

Water Quality Response to Jones Creek Vegetation Trimming Project

May 2023 – April 2025



Prepared By:



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August 2025

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Executive Summary

The Jones Creek Vegetation Trimming Project, conducted between May 2023 and April 2025, aimed to improve water quality by enhancing sunlight exposure and tidal flushing through the removal of overgrown vegetation. This initiative was a collaborative effort between the Town of Jupiter and local residents, supported by comprehensive environmental monitoring led by the Loxahatchee River District (LRD).

Key Findings:

Improved Light Penetration and Flushing

Ambient light monitoring and high-resolution aerial imagery confirmed a 100% increase in canopy opening area post-trimming. Light reaching the creek surface more than doubled, from 25% to 59% of ambient downwelling light, significantly enhancing conditions for natural UV disinfection.

Water Quality Response

Despite expectations of elevated Fecal Indicator Bacteria (FIB; enterococci and fecal coliform bacteria) concentrations due to sediment disturbance caused by trimming activities, FIB concentrations during trimming remained lower than historical dry-season levels. Post-trimming spikes in FIB concentrations coincided with the onset of the wet season and aligned with historical seasonal trends. Turbidity levels remained within normal ranges throughout the project (with the exception of high fecal coliform bacteria concentration measured in July 2024).

Tidal Influence on Bacteria

Correlation analyses revealed strong associations between FIB concentrations and tidal conditions. Marine water inflows—characterized by higher dissolved oxygen (DO), salinity, and pH—were consistently linked to lower bacterial levels.

Shifts in Correlation Patterns

Post-trimming data showed pH surpassing DO as the most negatively correlated parameter with FIB. Turbidity's correlation with FIB decreased from moderate to low. These parameters suggest improved flushing and reduced sediment suspension.

Nutrient Associations

Phosphorus and color (indicative of dissolved organic matter) remained the strongest positive correlates with FIB, highlighting their potential role in supporting bacterial growth and improved tidal flushing.

Instrumentation Insights

Continuous water quality monitoring indicated increased salinity and pH in upstream stations post-trimming, suggesting enhanced marine water intrusion. Temperature increases were observed but likely driven by seasonal ambient conditions rather than trimming alone.

Conclusion and Next Steps

The trimming project successfully increased light exposure and improved water movement within Jones Creek. While immediate reductions in FIB were not observed, the data suggest improved environmental conditions that may support long-term water quality improvements. Continued monitoring is essential to assess seasonal dynamics and long-term impacts.

LRD will maintain ongoing water quality surveillance and publish updates at:

 loxahatcheeriver.org/jonescreek

 loxahatcheeriver.org/river/river-keeper

Stakeholders are encouraged to check regularly for updates and contact LRD with any questions or feedback.

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Introduction

Jones Creek

Jones Creek is a shallow, mangrove-lined tidal creek in the southwest fork of the Loxahatchee River estuary in the Town of Jupiter, within Palm Beach County, southeastern Florida (**Figure 1**). The creek winds through urban residential neighborhoods before emptying into the southwest fork of the Loxahatchee River. It is influenced by mixed semidiurnal tides that originate from the Jupiter Inlet, which is situated approximately 5 km (3.1 miles) east of the mouth of Jones Creek.

Jones Creek extends approximately 4 km in length and consists of natural and man-made segments. Historical aerial photos indicate that the man-made canals in the Jupiter River Estates community were dredged in the late 1960's, with most of the canal front homes constructed in the late 1960's through the 1970's.

Based on a 2004-2005 survey, the upstream study area, located south of Indiantown Road (S.R. 706), encompasses approximately 46,670 m² at high tide within the creek basin, with a total water volume of 37,362 m³ [1]. The estimated tidal prism is 22,477 m³, indicating that roughly 60% of the creek's volume is exchanged during each tidal cycle. From these measurements, the average volumetric flow rate in the upper portion of the creek over a typical 6-hour tidal cycle was calculated to be approximately 1.25 m³/s (44 cfs)[1].

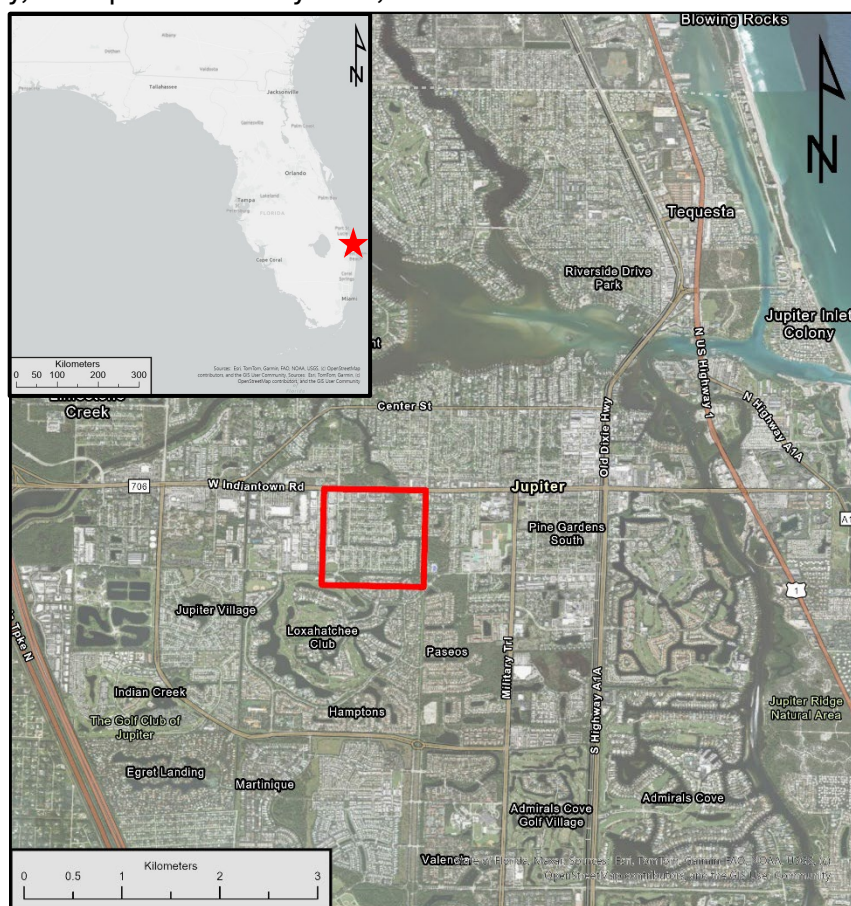


Figure 1. Map showing Jones Creek project area (red square) in reference to the Loxahatchee River and Jupiter Inlet. Red star on inset map shows study location relative to Florida.

History of Water Quality issues in Jones Creek

Since the 1980s, water quality in Jones Creek has been a persistent concern due to high nutrient and fecal indicator bacteria (FIB) concentrations that exceeded State water quality standards and discharge directly into the Loxahatchee River [2]. In the 1990s, Lapointe and Krupa [3] used coprostanol, a fecal sterol, and stable isotope analysis to confirm septic system effluent as a source of surface water contamination in Jones Creek.

In 1997, the Loxahatchee River District (LRD) constructed sanitary sewer infrastructure to serve all houses adjacent to Jones Creek (i.e. Jupiter River Estates), eliminating septic systems in this area.

The LRD's water quality monitoring program named "RiverKeeper" regularly tested water quality in Jones Creek at Indiantown Road (S.R. 706) as early as 2007 and gradually expanded the monitoring to 4 sites within Jones Creek in 2016.

Because of high FIB observed within the creek, the LRD, in partnership with the Town of Jupiter (TOJ), continued to expand the water quality monitoring effort attempt to identify potential source(s) of FIB in Jones Creek through a combination of ongoing monitoring and a series of special sampling efforts at 10 sampling sites.

This monitoring demonstrated consistently poor water quality with FIB concentrations (both enterococci and fecal coliform), frequently exceeding thresholds established by the U.S. Environmental Protection Agency (130 MPN/100 mL for enterococci) and the Florida Department of Environmental Protection (800 MPN/100 mL for fecal coliform) (Figure 2).

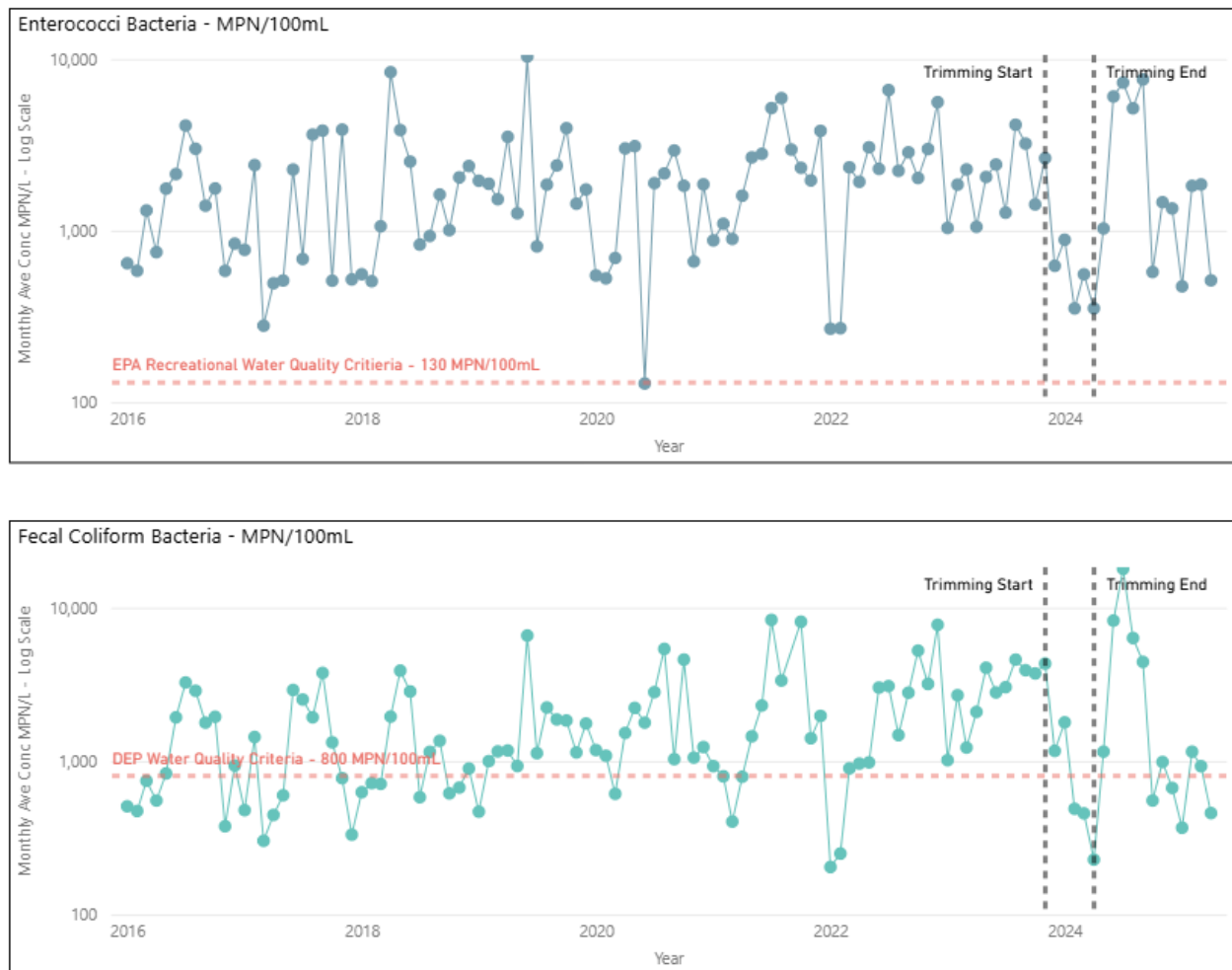


Figure 2. Monthly average Fecal Indicator Bacteria (*Enterococci* and *Fecal Coliform*) concentration (log scale) sampled at 4 locations within Jones Creek between January 2016 and April 2025 relative to the EPA and DEP recreational water quality standard (red dashed line) illustrating the chronic poor water quality (from <https://loxahatcheeriver.org/jonescreek>).

Jones Creek is actively used for recreational activities such as boating, kayaking, paddleboarding, and fishing by the creek residents and visitors to the Town of Jupiter’s Jones Creek Preserve park and kayak launch, making bacterial contamination a significant public health concern. To better understand the elevated FIB levels, the LRD has collaborated with multiple agencies, including the Florida Department of Environmental Protection and the TOJ, to identify potential sources of contamination.

Multiple Microbial Source Tracking sample collection efforts in the past found the absence of chemical tracers, combined with low concentrations of human genetic markers, suggested no significant human waste pollution. The limited detections suggested a possible source from a small population, such as a single residence, recreational vehicle, or transient encampment [4].

The high FIB concentrations often coincide with elevated turbidities and chlorophyll-a concentrations, but to date no obvious sources have been identified. The general conclusion was that high FIB concentrations can be observed across many environments including brackish water mangrove creeks with organic rich sediments [5]. Comparisons to other similar sites in the area, and laboratory studies evaluating FIB in the organic rich sediments (unpublished data) strongly suggest that the high FIB concentrations are likely driven by extensive decaying vegetation, debris, and organic sediments within Jones Creek [6]. Analysis of the organic rich sediments from Jones Creek indicate high FIB concentrations that persist for long durations. Clearly, these organic rich sediments are a food source for FIB and the bacteria thrive in this medium.

Remediation Objective

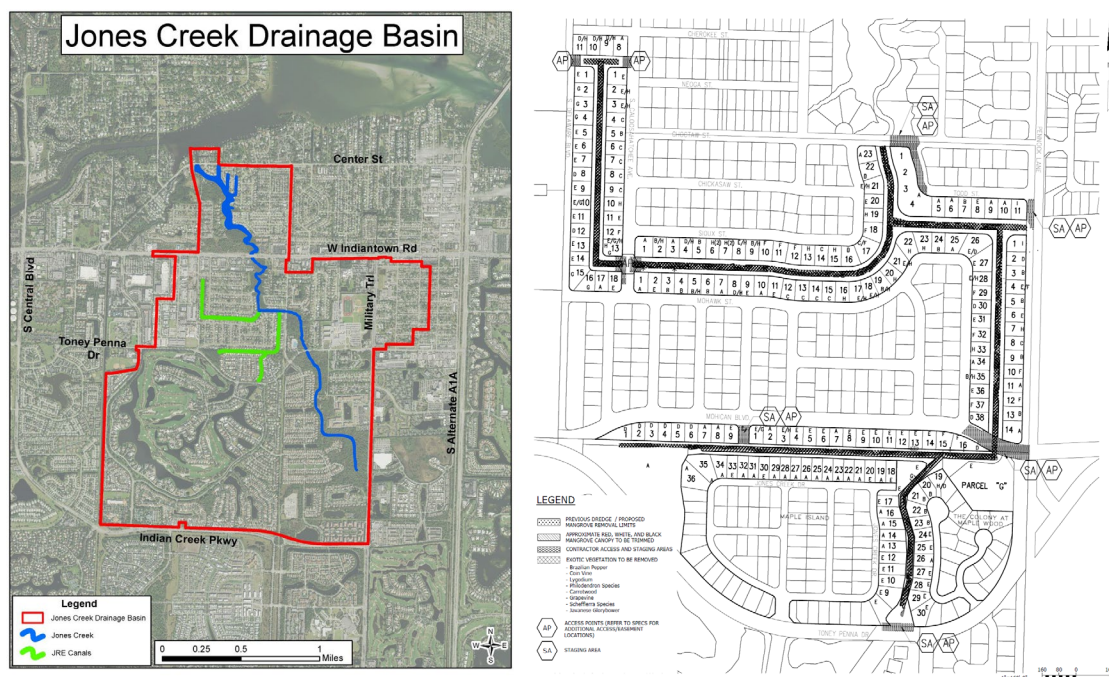
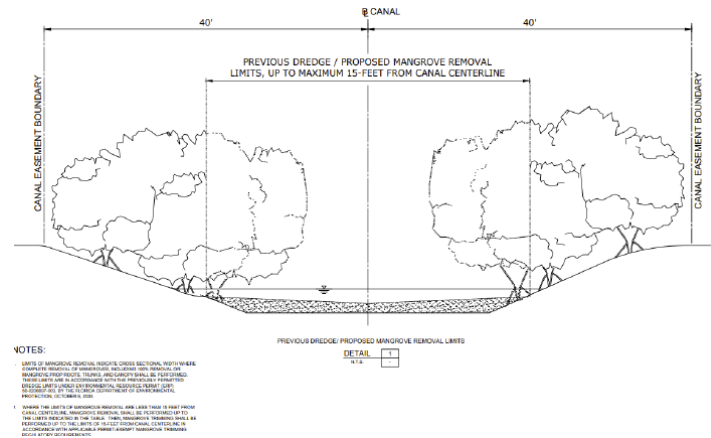
Following extensive discussions and site visits with scientists that specialize in FIB, the consensus was that the simplest option to potentially improve water quality (i.e., lower FIB concentrations) within the creek was to trim and clean up the severely overgrown vegetation. This cleanup would: 1) increase sunlight exposure for potential UV water treatment, 2) improve flushing and water flow through the creek, and 3) decrease the organic load of leaves and plant material destined to fall into the creek and fueling the microbiome in Jones Creek.

Numerous studies have demonstrated that sunlight can effectively inactivate or kill bacteria in aquatic environments. Fujioka et al., [7] found that fecal coliform bacteria were inactivated within 30 to 180 minutes following at least four hours of sunlight exposure. Even under overcast conditions—where light intensity was reduced to approximately 25% of that on a sunny day—nearly 99% of fecal coliforms were still inactivated.

In the upper extents of the creek, the overgrown and floating vegetation severely compromised water flow, tidal flushing, and prevented access even in a small kayak. Improving tidal exchange by allowing the higher quality marine waters flowing in through Jupiter inlet to flow upstream into the creek during flood tide may improve water quality in the creek.

In support of this remediation effort, the TOJ initiated a vegetation trimming program, in coordination with the residents that live along the creek. LRD, in partnership with the TOJ, increased environmental monitoring efforts by conducting additional water quality monitoring, a light measurement study, and obtained high resolution aerial photography for project documentation and quantification of sunlight exposure to the creek.

The TOJ initiated Vegetative Trimming and exotic plant removal project to increase sunlight exposure for UV treatment and improve water flow and flushing. The project design consisted of trimming an approximate 30-foot-wide corridor over the creek waters ([Figure 3](#)) in the upstream extents of the creek that were most overgrown and had the highest concentrations of FIB ([Figure 4](#)). In addition to potentially improving water quality, the project would yield ecological benefits of removing exotic and invasive plants.



Funding

The funding of the project was a joint venture between the Town of Jupiter and the residents that live along the creek. The Town of Jupiter funded the initial vegetation trimming and exotic plant removal at a cost of \$533,338. The initial cleanup work was contingent on the long-term maintenance trimming funded by residents of Jupiter River Estates (187 properties) via a non-ad valorem tax assessment over the next 10 years. The resident funding responsibility reflected the strong community support and their commitment to water quality improvements. The assessment is based on canal frontage, with annual contributions ranging from \$120 to \$2,000 per property each year, generating approximately \$130,000 for the biennial trimming work, which will be managed by the Town.

Initial Trimming Project

Following the issuance of mangrove trimming permits by FDEP and ACOE, the TOJ awarded Sherlock Tree Company the contract for the trimming and cleanup work (**Figure S1**). The project commenced in October 2023 and was completed in April 2024. The vegetation along 16,469 linear feet of shoreline was trimmed, and 284 exotic trees and plants were removed (**Figure S2-Figure S7**). Additionally, floating vegetation and accumulated organic matter were cleared to improve water flow and tidal flushing.

Environmental Monitoring

To evaluate water quality conditions and assess the effectiveness of the vegetation trimming project, LRD implemented a comprehensive monitoring strategy that included: 1) additional water quality sampling, both grab sampling and continuous data collection using data sonde instruments; 2) light measurement using light data loggers to quantify the amount of light reaching the creek water before and after trimming; and 3) high resolution aerial drone photography to document before and after trimming conditions, and to quantify the change in sunlight exposure reaching the creek waters.

Water Quality - Grab samples

As part of LRD's long-term *Riverkeeper* water quality monitoring program (<https://loxahatcheeriver.org/river/river-keeper/>), FIB concentration and other key water quality parameters are routinely measured throughout the Loxahatchee River watershed.

Within Jones Creek, four established *Riverkeeper* stations were previously sampled quarterly (**Figure 5**; more site details in **Table 1**):

- **Station 71** – Jones Creek at Center Street Bridge
- **Station 75** – Jones Creek at Indiantown Road Bridge
- **CALC** – Caloosahatchee Drive Culvert
- **TPJ** – Toney Penna Drive Footbridge

During this study, two additional short-term monitoring stations were established in the upper reaches of the creek to capture water quality conditions in the most heavily vegetated areas:

- **DEL** – Upper extent at Delaware Boulevard, just south of Cherokee Street
- **JCU** – Upper extent at Toney Penna Drive and Mohican Street

Sampling frequency increased from quarterly to monthly six months prior to trimming beginning May 2023, during the trimming, and 6 months post trimming, through December 2024.

A summary of the water quality grab sampling locations, parameters and frequency are summarized in [Figure 6](#) and [Table 2](#).

Each sampling event included the analysis of a full suite of water quality parameters including total suspended solids (TSS), total organic carbon (TOC), nutrients, FIB including enterococci (the current State FIB water quality standard for brackish water) and fecal coliform bacteria (the former State water quality standard for historical comparisons), and chlorophyll-a, turbidity, and other parameters.

All surface water field sample collection methods followed Florida Department of Environmental Protection's Standard Operating Procedures (FDEP DEP-SOP-001/01). Samples were taken at a depth of 0.3 meters to ensure consistency and comparability across sites. Laboratory analyses were conducted by LRD's Wildpine Laboratory a NELAP Recognized Accreditation Body (TNI). The laboratory maintains rigorous quality assurance protocols, including biennial proficiency testing and analyst demonstrations of capability, and analytical QC measures to ensure data accuracy and precision. All analytical methods followed protocols published by the U.S. Environmental Protection Agency (USEPA) or the *Standard Methods for the Examination of Water and Wastewater*. Detailed information

on analytical methods, preservation techniques, and maximum holding times are provided in appendix [Table S1](#).



Figure 5. University of Central Florida students are partnering with the Town of Jupiter Water Plant Utility staff to gain water quality field experience in the environmental monitoring of Jones Creek.

Water Quality - Continuous Instrumentation

In addition to grab samples, we monitored several water quality parameters every 15 minutes using a YSI EXO2 data sonde instrument at two stations (CALC and TPJ) for 3-month deployments before and following trimming ([Figure 7](#)). The instruments were not deployed during the trimming work because the area was regularly disturbed and to avoid unintentional damage to the equipment. An additional monitoring station JC, located near Station 75 in a non-trimmed section of Jones Creek, was used as a downstream reference/comparison site. The JC station only recorded temperature, depth, and salinity. To make comparisons of equivalent time durations, data from JC were extracted for the same pre- and post-trimming periods (August 1 – October 11, 2023, and May 30 – August 31, 2024). A summary of the instrumentation sampling sites and parameters is provided in [Table 3](#).

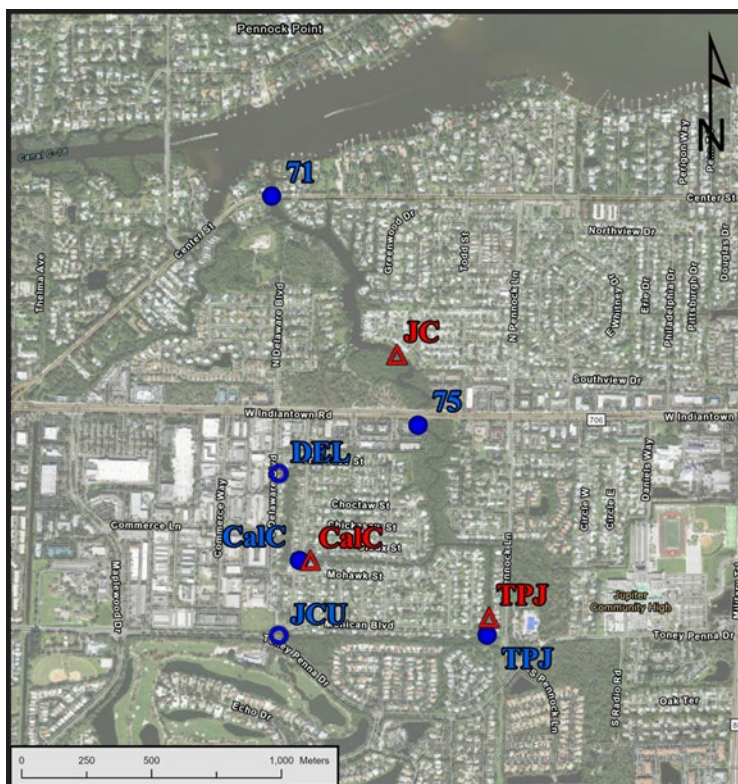


Figure 6. Map showing all sampling locations; long term grab sampling locations are solid blue dots, short-term project sampling locations are open blue circles, continuous field sampling instruments are red triangles.

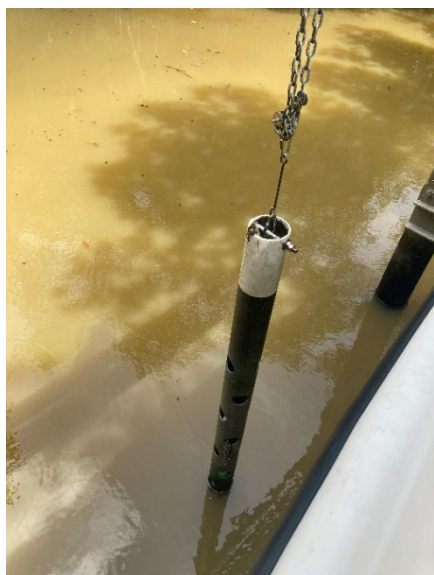


Figure 7. Continuous monitoring apparatus shown deployed at CALC (on left) and at TPJ (above on right).

Table 1 *Water quality monitoring sites in Jones Creek*

Site Name	Site ID	Latitude DD	Longitude DD	Trimming area
Center St Bridge	71	26.941608	-80.11819	No
Indiantown Rd Bridge	75	26.933685	-80.113127	No
Caloosahatchee Culvert	CALC	26.929011	-80.117231	Yes
Jones Creek Footbridge	TPJ	26.926428	-80.110738	Yes
Upper Extent Delaware Blvd	DEL	26.931994	-80.117956	Yes
Jones Creek Upper	JCU	26.926391	-80.117957	Yes

Table 2 *Summary of Grab sampling locations, frequency, and analyses performed*

Events	Site	Bacteria ¹	CHLA	Datasonde ²	Color	Conduct.	Alkalinity	Nutrients ³	TOC	TSS/Turbidity
Monthly monitoring	All	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly
Long term monitoring	71, 75, CALC, TPJ	Monthly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly

¹ Enterococci and Fecal Coliform² Temperature, pH, salinity, and dissolved oxygen (DO)³ Total Nitrogen and Total Phosphorus**Table 3** *Summary of water quality instrumentation locations and parameters*

Events	Site	Temperature	Salinity	pH	DO	Turbidity	Chlorophyl a
Trimming monitoring	CALC, TPJ	Yes	Yes	Yes	Yes	Yes	Yes
Long term monitoring	75	Yes	Yes				

Data analysis

To evaluate water quality pre- and post- vegetation trimming, two statistical methods were employed: Principal Component Analysis (PCA) and Spearman Rank Correlation.

- PCA was used to reduce data dimensionality and identify patterns in variable relationships. In PCA plots, vectors pointing in the same direction indicate positive correlations, while perpendicular vectors suggest no relationship. The proximity of vectors reflects the strength of correlation.
- Spearman Rank Correlation was applied to quantify monotonic relationships between variables, particularly useful for environmental datasets that may not exhibit linear trends.

All the data were normalized before doing analysis and the software used for data analysis were SigmaPlot 15.0 and Primer 7 for PCA and Spearman, respectively.

Ambient Light Monitoring

To assess changes in sunlight exposure before and after vegetation trimming, ambient downwelling light levels were continuously recorded using paired HOBO light data loggers (model UA-002-64) that were standardized to a Licor Li-1500 meter and a Li-192 quantum sensors. Sensors were placed near the approximate center of the creek near the TPJ water quality site and mounted to a pole set vertically into the sediment ([Figure 8](#)). The two sensors were spaced at slightly different angles on the horizontal plane to help minimize the effects of shading and were later averaged together. Light intensity data were recorded every 10 seconds and averaged over 15-minute intervals during the peak solar window (11:15 AM to 3:45 PM), when the solar angle was within 45 degrees of vertical. Monitoring was conducted at the same time of the year before and after trimming:

- **Pre-trimming:** October 5–13, 2023
- **Post-trimming:** October 3–16, 2024

An additional sensor that was unaffected by overhead vegetation was deployed to make quantitative comparisons under varying cloud cover and weather conditions. During October 2023 the sensor was placed near the mouth of Jones Creek (26.9431°N, -80.1166°W), and during October 2024 the sensor was placed in the intracoastal waterway approximately 9 km (5.5 mi) north of the study area (27.0089°N, -80.0987°W)



Figure 8. LRD Staff setting up the light monitoring apparatus at TPJ both before (left photo) vegetation trimming started and after (right photo) the vegetation trimming was completed.

High Resolution Aerial Photography

To quantify the changes in the areal extent of sunlight exposure on Jones Creek LRD contracted a licensed UAV/Drone Operator to take high resolution aerial photos of Jones Creek before and after the vegetation trimming process.

The pre-trimming photography took place in October 2023 (10/6/2023-10/28/2023), and the post trimming photography took place in April 2024 (04/23/2024-05/01/2024). The DJI Phantom 4 Pro v2.0 drone was used for both missions and flights were flown at 200 feet at mid-day.

GIS image processing was used to merge the individual photos to create rectified 2D ortho mosaic photos of the entire project area. From the ortho photos taken pre- and post-trimming, the visible water was digitized as polygon features and the area statistics computed.

Results & Discussion

Water Quality Monitoring

Comparison of water quality at the 6 monitoring stations (71, 75, CALC, TPJ, DEL, and JCU) from grab samples collected monthly before, during and after the vegetation trimming - May 2023-Dec 2024.

The monthly average of FIB concentration at the 6 stations sampled monthly are shown in [Figure 9](#). Fecal coliform and enterococci concentrations were moderate prior to the trimming work, decreased during the months that trimming occurred, and then increased following the trimming work. It is important to note that the pre- and post-sampling mostly occurred during the wet season, while the trimming work occurred during the dry season.



Figure 9. Monthly average FIB concentration (log scale) of all 6 stations sampled monthly prior to, during, and after the vegetation trimming project (May 2023 through April 2025). Note: The pre- and post-trimming sampling occurred mostly in the wet season, and the trimming work and sampling occurred during the dry season.

Because the trimming activities required extensive work in water, we expected to see increases in FIB concentrations from the mobilization of the sediments that have very high concentrations of FIB (previous unpublished work). However, despite the sediment disturbances from the in-water work, the FIB concentrations in the grab samples were generally low and typical of previous dry season samples.

To gauge the magnitude of the post-trimming FIB concentrations relative to historical measurements, we plotted the data for the 4 sites that had data back to January 2016. The time series plot in [Figure 10](#) indicates there were higher monthly enterococci concentrations in 2018 and 2019, but the fecal coliform concentration early post-trimming was the highest we measured since 2016.

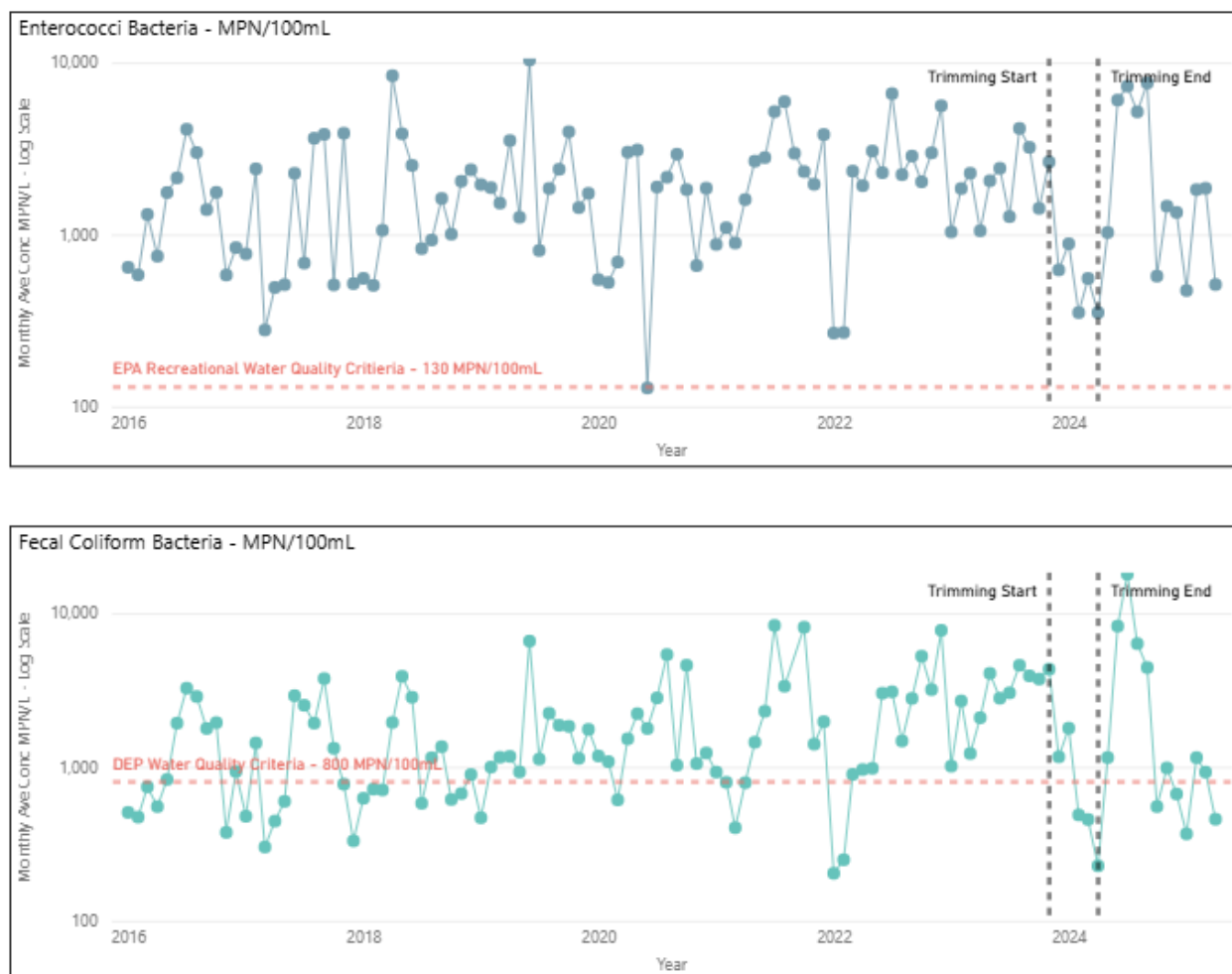


Figure 10. The monthly average FIB concentrations (log scale) from the 4 long-term water quality stations sampled from January 2016 through April 2025 for historical context.

Historical FIB data typically shows increased FIB concentrations during the wet season associated with increased rains and stormwater flows compared to the dry season, but there is inconsistency in the months of the wet versus dry seasons. Grouping the monthly average FIB concentrations and plotting them in box and whisker plots show the post-trimming FIB concentrations for enterococci bacteria were near record lows in April and October, but record high in July and September **Figure 11**. The post-trimming FIB concentrations for fecal coliform bacteria were near record or lowest in April and October, but were record highs in June, July, August, and September. Perhaps the additional sunlight and disturbance from the trimming increased bacteria production in the months immediately following the trimming. The most recent seven months of measurements (October 2024-April 2025) show notably lower FIB concentrations, albeit the dry season **Figure 10**.

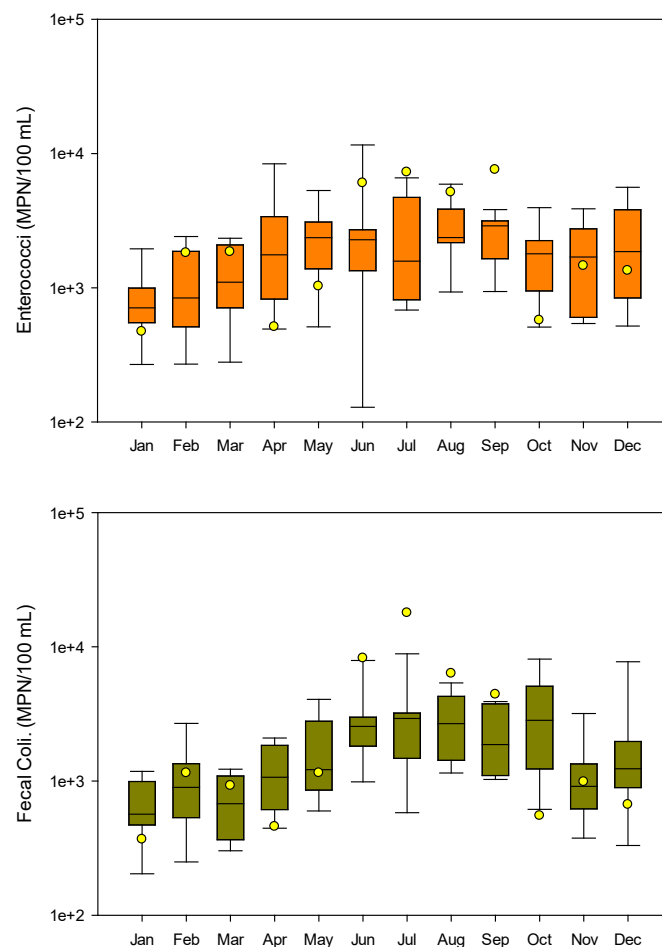


Figure 11. Box and whisker plots to show the monthly average FIB concentrations post-trimming relative to the pre-trimming data for historical context. Data from the 4 long-term water quality stations sampled from November 2015 through April 2025. The whiskers are the minimum and maximum range of the historical monthly average, the boxes the interquartile range, the bar is the median, and the yellow dot is the post-trimming monthly average.

Initial results, following the trimming project, do not indicate a reduction in enterococci FIB relative to historical values collected during the wet and dry seasons, while one month (July 2024) following trimming had unusually high concentrations of fecal coliform bacteria but then returned to typical concentrations (Figure 10). LRD intends to continue FIB monitoring, albeit at a lower sampling frequency, to monitor for any potential shifts in FIB concentrations potentially resulting from the trimming project.

Correlation Analysis

To compare water quality conditions prior to, and after trimming, we performed independent correlation analysis on each of the datasets (pre and post) to identify the relationships among the various water quality parameters. The assumption was that changes in the relationships among the parameters may be associated with the increased sunlight or water flow/flushing brought about by the vegetation trimming and cleanup project.

The results from two different statistical tools (PCA and Spearman rank correlation) were consistent. The direction and strength of correlations between water quality parameters were aligned across both methods, confirming the robustness of the analysis. Visual representations of the PCA and correlation matrices are provided in appendix [Figure S8](#) and appendix [Figure S9](#) and a summary of key correlations is presented below in [Table 4](#).

During the **pre-trimming period**, there were moderate to strong negative correlations ($r = -0.58$ to -0.81) between FIB and Dissolved Oxygen (DO), Salinity, Conductivity and pH (Table 4). Conversely, there were moderate to strong positive correlations ($r = 0.45$ to 0.79) between FIB and Total Phosphorus, Color, TOC, Turbidity, and Total Nitrogen. In general, the correlations among these parameters are likely related to the influence of tidal flushing where marine water brought in by incoming/flood tide that has higher DO, higher salinity, higher pH, and low bacteria, versus outgoing/falling tide that has more freshwater, lower salinity, lower pH, and higher bacteria concentrations.

In the **post-trimming period**, several notable shifts in correlation patterns were observed. The strength of the negative correlation between fecal coliform and enterococci increased significantly from $r = 0.70$ pre-trimming to $r = 0.96$ post-trimming. This suggests that both FIB indicators responded similarly to environmental conditions after the trimming work.

Therefore, the correlation coefficients to other parameters were similar for both bacteria studied.

Following the trimming work, pH surpassed DO as the most strongly, negatively correlated parameter with FIB concentrations ($r = -0.78$ to -0.80), followed by DO and Salinity (Table 4). The marine waters have a higher pH than the freshwater in Jones Creek. Like the pre trimming sampling, there was a strong, positive correlation between FIB and Total Phosphorus and Color ($r = 0.65$ to 0.75). Like the pre trimming data, these data may simply suggest the influence of tidal flushing on FIB concentrations.

Interestingly, turbidity, which prior to the trimming project showed moderate correlations with FIB ($r = 0.57$ – 0.63), had a low correlation ($r = 0.20$ – 0.22) post-trimming. Prior to trimming FIB concentrations closely mirrored turbidity values, whereas there is a greater spread and variability between FIB and turbidity results following the trimming work (Figure 12).

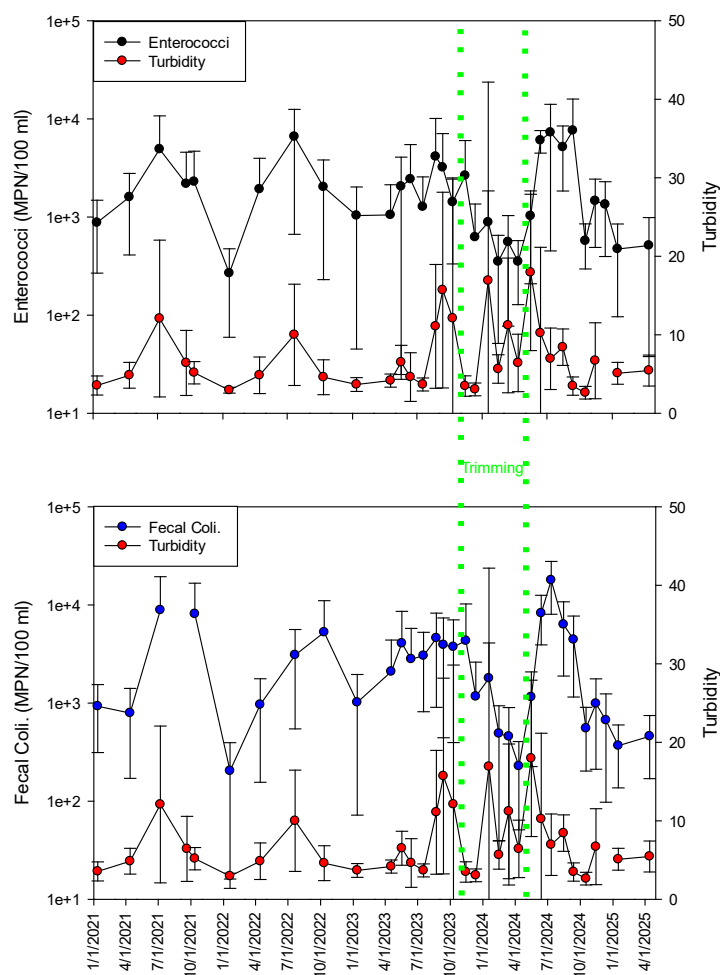


Figure 12. FIB concentrations with Turbidity measurements before, during and after the trimming work.

Table 4 The summary of pre and post trimming correlation coefficients (*r*) of FIB (enterococci and fecal coliform) with water quality parameters. See appendix **Figure S9** for the full correlation matrix.

Pre trimming	
Positive Correlation	Negative Correlation
Total P (0.70-0.79)	DO (0.69-0.81)
Color (0.65-0.75)	Salinity (0.70-0.79)
TOC (0.57-0.72)	pH (0.58-0.74)
Turbidity (0.57-0.63)	
Total N (0.45-0.63)	
Post trimming	
Positive Correlation	Negative Correlation
Total P (0.75-0.75)	pH (0.78-0.80)
Color (0.65-0.67)	DO (0.72-0.74)
TOC (0.49-0.52)	Salinity (0.72-0.72)
Total N (0.36-0.44)	
Turbidity (0.20-0.22)	

Water Quality Data from Instrumentation

Data sonde water quality instruments were used to measure temperature, salinity and dissolved oxygen every 15 minutes at the background/reference station downstream of the trimming area and at two stations within the vegetation trimming area. In addition, two study area instruments included probes to measure turbidity and chlorophyll.

The results were computed into daily averages and time series plots for each parameter created (**Figure S10**). The results indicate a significant increase in water temperature across both the trimmed area and the non-trimmed segments of the creek following the trimming activities (**Table 5**). However, this change is likely not solely attributable to the trimming itself, as the reference station (Station 75) also exhibited a notable rise in mean temperature (29.99 to 30.65 °C). It is possible that the increase in temperature was primarily due to warmer weather conditions in 2024 compared to 2023. Further, the 0.33 °C difference in mean temperature between pre- and post-trimming is not likely to be biologically significant, given the difference in mean temperature pre- and post-trimming at the reference site was 0.66 °C. While vegetation removal may have allowed more sunlight to penetrate the water surface, contributing to heating, the overarching influence of higher ambient temperatures in 2024 complicates any direct attribution to increased sunlight exposure from trimming.

Salinity values suggest that trimming may have resulted in increased marine water inflow during incoming/flood tide. While the salinity at Station 75 remained relatively constant before and after trimming, the upstream monitoring stations CALC and TPH showed higher salinity, higher pH, and lower turbidity data. These data suggest an increase in seawater migration during incoming/flood tide into the creek up to the CALC and TPJ stations following the trimming. The removal of extensive overgrown and floating vegetation mats likely improved flushing and water flow, particularly into the upper extents of the creek.

Oddly, despite the apparent increase in marine water inflow, there was no significant change in DO concentrations, as might be expected with the typically higher DO marine water. Perhaps the higher temperatures and high heterotrophic respiration consuming DO may have affected DO concentrations as the marine water traveled upstream through the creek.

Table 5 Summary statistics of pre- and post-trimming water quality data from the data sonde instruments.

Time Period			Site	
Pre Trimming (08/01/2023-10/11/2023)			CALC (N=57)	TPJ (N=70) 75 (N=55)
Temp (°C)	Range	27.12-29.91	26.73-30.1	28.18-31.96
	Mean±SD	28.67±0.72	28.34±0.83	29.99±0.97
Salinity (ppt)	Range	0.95-16.84	0.46-12.63	5.25-26.14
	Mean±SD	7.90±4.45	7.20±3.54	19.20±5.74
pH	Range	6.85-7.16	6.74-6.88	
	Mean±SD	6.95±0.068	6.83±0.029	
DO (%)	Range	-1.86-32.15	1.44-19.79	
	Mean±SD	6.75±10.88	3.86±3.80	
Turb (NTU)	Range	6.16-28.16	0.87-25.74	
	Mean±SD	16.10±5.55	9.79±6.15	
Chla (ug/L)	Range	2.75-7.39	10.37-21.26	
	Mean±SD	4.56±1.07	13.17±2.76	
Post Trimming (05/30/2024-08/31/2024)			CALC (N=89)	TPJ (N=93) 75 (N=62)
Temp (°C)	Range	26.55-32.60	25.94-33.43	26.75-33.53
	Mean±SD	30.01±1.31	29.74±1.21	30.65±1.43
Salinity (ppt)	Range	2.37-24.3	0.90-23.11	11.55-32.07
	Mean±SD	10.84±5.07	10.18±5.53	20.36±5.86
pH	Range	6.75-7.13	6.63-7.07	
	Mean±SD	6.97±0.068	6.87±0.088	
DO (%)	Range	-1.85-26.8	-1.79-27.49	
	Mean±SD	3.9±4.71	5.17±5.92	
Turb (NTU)	Range	6.87-20.08	1.58-15.17	
	Mean±SD	10.96±2.48	7.22±3.17	
Chla (ug/L)	Range	4.43-19.01	10.55-20.07	
	Mean±SD	9.67±2.83	14.75±2.05	

Light Monitoring

Results from the light monitoring system before and after the trimming indicated there was a notable improvement in light reaching the water's surface following the trimming ([Figure 13](#)).

Prior to trimming, approximately 25% of available ambient downwelling light reached Jones Creek. Additionally, light measured under the canopy averaged $400 \mu\text{mol s}^{-1} \text{m}^{-2}$ (Figure 10, top panel).

Following the trimming, available downwelling light reaching the creek improved to 59% while the light measured under the canopy averaged $810 \mu\text{mol s}^{-1} \text{m}^{-2}$ (Figure 10, bottom panel). This demonstrates the desired outcome of the trimming by increasing, by more than double, the amount of available downwelling light reaching the center of Jones Creek.

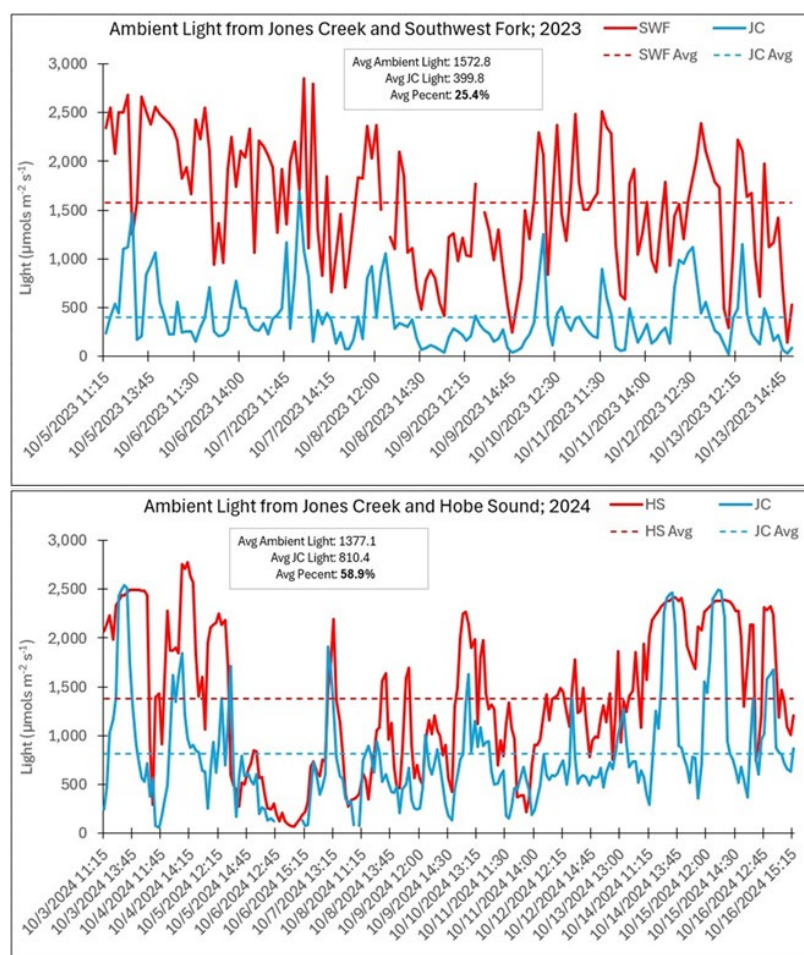


Figure 13. Time-series graphs comparing light measured just above the surface of Jones Creek (blue line) and a reference site unaffected by overhead vegetation (red line). Top graph shows pre-trim light while the bottom graph shows post-trim light. Summary statistics indicated.

High Resolution Aerial Photography

The high-resolution aerial drone photography provided thorough documentation and quantification of the visible changes of creek water before and after trimming.

Digitization of the visible water before and after trimming indicated the pre-trimmed area of visible water was approximately 1.7 acres. The post-trimmed area was approximately 3.4 acres, effectively doubling (or 100% increase) the canopy opening and sunlight exposure to the creek waters (**Figure 14**).

Comparing side by side photos, you can clearly see that the vegetation has been effectively cut back to allow for greater sunlight penetration (**Figure 15**).

Additional before-and-after drone images are provided in appendix **Figure S11-Figure S14**, which further illustrate the extent of vegetation removal and increased sunlight exposure.

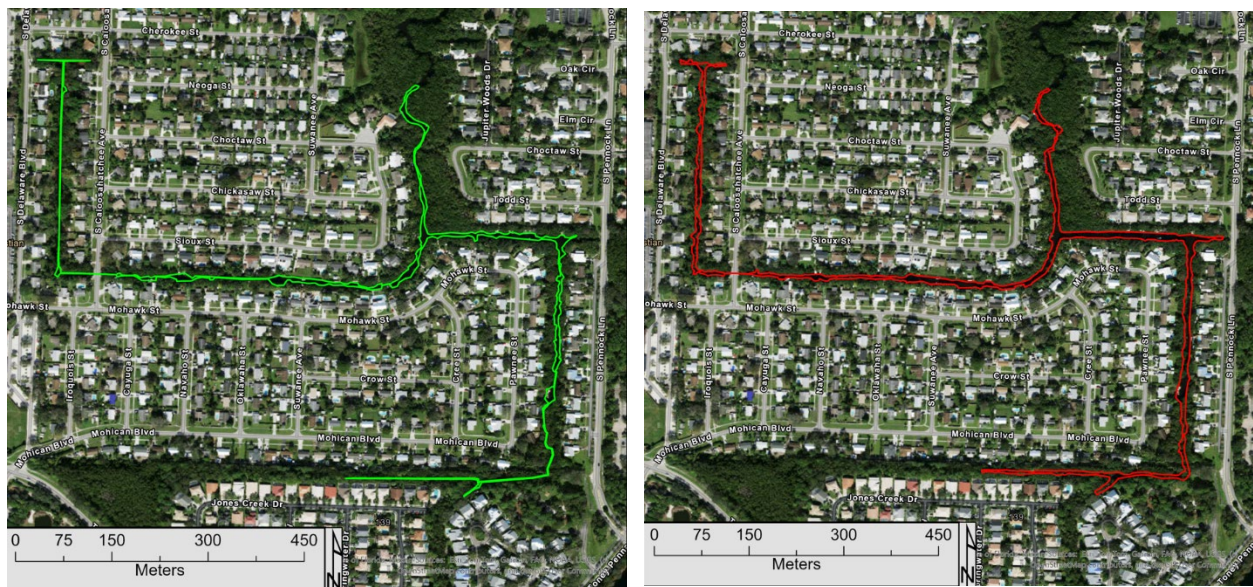


Figure 14. The comparison of the digitized open water in Jones Creek pre-trimming (left) and post-trimming (right).



Figure 15. Section of Jones Creek between Delaware Street to the west, Cherokee Street to the north, and Caloosahatchee Drive to the east. Drone imagery taken before trimming (left) and after trimming (right). See Appendix for additional comparison photos.

Summary

Based on light availability assessments and analysis of the water quality data from instrumentation, the recent trimming activities in the Jones Creek area have demonstrably improved both light penetration and water flushing. High-resolution aerial imagery analysis indicates a 100% increase in canopy opening area following the trimming.

Key observations from post-trimming monitoring include:

1. **Bacterial Response:** Water samples collected during the trimming project showed lower concentrations of Fecal Indicator Bacteria (FIB; *Enterococci* and *Fecal Coliform*) than historically observed during the dry season. This was unexpected given the disturbances of sediments with high FIB concentrations during the trimming work. Noticeable spikes in *Enterococci* and *Fecal Coliform* concentrations were observed immediately following the trimming activities coinciding with the start of the wet season, and similar to concentrations observed in historical data. Bacteria concentrations have generally shown a declining trend over time.
2. **Turbidity:** Despite in-water operations during the trimming process, turbidity levels remained within the normal range, indicating minimal disturbance to water clarity.
3. **Tidal Influence on FIB:** Correlation analyses suggest that fluctuations in fecal indicator bacteria (FIB) concentrations are strongly influenced by tidal conditions. Marine water inflows, characterized by higher dissolved oxygen (DO), salinity, and pH, are generally associated with lower bacterial levels.
4. **Shifts in Correlation Patterns:** While most pre- and post-trimming correlation patterns remain consistent, notable changes include:
 - Post-trimming, pH has surpassed DO as the most strongly negatively correlated parameter indicative of the higher pH marine water migrating into the creek during flood tide.
 - Turbidity's correlation with FIB has decreased from moderate to low.
5. **Nutrient Associations:** Phosphorus and color (indicative of dissolved organic matter) exhibit the strongest positive correlations with FIB, suggesting their potential role as key nutrients supporting bacterial growth and evidence of improved tidal flushing.

6. **Need for Long-Term Monitoring:** As the trimming was completed within the past year, continued long-term monitoring is essential to draw more definitive conclusions, particularly given the seasonal variability in FIB concentrations and the likelihood that the system needs to equilibrate to the new, increased light levels and improved flushing.

LRD intends to continue water quality monitoring and will publish the results to our website (<https://loxahatcheeriver.org/jonescreek/> and <https://loxahatcheeriver.org/river/river-keeper/>). We encourage stakeholders to check regularly for updates and reach out with any questions or feedback.

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7. Fujioka, R.S., et al., *Effect of sunlight on survival of indicator bacteria in seawater*. Applied and environmental microbiology, 1981. **41**(3): p. 690-696.

Appendix

Table S1 Summary of method number, sample preservation, and maximum hold time

Analyte	Method	Preservation Method ⁽¹⁾	Maximum Hold Time ⁽¹⁾
Alkalinity (Alk) as CaCO ₃	SM2320B	Refrigerate < 6°C	14 days
Ammonia as N (NH ₃)	SM4500-NH3C	Sulfuric acid H ₂ SO ₄ to pH < 2	28 days
Ammonia as N (NH ₃)	SM4500-NH3G	Sulfuric acid H ₂ SO ₄ to pH < 2	28 days
Chlorophylls (Chla)	SM10200H	GF filter; MgCO ₃ ; freeze	28 days
Color	SM2120B	Refrigerate < 6°C	48 hours
Dissolved Oxygen (DO)	EPA360.1	Not Applicable	Analyze Immediately
Enterococcus (Enter)	Enterolert	Refrigerate < 6°C	8 hours
Fecal Coliform (Fecal)	SM9222D and Colilert-18	Refrigerate < 6°C	8 hours
Kjeldahl Nitrogen, total (TKN)	EPA351.2	Sulfuric acid H ₂ SO ₄ to pH < 2	28 days
Nitrate-Nitrite Nitrogen (NO _x)	EPA353.2	Sulfuric acid H ₂ SO ₄ to pH < 2	28 days (acid preserved)
Nitrate-Nitrite Nitrogen (NO _x)	EPA353.2	Field Filtered; Refrigerate < 6°C	48 hours (unpreserved)
Orthophosphate as P (o-P)	SM4500-P E	Field Filtered; Refrigerate < 6°C	48 hours
Orthophosphate as P (o-P)	SM4500-P F	Field Filtered; Refrigerate < 6°C	48 hours
Phosphorus, total (TP)	SM4500-P E	Sulfuric acid H ₂ SO ₄ to pH < 2	28 days
pH	EPA150.1	Not Applicable	15 minutes
Residue-nonfilterable (TSS)	SM2540D	Refrigerate < 6°C	7 days
Turbidity (Turb)	EPA180.1	Refrigerate < 6°C	48 hours



Figure S1. Staff from Sherlock Tree Company shown here trimming and removing exotic plants (Photos: Town of Jupiter Water Utilities and Loxahatchee River District).



Figure S2. Photos before trimming (on left) and after trimming (on right) looking north from Toney Penna Footbridge (TPJ) monitoring site.



Figure S3. Photos before trimming (on left) and after trimming (on right) looking south from Toney Penna Footbridge (TPJ) monitoring site.



Figure S4. Photos before trimming (on left) and after trimming (on right) looking east from Caloosahatchee Culvert (CALC) monitoring site.

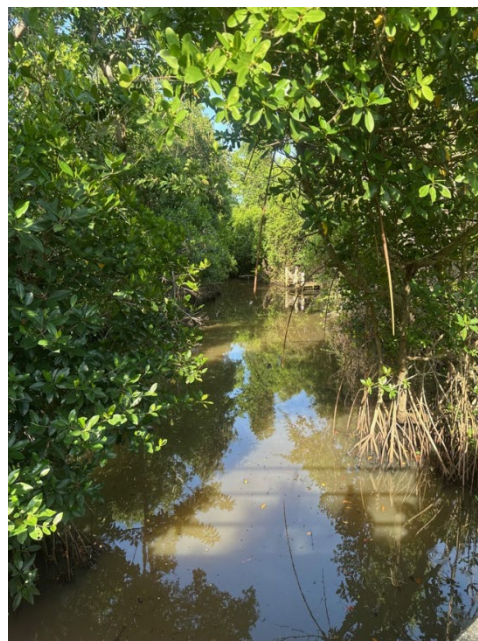
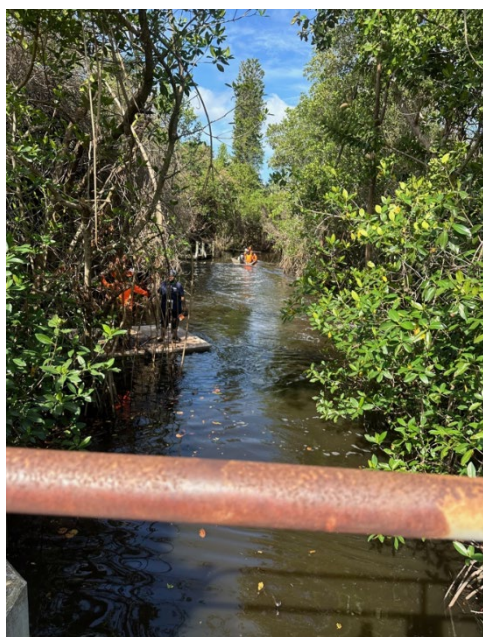


Figure S5. Photos before trimming (on left) and after trimming (on right) looking west from Caloosahatchee Culvert (CALC) monitoring site.



Figure S6. Photos before trimming (on left) and after trimming (on right) looking east from Delaware Street (DEL) monitoring site.

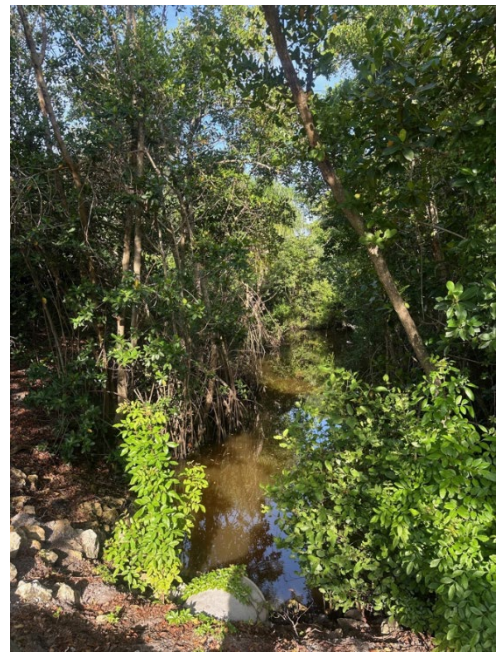


Figure S7. Photos before trimming (on left) and after trimming (on right) looking west toward the Delaware Street (DEL) monitoring site.

Correlation (-1 to 1)																							
	Variables																						
	Alkalinity	Chla corr.	Chla	Color	Conduc.	DO%	DO	Enteroc.	Fecal.	NH3	NOx	Organic N	Ortho P	pH	Salinity	Temp	TKN	TOC	Total N	Total P	TSS	Turbidity	
Alkalinity																							
Chla corr.	0.030785																						
Chla	0.039357	0.9982																					
Color	0.22355	0.286	0.28176																				
Conduc.	-0.12791	-0.3798	-0.37812	-0.81151																			
DO%	-0.36133	-0.28205	-0.27405	-0.76125	0.80649																		
DO	-0.37599	-0.31757	-0.30938	-0.74949	0.7941	0.99508																	
Enteroc.	0.35964	0.43902	0.43815	0.75413	-0.79013	-0.81169	-0.8106																
Fecal.	0.40814	0.38172	0.38164	0.64673	-0.69667	-0.69123	-0.71363	0.69603															
NH3	0.099227	-0.11077	-0.11975	0.70619	-0.58385	-0.64125	-0.612	0.58866	0.36947														
NOx	-0.085301	-0.19151	-0.18147	-0.32646	0.255	0.34543	0.3515	-0.17837	-0.25317	-0.22707													
Organic N	0.22055	0.46216	0.45996	0.47251	-0.50218	-0.51037	-0.50748	0.5044	0.35485	0.32208	-0.42295												
Ortho P	0.33953	0.21087	0.21156	0.72352	-0.74585	-0.77328	-0.74667	0.77947	0.55255	0.63203	-0.17869	0.49859											
pH	-0.37966	-0.23096	-0.22087	-0.70704	0.69536	0.85861	0.85223	-0.7369	-0.58528	-0.58519	0.26598	-0.50614	-0.67001										
Salinity	-0.12415	-0.38387	-0.38206	-0.81027	0.99966	0.80664	0.79489	-0.79044	-0.69823	-0.58327	0.25402	-0.50404	-0.74431	0.69453									
Temp	0.021392	0.42821	0.42754	-0.1616	0.13174	0.1417	0.066464	-0.14674	0.1739	-0.32771	0.01631	-0.043753	-0.30608	0.23779	0.12383								
TKN	0.2866	0.40396	0.40195	0.59575	-0.58452	-0.64504	-0.63914	0.62858	0.44878	0.469	-0.37181	0.90709	0.65426	-0.61123	-0.58491	-0.10844							
TOC	0.17754	0.31545	0.31382	0.77843	-0.77282	-0.6804	-0.67585	0.72455	0.56679	0.5676	-0.3253	0.40499	0.69915	-0.54111	-0.77244	-0.055868	0.52096						
Total N	0.28722	0.42156	0.41934	0.5923	-0.58736	-0.64164	-0.63538	0.63258	0.45477	0.45492	-0.33834	0.90486	0.66099	-0.61592	-0.58778	-0.10471	0.99645	0.51238					
Total P	0.33867	0.3704	0.36779	0.77849	-0.79764	-0.8639	-0.8589	0.79399	0.7051	0.56765	-0.43902	0.60353	0.79744	-0.74192	-0.79892	-0.14663	0.7164	0.7081	0.71104				
TSS	0.17103	0.093129	0.10252	-0.093798	0.065063	-0.10604	-0.10838	0.13577	0.10196	-0.080061	0.24853	-0.12664	0.19221	-0.052746	0.064059	0.00020355	-0.070893	0.015087	-0.05345	0.1169			
Turbidity	0.31706	0.55107	0.56199	0.3673	-0.42302	-0.43327	-0.45162	0.63322	0.5674	0.21771	-0.17706	0.27311	0.41296	-0.28883	-0.42367	0.2016	0.34232	0.44863	0.3448	0.47286	0.30482		

Correlation (-1 to 1)																							
	Variables																						
	Alkalinity	Chla corr.	Chla	Color	Conduc.	DO%	DO	Enteroc.	Fecal.	NH3	NOx	Organic N	Ortho P	pH	Salinity	Temp	TKN	TOC	Total N	Total P	TSS	Turbidity	
Alkalinity																							
Chla corr.	0.20622																						
Chla	0.22216	0.98921																					
Color	-0.13692	0.37293	0.3254																				
Conduc.	0.20076	-0.26053	-0.2137	-0.87685																			
DO%	-0.27421	-0.39786	-0.3511	-0.64696	0.63802																		
DO	-0.26503	-0.42272	-0.37581	-0.63251	0.61105	0.99287																	
Enteroc.	-0.11182	0.45031	0.41316	0.67155	-0.72253	-0.74181	-0.75549																
Fecal.	-0.15056	0.51145	0.46655	0.65278	-0.71686	-0.72469	-0.74925	0.95613															
NH3	-0.20293	-0.54459	-0.55942	0.1446	-0.30217	-0.30251	-0.29345	0.34167	0.24988														
NOx	-0.49579	-0.52794	-0.51373	-0.14099	0.020504	0.46284	0.46401	-0.14174	-0.18658	0.34158													
Organic N	0.11139	0.34073	0.33715	0.63023	-0.54451	-0.29999	-0.26808	0.2875	0.2608	-0.1566	-0.11906												
Ortho P	0.14797	0.25908	0.21612	0.67416	-0.72363	-0.87892	-0.8791	0.73622	0.71933	0.46703	-0.17633	0.38354											
pH	0.02756	-0.33443	-0.30164	-0.75768	0.85641	0.82099	0.80337	-0.7952	-0.77835	-0.38884	0.15004	-0.47279	-0.85912										
Salinity	0.20003	-0.25952	-0.21287	-0.87802	0.99991	0.63911	0.61224	-0.72325	-0.71646	-0.3053	0.019848	-0.54385	-0.72445	0.857									
Temp	-0.1936	0.63344	0.63122	0.3293	-0.25164	-0.088528	-0.13872	0.44522	0.5283	-0.29249	-0.062582	0.17146	0.12765	-0.22617	-0.25157								
TKN	0.059667	0.14403	0.13136	0.67281	-0.63612	-0.42305	-0.38843	0.39532	0.32999	0.16816	-0.0030299	0.93044	0.54817	-0.58903	-0.63712	0.044693							
TOC	0.1291	0.44235	0.39441	0.87017	-0.77464	-0.61533	-0.59793	0.5188	0.49078	-0.025197	-0.3389	0.67452	0.61868	-0.60433	-0.77519	0.16408	0.66547						
Total N	0.10067	0.16788	0.16172	0.58721	-0.52524	-0.42423	-0.40109	0.43666	0.36072	0.17073	-0.030769	0.85601	0.4945	-0.50619	-0.52647	0.082039	0.9346	0.58237					
Total P	0.047648	0.47825	0.44058	0.73681	-0.78741	-0.72983	-0.73051	0.74539	0.7453	0.24104	-0.26641	0.55376	0.80882	-0.80219	-0.78772	0.26032	0.62187	0.73646	0.57253				
TSS	0.21844	0.29784	0.35877	-0.53683	0.49484	0.28797	0.27349	-0.32672	-0.25392	-0.48795	-0.18517	-0.16684	-0.37063	0.27242	0.49826	0.10432	-0.36725	-0.42957	-0.28391	-0.20831			
Turbidity	0.4384	0.37207	0.3917	-0.050415	0.13802	-0.41375	-0.4228	0.22338	0.20042	-0.037697	-0.49172	-0.051859	0.21837	-0.23779	0.13906	0.16543	-0.065026	-0.086077	0.038286	0.16342	0.45125		

Figure S9. Spearman rank correlation values of the water quality parameters measured with instrumentation (a) pre and post (b) trimming.

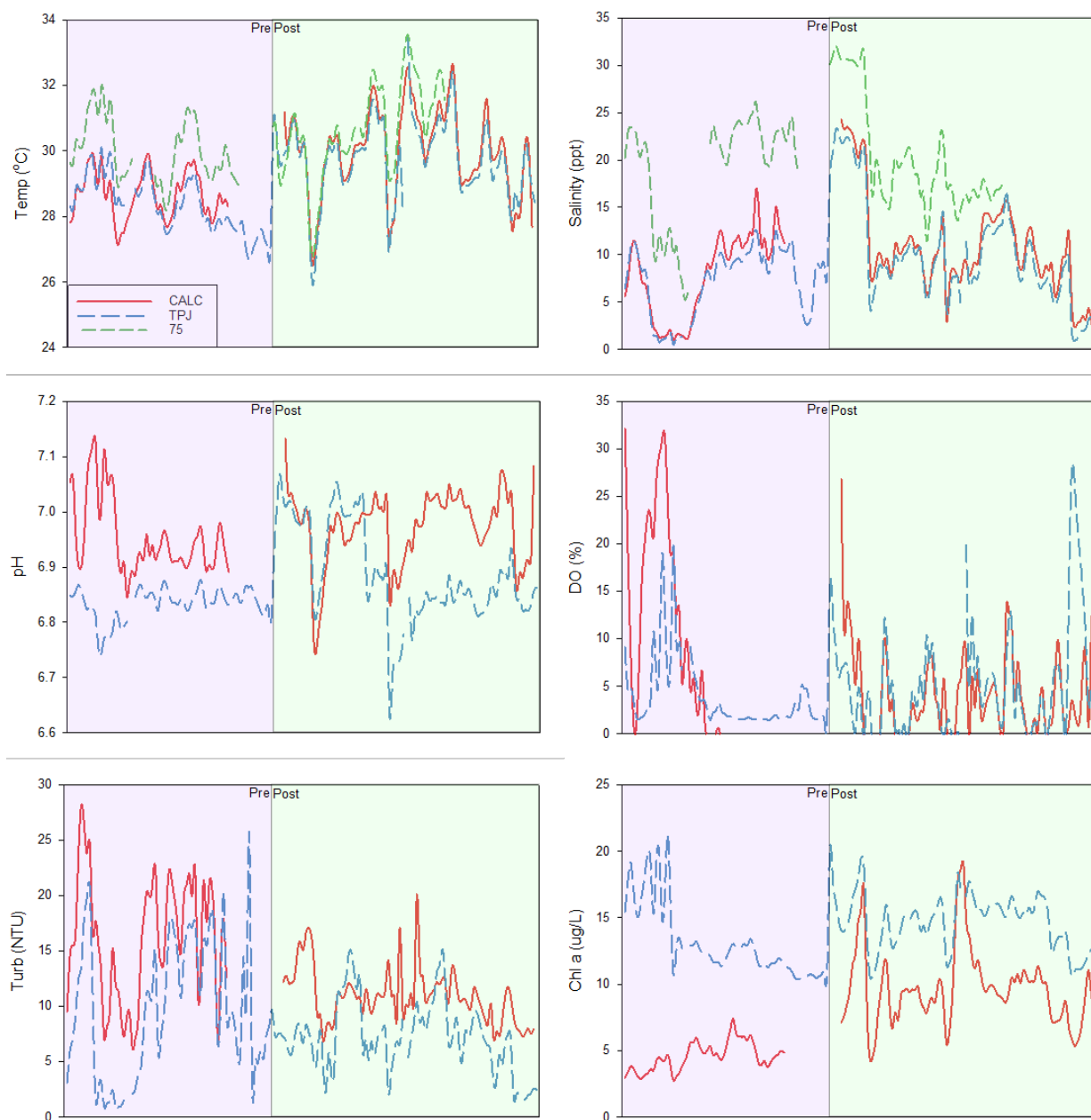


Figure S10. Water quality data from instrumentation before (08/01/2023-10/11/2023) and after (05/30/2024-08/31/2024) trimming. Pre-trimming has a purple background and post-trimming has a green background.

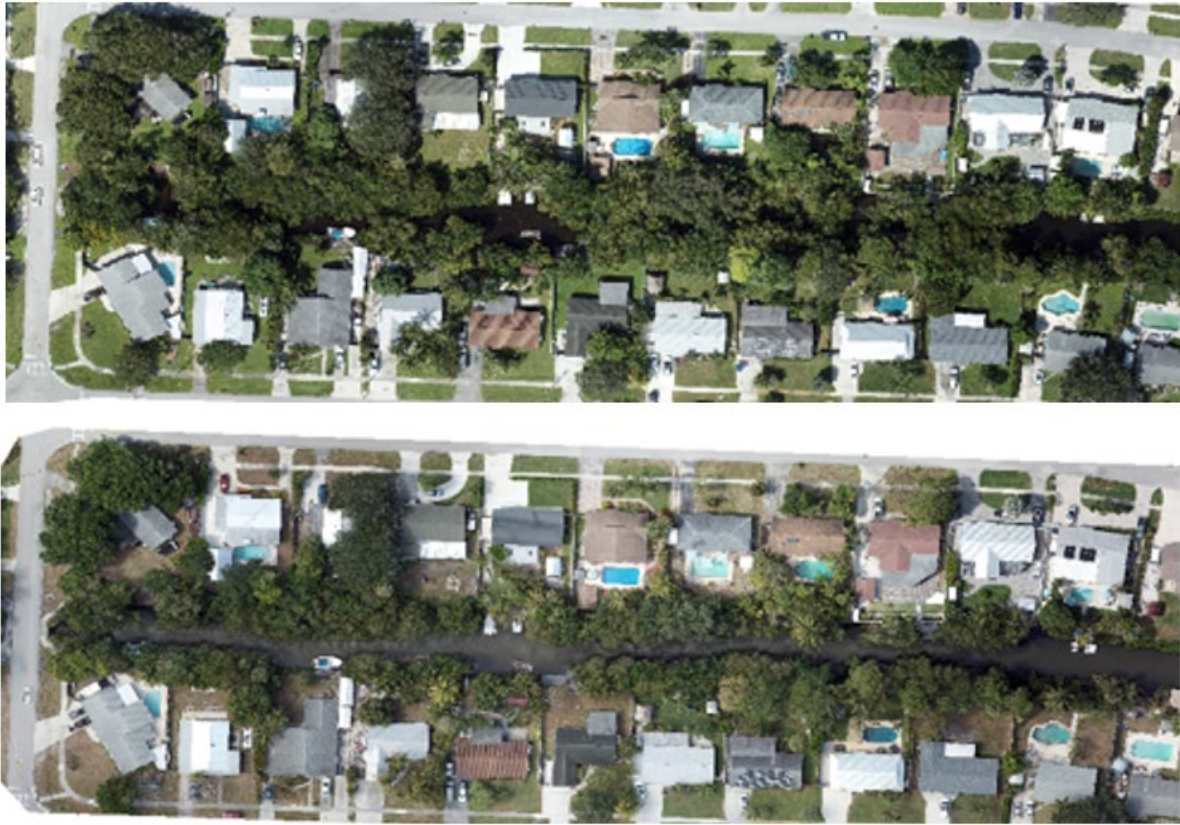


Figure S11. Section of Jones Creek between Sioux Street to the north and Mohawk Street to the south. Caloosahatchee Culvert Water Quality site is at far left. Drone imagery taken before trimming (top) and after trimming (bottom).



Figure S12. Section of Jones Creek north of Mohawk Street. Drone imagery taken before trimming (top) and after trimming (bottom).



Figure S13. Section of Jones Creek between Pawnee Street to the west and Pennock Lane to the east. Drone imagery taken before trimming (left) and after trimming (right).



Figure S14. Section of Jones Creek with Mohican Blvd to the north and the Colony/Maple Isle neighborhoods. Drone imagery taken before trimming (top) and after trimming (bottom).