, fostering the growth of diverse flora, nurturing fauna, and providing a conducive environment for thriving macroinvertebrates, essential components of a balanced and vibrant ecosystem.

The Sankofa Wetland Park stands as a testament to ecological restoration and conservation efforts, providing a sanctuary for a myriad of animal species. Among the park's inhabitants are beavers, river otters, perch, bass, swamp rabbits, turtles, crawfish, and numerous other representatives of Louisiana's rich wildlife. Notably, the park has become a haven for over 80 bird species, including captivating sightings such as Black-bellied Whistling-Ducks, White Ibis, Great Egrets, Yellow-crowned Nights, Anhingas, and Red-shouldered hawks. This diverse ecosystem not only serves as a habitat for these creatures but also as an educational and recreational space for visitors to appreciate and learn about the natural world.

March 22, 2024: Rashida Ferdinand contacted Rob Lane and Jason Day concerning alligators in the park. She was concerned for visitors of the park. Dr. Lane responded with the following:

Hi Rashida, I spoke with Jason about the alligators at the park and we think you need to put up signs saying not to feed them. See the pic attached of a sign from the Lafitte National Park. If you make your own signs, add that feeding the gators makes them more dangerous to people and pets. Alligators under 5 ft they are not aggressive or dangerous to people. After they reach 5 ft they start getting territorial and should be relocated - we can find someone to do that if you need us to. In regards to a gator eating a whistling duck, that's what they do and no one should get too upset by it. They eat pretty infrequently, maybe once every few weeks, so they shouldn't significantly impact bird populations. Best, Rob

Alligator signs at the Lafitte National Park.

March 26, 2024: Rob Lane traveled to the L9W to attend a meeting with the National Park Service at 9am, followed by a tour of the wetland park from 10:30-noon. Dr. Lane then met with Mr. Bradley of St. Bernard Parish at 1pm concerning flooding at the wetland park. They followed the drainage ditch from the wetland park back into the dumping area to the east. There they found a potential blockage of flow. Mr. Bradley said that the pump operator at pumping stations #1 & #6 did not change the water level in the drainage ditches and that the cause of high water in the park was likely due to a blockage between the park and the pumping station. They agreed that Dr. Lane would carry out and investigative survey to determine where the blockage was. This will be carried out during the first week of April.

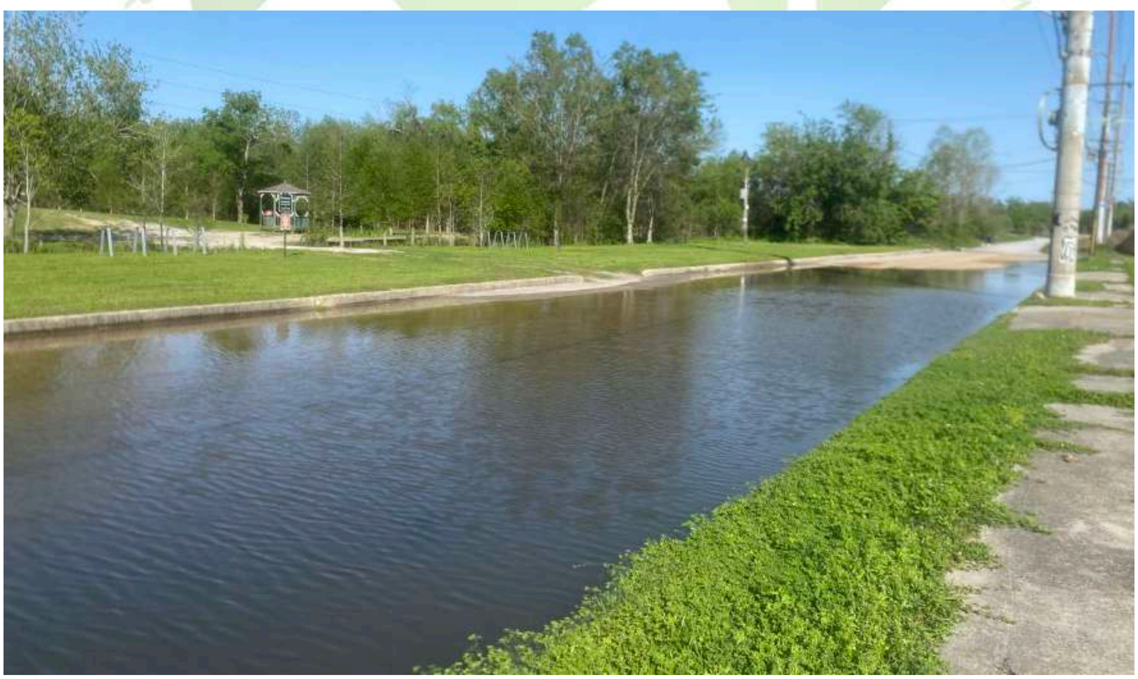
Devin Theobold and Dennis Bradley at the dumping site located east of the park past the curve in the road leading to the Veolia plant.

Dennis Bradley, MS4 Inspector
St Bernard Parish Government - Public Works
1125 East St. Bernard Highway
Chalmette, LA 70043
504 278-4312 (Office)
504 352-5582 (Cell)
dbradley@sbpg.net

After the meeting with Mr. Bradley, Dr. Lane gave a short lecture about how to plant cypress trees to Devin and Bryant. Later that afternoon, Devin Theobold and Rob Lane assisted the backhoe operator in the removal the old culvert.

Devin Theobold getting wet while positioning the culvert.

Unfortunately, the removal of the culvert ended up flooding Florida Ave. with several inches of water. Water level was much lower the following day.



Several lessons were learned from this experience. There are two drains along the edge of Florida Ave. on either side of Delery St. that do not work at all – water was sitting still on top of them. Also, there is a connection between the ditch facing the park and a sewer manhole cover nearby. This was the only place where water from the park could be seen flowing onto Florida Ave. There was a distinct odor of sewage during the flooding event. **We recommend that the connecting ditch spur be filled-in so that this does not occur again.**

At 5pm, Dr. Lane attended the NPS community meeting at the Sanchez Community Center. He left at approximately 7pm to return to Baton Rouge.

March 28, 2024: Jason Day traveled to the Sankofa Wetland Park where he gave a nature tour of the park to NPS staff and community stake holders. Later he met a group of Tulane students and guided them in planting 138 trees on the western end of the park. Afterwards, he followed the St. Bernard drainage ditch from the park eastwards all the way to Pump Station #2 at 4201 Jean Lafitte Pkwy. The decrease in water level extended from the park all the way to that pumping station, which is where he stopped, so possibly further. This suggests that pumping station had been allowing water levels to rise. This information was provided to Mr. Bradley.

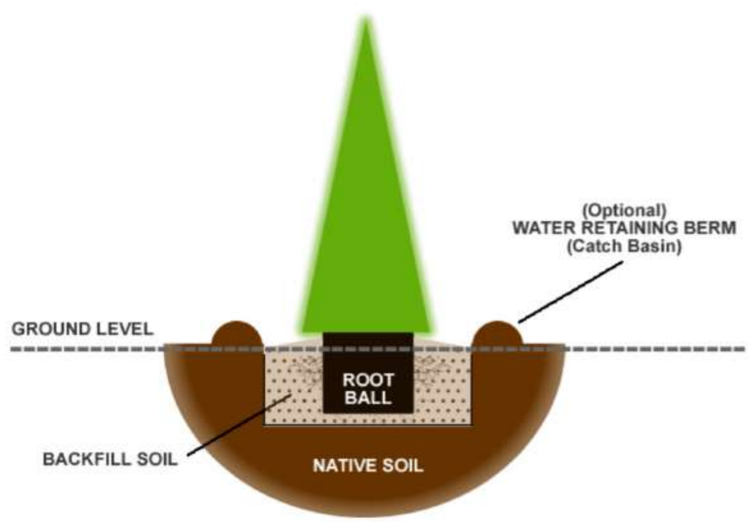
Cypress Planting Instructions

Step 1:
Start by digging a planting hole at least two to three times as wide and 6 inches or more deeper than the height of the rootball of the plant. The wider the hole the better. Place native soil removed from planting hole around the perimeter of the hole, in a wheel barrow, or on a tarp.

Step 2:
When planting in dense clay or other poor draining soils it is beneficial to thoroughly mix in some good organic matter such as bagged top soil and/or a good planting mix at a 25-50% ratio with the soil removed from the planting hole.

Step 3:
Be very careful not to damage the cypress seedling when removing it from its nursery container. If the root ball is stuck in the pot it's best to cut the container away. Trees grown in plastic pots often have circling roots which will need to be completely removed before planting. Although this seems severe, removing circling roots helps the long-term health of the tree by preventing future root girdling, which puts pressure on the main trunk. Use a sharp spade, planting knife or hand saw to shave off the outer circling roots.

Step 4:
Set your cypress in the planting hole so that the top edge of the rootball is at or just slightly above ground level to allow for settling. If necessary, add some backfill soil mixture to the bottom of the hole to achieve proper planting height, as shown in illustration below.



Step 5:
After setting your cypress in the planting hole, use one hand to hold the plant straight and your other hand to begin back-filling your soil mixture around the root ball, tamping as you go to remove air pockets. When you have filled the hole to the halfway point you can soak the soil with a gallon or two of water. Then continue back-filling to the top edge of the root ball. If you are planting the root ball higher than ground level, as shown in the illustration above, taper your soil mixture gradually from the top edge of the root ball to the ground level. To avoid suffocating your plant, avoid placing any soil on top of the root ball.

Step 6:
Use the remaining soil mixture to build a water retaining berm (catch basin/doughnut) that is 2 inches or so high around the outside perimeter of the planting hole (see image above). This basin will help to collect water from rainfall and irrigation, which helps to reduce the need for hand-watering. The berm can be removed after the first growing season.

Step 7:
Next, deeply water the planting area, including the root ball. For an extra boost, water the newly planted cypress with a solution of Root Stimulator, which stimulates early root formation and stronger root development, reduces plant shock, and promotes greener, more vigorous plants.

Step 8:
To conserve moisture and suppress weed growth, apply a 1 to 2" layer of mulch or pine straw around the planting area. Avoid the use of freshly chipped wood for mulch until it has cured in a pile for at least 6 months, a year is better. Avoid placing or piling mulch directly against the base of your plant as this could cause the bark to rot.

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ANALYTICAL RESULTS

Project: SANKOFA
Pace Project No.: 20306454

Sample: BRIDGE **Lab ID: 20306454001** Collected: 02/06/24 11:15 Received: 02/06/24 15:35 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
BR SM2540D TSS	Analytical Method: SM 2540D 2011 Pace Analytical Services - Baton Rouge							
Total Suspended Solids	**7.2**	mg/L	6.9	1		02/08/24 12:13		
BR 5210B 2016 BOD, 5 day	Analytical Method: SM 5210B-2016 Preparation Method: SM 5210B-2016 Pace Analytical Services - Baton Rouge							
BOD, 5 day	**7.5**	mg/L	1.6	1.5	02/07/24 17:00	02/12/24 10:07		
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - New Orleans							
Nitrogen, Kjeldahl, Total	**3.8**	mg/L	0.10	1	02/14/24 11:53	02/17/24 14:55	7727-37-9	
365.4 Total Phosphorus	Analytical Method: EPA 365.4 Preparation Method: EPA 365.4 Pace Analytical Services - New Orleans							
Phosphorus	**0.60**	mg/L	0.10	1	02/14/24 11:55	02/16/24 13:11	7723-14-0	
4500 Ammonia Water	Analytical Method: SM 4500-NH3 G Pace Analytical Services - New Orleans							
Nitrogen, Ammonia	**3.6**	mg/L	0.50	5		02/13/24 15:08	7664-41-7	D4
SM4500P-E, Phosphate, Ortho	Analytical Method: SM 4500-P E Pace Analytical Services - New Orleans							
Orthophosphate as P	**0.54**	mg/L	0.050	1		02/07/24 17:29		
4500NO3-F, NO3-NO2	Analytical Method: SM 4500-NO3 F Pace Analytical Services - New Orleans							
Nitrogen, NO2 plus NO3	**0.087**	mg/L	0.050	1		02/14/24 13:44		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: SANKOFA
Pace Project No.: 20306454

Sample: ONE **Lab ID: 20306454002** Collected: 02/06/24 11:30 Received: 02/06/24 15:35 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
BR SM2540D TSS	Analytical Method: SM 2540D 2011 Pace Analytical Services - Baton Rouge							
Total Suspended Solids	ND	mg/L	5.0	1		02/08/24 12:13		
BR 5210B 2016 BOD, 5 day	Analytical Method: SM 5210B-2016 Preparation Method: SM 5210B-2016 Pace Analytical Services - Baton Rouge							
BOD, 5 day	**4.5**	mg/L	1.6	1.5	02/07/24 17:00	02/12/24 10:10		
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - New Orleans							
Nitrogen, Kjeldahl, Total	**0.80**	mg/L	0.10	1	02/14/24 11:53	02/17/24 14:56	7727-37-9	
365.4 Total Phosphorus	Analytical Method: EPA 365.4 Preparation Method: EPA 365.4 Pace Analytical Services - New Orleans							
Phosphorus	**0.10**	mg/L	0.10	1	02/14/24 11:55	02/16/24 13:12	7723-14-0	
4500 Ammonia Water	Analytical Method: SM 4500-NH3 G Pace Analytical Services - New Orleans							
Nitrogen, Ammonia	ND	mg/L	0.10	1		02/13/24 15:09	7664-41-7	
SM4500P-E, Phosphate, Ortho	Analytical Method: SM 4500-P E Pace Analytical Services - New Orleans							
Orthophosphate as P	**0.087**	mg/L	0.050	1		02/07/24 17:29		
4500NO3-F, NO3-NO2	Analytical Method: SM 4500-NO3 F Pace Analytical Services - New Orleans							
Nitrogen, NO2 plus NO3	**0.25**	mg/L	0.050	1		02/14/24 13:45		

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ANALYTICAL RESULTS

Project: SANKOFA
Pace Project No.: 20306454

Sample: TWO **Lab ID: 20306454003** Collected: 02/06/24 12:30 Received: 02/06/24 15:35 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
BR SM2540D TSS	Analytical Method: SM 2540D 2011 Pace Analytical Services - Baton Rouge							
Total Suspended Solids	**9.8**	mg/L	5.0	1		02/08/24 12:13		
BR 5210B 2016 BOD, 5 day	Analytical Method: SM 5210B-2016 Preparation Method: SM 5210B-2016 Pace Analytical Services - Baton Rouge							
BOD, 5 day	**4.2**	mg/L	1.6	1.5	02/07/24 17:00	02/12/24 10:18		
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - New Orleans							
Nitrogen, Kjeldahl, Total	**0.44**	mg/L	0.10	1	02/14/24 11:53	02/17/24 14:57	7727-37-9	
365.4 Total Phosphorus	Analytical Method: EPA 365.4 Preparation Method: EPA 365.4 Pace Analytical Services - New Orleans							
Phosphorus	ND	mg/L	0.10	1	02/14/24 11:55	02/16/24 13:13	7723-14-0	
4500 Ammonia Water	Analytical Method: SM 4500-NH3 G Pace Analytical Services - New Orleans							
Nitrogen, Ammonia	ND	mg/L	0.10	1		02/13/24 15:11	7664-41-7	
SM4500P-E, Phosphate, Ortho	Analytical Method: SM 4500-P E Pace Analytical Services - New Orleans							
Orthophosphate as P	ND	mg/L	0.050	1		02/07/24 17:29		
4500NO3-F, NO3-NO2	Analytical Method: SM 4500-NO3 F Pace Analytical Services - New Orleans							
Nitrogen, NO2 plus NO3	**0.11**	mg/L	0.050	1		02/14/24 13:46		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: SANKOFA
Pace Project No.: 20306454

Sample: THREE | **Lab ID: 20306454004** | Collected: 02/06/24 13:00 | Received: 02/06/24 15:35 | Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
BR SM2540D TSS	Analytical Method: SM 2540D 2011 Pace Analytical Services - Baton Rouge							
Total Suspended Solids	**13.2**	mg/L	5.0	1		02/08/24 12:13		
BR 5210B 2016 BOD, 5 day	Analytical Method: SM 5210B-2016 Preparation Method: SM 5210B-2016 Pace Analytical Services - Baton Rouge							
BOD, 5 day	**4.9**	mg/L	1.6	1.5	02/07/24 17:00	02/12/24 10:24		
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - New Orleans							
Nitrogen, Kjeldahl, Total	**0.78**	mg/L	0.10	1	02/14/24 11:53	02/17/24 14:59	7727-37-9	
365.4 Total Phosphorus	Analytical Method: EPA 365.4 Preparation Method: EPA 365.4 Pace Analytical Services - New Orleans							
Phosphorus	ND	mg/L	0.10	1	02/14/24 11:55	02/16/24 13:13	7723-14-0	
4500 Ammonia Water	Analytical Method: SM 4500-NH3 G Pace Analytical Services - New Orleans							
Nitrogen, Ammonia	ND	mg/L	0.10	1		02/13/24 15:12	7664-41-7	
SM4500P-E, Phosphate, Ortho	Analytical Method: SM 4500-P E Pace Analytical Services - New Orleans							
Orthophosphate as P	ND	mg/L	0.050	1		02/07/24 17:29		
4500NO3-F, NO3-NO2	Analytical Method: SM 4500-NO3 F Pace Analytical Services - New Orleans							
Nitrogen, NO2 plus NO3	**0.40**	mg/L	0.050	1		02/14/24 13:48		

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ANALYTICAL RESULTS

Project: SANKOFA
Pace Project No.: 20306454

Sample: FOUR **Lab ID: 20306454005** Collected: 02/06/24 13:15 Received: 02/06/24 15:35 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
BR SM2540D TSS	Analytical Method: SM 2540D 2011 Pace Analytical Services - Baton Rouge							
Total Suspended Solids	**20.8**	mg/L	5.0	1		02/08/24 12:13		
BR 5210B 2016 BOD, 5 day	Analytical Method: SM 5210B-2016 Preparation Method: SM 5210B-2016 Pace Analytical Services - Baton Rouge							
BOD, 5 day	**4.6**	mg/L	1.6	1.5	02/07/24 17:00	02/12/24 10:26		
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - New Orleans							
Nitrogen, Kjeldahl, Total	**0.70**	mg/L	0.10	1	02/14/24 11:53	02/17/24 14:59	7727-37-9	
365.4 Total Phosphorus	Analytical Method: EPA 365.4 Preparation Method: EPA 365.4 Pace Analytical Services - New Orleans							
Phosphorus	ND	mg/L	0.10	1	02/14/24 11:55	02/16/24 13:15	7723-14-0	
4500 Ammonia Water	Analytical Method: SM 4500-NH3 G Pace Analytical Services - New Orleans							
Nitrogen, Ammonia	ND	mg/L	0.10	1		02/13/24 15:14	7664-41-7	
SM4500P-E, Phosphate, Ortho	Analytical Method: SM 4500-P E Pace Analytical Services - New Orleans							
Orthophosphate as P	ND	mg/L	0.050	1		02/07/24 17:29		
4500NO3-F, NO3-NO2	Analytical Method: SM 4500-NO3 F Pace Analytical Services - New Orleans							
Nitrogen, NO2 plus NO3	**0.26**	mg/L	0.050	1		02/14/24 13:51		

Pace Analytical Services, LLC
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Baton Rouge, LA 70820
(225) 769-4900

ANALYTICAL RESULTS

Project: SANKOFA
Pace Project No.: 20306454

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Sample: FIVE	**Lab ID: 20306454006**	Collected: 02/06/24 13:40			Received: 02/06/24 15:35	Matrix: Water		
BR SM2540D TSS	Analytical Method: SM 2540D 2011 Pace Analytical Services - Baton Rouge							
Total Suspended Solids	**10.0**	mg/L	5.0	1		02/08/24 12:13		
BR 5210B 2016 BOD, 5 day	Analytical Method: SM 5210B-2016 Preparation Method: SM 5210B-2016 Pace Analytical Services - Baton Rouge							
BOD, 5 day	**3.7**	mg/L	1.6	1.5	02/07/24 17:00	02/12/24 10:31		
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - New Orleans							
Nitrogen, Kjeldahl, Total	**0.38**	mg/L	0.10	1	02/14/24 11:53	02/17/24 15:02	7727-37-9	
365.4 Total Phosphorus	Analytical Method: EPA 365.4 Preparation Method: EPA 365.4 Pace Analytical Services - New Orleans							
Phosphorus	ND	mg/L	0.10	1	02/14/24 11:55	02/16/24 13:15	7723-14-0	
4500 Ammonia Water	Analytical Method: SM 4500-NH3 G Pace Analytical Services - New Orleans							
Nitrogen, Ammonia	ND	mg/L	0.10	1		02/13/24 15:15	7664-41-7	
SM4500P-E, Phosphate, Ortho	Analytical Method: SM 4500-P E Pace Analytical Services - New Orleans							
Orthophosphate as P	ND	mg/L	0.050	1		02/07/24 17:29		
4500NO3-F, NO3-NO2	Analytical Method: SM 4500-NO3 F Pace Analytical Services - New Orleans							
Nitrogen, NO2 plus NO3	**0.050**	mg/L	0.050	1		02/14/24 13:52		

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ANALYTICAL RESULTS

Project: SANKOFA
Pace Project No.: 20306454

Sample: TRIANGLE **Lab ID: 20306454007** Collected: 02/06/24 13:30 Received: 02/06/24 15:35 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
BR SM2540D TSS	Analytical Method: SM 2540D 2011 Pace Analytical Services - Baton Rouge							
Total Suspended Solids	ND	mg/L	5.0	1		02/08/24 12:13		
BR 5210B 2016 BOD, 5 day	Analytical Method: SM 5210B-2016 Preparation Method: SM 5210B-2016 Pace Analytical Services - Baton Rouge							
BOD, 5 day	**5.3**	mg/L	1.6	1.5	02/07/24 17:00	02/12/24 10:29		
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - New Orleans							
Nitrogen, Kjeldahl, Total	**0.93**	mg/L	0.10	1	02/14/24 11:53	02/17/24 15:03	7727-37-9	
365.4 Total Phosphorus	Analytical Method: EPA 365.4 Preparation Method: EPA 365.4 Pace Analytical Services - New Orleans							
Phosphorus	**0.49**	mg/L	0.10	1	02/14/24 11:55	02/16/24 13:16	7723-14-0	
4500 Ammonia Water	Analytical Method: SM 4500-NH3 G Pace Analytical Services - New Orleans							
Nitrogen, Ammonia	**0.22**	mg/L	0.10	1		02/13/24 15:16	7664-41-7	
SM4500P-E, Phosphate, Ortho	Analytical Method: SM 4500-P E Pace Analytical Services - New Orleans							
Orthophosphate as P	**0.37**	mg/L	0.050	1		02/07/24 17:29		
4500NO3-F, NO3-NO2	Analytical Method: SM 4500-NO3 F Pace Analytical Services - New Orleans							
Nitrogen, NO2 plus NO3	ND	mg/L	0.050	1		02/14/24 13:54		