Appendix 2-3: Annual Permit Report for the Biscayne Bay Coastal Wetlands Project

Permit Report (May 1, 2020–April 30, 2021)
Permit Number: 0271729

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SUMMARY

Based on Florida Department of Environmental Protection (FDEP) permit reporting guidelines, **Table 1** lists key permit-related information associated with this report. **Table 2** lists the attachments included with this report. **Table A-1** in Attachment A lists specific pages, figures, tables, and attachments where project status and annual reporting requirements are addressed. This annual report satisfies the reporting requirements specified in the permit.

Table 1. Key permit-related information.

Project Name:	Biscayne Bay Coastal Wetlands Project
Permit Number:	0271729-010
Issue and Expiration Dates:	Issued: 2/13/2018; Expires 2/13/2023
Project Phase:	Operation
Permit Specific Condition Requiring Annual Report:	38
Reporting Period:	May 1, 2020–April 30, 2021
Report Lead:	Bahram Charkhian (bcharkh@sfwmd.gov, 561-682-2284)
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Table 2. Attachments included with this report.

Attachment	Title
A	Specific Conditions and Cross- References
B	Water Quality and Mercury Data
C	Hydrologic Data
D	Summary of Water Quality in Nearshore Biscayne Bay Waters in the L-31E Canal Area During WY2021 and Comparisons with Florida Class III Criteria for Marine Waters [a]

a. WY2021 – Water Year 2021 (May 1, 2020–April 30, 2021).

PROJECT STATUS

During Water Year 2021 (WY2021; May 1, 2020–April 30, 2021), routine compliance monitoring of water quality and ecological parameters was conducted for the Biscayne Bay Coastal Wetlands (BBCW) project. Short-term hydrologic improvements continued to be realized, as described in *Conclusions Regarding Project Success* and other sections of this report. Staff from the South Florida Water Management District (SFWMD), Miami-Dade County, Biscayne National Park, Deering Estate Park, the National Oceanic and Atmospheric Administration, Fairchild Tropical Botanic Garden, and Florida International University contributed to project efforts.

For the L-31E Culverts, there were no exceedances of the Class III marine water criteria for any parameter during WY2021. For the Deering Estate component, all parameters sampled at the S-700 pump station met the Class III freshwater criteria in WY2021. Additional details about water quality during the reporting period and trends for the last five water years are provided in the *Water Quality Monitoring Summary* section of this report.

In WY2021, 212,321 acre-feet (ac-ft) (dry season [November–April]: 81,512 ac-ft; wet season [May–October]: 130,809 ac-ft) and 136,826 ac-ft (dry season: 55,715 ac-ft; wet season: 81,111 ac-ft) of fresh water was discharged to Biscayne Bay through structures S-20F and S-21A, respectively. These total volumes of fresh water diverted through S-20F and S-21A in WY2021 are higher than the totals diverted in WY2020. Similarly, daily average flow through coastal structure S-20F was higher during the wet and dry seasons of WY2021 than in WY2020, and daily average flow through coastal structure S-21A was higher during the wet and dry seasons of WY2021 than previous water years (WY2017–WY2020).

During WY2021, 20,206 ac-ft (dry season: 3,183 ac-ft; wet season: 17,023 ac-ft) of fresh water was diverted as sheetflow from the C-102 and C-103 canals via the L-31E Canal and L-31E Culverts to the freshwater and saltwater wetlands east of the L-31E Levee and nearshore Biscayne Bay. Due to the unavailability of water for the project through some of the L-31E Culverts, the project was unable to divert adequate fresh water through the culverts to the historical tidal wetlands and Biscayne Bay in WY2021. The total volume of fresh water diverted through the L-31E Culverts in this water year was slightly higher than the total volume diverted in WY2020.

Water levels upstream and downstream of the L-31E Culverts were below the desired level of 2.2 feet National Geodetic Vertical Datum of 1929 (ft NGVD29) during low tide events, and water levels were lower in the dry season than in the wet season during the reporting period. Due to the unavailability of sufficient fresh water, water levels at the wetland stage monitoring stations downstream of culverts S-23A, S-23D (S-23H), S-706B, S-708, and S-712B were also below the desired stage of 2.2 ft NGVD29 during the water year. The hydroperiod (the length of time and portion of year the wetland holds ponded water) increased in WY2021.

S-700 diverted approximately 36,948 ac-ft (dry season: 17,029 ac-ft; wet season: 19,919 ac-ft) of fresh water in the form of sheetflow from the C-100 Canal to the historic remnant wetlands near Cutler Creek east of Old Cutler Road in WY2021, compared to 30,951 ac-ft in WY2020. The daily average discharge through S-700 during the WY2021 dry season was 80 ac-ft, compared to 58 ac-ft during the WY2020 dry season. The daily average discharge through S-700 during the WY2021 wet season was 130 ac-ft, compared to 111 ac-ft during the WY2020 wet season.

L-31E Flow-way annual vegetation monitoring in WY2021 provided insight on the structure of mangrove forests along the freshwater to marine gradients in this region and should continue to provide insight into changes driven by shifting freshwater delivery. All transect points sampled remained dominated by a mangrove overstory and, for the most part, red mangrove (*Rhizophora mangle*) was the predominant species; continued recruitment of red mangrove was apparent through the presence of seedlings. The dominance of herbaceous species establishment was confined to a few localities and was largely restricted to salt-tolerant species. Periphyton was not observed to be forming cohesive mats in the L-31E transects, likely indicating the predominance of higher salinity conditions. WY2021 Deering Estate annual vegetation monitoring observations noted a shift in vegetation communities from upland to wetland species and that sawgrass has begun to establish naturally in the coastal wetlands.

To fulfill the requirements of specific condition 37 of the permit, in July 2020, SFWMD submitted a pump test summary report ("After Action Assessment for the Biscayne Bay Coastal Wetlands L-31E Flow-way Pilot Pump Test") for the testing that was conducted from August 2017 to March 2019. Based on data collected during that time and as noted in the summary report, the pump test was successful and it improved the quality, quantity, timing, and distribution of fresh water to Biscayne Bay and minimized point source discharges by diverting fresh water to coastal wetlands via the L-31E Culverts. The test results indicate that a 40-cubic feet per second (cfs) pump station for this location meets all the requirements identified in the *Central and Southern Florida Project Comprehensive Everglades Restoration Plan Biscayne Bay Coastal Wetlands Phase 1 Final Integrated Project Implementation Report and Environmental Impact Statement* (USACE and SFWMD 2012).

CONCLUSIONS REGARDING PROJECT SUCCESS

A comparison of the monitoring data with previous baseline data indicates the project is trending towards achieving project goals. Point source freshwater discharges have been reduced. Monitoring results clearly demonstrate improved hydrologic conditions in response to operation of the Deering Estate pump station (S-700).

During this reporting period, sawgrass recruitment was observed east of the L-31E Canal and in various locations within the Deering Estate coastal wetlands. An increased abundance of various bird species, amphibians, invertebrates, and fish was also observed in WY2021. Overall, these results demonstrate that the BBCW project is achieving short-term hydrologic improvements and that early restoration benefits are being realized.

PROBLEMS ENCOUNTERED

L-31E Culverts

Delivering adequate fresh water to wetlands east of the L-31E Canal through the L-31E Culverts has been a continuous challenge for SFWMD due to the unavailability of enough fresh water in the L-31 Canal. The L-31E pump stations (S-709 and S-705) that will divert fresh water into the L-31 Canal and to the L-31E Culverts are still under construction. Additional fresh water would improve and enhance performance of this project component.

Delivery of fresh water from the main L-31E Flow-way canals through the L-31E Canal and the L-31E Culverts to the coastal wetlands and Biscayne Bay was significantly impacted by construction of pump stations S-709 and S-705 along the L-31E Canal in WY2021.

The performance of the L-31E Culverts (S-23A through F) has been significantly impacted by the buildup of dirt, sand, and silt, as well as the encroachment of vegetation at the culvert outflows and within the riprap surrounding each culvert. District submitted a Project Activity Form to FDEP in April 2020 and received approval from FDEP to conduct maintenance activities.

ACTIONS TO ADDRESS PROBLEMS

L-31E Culverts

The United States Army Corps of Engineers (USACE) continued construction of the L-31E Flow-way, S-709 and S-705 pump stations phase of the project in WY2021. This phase includes construction of a permanent 40-cfs pump station (S-709) and a permanent 100-cfs pump station (S-705). The purpose of these pump stations is to deliver water to the L-31E Canal from the C-103 and C-102 canals to maintain an optimal stage of 2.21 ft NGVD29 so water can be distributed to the coastal wetlands via the existing culverts. The estimated completion of the S-709 pump station is November 2022, and the S-705 pump station is estimated to be completed in October 2023. Additionally, USACE initiated construction of a permanent 50-cfs pump station (S-703) in WY2022 and two new 40-cfs pump stations S-710 and S-711 in WY2022.

In WY2021, SFWMD completed maintenance of the L-31E Culverts (S-23A through F) and removed vegetation and debris downstream of culverts that had been restricting the free movement of fresh water from the L-31E Canal through the culverts to the coastal wetlands and Biscayne Bay.

INTRODUCTION

PROJECT OVERVIEW

The BBCW project was designed to address issues with nearshore hypersalinity and coastal wetlands degradation by restoring more natural patterns of freshwater delivery into Biscayne Bay. By rehydrating coastal wetlands and reducing point-source freshwater discharges, the project will improve nearshore substrate and fish habitats which have been stressed by high salinities in the dry season and reduce excessive freshwater outflow during the rainy season. The project will accomplish these goals by redirecting fresh water that had been discharged directly and rapidly to the bay through man-made canals to spreaders in coastal wetlands adjacent to the bay that are currently bypassed by the canals. This will help restore freshwater and saltwater wetlands, reestablish more natural salinity, and provide a more productive nearshore nursery habitat.

Project Purpose and Benefits

The Water Resources Development Act of 2000, Section 601(b)(1)(A), authorized the Comprehensive Everglades Restoration Project (CERP) as the framework for restoration of the South Florida ecosystem. The BBCW project is a component of CERP, conducted in partnership between USACE and SFWMD and authorized under Section 7002(5)(5) of the Water Resources Reform and Development Act of 2014. The project, located in southeast Miami-Dade County, incorporates the Deering Estate, the Cutler Wetlands, the L-31E Flow-way/North Canal, and recreational features.

Biscayne Bay, a shallow estuarine lagoon extending nearly the entire length of Miami-Dade County in southeastern Florida, is home to over 500 species of fish and other marine organisms. A large area of the south-central portion of Biscayne Bay is contained within Biscayne National Park, the largest marine park

in the United States National Park System; 95% of its 172,000 acres is underwater. The park contains four distinct ecosystems: Biscayne Bay, the mangroves along the shore, the coral limestone keys, and the offshore Florida Reef. The longest stretch of mangrove forest remaining on Florida's eastern seaboard occurs within Biscayne Bay. Extensive areas of seagrasses in the bay serve as an important food source for the endangered Florida manatee (*Trichechus manatus latirostris*) and as nursery areas for many ecologically and commercially important estuarine species, such as shrimp, crabs, lobster, and sponges.

Major vegetation changes have occurred in the coastal wetlands of Biscayne Bay over the past century in response to hydrologic changes, sea level rise, and storms. The hydrologic changes include significant modifications to the hydropatterns and salinity regime that are the key drivers of vegetation communities in the coastal wetlands of South Florida. These changes have resulted in the landward movement of mangroves into coastal freshwater communities at a rate ranging from 3 to 30 meters (m) per year over the last several decades; coastal development has further reduced acreage of wetland habitat and, together, these forces have diminished freshwater wetlands to 10% of their original area, with the remaining undeveloped land being encroached by coastal as well as exotic vegetation.

The purpose of the BBCW project is to rehydrate the coastal wetlands and reduce abrupt point-source freshwater discharges to Biscayne Bay and Biscayne National Park that are physiologically stressful to fish and benthic invertebrates in the bay near the canal outlets. The BBCW project will restore wetland and estuarine habitats and divert an average of 59% of the annual coastal structure discharge into freshwater and saltwater wetlands instead of directly discharging it all to Biscayne Bay and Biscayne National Park.

As stated in the project implementation report, project objectives include capturing freshwater runoff from the watershed into Biscayne Bay (USACE and SFWMD 2012). This freshwater runoff will be redistributed in the form of sheetflow through the historical freshwater and tidal wetlands to moderate point-source canal discharges and to do the following:

- ✓ Improve freshwater and estuarine habitat.
- ✓ Improve salinity distribution and reestablish productive nursery habitat along the shoreline.
- ✓ Restore the quantity, quality, timing, and distribution of fresh water to Biscayne Bay and Biscayne National Park.
- ✓ Preserve and restore the spatial extent of natural coastal glades habitat within the BBCW project study area.

In addition to providing these anticipated benefits, the project will maintain the current level of flood protection within the drainage basin.

Project Description

The BBCW project is the first CERP project constructed with direct benefit to Biscayne National Park and Biscayne Bay in Miami-Dade County. Due to the important benefits of this project, and because SFWMD had secured most of the land required for construction and implementation of the project, SFWMD moved forward with expedited design and construction prior to the congressional authorization. The project encompasses a footprint of approximately 3,761 acres and includes three components: The L-31E Culverts, Deering Estate, and Cutler Wetlands (**Figure 1**).

The project is essential to achieving restoration of tidal wetlands and nearshore habitats within Biscayne Bay, including Biscayne National Park. Comprehensive Everglades Restoration Plan Regulation Act (CERPRA) permit 0271729, issued by FDEP, authorized SFWMD to construct and operate the L-31E Culverts and Deering Estate components.

This report satisfies Specific Condition 38 of the permit, which requires SFWMD to submit an annual report to FDEP detailing the progress of the BBCW project, and to incorporate it into the *South Florida Environmental Report.*

L-31E CULVERTS

The L-31E Culverts component is in Miami-Dade County between the C-102 and C-103 canals (Sections 4, 9, 28, 33, and Township 56 South Range 40 East and Township 57 South Range 40 East). The component's goal is to reestablish, at least in part, historical sheetflow and wetland hydroperiods downstream of the project area. This component may also provide the additional benefit of mitigating impacts of discharging fresh water via the existing canals. The component is expected to achieve its objectives by redirecting flow that was historically discharged through structures S-21A, S-20F, and S-20G. This flow is now discharged into the coastal wetlands east of the L-31E Levee, along Biscayne Bay, via four flap-gated culverts: S-23A, S-23B, S-23C, and S-23D (**Figure 2**). Construction of the culverts began on January 11, 2010, and was completed on June 10, 2010.

USACE completed construction of two culverts (S-712A and S-712B) and they became operational in WY2019; this work was authorized under a CERPRA permit (0344004-001) issued to USACE by FDEP, the culverts were transferred to SFWMD, therefore permit mandated monitoring required under the USACE permit has been included in this report. In WY2018, SFWMD obtained a permit modification (0271729-010) and initiated construction of the four remaining culverts (S-706A, S-706B, S-706C, and S-708) along the L-31E Canal to divert fresh water from the L-31E Canal to the L-31E coastal wetlands and Biscayne Bay. In WY2019, SFWMD completed construction of the four culverts, and they became operational in October 2018.

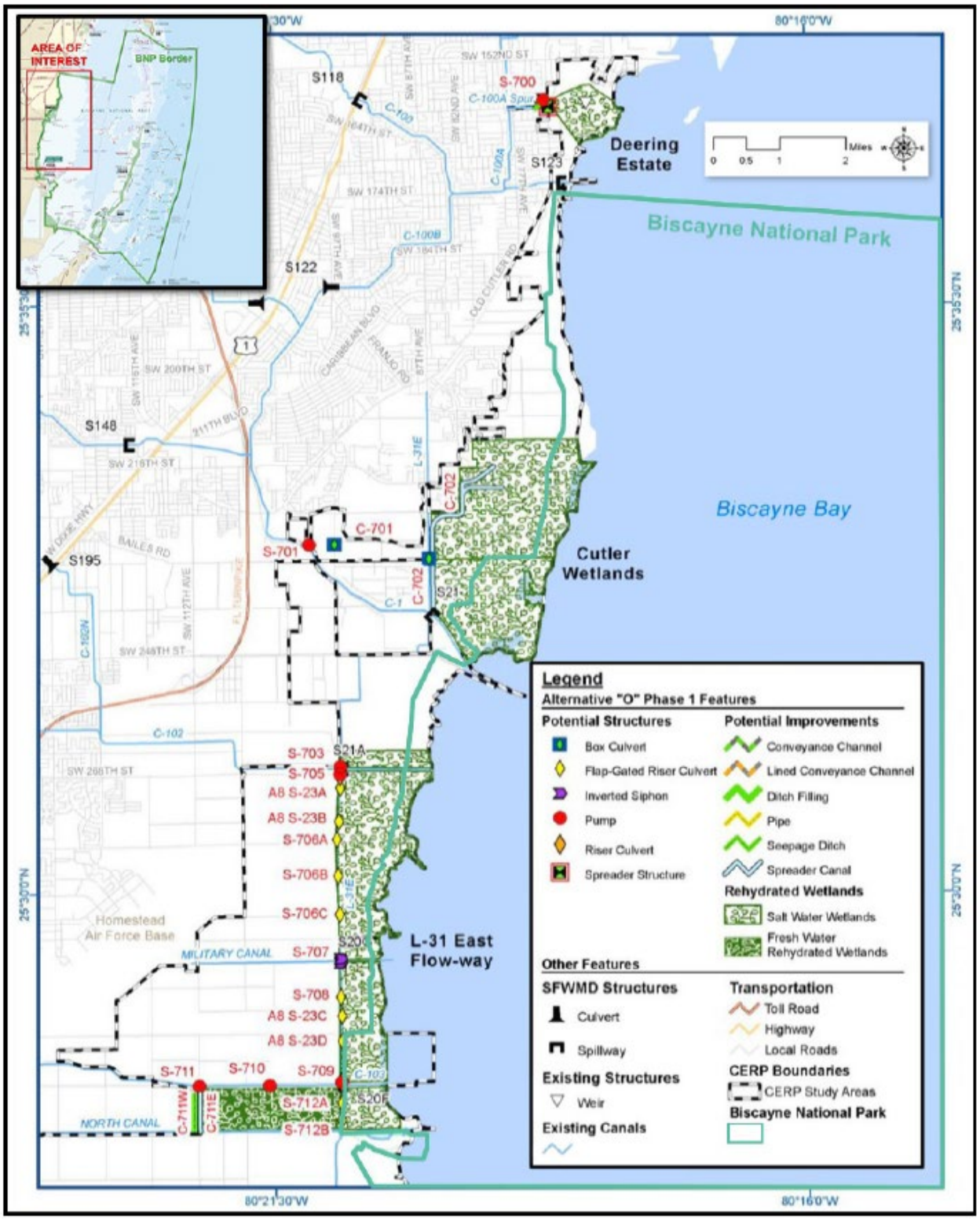

Figure 1. Biscayne Bay Coastal Wetlands project features.

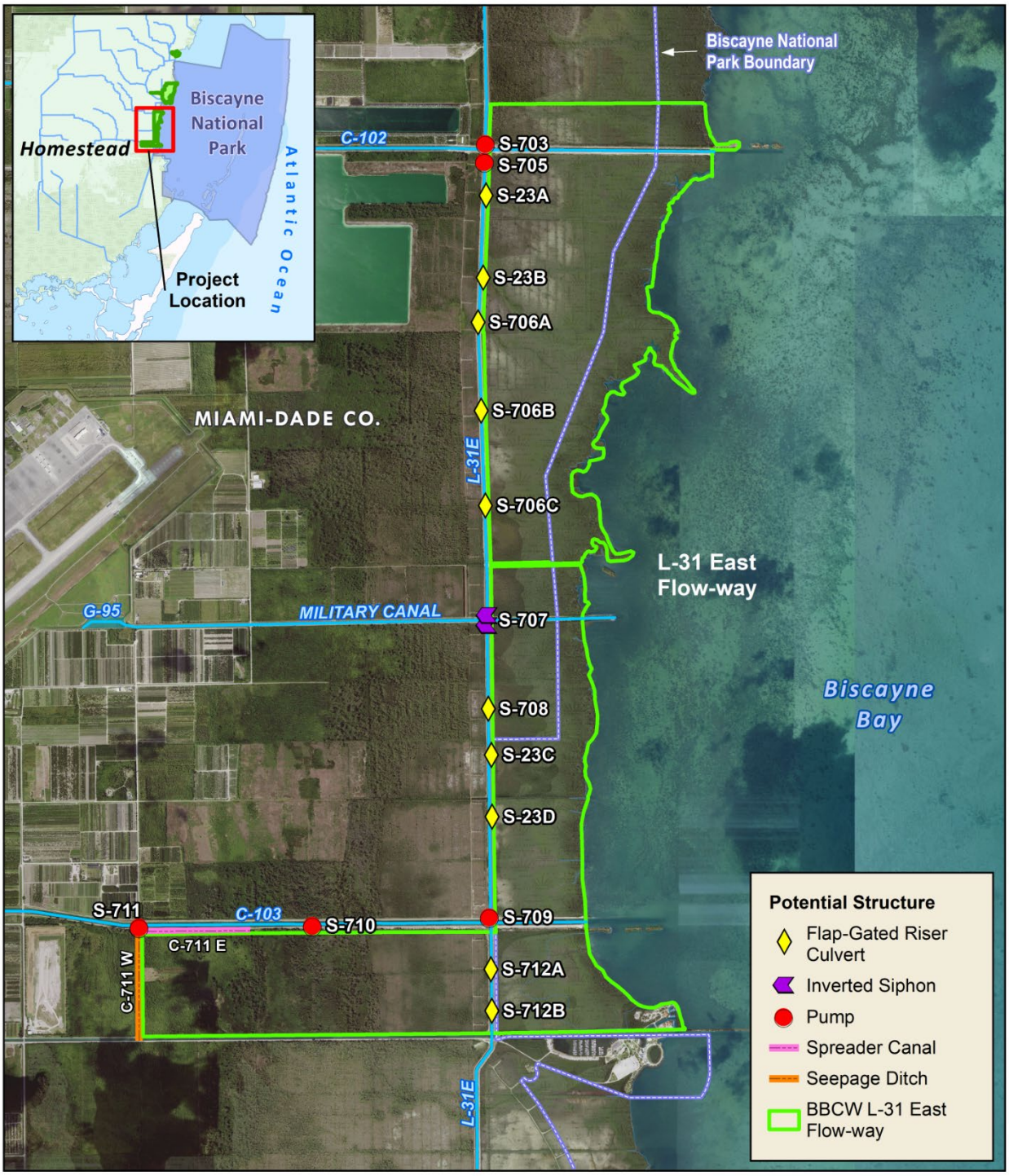

Figure 2. L-31E component features.

DEERING ESTATE

The Deering Estate component is in southeastern Miami-Dade County at 1580 Old Cutler Road, Palmetto Bay, Florida (**Figure 3**). This component included construction of a 500-foot extension of a spur canal off the C-100A Canal, a 100-cfs pump station with associated discharge piping, and an outlet spreader structure. Excluding the spreader structure, these components were constructed on a 9.7-acre tract referred to as the "Powers Addition Parcel", located west of and adjacent to the Deering Estate.

The Deering Estate component can redirect up to 100 cfs of water from the C-100A Canal system, through the C-100A spur canal into the Cutler Drain on the component site, and within the Deering Estate component, thus restoring a portion of the historic freshwater flow through the freshwater wetland and tidal wetland, and into Biscayne Bay (**Figure 3**). Final project completion of the S-700 pump station was in March 2012. Initial operational testing began in April 2012, water quality monitoring started in May 2012, and routine operation began in December 2012.

Miami-Dade County and SFWMD are cooperating on this component with the following goals and benefits:

- Redirection of up to 100 cfs of the existing point-source discharge from the S-123 structure by optimizing the capture and conveyance of fresh water from the C-100A spur canal to the coastal wetlands in the immediate vicinity of the Cutler Drain, east of Old Cutler Road. This will result in a small reduction in the point-source discharges at S-123.
- Rehydration of the wetland region east of Old Cutler Road, and restoration of a more natural freshwater flow regime.
- Improvement of the benefits of the Deering Estate component by construction of a one-acre expansion of the BBCW Deering Estate Charles Deering Education Wetlands. This was initiated and completed by Miami-Dade County in collaboration with SFWMD in May 2015.

Figure 3. Deering Estate component features.

PERMIT HISTORY

The original CERPRA permit and all modifications issued to SFWMD are as follows:

- 0271729-001, issued September 10, 2007, with an expiration date of September 10, 2012, is the original permit for the L-31E Culverts.
- 0271729-002, issued May 23, 2008, with an expiration date of May 23, 2013, is a modification that included the Deering Estate component.
- 0271729-003, issued January 11, 2007, is an exemption for a geotechnical survey for the Cutler component.
- 0271729-004, is a permit application under review by FDEP for the BBCW Cutler Wetlands component.
- 0271729-005, issued June 8, 2012, is a minor modification that updated the water quality monitoring requirements for the Deering Estate component and included minor changes to the permit language.
- 0271729-006, issued April 18, 2013, with an expiration date of April 18, 2018, is a minor modification that renewed the permit for five years.
- 0271729-007, issued July 18, 2014, is a minor modification for the L-31E Pilot Pump Test.
- 0271729-008, issued July 2, 2015, is a minor modification that allows direct total nitrogen analysis from a sample instead of the previous calculation of total nitrogen from total Kjeldahl nitrogen and nitrate + nitrite data.
- 0271729-009, issued September 11, 2015, is a minor modification that extended the L-31E Pilot Pump Test for five years.
- 027129-010, issued February 13, 2018, with an expiration date of February 13, 2023, is a major modification that renewed the permit for five years and authorized construction of four culverts along L-31E Canal.

WATER QUALITY MONITORING SUMMARY

This section summarizes results of water quality monitoring conducted during WY2021 for the BBCW project. All monitoring was performed in accordance with Section 62-160, Florida Administrative Code (F.A.C.), the water quality compliance monitoring plan (SFWMD 2020a) associated with the permit, and SFWMD's *Field Sampling Manual* (SFWMD 2020b) and *Quality Manual* (SFWMD 2020c). Parameters analyzed by the SFWMD laboratory followed the *Chemistry Laboratory Quality Manual* (SFWMD 2021). Water quality data for the reporting period are provided in Attachment B.

STATISTICAL METHODOLOGY

The current analysis assesses water quality in Biscayne Bay nearshore L-31E Canal waters as well as the water quality of freshwater input to Biscayne Bay at the Deering Estate pump station.

The first purpose of the analysis is to evaluate the water quality parameters during the reporting period by calculating basic statistics (i.e., minimums, maximums, means, medians, etc.) of parameter values for the water year and comparing measured values with Class III marine or freshwater criteria (62-302.530, F.A.C.), where applicable.

The second purpose of the analysis is to evaluate temporal trends of water quality parameters in the two areas of the project. To evaluate water quality input and in nearshore waters over time, temporal water

quality trends were assessed using the Seasonal Kendall-Tau test. This test is a nonparametric method for detecting long-term trends in time-series data while considering inherent seasonal variability and providing adjusted significance (p-values) when statistically significant autocorrelation exists among time series values. Results of the Seasonal Kendall-Tau test are presented as Sen's slopes and probability values (p-values) for each parameter and station. Sen's slope is an estimate of the annual trend of the time series, while p-value determines the statistical significance of the trend when compared to the chosen significance level. A significance level of $\alpha = 0.05$ was used for the Seasonal Kendall-Tau test. Therefore, if the p-value is less than 0.05, the trend is considered statistically significant.

The third purpose of the analysis, applicable to Biscayne Bay nearshore L-31E Canal waters, is to determine if there are differences in spatial distribution of the water quality parameters. In other words, it is to evaluate differences in water quality parameter data sets between stations BB53, MI01, MW01, and PR01. Comparisons between stations were performed using box plots for data sets measured during the entire POR.

Notched Box Plot Comparisons

A notched box plot is a way of displaying the distribution of a set of data. Each plot shows the annual median, the 95% confidence interval around the median, the 75th and 25th percentiles, and the range (minimum and maximum values) (**Figure 4**). When a notched box plot appears to be folded over, the overlap means the 95% confidence limits for the median exceed the 25th or 75th percentile, or both, which is indicative of highly variable data.

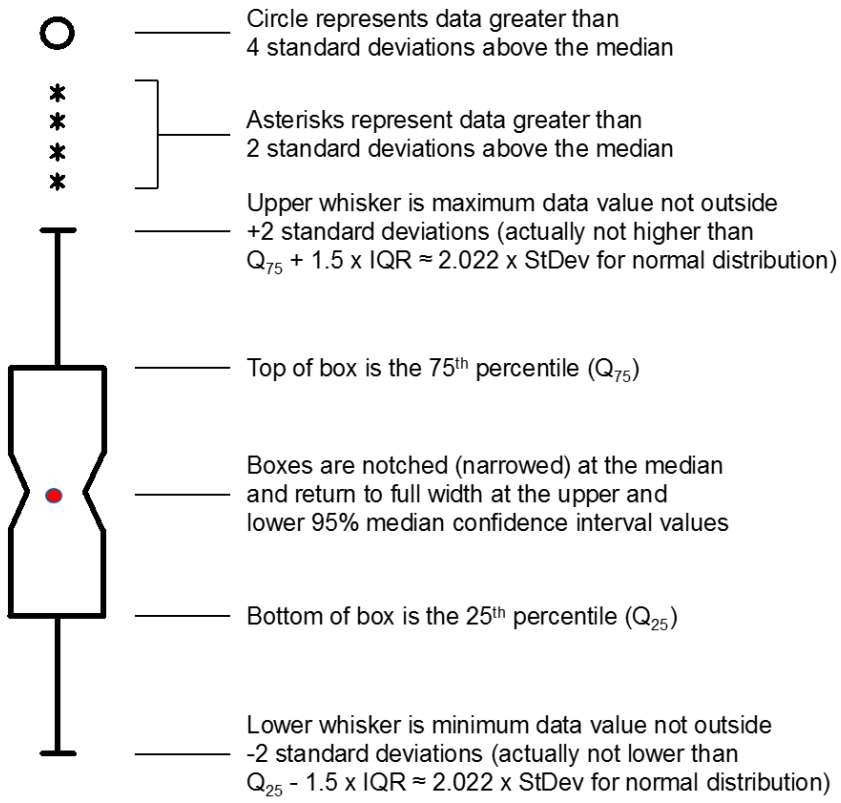

Figure 4. Description of notched box plots used in this report. (Note: IQR = interquartile range, which is Q_{75}–Q_{25}, and StDev = standard deviation. The red dot represents the arithmetic mean.)

L-31E CULVERTS

Conditions During WY2021

During WY2021, monthly water quality samples were collected at stations BB53, MI01, MW01, and PR01, to evaluate the condition of nearshore Biscayne Bay waters in the L-31E Canal area (**Figure 5**). Station BB53 is in saline bay waters, while stations MI01, MW01, and PR01 are located at the mouth of freshwater inputs to the bay through the Military, C-103, and C-102 canals, respectively.

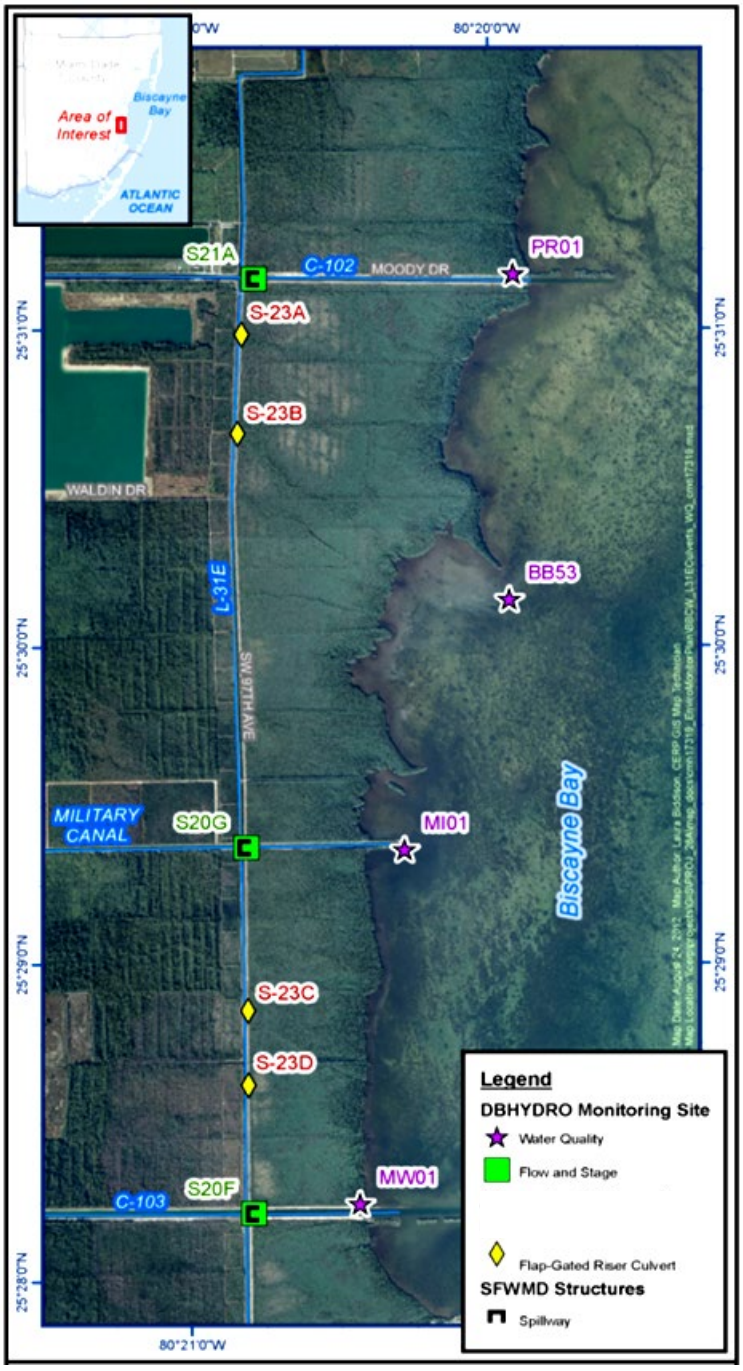

Figure 5. Water quality monitoring stations for the BBCW L-31E Culverts component.

Field parameters (dissolved oxygen [DO], pH, salinity, specific conductance, and temperature) and parameters collected by grab and analyzed in the laboratory (ammonia, color, nitrate + nitrite, total nitrogen (TN), total phosphorus (TP), and total suspended solids) are listed in **Table D-1** (Attachment D).

Table D-1, in Attachment D, presents basic statistics of water quality parameters by station for WY2021. Where applicable, **Table D-1** presents comparisons of parameter values with Class III marine criteria. During WY2021, there were no exceedances of Class III marine water criteria for any parameter.

System Changes Over Time

In addition to assessing the quality of Biscayne Bay nearshore L-31E Canal waters for WY2021, this analysis includes an evaluation of the system's temporal dynamics. Parameter changes over time at each station were analyzed using the Seasonal Kendall-Tau test. The results are presented as Sen's slopes and p-values in **Table 3**, which lists field parameters, followed by parameters sampled by grab and measured in the laboratory.

Table 3. Seasonal Kendall-Tau results for water quality parameters by station in nearshore Biscayne Bay waters in the L-31E Canal area for WY2017–WY2021. (Note: p-values less than 0.05 indicate a statistically significant trend and are shown in red.)

Parameter	Unit [a]	BB53		MI01		MW01		PR01	
		Sen's Slope	p-value	Sen's Slope	p-value	Sen's Slope	p-value	Sen's Slope	p-value
Field Parameters									
Dissolved Oxygen Percent Saturation	%	-1.2	0.718	-0.8	0.942	-1.8	0.277	-0.2	0.713
pH		0.00	0.317	0.00	0.652	-0.03	0.162	0.00	1.000
Salinity		1.3	0.229	0.8	0.525	0.1	1.000	0.6	0.358
Specific Conductance	µS/cm	1,899	0.229	1,164	0.525	469	0.832	905	0.437
Temperature	°C	0.2	0.321	0.2	0.478	0.1	0.321	0.2	0.281
Lab Analyzed Parameters									
Color	PCU	0.5	0.271	1	**0.036**	1	**0.001**	1	0.124
Total Ammonia Nitrogen	mg/L	-0.008	0.060	-0.003	0.587	0.004	0.146	-0.004	0.210
Nitrate Plus Nitrite	mg/L	-0.045	0.051	0.000	1.000	0.028	0.427	-0.052	0.613
Total Nitrogen	mg/L	-0.04	**0.043**	0.00	0.884	0.02	0.244	-0.05	0.516
Total Phosphorus	mg/L	0.000	1.000	0.000	0.727	0.000	0.517	0.000	0.727
Total Suspended Solids	mg/L	0.0	0.054	-0.2	**0.020**	-0.3	0.092	0.0	0.128

a. Key to units: % - percent; °C – degrees Celsius; µS/cm – microsiemens per centimeter; mg/L – milligrams per liter; PCU – platinum-cobalt units.

During WY2017–WY2021, no statistically significant trends were observed for field parameters (DO, pH, salinity, specific conductance, and temperature) and few statistically significant trends were observed for parameters analyzed in the laboratory. Color, which increased at all stations, had statistically significant increases at MI01 and MW01 in WY2021; however, Sen's slopes associated with these increases were equal to the laboratory method detection limit (MDL) for color (MDL = 1 CPU). As shown in **Figure 6**,

the significant increase in color occurred in WY2021, not throughout the entire period (WY2017–WY2021). Other statistically significant trends were observed at station BB53, where TN decreased with a Sen's slope of 0.04 milligrams per liter (mg/L), and at station MI01, where total suspended solids decreased with a Sen's slope of 0.2 mg/L. For each of these parameters, the median annual decrease (Sen's slopes) was the same order of magnitude or smaller than the corresponding MDL. TN had MDL values between 0.02-0.05 mg/L, and total suspended solids had MDL values between 3.0 and 6.0 mg/L.

To determine persistent spatial variability in parameter values from station to station, notched box plot comparisons among stations by nearshore location and parameter are presented in **Figure 6** for field parameters, and in **Figure 7** for parameters sampled by grab and measured in the laboratory. For Biscayne Bay nearshore L-31E Canal waters, ammonia, nitrate + nitrite, and TN had the largest values at station PR01 during WY2017–WY2020, as well as during WY2021.

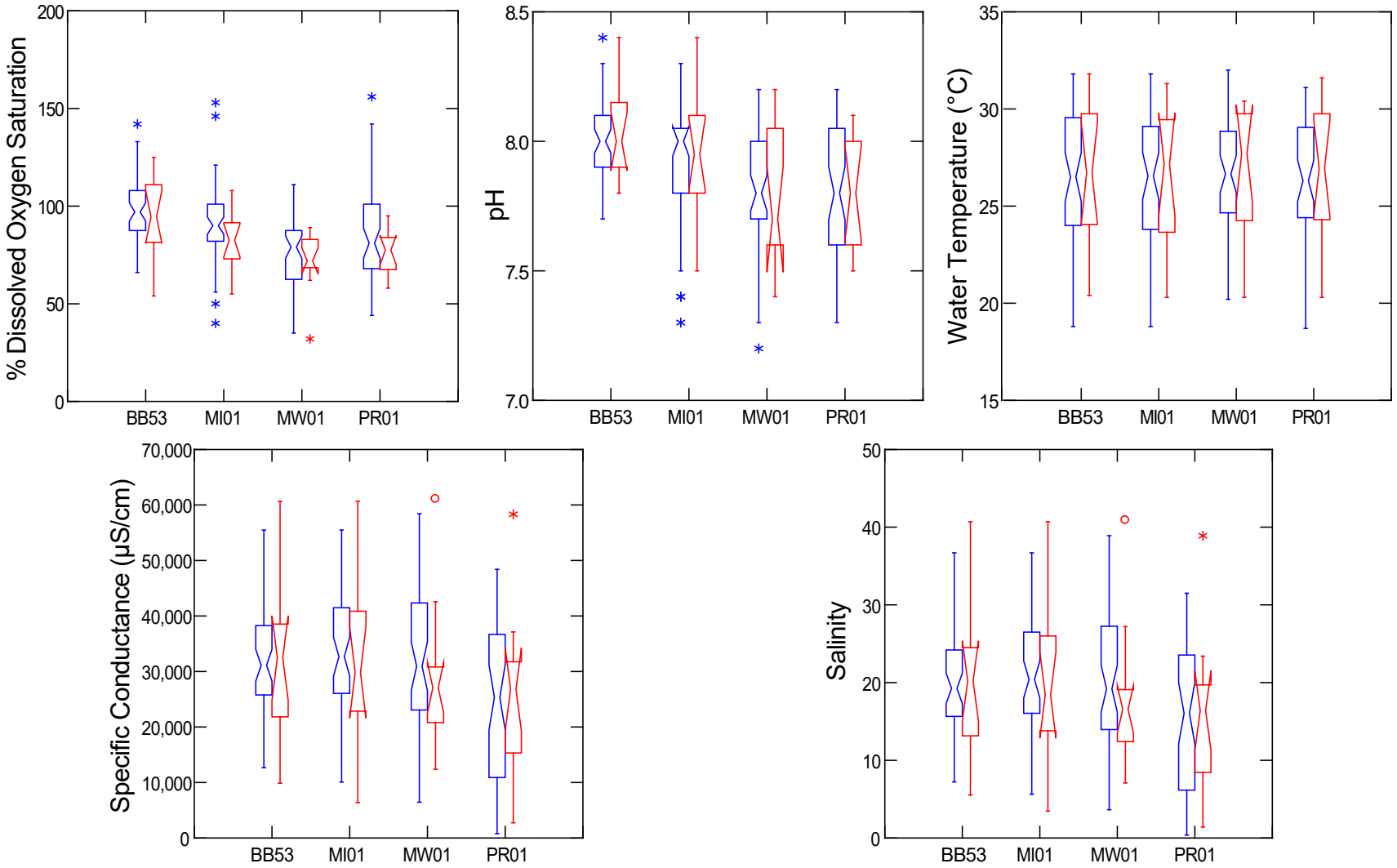

Figure 6. Notched box plot comparisons of water quality field parameters at stations BB53, MI01, MW01, and PR01 for WY2017–WY2020 (blue plots) and WY2021 (red plots).

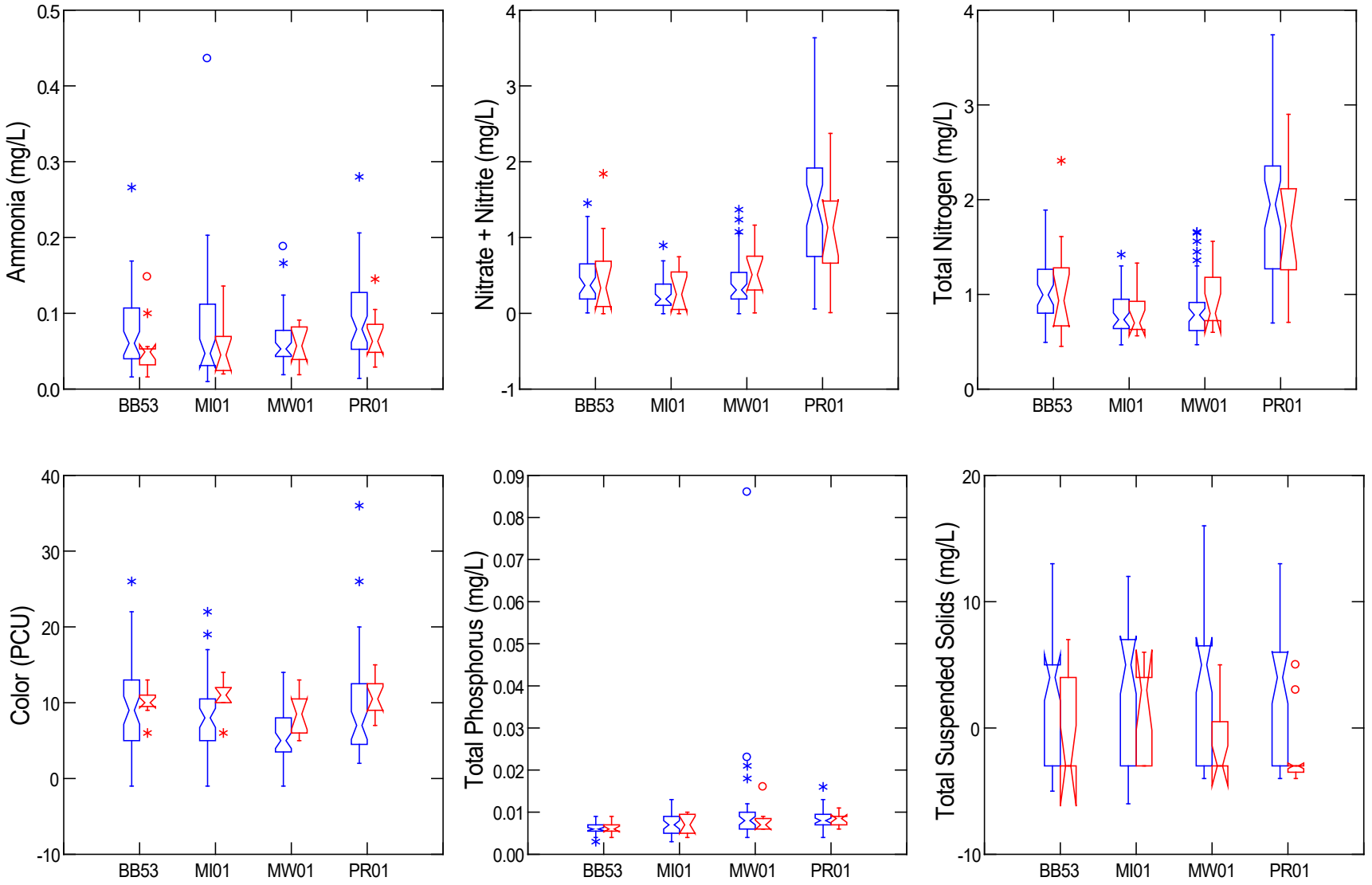

Figure 7. Notched box plot comparisons of lab analyzed water quality parameters at stations BB53, MI01, MW01, and PR01 for WY2017–WY2020 (blue plots) and WY2021 (red plots).

DEERING ESTATE

Water quality parameters collected at the S-700 pump station (**Figure 3**) during the reporting period were analyzed to evaluate the water quality of freshwater input to Biscayne Bay at the Deering Estate pump station (S-700) during the water year. Additionally, water quality parameters for WY2017–WY2021 have been analyzed to determine trends.

Conditions During WY2021

Basic statistics of water quality parameters for WY2021 and comparisons with Class III freshwater criteria (62-302.530, F.A.C.), where applicable, are presented in **Table 4**. During WY2021, all parameters sampled at the S-700 pump station met the Class III freshwater criteria.

Table 4. Statistical summary of water quality parameters measured at the S-700 pump station in WY2021 and comparisons with Florida Class III freshwater criteria for applicable parameters.

Parameter	Units [a]	Class III Criteria for Fresh Water	Samples	Geometric Mean	Mean	Standard Deviation	Minimum	Q_{25} [b]	Median	Q_{75} [c]	Maximum	Number of Excursions	Percent Excursions
PHYSICAL PARAMETERS													
Dissolved Oxygen Percent Saturation	%	See footnote [d]	25	53%	53%	8%	30%	50%	53%	57%	68%	1	4%
pH		6 < pH ≤ 8.5	25	7.34	7.34	0.21	6.90	7.20	7.30	7.40	8.00	0	0%
Specific Conductance	µS/cm	< 1,275 µS/cm	25	619	625	97	535	576	605	627	1,032	0	0%
Temperature	°C	None	25	26.5	26.6	2.2	23.2	24.6	26.9	28.6	29.7	NA [e]	NA
CHEMICAL PARAMETERS													
Total Ammonia Nitrogen	mg/L	See footnote [f]	21	0.021	0.022	0.007	0.011	0.017	0.020	0.027	0.035	0	0%
Total Nitrogen	mg/L	See footnote [g]	23	0.51	0.52	0.09	0.33	0.44	0.54	0.59	0.63	NA	NA
Total Phosphorus	mg/L	See footnote [g]	24	0.014	0.014	0.002	0.010	0.012	0.014	0.015	0.018	NA	NA

a. Key to units: % – percent; °C – degrees Celsius; µS/cm – microsiemens per centimeter; and mg/L – milligrams per liter.

b. Q_{25} – 25th quartile; 25% of the data lies below this value.

c. Q_{75} – 75th quartile; 75% of the data lies below this value.

d. No more than 10% of daily average DO percent saturation values shall be below 38% in the Everglades Bioregion, or, for instantaneous data, no more than 10% of the DO percent saturation values shall be below the time-of-day specific translation.

e. NA – Not applicable.

f. 30-day average total ammonia nitrogen (TAN) value shall not exceed the average of the values calculated from the FDEP TAN equation, with no single value exceeding 2.5 times the value from the equation.

g. There is no Class III numeric criterion because S-700 is a freshwater canal monitoring location; the Section 62-302.532, F.A.C., estuary-specific nutrient criterion does not apply.

System Changes Over Time

The Seasonal Kendall-Tau test was used to estimate water quality trends at S-700. Results of this analysis are listed in **Table 5**.

Table 5. Seasonal Kendall-Tau results for water quality parameters measured at S-700 for WY2017–WY2021. (Note: p-values less than or equal to 0.05 indicate a statistically significant trend and are shown in red.)

Parameter	Unit [a]	S-700	
		Sen's Slope	p-value
Dissolved Oxygen Percent Saturation	%	-3.7	**0.013**
pH		-0.02	**0.017**
Specific Conductance	µS/cm	18	**0.008**
Temperature	°C	-0.1	0.772
Total Ammonia Nitrogen	mg/L	0.001	0.274
Total Nitrogen	mg/L	0.02	0.112
Total Phosphorus	mg/L	0.000	0.882

a. Key to units: % – percent; °C – degrees Celsius; µS/cm – microsiemens per centimeter; and mg/L – milligrams per liter.

From WY2017–WY2021, statistically significant trends were observed for DO percent saturation, with a median annual decrease of 3.7%; for pH, with a median annual decrease of 0.02; and for specific conductance with a median annual increase of 18 microsiemens per centimeter (µS/cm). These trends, though statistically significant, are small. The DO percent saturation decrease is not a concern since most of the WY2021 samples were 12% to 33% above the minimum DO percent saturation criterion, as shown in Attachment B. pH is a parameter with a natural low variability which might cause small variations to seem statistically significant; in fact the Sen's slope for pH was very close to the precision of most pH sampling probes (0.01). The specific conductance Sen's slope represents less than 3% of 625 µS/cm, the average specific conductance for WY2021 (**Table 4**).

OPERATIONS

This section includes information about BBCW project operations and associated hydrologic monitoring results, including summaries of stage and flow. These data are essential for gauging the success of the project toward its goals to restore the quantity, quality, timing, and distribution of fresh water to Biscayne Bay and Biscayne National Park, and to preserve and restore the spatial extent of natural coastal glades habitat in the project area. Hydrologic data for the reporting period are provided in Attachment C.

L-31E CULVERTS

Flow

The L-31E Culverts are passive, flap-gated devices designed to divert available fresh water from the L-31E Canal into adjacent wetlands. Because of the proximity of the culverts to the structures and because of the frequent stage measurements at the structures, daily flow rates for culverts S-23A, S-23B, S-706A, S-706B, and S-706C were based on mean daily stages at structure S-21A, while daily flow rates for culverts S-23C, S-23D, S-708 , S-712A, and S-712B were based on mean daily stages at structure S-20F. More specifically, the mean daily flow rates at each of the ten culverts were derived by manually entering the mean daily stage at the physically closest structure (S-21A and S-20F stage recorder) into the design rating curve and identifying the corresponding flow rate. **Figure 8** shows views near culvert S-708 and the replaced FPL culverts in the western side of the L-31E Canal.

Figure 8. A and B. BBCW L-31E culvert S-708, facing downstream (A) and upstream (B) of the culvert; C. FPL replaced culverts in the western side of the L-31E Canal.

In WY2021, 212,321 ac-ft (dry season: 81,512 ac-ft; wet season: 130,809 ac-ft) and 136,826 ac-ft (dry season: 55,715 ac-ft; wet season: 81,111 ac-ft) of fresh water was discharged to Biscayne Bay through S-20F and S-21A, respectively (**Figures 9** and **10**). These total volumes of fresh water diverted through S-20F and S-21A in WY2021 are higher than the amount diverted in WY2020. Similarly, daily average flow through coastal structure S-20F was higher during the wet and dry seasons of WY2021 than in WY2020, and daily average flow through coastal structure S-21A was higher during the wet and dry seasons of WY2021 than previous water years (WY2017–WY2020) (**Figures 11** and **12**).

During WY2021, 20,206 ac-ft (dry season: 3,183 ac-ft; wet season: 17,023 ac-ft) of fresh water was diverted as sheetflow from the C-102 and C-103 canals via the L-31E Canal and L-31E Culverts to the freshwater and saltwater wetlands east of the L-31E Levee and nearshore Biscayne Bay (**Table 6**). Due to the unavailability of water for the project through some of the L-31E Culverts, the project was unable to divert adequate fresh water through the culverts to the historical tidal wetlands and Biscayne Bay in WY2021 (**Table 6** and Attachment C). The total volume of fresh water diverted through the L-31E Culverts in this water year was higher than the total volume diverted in WY2020. **Table 7** provides a monthly summary of hydroperiods (days) for the L-31E Flow-way in the coastal wetlands downstream of the L-31E Culverts in WY2021.

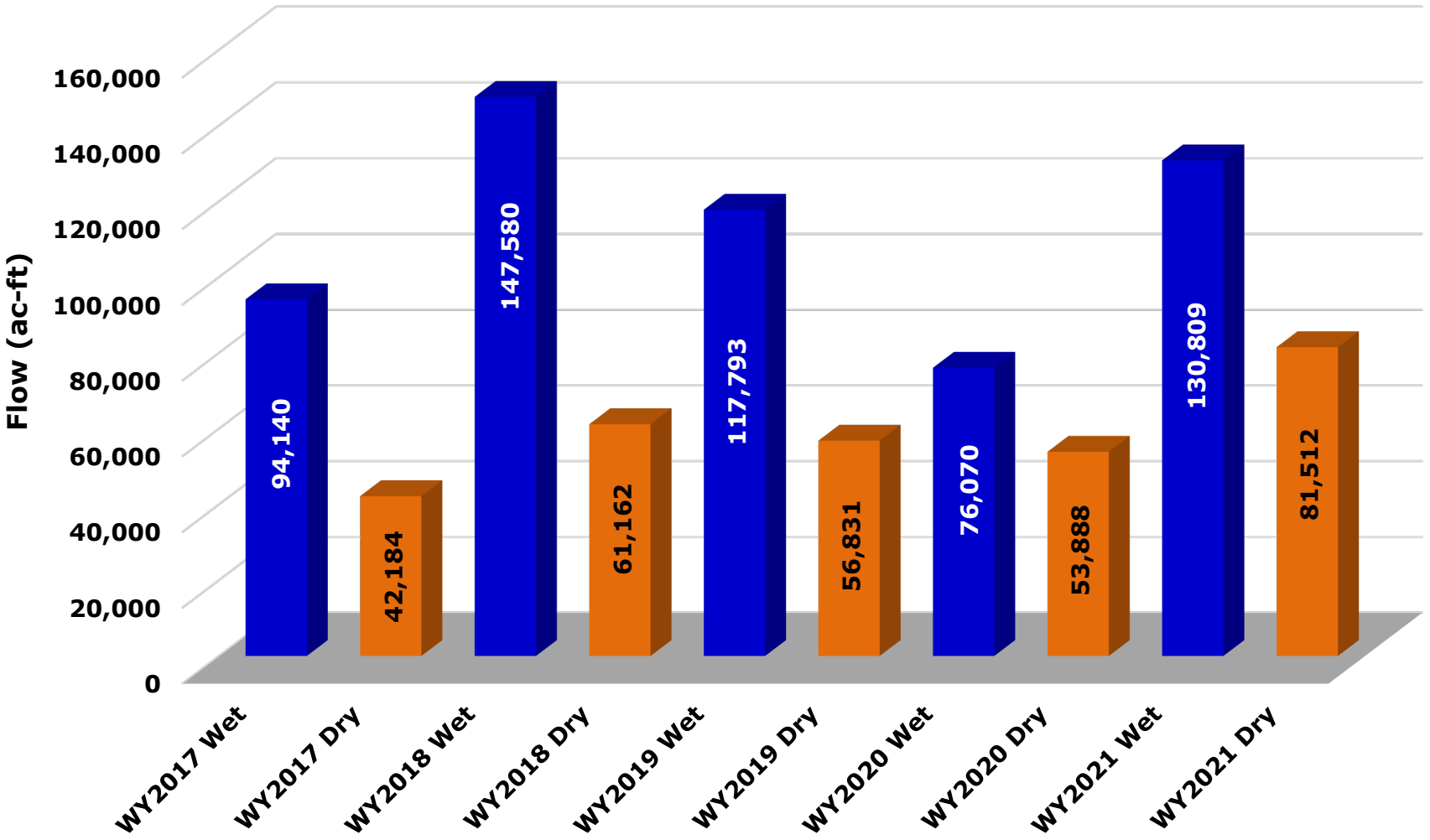

Figure 9. Total flow through coastal structure S-20F in the wet and dry seasons of WY2017–WY2021. (Note: Dry season is November–April and wet season is May–October.)

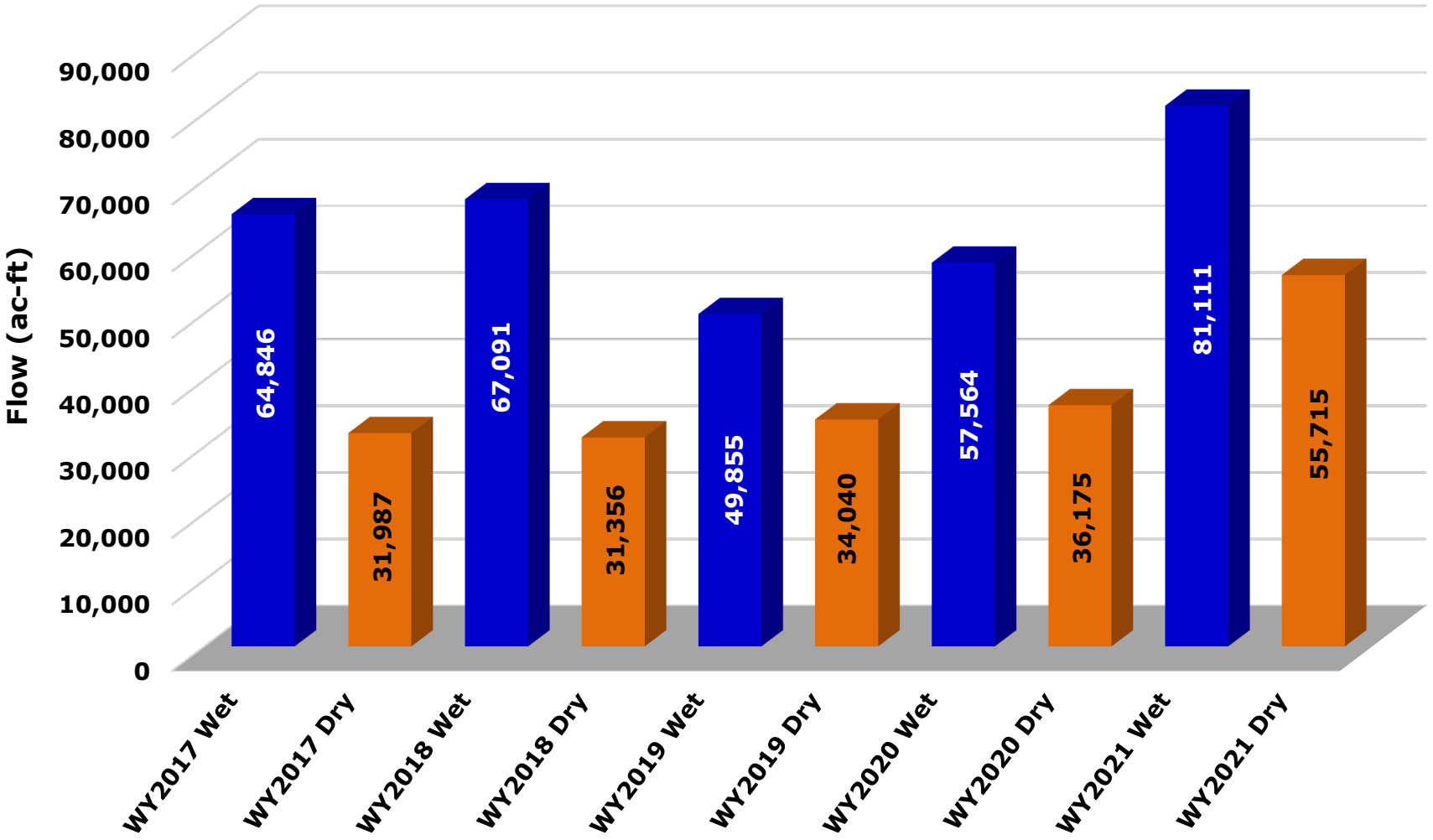

Figure 10. Total flow through coastal structure S-21A in the wet and dry seasons of WY2017–WY2021. (Note: Dry season is November–April and wet season is May–October.)

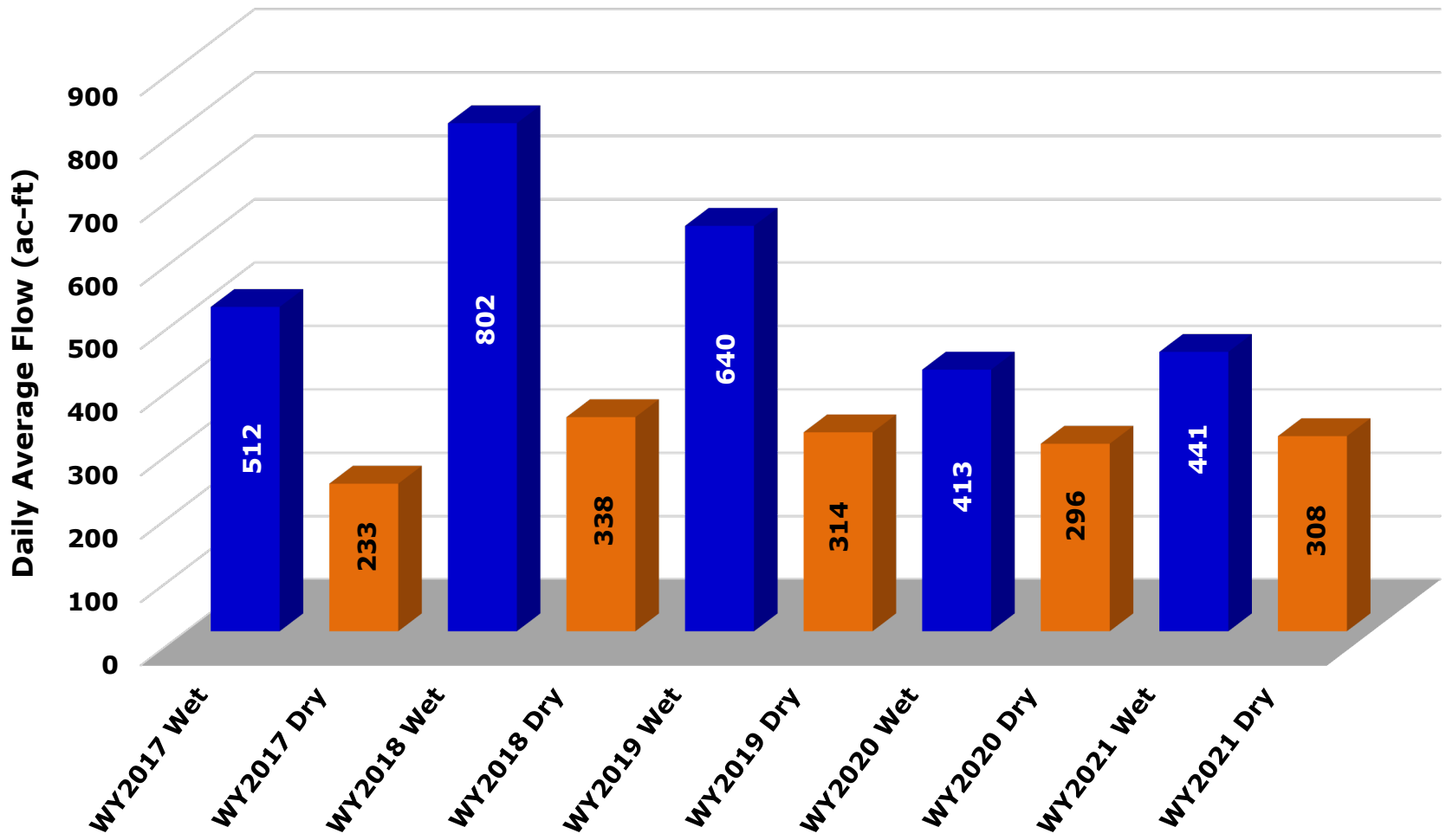

Figure 11. Daily average flow through coastal structure S-20F in the wet and dry seasons of WY2017–WY2021. (Note: Dry season is November–April and wet season is May–October.)

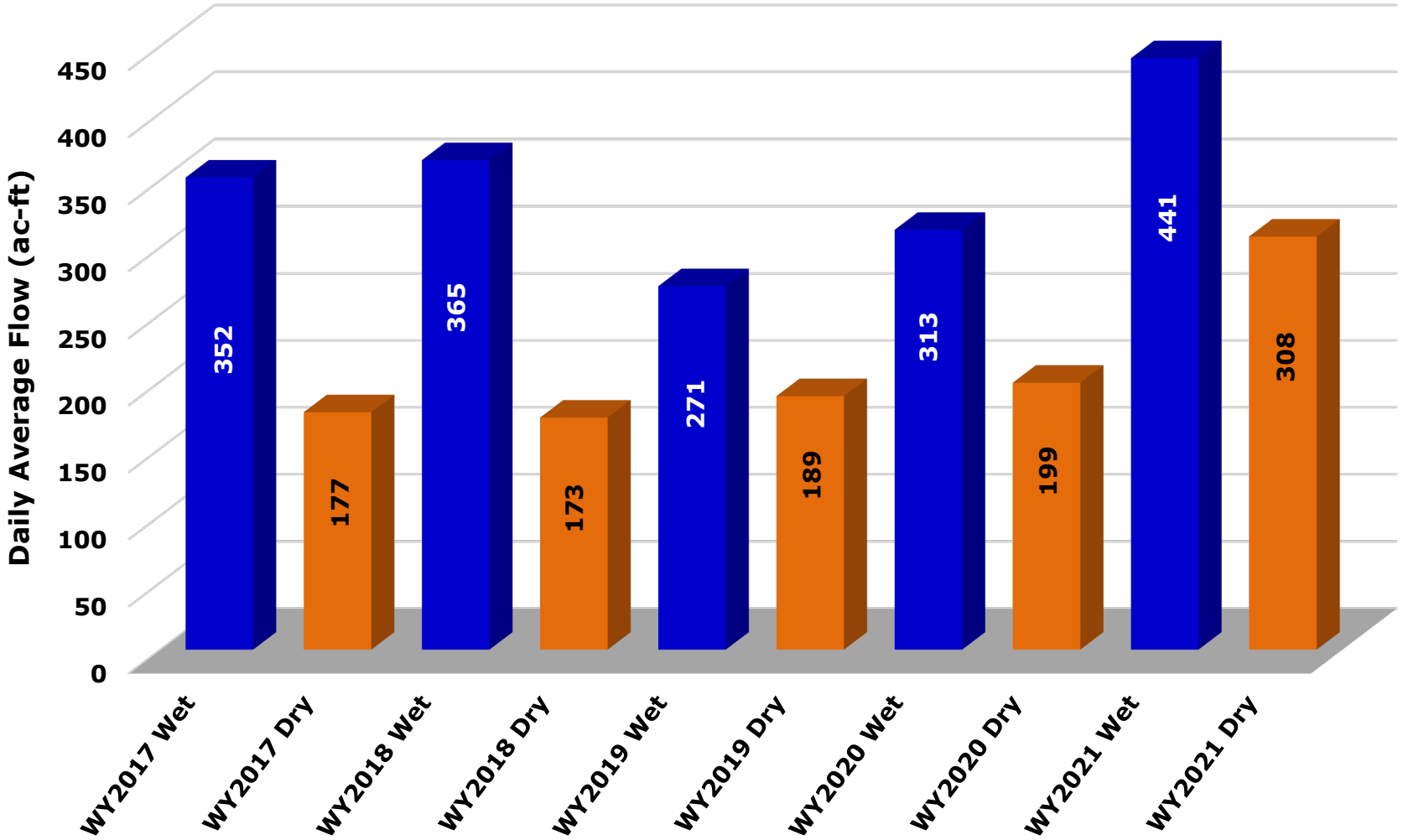

Figure 12. Daily average flow through coastal structure S-21A in the wet and dry seasons of WY2017–WY2021. (Note: Dry season is November–April and wet season is May–October.)

Table 6. Monthly freshwater flow (in ac-ft) diverted from the L-31E Canal through the coastal structures and the L-31E Culverts to the coastal wetlands and Biscayne Bay in WY2021.

Month	Coastal Structures		L-31E Culverts Daily Flow (ac-ft)										Total Flow Through L-31E Culverts
	S-21A	S-20F	S-712A	S-712B	S-708	S-23C	S-23D	S-23A	S-23B	S-706A	S-706B	S-706C	
May 2020	9,632	17,933	182	182	71	110	189	56	66	132	132	132	1,254
June 2020	14,426	17,135	465	465	177	332	470	8	12	274	274	274	2,750
July 2020	15,081	24,391	345	345	98	222	352	18	20	201	201	201	2,004
August 2020	6,122	8,189	678	678	284	486	662	87	208	540	540	540	4,705
September 2021	15,174	27,055	421	421	198	282	437	112	186	388	388	388	3,223
October 2020	20,676	36,106	426	426	247	273	439	99	163	338	338	338	3,087
Wet Season Total	**81,111**	**130,809**	**2,518**	**2,518**	**1,076**	**1,705**	**2,549**	**381**	**655**	**1,874**	**1,874**	**1,874**	**17,023**
November 2020	17,053	29,692	432	432	287	273	429	109	169	351	351	351	3,183
December 2021	12,040	17,218	0	0	0	0	0	0	0	0	0	0	0
January 2021	7,821	10,119	0	0	0	0	0	0	0	0	0	0	0
February 2021	6,000	10,251	0	0	0	0	0	0	0	0	0	0	0
March 2021	7,637	8,106	0	0	0	0	0	0	0	0	0	0	0
April 2021	5,156	6,127	0	0	0	0	0	0	0	0	0	0	0
Dry Season Total	**55,715**	**81,512**	**432**	**432**	**287**	**273**	**429**	**109**	**169**	**351**	**351**	**351**	**3,183**
Water Year Total	**136,826**	**212,321**	**2,950**	**2,950**	**1,362**	**1,978**	**2,978**	**490**	**824**	**2,224**	**2,224**	**2,224**	**20,206**

Table 7. Monthly summary of hydroperiods (days) for the L-31E Flow-way in the coastal wetlands downstream of the L-31E Culverts in WY2021.

Month	S-712A	S-712B	S-708	S-23C	S-23D	S-23A	S-23B	S-706A	S-706B	S-706C
May 2020	7	7	4	4	8	4	3	5	5	5
June 2020	19	19	18	19	21	2	4	19	19	19
July 2020	15	15	7	13	15	12	4	14	14	14
August 2020	26	16	26	25	28	14	18	25	25	25
September 2020	17	17	13	18	21	12	13	16	16	16
October 2020	17	17	12	15	19	10	10	13	13	13
Wet Season Total	**101**	**91**	**80**	**94**	**112**	**54**	**52**	**92**	**92**	**92**
November 2020	16	16	12	15	18	9	12	14	14	14
December 2020	0	0	0	0	0	0	0	0	0	0
January 2021	0	0	0	0	0	0	0	0	0	0
February 2021	0	0	0	0	0	0	0	0	0	0
March 2021	0	0	0	0	0	0	0	0	0	0
April 2021	0	0	0	0	0	0	0	0	0	0
Dry Season Total	**16**	**16**	**12**	**15**	**18**	**9**	**12**	**14**	**14**	**14**
Water Year Total	**117**	**107**	**92**	**109**	**130**	**63**	**64**	**106**	**106**	**106**

Water Levels

L-31E Culverts Stages

During this reporting period, water levels upstream and downstream of the L-31E Culverts were below the desired level of 2.2 ft NGVD29 during low tide events (**Table 8**). Water levels were lower in the dry season than in the wet season.

Table 8. Upstream (Up) and downstream (Down) water levels (in ft NGVD29) at the BBCW L-31E Culverts in WY2021. Values at or above 2.2 ft NGVD29 are highlighted in green.

Date	S-23A		S-23B		S-23C		S-23D		S-706B		S-708		S-712A	S-712B	
	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Down	Up	Down
5/4/2020	1.41	1.31	1.42	1.35	1.40	1.20	1.39	1.21	1.51	1.52	1.49	1.49	1.48	1.45	1.46
5/7/2020	1.31	1.20	1.31	1.20	1.30	1.02	1.30	1.01	1.53	1.51	1.30	1.30	1.01	1.11	1.11
5/11/2020	1.73	1.73	1.63	1.63	1.63	1.53	1.63	1.53	1.63	1.93	1.63	1.53	1.53	1.63	1.53
5/27/2020	1.50	1.49	1.52	1.51	2.10	2.06	2.10	2.01	1.52	1.51	2.13	2.13	1.48	1.49	1.51
6/2/2020	2.19	2.16	2.19	2.22	2.02	2.21	1.99	2.02	2.32	2.32	2.29	2.30	2.46	2.12	2.53
6/8/2020	1.54	1.54	1.54	1.54	1.89	1.87	1.92	1.82	1.93	1.93	1.93	1.93	2.33	2.24	2.23
6/20/2020	1.93	1.92	2.02	2.03	1.91	1.94	1.88	1.86	2.12	2.13	1.93	1.93	2.13	2.31	2.31
6/29/2020	1.83	1.78	1.92	1.92	2.12	1.92	2.12	1.92	2.13	2.11	2.12	2.12	2.11	2.13	2.13
7/6/2020	**	**	**	**	1.85	1.87	1.85	1.85	2.18	2.23	1.93	1.91	2.34	2.32	2.34
7/13/2020	2.03	2.03	2.03	2.13	2.03	2.13	1.99	1.88	2.15	2.13	1.95	2.12	2.13	2.13	2.10
7/18/2020	2.02	2.06	2.02	2.26	2.02	1.96	2.12	1.82	2.08	2.13	2.06	2.06	1.23	1.32	2.04
7/20/2020	**	**	2.02	2.08	1.74	1.86	1.74	1.90	2.12	2.13	1.93	1.93	**	1.92	2.08
7/27/2020	1.13	1.03	1.13	1.13	1.63	1.84	1.63	1.84	1.13	2.12	1.68	2.12	1.13	1.13	1.13
8/3/2020	2.14	2.13	2.16	2.17	2.03	2.01	2.03	2.03	2.30	2.31	2.06	2.12	2.30	2.12	2.30
8/6/2020	2.11	2.12	2.15	2.12	1.91	1.90	2.02	1.97	2.31	2.28	2.02	2.03	2.29	2.53	2.53
8/9/2020	2.13	2.15	2.13	2.14	2.13	2.06	2.11	2.09	2.14	2.15	2.13	2.14	2.51	2.26	2.25
8/13/2020	2.14	2.13	2.15	2.16	2.03	2.01	2.03	2.02	2.30	2.30	2.06	2.12	2.30	2.12	2.30
8/17/2020	2.12	2.13	2.16	2.07	2.11	2.06	2.13	2.13	2.31	2.28	2.13	2.13	2.31	2.32	2.13
8/24/2020	1.92	2.04	1.94	2.12	1.25	1.65	1.23	1.68	1.98	2.02	1.63	2.03	2.04	1.43	1.95
8/27/2020	**	**	2.11	2.08	1.98	1.95	1.98	1.95	2.13	2.12	2.11	2.11	1.96	2.31	2.13
9/2/2020	2.21	2.25	2.22	2.42	2.06	2.02	2.04	.05	2.33	2.31	2.13	2.12	2.13	2.33	2.13
9/9/2020	1.23	1.54	2.13	1.86	1.73	1.73	1.88	1.73	1.93	1.83	1.74	2.11	2.07	2.13	2.13
9/17/2020	2.11	2.17	2.20	2.41	2.13	2.44	2.14	2.63	2.33	2.53	2.36	2.45	2.44	2.28	2.32
9/30/2020	2.38	2.39	2.41	2.81	2.34	2.63	2.35	2.63	2.33	2.86	2.43	2.63	**	**	**
10/6/2020	1.84	2.15	1.91	2.13	2.18	2.12	2.21	2.06	2.04	2.33	2.32	2.12	2.12	2.13	2.13
10/15/2020	2.14	2.13	2.33	1.82	2.15	2.10	2.11	2.93	2.23	2.23	2.34	2.16	3.12	2.13	3.06
10/22/2020	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
10/29/2020	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
11/6/2020	2.14	2.13	2.21	2.33	2.15	2.10	2.14	2.08	2.23	2.23	2.32	2.16	2.13	2.12	2.13
11/10/2020	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
11/18/2020	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
11/24/2020	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
12/1/2020	1.68	1.87	1.72	1.73	1.64	1.66	1.71	1.65	**	**	1.68	1.93	2.01	1.91	2.11
12/8/2020	1.23	1.33	1.23	1.43	1.33	1.23	1.33	1.33	1.32	1.32	1.30	1.53	1.93	2.12	1.94
12/15/2020	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
12/29/2020	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
1/8/2021	**	**	**	**	1.13	1.13	1.13	1.13	1.23	1.43	1.33	1.43	1.13	1.13	1.11
1/15/2021	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
1/27/2021	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
1/29/2021	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
2/5/2021	1.13	1.13	1.13	1.13	1.33	1.28	1.33	1.33	1.33	1.33	1.32	1.32	1.34	1.33	1.33
2/9/2021	1.33	1.33	1.33	1.33	1.33	1.28	1.33	1.28	1.33	1.78	1.33	1.33	**	**	**
2/15/2021	1.33	1.33	1.33	1.33	**	**	**	**	1.33	1.28	1.28	1.28	**	**	**
2/26/2021	1.86	1.86	1.53	1.74	1.23	1.43	1.23	1.43	1.53	1.63	1.43	1.53	**	1.54	1.93
3/3/2021	1.23	1.28	1.23	1.23	1.33	1.13	1.33	1.13	1.23	1.53	1.43	1.43	**	**	**
3/18/2021	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
3/23/2021	**	**	**	**	1.33	1.33	1.33	1.33	1.43	1.42	1.43	1.42	1.33	1.33	1.33
4/9/2021	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.54	1.54	1.33	1.33	1.53	1.43	1.53
4/14/2021	1.31	1.23	1.32	1.23	1.32	1.74	1.32	1.32	1.32	1.27	1.38	1.43	**	**	**
4/23/2021	1.32	1.32	1.32	1.32	1.53	1.53	1.63	1.95	1.75	1.73	1.71	1.73	**	**	**
4/30/2021	1.33	1.33	1.33	1.33	1.32	1.32	1.33	1.33	1.43	1.93	1.32	1.93	1.32	1.32	1.83

** Access issue due to construction of L-31E Culverts along the L-31E Canal.

Wetland Transect Stages

During WY2021, due to the unavailability of sufficient fresh water, water levels at the wetland stage monitoring stations downstream of culverts S-23A, S-23D (S-23H), S-706B, S-708, and S-712B were below the desired stage of 2.2 ft NGVD29 (**Table 9**).

Table 9. Water levels at BBCW wetland stage monitoring stations in WY2021.

Date	S-23A	S-23D (S-23H)	S-706B	S-708	S-712B
5/4/2020	*	*	*	*	*
5/7/2020	*	*	*	*	*
5/11/2020	*	*	1.74	*	*
5/27/2020	*	*	*	1.58	*
6/2/2020	*	1.74	1.84	1.84	1.93
6/8/2020	*	1.63	1.74	1.65	1.85
6/20/2020	*	1.74	1.84	1.84	1.94
6/29/2020	*	1.64	1.71	1.75	1.74
7/6/2020	**	1.76	1.85	1.74	1.85
7/13/2020	*	1.64	1.84	1.74	1.63
7/18/2020	*	1.71	1.84	1.76	1.84
7/20/2020	**	Dry	1.85	1.74	1.64
7/27/2020	*	Dry	1.63	1.63	*
8/3/2020	*	*	1.86	*	1.63
8/6/2020	*	1.8	1.91	1.85	1.76
8/9/2020	*	1.72	1.84	1.84	1.84
8/13/2020	*	Dry	1.86	1.74	1.63
8/17/2020	*	1.86	1.91	1.84	1.84
8/24/2020	*	*	1.74	1.74	1.65
8/27/2020	**	1.63	1.84	1.74	1.86
9/2/2020	*	1.74	1.84	1.84	1.84
9/9/2020	*	*	1.72	1.74	1.74
9/17/2020	1.65	2.04	2.07	2.11	1.92
9/30/2020	1.84	2.13	2.13	2.02	**
10/6/2020	*	1.92	1.86	1.92	1.84
10/15/2020	1.72	2.04	1.84	1.86	1.94
10/22/2020	**	**	**	**	**
10/29/2020	**	**	**	**	**
11/6/2020	1.72	1.65	1.82	1.86	1.74
11/10/2020	**	**	**	**	**
11/18/2020	**	**	**	**	**
11/24/2020	**	**	**	**	**
12/1/2020	Dry	Dry		1.68	1.68
12/8/2020	Dry	Dry	Dry	Dry	Dry
12/15/2020	**	**	**	**	**
12/29/2020	**	**	**	**	**
1/8/2021	*	*	*	*	*
1/15/2021	**	**	**	**	**
1/27/2021	**	**	**	**	**
1/29/2021	**	**	**	**	**
2/5/2021	*	*	*	*	*
2/9/2021	*	*	1.66	*	**
2/15/2021	*	**	*	*	**
2/26/2021	*	*	*	*	*
3/3/2021	*	*	*	*	**
3/18/2021	**	**	**	**	**
3/23/2021	**	*	*	*	*
4/9/2021	*	*	*	*	*
4/14/2021	*	*	*	*	**
4/23/2021	*	*	*	*	*
4/30/2021	*	*	1.73	*	1.84

* Dry conditions (no standing water above ground surface) but wet soil.

** Access issue due to construction of L-31E Culverts along the L-31E Canal.

DEERING ESTATE

The Deering Estate component (**Figure 3**) redirects excess water from the C-100A Canal system through the existing C-100A spur canal into the Cutler Drain on the project site and within the Deering Estate, thus restoring a portion of the historic freshwater flow through the Deering Estate and into Biscayne Bay. Goals and benefits of this component are described in the *Introduction* section of this report.

The operational intent is to maximize pumping when water is available (excess water in the C-100 basin) to improve the Deering Estate wetland ecosystem without adversely affecting groundwater levels and water supply to local water users. The station's operation is flexible to address various hydrologic conditions, and the coastal wetlands are monitored to measure any response. Monitoring, data collection, and reporting are currently being coordinated between Miami-Dade County and SFWMD. Normal operations will likely continue to be modified in the future to optimize the wetland benefits of the project.

Although the station would normally be operated automatically in accordance with the inflow canal stage, it can be operated manually or remotely via telemetry communication facilities. These are alternatives to the pump on/off sequencing that accomplish the objective of an incremental increase of 25 cfs with an increase in stage. Pumps can be alternated as appropriate to equalize usage (SFWMD 2018).

During WY2021, S-700 diverted approximately 36,948 ac-ft (dry season: 17,029 ac-ft; wet season: 19,919 ac-ft) of fresh water from the C-100 Canal to the historic remnant wetlands near Cutler Creek east of Old Cutler Road in the form of sheetflow (**Figure 13**) compared to 30,951 ac-ft in WY2020.

The WY2021 daily average discharge through S-700 during the WY2021 dry season was 80 ac-ft, compared to 58 ac-ft during the WY2020 dry season. The daily average discharge through S-700 during the WY2021 wet season was 130 ac-ft, compared to 111 ac-ft during the WY2020 wet season (**Figure 14**). **Figure 15** provides a summary of Deering Estate hydroperiods (days) during the wet and dry seasons WY2013–WY2021. Compared to WY2020, the WY2021 dry season hydroperiod was extended by 40 days, from 140 to 180 days of inundation, an increase of nearly 30%.

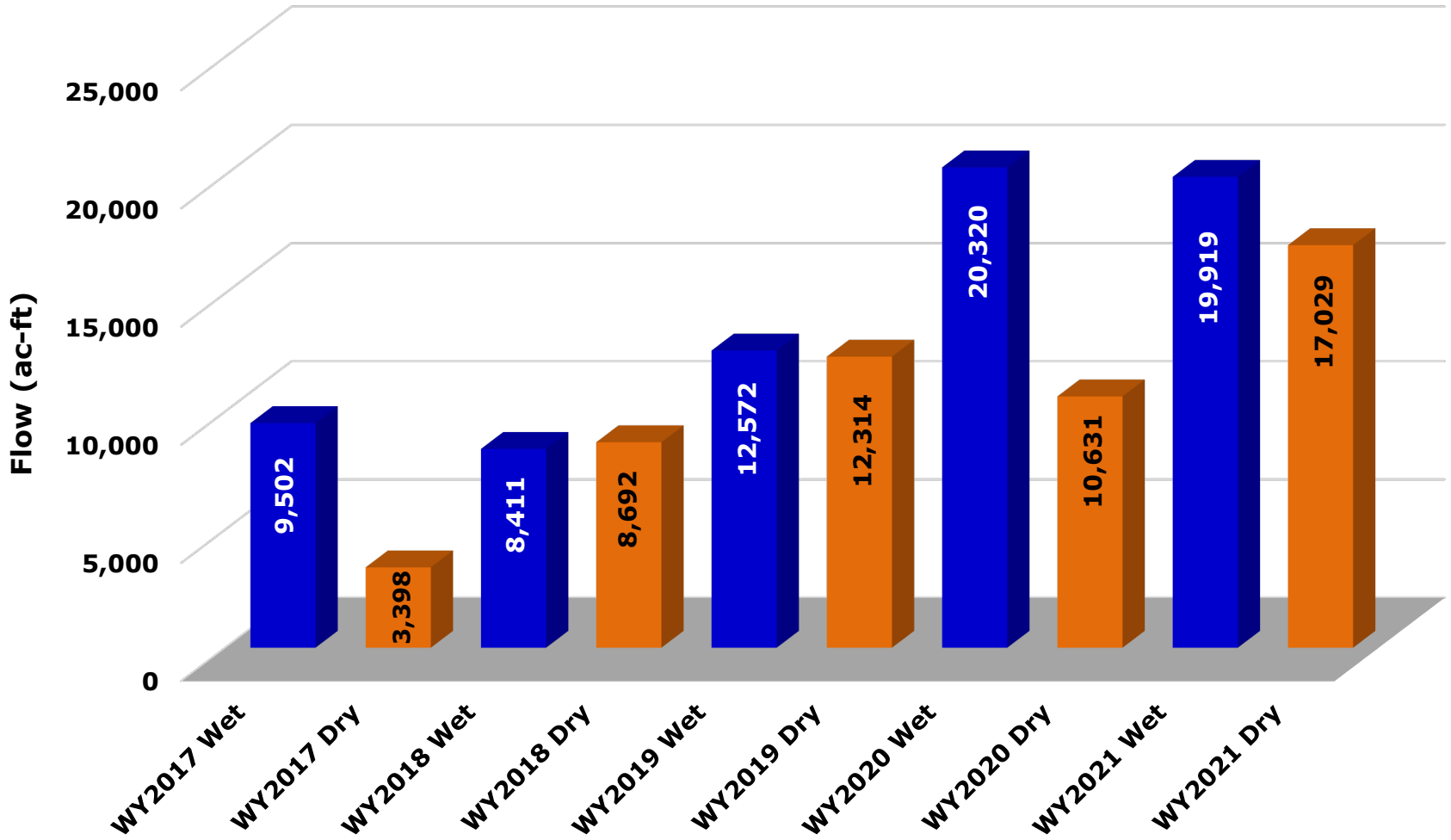

Figure 13. Annual discharges from coastal structure S-700 during the wet and dry seasons of WY2017–WY2021. (Note: Dry season is November–April and wet season is May–October.)

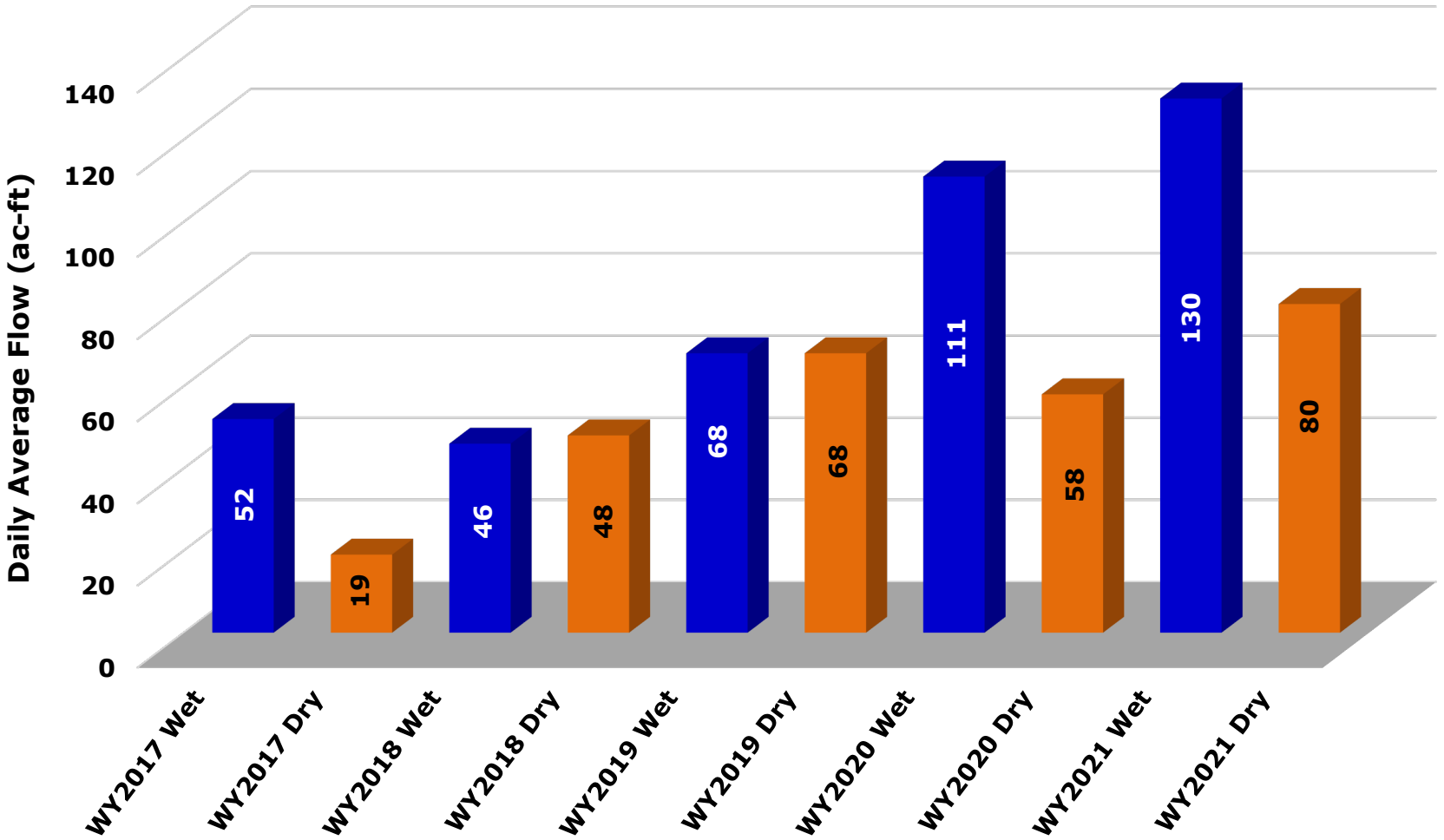

Figure 14. Deering Estate daily average flow during the wet and dry seasons of WY2017–WY2021. (Note: Dry season is November–April and wet season is May–October.)

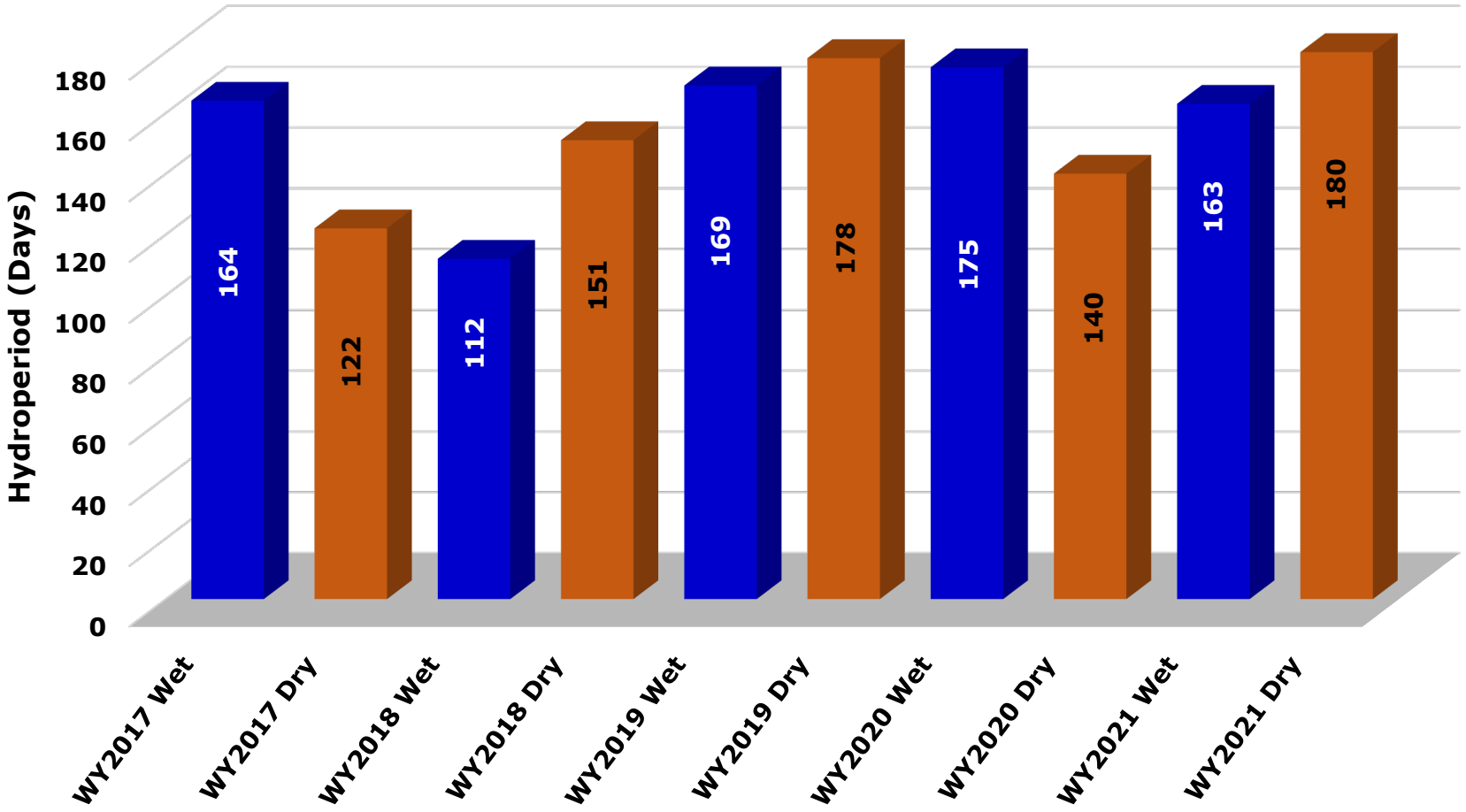

Figure 15. Deering Estate hydroperiods (days) during the wet and dry seasons of WY2017–WY2021. (Note: Dry season is November–April and wet season is May–October.)

ECOLOGICAL MONITORING

In accordance with Specific Condition 38 of FDEP permit 0271729-010, SFWMD performed ecological monitoring in the vicinity of the L-31E Culverts, including annual assessment and documentation of changes in vegetation. This work was conducted by SFWMD contractors, Dr. Evelyn Gaiser and Dr. Michael S. Ross, Southeast Environmental Research Center, Florida International University (Agreement 4600003666). Ecological conditions in the L-31E Culverts area are anticipated to be enhanced by water deliveries (**Figure 16**).

In WY2021, all transect sites remained dominated by a mangrove overstory (**Figures 17** and **19**); mangrove cover ranged from 35-78% (**Figure 17**). Red mangrove, *Rhizophora mangle,* had the highest percent cover of all mangrove species in all sites, ranging from 33-70% (**Figure 18**), with highest cover in the northernmost L-31E Transect 14 (70%), followed by the southern three transects (1, 2, 0). White mangrove, *Laguncularia racemosa,* was present in all transects, ranging on average from 0.3-21% cover, with the highest cover in Transect 4, as it was in prior samplings. Black mangrove, *Avicennia germinans,* cover slightly increased in Transect 4 from 0.2% to 2% average plant cover across the three sites (its cover was previously limited to the interior site of Transect 4), and was newly found in Transect 8 with an average of 1% cover (east site) this year. Buttonwood, *Conocarpus erectus,* was present in Transects 4 and 13, with 3% and 1% average cover, and was also present in Transect 8 and 14, with 0.3% average cover in both. The western site of Transect 8 had visibly decreased cover in 2020 that could be related to the installation of a staff gauge at the site, but by 2021, red mangrove cover increased about 10% at this site.

Herbaceous cover was only present in Transect 1, 8, 13, and 14. In 2019, *Eleocharis cellulosa* was present very sparsely within Transect 1 and 2. In 2021, *E. cellulosa* cover was less than 1%, sparsely present and mostly dry in the western part of Transect 1, and not present in Transect 2. *Rhabdadenia biflora* (a salt tolerant plant commonly known as mangrove vine), which was minimally present in 2020, was not found along Transect 4 in 2021. In Transect 8, the cover of *Sesuvium portulacastrum* (sea purslane) increased at the interior site, but less than 1% was present in the east site; where it was observed, it was present as ground cover with mangrove canopy cover overlap. Similar to the 2017 and 2019 surveys, *Juncus roemerianus* was present throughout all sites in Transect 13—predominantly in the west site. Newly established Transect 14 had an herb gradient, with 5% *E. cellulosa* cover in the west site, 0.5% *J. roemerianus* in the interior, and a grass identified as either *Distichlis spicata* or *Sporobolus virginicus* (both halophytes—an inflorescence would be needed for distinction) at the east site. No *Cladium jamaicense* was found within our sampling sites, but on occasion it was seen near the culverts.

Periphyton was not observed to be forming cohesive mats in the L-31E transects, likely indicating the predominance of higher salinity conditions. Periphyton is more likely to form calcareous aggregations at the near-canal plots than in the mangrove forests toward the coast. Phosphorus content of periphyton in the near-canal plots was highest where salinity was lowest, indicating delivery of fresh water from the canal is elevating the phosphorus content of these communities. Where exposed to elevated phosphorus, periphyton chlorophyll *a* content, an index of algal abundance in the periphyton, increases. The significant separation of sites and blocks by diatom assemblages, and the strong association of this separation with environmental drivers, suggests the diatoms will provide a strong indication of hydrologic restoration.

Deering Estate component annual vegetation monitoring plots in WY2021 contained a total of 77 different vascular plant taxa, 13 of which were non-native, but these were generally low in abundance. Three new native plant species were recorded in WY2020: toothed spleenwort (*Asplenium dentatum*), smallfruit primrose willow (*Ludwigia microcarpa*), and peppervine (*Nekemias arborea*). The non-native downy maiden fern (*Thelypteris dentata*) first recorded in WY2020 was determined in WY2021 to be the non-native jeweled maiden fern (*Thelypteris opulenta*). The number of native tree, shrub, and palm seedlings decreased slightly from previous water years, with the wetter plots (excluding the mangrove plot), possessing only 10% of the total seedlings. In the past year, overall herb and shrub cover increased, while canopy cover decreased, and sawgrass began to establish naturally in the slough.

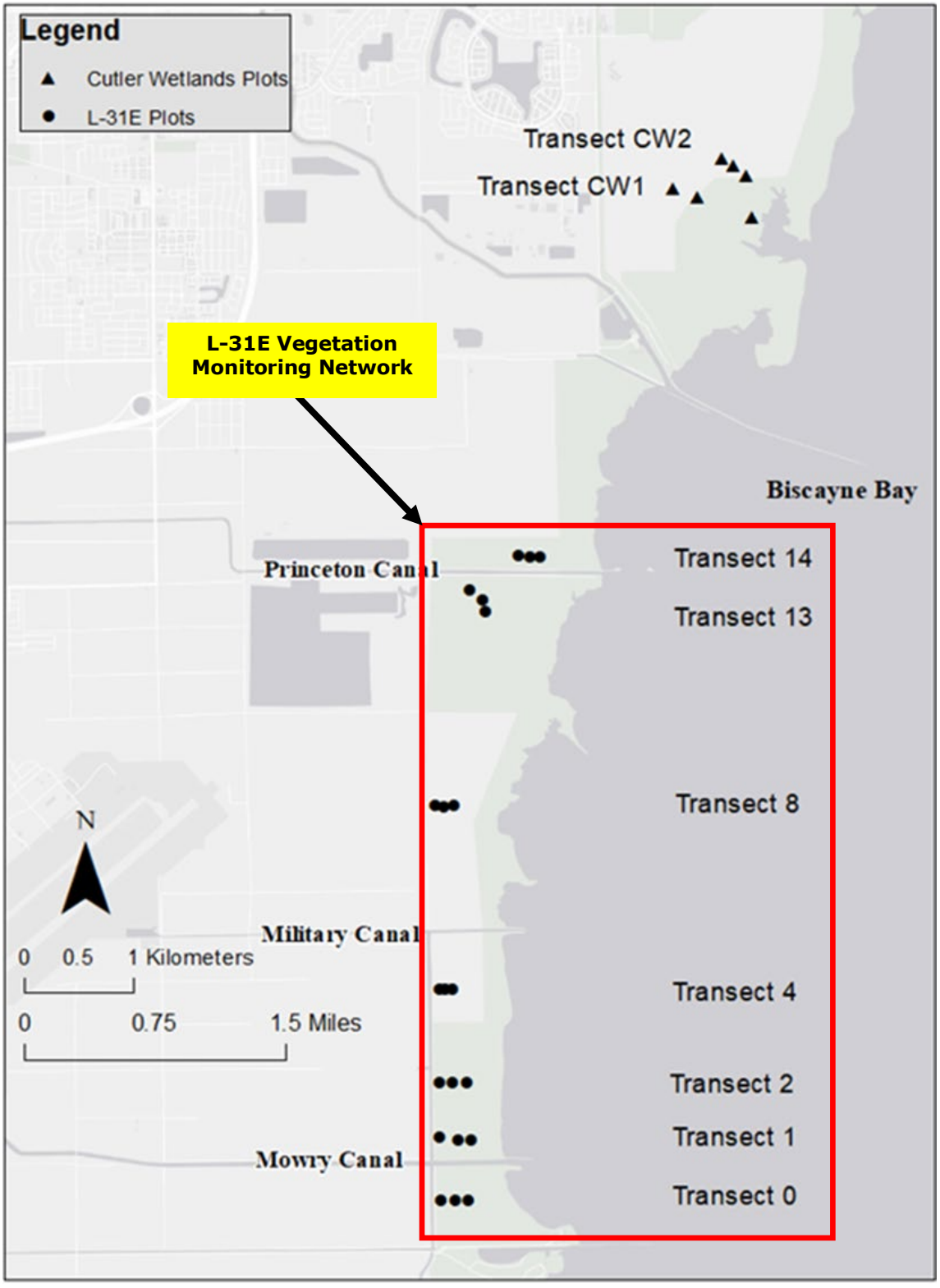

Figure 16. Map of L-31E (black dot symbols) and Cutler Wetland (black triangle symbols) sites sampled along Transects 0, 1, 2, 4, 8, 13, 14, CW1, and CW2 in 2021. For each transect, points from left to right are the West (W), Interior (I), and East (E) sites, respectively.

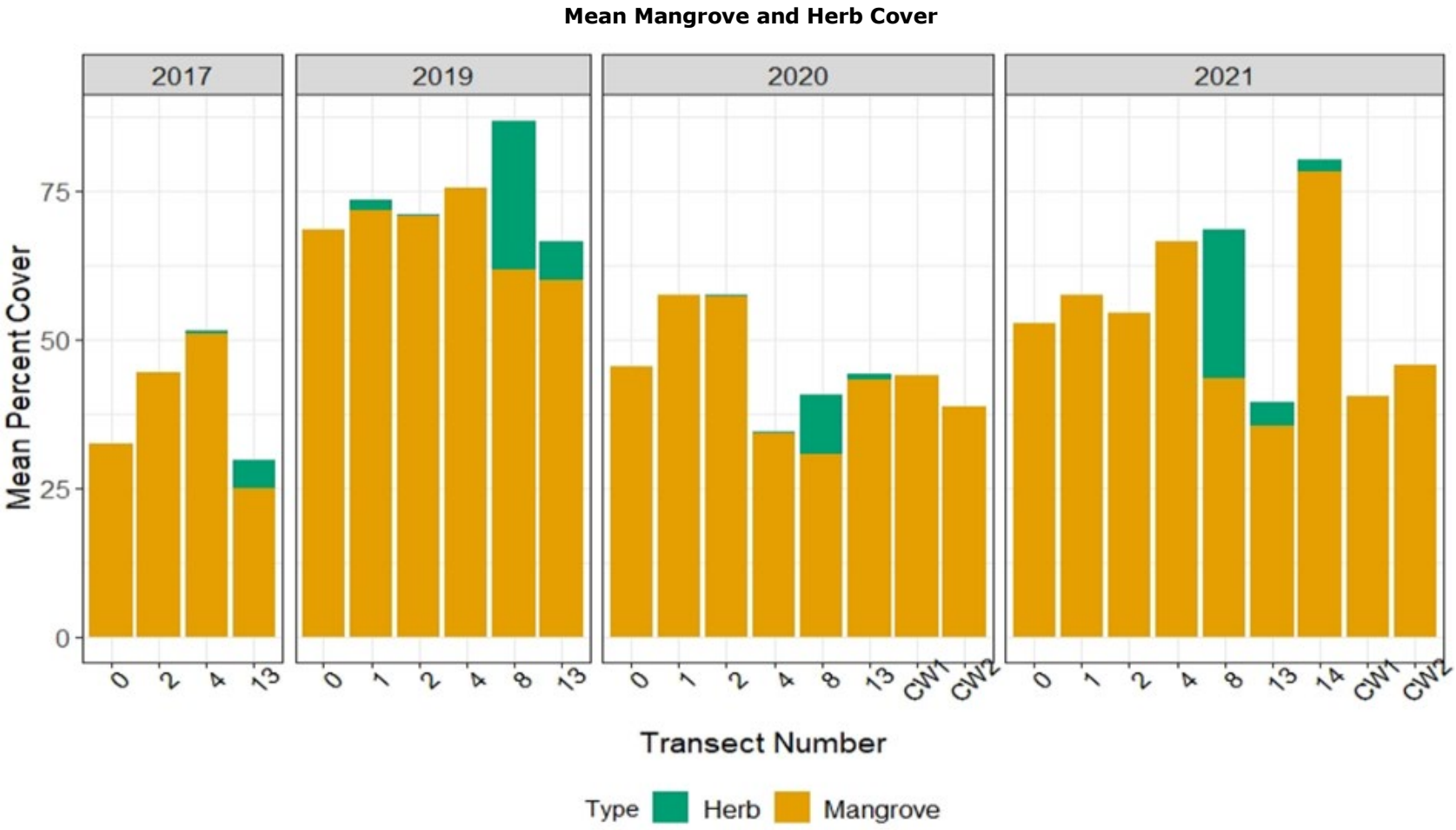

Figure 17. Mean cover of BBCW Project mangroves (yellow bars) and herbaceous plants (green bars) in nine study transects between 2017–2021. As shown, only four of the transects were sampled in 2017, six in 2019, and eight in 2020; there was no monitoring in 2018.

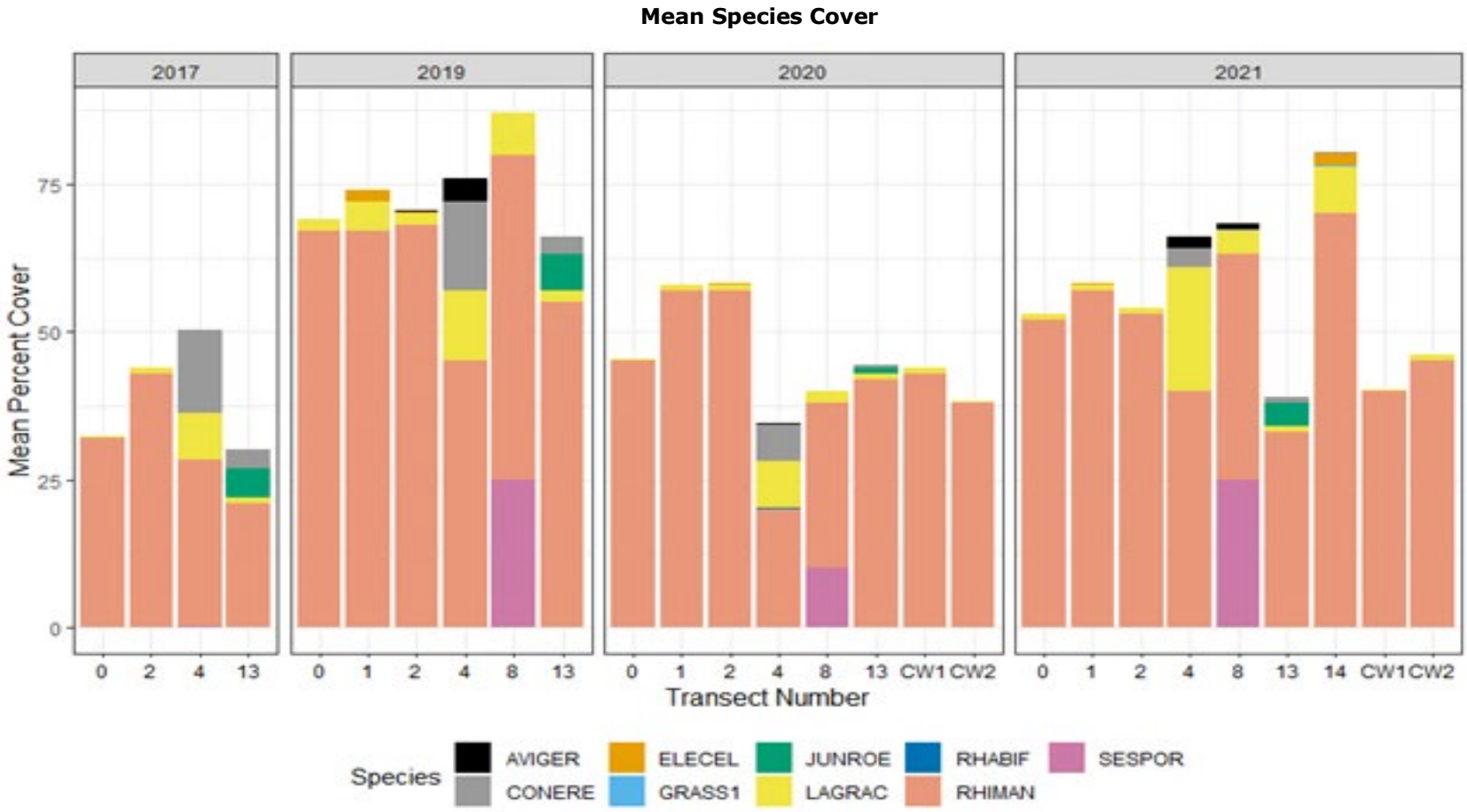

Figure 18. Mean shoot cover of species in nine study transects between 2017–2021. As shown, only four transects were sampled in 2017, six in 2019, and eight in 2020; there was no monitoring in 2018. Averages are based on percent cover in three 2-meter radius sites (W, I, E) for each transect. Species codes shown in the figure are: AVIGER – black mangrove (*Avicennia germinans);* CONERE – buttonwood (*Conocarpus erectus*); ELECEL – *Eleocharis cellulosa*, GRASS1 – a species found in Transect 14 that could be *Distichlis spicata* or *Sporobolus virginicus;* JUNROE – *Juncus roemerianus;* LAGRAC – white mangrove (*Laguncularia racemosa*); RHABIF – mangrove vine (*Rhabdadenia biflora*); RHIMAN – red mangrove (*Rhizophora mangle*); and SESPOR – sea purslane (*Sesuvium portulacastrum)*.

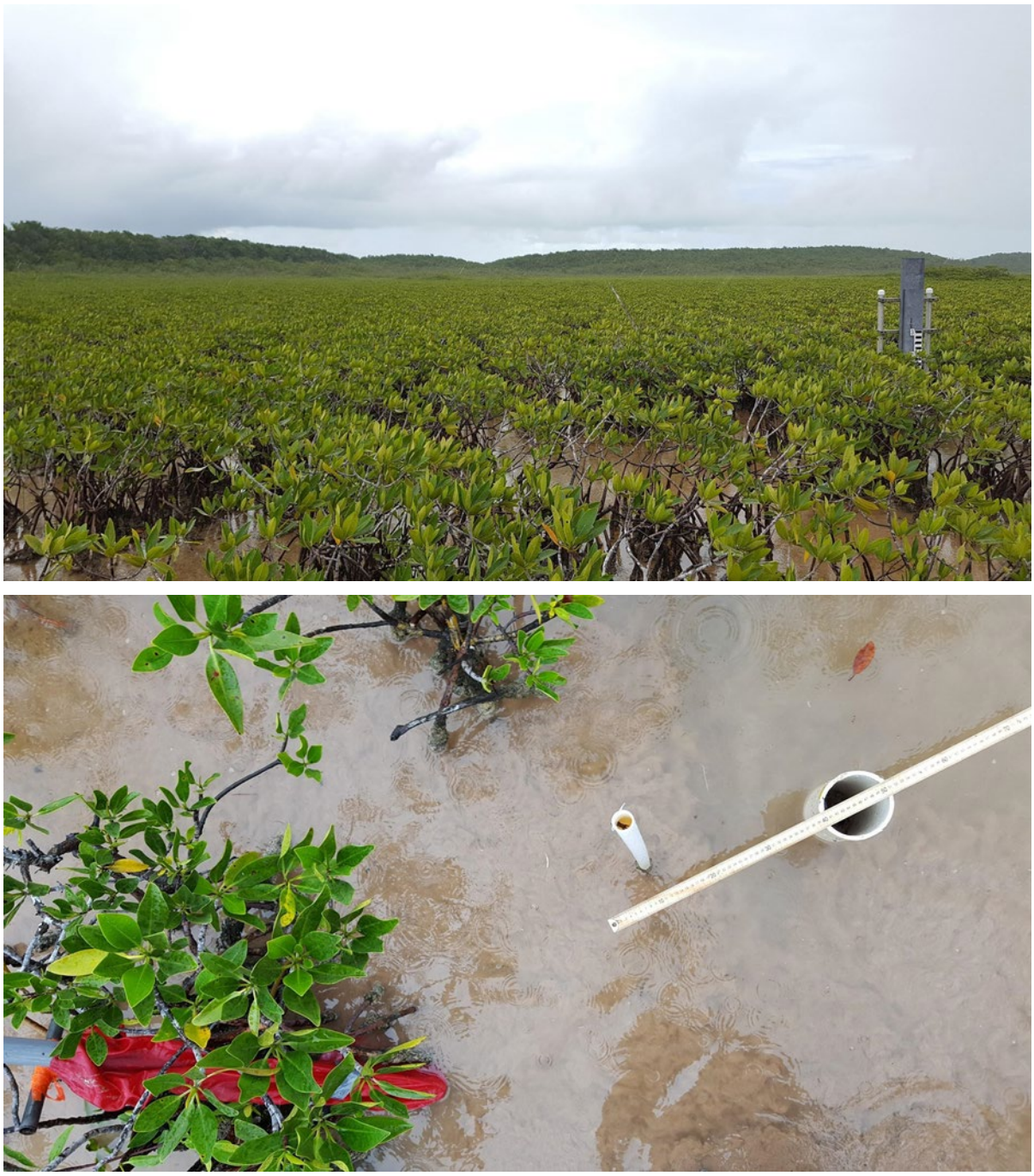

Figure 19. Top: Photo of Transect 2 landscape from west site center facing east in 2021. Bottom: Photo of Transect 2 vegetation at west site center in 2021; the white pipes and measuring tape are part of the monitoring equipment in the field.

HERBICIDE AND PESTICIDE TRACKING

L-31E CULVERTS

Primary species treated in WY2021 were Australian pine (*Casuarina* spp.), beach naupaka (*Scaevola taccada*), and Brazilian pepper (*Schinus terebinthifolia*). Crews swept 50 acres for all invasive species and applied 7.44 gallons of triclopyr.

DEERING ESTATE

Educational Wetland

Primary species treated were cattail (*Typha* spp.), torpedograss (*Panicum repens*), rotala (*Rotala rotundifolia*), hempvine (*Mikania scandens*), and primrose willow (*Ludwigia octovalvis*) across the 7-acre site. Plants were hand-pulled when possible. Large woody species were cut and treated with herbicide. Non-native grasses and aquatics were treated with a foliar chemical application. Herbicides applied were glyphosate (0.8 gallons) and triclopyr (0.38 gallons).

Deering Estate Coastal Wetlands

Exotic plant species within the Deering Estate historic wetland in the vicinity of Cutler Creek were treated chemically (herbicides) and mechanically during WY2021. The dominant exotic species removed or treated were Arrowhead (*Syngonium podophyllum*), bishopwood (*Bischofia javanica*), air potato (*Dioscorea bulbifera*), and Brazilian pepper (*Schinus terebinthifolius*). Herbicides applied were triclopyr amine (between 5 to 6 gallons) and triclopyr ester (approximately 0.3 gallons).

LITERATURE CITED

SFWMD. 2018. *Interim 2018 Project Operating Manual Deering Estate Component of the Biscayne Bay Coastal Wetlands Project*. South Florida Water Management District, West Palm Beach, FL. September 2018.

SFWMD. 2020a. *Compliance Monitoring Plan for Biscayne Bay Coastal Wetland Project (BBCW)*. SFWMD-FIELD-CMP-005-06. South Florida Water Management District, West Palm Beach, FL. April 13, 2020.

SFWMD. 2020b. *Field Sampling Manual*. SFWMD-FIELD-FSM-001-11, South Florida Water Management District, West Palm Beach, FL. Effective September 21, 2020.

SFWMD. 2020c. *Quality Manual*. SFWMD-FIELD-QM-001-11, South Florida Water Management District, West Palm Beach, FL. Effective December 15, 2020.

SFWMD. 2021. *Chemistry Laboratory Quality Manual*. SFWMD-LAB-QM-2021-001, South Florida Water Management District, West Palm Beach, FL. Effective January 22, 2021.

USACE and SFWMD. 2012. *Central and Southern Florida Project Comprehensive Everglades Restoration Plan Biscayne Bay Coastal Wetlands Phase 1 Final Integrated Project Implementation Report and Environmental Impact Statement.* United States Army Corps of Engineers, Jacksonville, FL, and South Florida Water Management District, West Palm Beach, FL.

Attachment A: Specific Conditions and Cross-References

Table A-1. Specific conditions, actions taken, and cross-references presented in this report for the Biscayne Bay Coastal Wetlands project (CERPRA permit 0271729-010).

Specific Condition	Description	Applicable Phase	Action Taken	Included in This Report as:			
				Narrative (page #s)	Figure	Table	Attachment
18	L-31E Culverts - Passive Structures	Operation	Operation of passive structures was conducted as required.	21–31	8–12	6-9	C
19	L-31E Culverts Pilot Pump Test	Operation	The pilot pump test was completed in WY2019 and an after-action report was submitted to FDEP in July 2020.	3	---	---	---
20	Deering Estate Flow-way Operations	Operation	Operation of the Deering Estate Flow-way was conducted as required.	31–34	13–15	---	C
21	Pump Station Testing and Maintenance	Operation & Maintenance	No pump station testing occurred during WY2021.	---	---	---	---
22	Emergency Operations	Operation & Maintenance	Emergency operations did not occur during the reporting period.	---	---	---	---
23	Public Health, Safety, and Welfare	Operation	Discharges did not pose a danger to public health, safety, or welfare.	---	---	---	---
24	Water Quality Monitoring Program	Operation	Monitoring program was conducted as required and records included all required details.	11–20	4–7	3–5	B, D
25	Mercury and Other Toxicants	Operation	On August 9, 2013, FDEP approved a revised water quality monitoring plan eliminating pesticides and other toxicants monitoring in surface water and fish tissue. On March 16, 2020, FDEP approved the SFWMD request to terminate remaining project-specific mercury monitoring for the Deering Estate Flow-way.	---	---	---	---
26	Hydrologic Monitoring	Operation	Hydrologic monitoring was conducted as required.	21–34	8–15	6–9	C
27A	Quality Assurance and Quality Control	Operation	Sampling and monitoring data were collected in accordance with Chapter 62-160, F.A.C.	11	---	---	B
27B	Method Detection Limits	Operation	Performed in accordance with Rule 62-4.246, F.A.C.	11–20	---	---	B, D
28	Water Quantity, Water Quality, and Flooding Impact	Construction	Project features were constructed, maintained, and operated to not adversely affect adjacent lands with regards to water quantity, water quality, or flooding.	---	---	---	---
29	Turbidity Monitoring	Construction	No action needed during the reporting period.	---	---	---	---

Table A-1. Continued.

Specific Condition	Description	Applicable Phase	Action Taken	Included in This Report as:			
				Narrative (page #s)	Figure	Table	Attachment
30	Removal of Parameters	Operation	On March 16, 2020, FDEP approved the SFWMD request to terminate the remaining project-specific mercury monitoring for the Deering Estate Flow-way.	---	---	---	---
31	Addition of Parameters	Operation	No additional monitoring added in WY2021.	---	---	---	---
32	Construction Status Reports	Construction	No action needed during the reporting period.	---	---	---	---
33	Notification of Substantial Completion	Operation	No action needed during the reporting period.	---	---	---	---
34	Notification of Final Completion	Operation	No action needed during the reporting period.	---	---	---	---
35	As-Built Certification and Record Drawings	Operation	No action needed during the reporting period.	---	---	---	---
36	Inspection Plan and Reports	Operation	No action needed during the reporting period.	---	---	---	---
37	L-31E Culverts Pilot Pump Test	Operation	The pilot pump test was completed in WY2019 and an after-action report was submitted to FDEP in July 2020.	3	---	---	---
38	Annual Reports	All	Annual performance was evaluated and reported as required.	All	All	All	All
38C	Water Quality Data	Operation	Records include all required details. Monthly flow is summarized in the report and in Attachment C.	---	---	7	B–D
38D	Performance Evaluation	Operation	Annual performance evaluated and reported as required.	All	All	All	All
38E	Herbicide and Pesticide Tracking	Operation	Herbicide and pesticide use tracked and reported as required.	40	---	---	---
42	Permit Renewal	All	Not needed during the reporting period. The permit was renewed for an additional five years on February 13, 2018.	11	---	---	---

Attachment B: Water Quality and Mercury Data

This project information is required by Specific Conditions 24, 25, and 38C of the Biscayne Bay Coastal Wetlands permit (0271729-010) and is available upon request.

Attachment C: Hydrologic Data

This project information is required by Specific Conditions 26 and 38 of the Biscayne Bay Coastal Wetlands permit (0271729-010) and is available upon request.

Attachment D: Summary of Water Quality in Nearshore Biscayne Bay Waters in the L-31E Canal Area During WY2021 and Comparisons with Florida Class III Criteria for Marine Waters

This project information is required by Specific Conditions 24 and 38 of the Biscayne Bay Coastal Wetlands permit (0271729-010).

Table D-1. Basic statistics of water quality parameters in nearshore Biscayne Bay waters in the L-31E Culverts area (at stations BB53, MI01, MW01, and PR01) during WY2021 and comparisons with Class III criteria for marine waters.

Parameter	Units [a]	Class III Criterion for Marine Waters	Samples	Geometric Mean	Arithmetic Mean	Standard Deviation	Minimum	Q25	Median	Q75	Maximum	Samples Below Detection Limit	Excursions	Percent Excursions
STATION: BB53														
Dissolved Oxygen Percent Saturation	%	See footnote [b]	12	92%	95%	21%	54%	82%	94%	111%	125%	NA [c]	0	0%
pH		6.5 ≤ pH ≤ 8.5	12	8.03	8.03	0.19	7.80	7.90	8.00	8.15	8.40	NA	0	0%
Specific Conductance	µS/cm	None	12	28,769	31,695	13,555	9,868	21,836	32,446	38,544	60,645	NA	NA	NA
Salinity		None	12	17.8	19.9	9.3	5.5	13.2	20.2	24.5	40.7	NA	NA	NA
Temperature	°C	None	12	26.5	26.7	3.6	20.4	24.0	26.7	29.8	31.8	NA	NA	NA
Color	PCU	None	12	10	10	2	6	10	10	11	13	0	NA	NA
Total Ammonia Nitrogen	mg/L	None	12	0.044	0.054	0.039	0.016	0.027	0.049	0.055	0.148	0	NA	NA
Nitrate + Nitrite	mg/L	None	12	0.188	0.488	0.584	0.005	0.084	0.335	0.832	1.841	1	NA	NA
Total Nitrogen	mg/L	See footnote [d]	12	0.94	1.05	0.55	0.45	0.67	0.93	1.28	2.41	0	NA	NA
Total Phosphorus	mg/L	See footnote [d]	12	0.006	0.006	0.001	0.004	0.006	0.006	0.007	0.009	0	NA	NA
Total Suspended Solids	mg/L	None	12	3.5	3.6	1.2	3.0	3.0	3.0	4.0	7.0	7	NA	NA
STATION: MI01														
Dissolved Oxygen Percent Saturation	%	See footnote [b]	12	81%	82%	15%	55%	73%	82%	92%	108%	NA	0	0%
pH		6.5 ≤ pH ≤ 8.5	12	7.95	7.96	0.25	7.50	7.80	7.95	8.10	8.40	NA	0	0%
Specific Conductance	µS/cm	None	12	27,762	31,380	14,127	6,383	22,851	29,818	40,868	60,690	NA	NA	NA
Salinity		None	12	17.1	19.7	9.7	3.5	13.8	18.4	26	40.7	NA	NA	NA
Temperature	°C	None	12	26.4	26.6	3.5	20.3	23.6	27.2	29.4	31.3	NA	NA	NA
Color	PCU	None	11	11	11	2	6	10	11	12	14	0	NA	NA
Total Ammonia Nitrogen	mg/L	None	11	0.046	0.055	0.036	0.020	0.024	0.045	0.070	0.136	0	NA	NA
Nitrate + Nitrite	mg/L	None	11	0.143	0.292	0.264	0.005	0.050	0.250	0.555	0.746	1	NA	NA
Total Nitrogen	mg/L	See footnote [d]	12	0.76	0.79	0.24	0.56	0.63	0.70	0.93	1.33	0	NA	NA
Total Phosphorus	mg/L	See footnote [d]	12	0.007	0.007	0.002	0.004	0.005	0.007	0.010	0.010	0	NA	NA
Total Suspended Solids	mg/L	None	12	3.5	3.6	0.9	3.0	3.0	3.0	4.0	6.0	5	NA	NA

Table D-1. Continued.

Parameter	Units [a]	Class III Criterion for Marine Waters	Samples	Geometric Mean	Arithmetic Mean	Standard Deviation	Minimum	Q25	Median	Q75	Maximum	Samples Below Detection Limit	Excursions	Percent Excursions
STATION: MW01														
Dissolved Oxygen Percent Saturation	%	See footnote [b]	12	70%	72%	15%	32%	68%	72%	83%	89%	NA	1	8%
pH		6.5 ≤ pH ≤ 8.5	12	7.77	7.78	0.29	7.40	7.60	7.70	8.05	8.20	NA	0	0%
Specific Conductance	µS/cm	None	12	25,700	28,205	13,297	12,391	20,784	27,070	30,814	61,079	NA	NA	NA
Salinity		None	12	15.7	17.5	9.2	7.1	12.4	16.6	19.1	40.9	NA	NA	NA
Temperature	°C	None	12	26.7	26.9	3.3	20.3	24.2	27.7	29.8	30.4	NA	NA	NA
Color	PCU	None	12	8	9	3	5	6	8	10	13	0	NA	NA
Total Ammonia Nitrogen	mg/L	None	10	0.053	0.058	0.024	0.019	0.039	0.057	0.082	0.091	0	NA	NA
Nitrate + Nitrite	mg/L	None	11	0.346	0.547	0.359	0.006	0.292	0.509	0.815	1.164	0	NA	NA
Total Nitrogen	mg/L	See footnote [d]	12	0.90	0.95	0.33	0.60	0.72	0.80	1.18	1.56	0	NA	NA
Total Phosphorus	mg/L	See footnote [d]	12	0.007	0.008	0.003	0.006	0.006	0.007	0.008	0.016	0	NA	NA
Total Suspended Solids	mg/L	None	12	3.3	3.3	0.7	3.0	3.0	3.0	3.5	5.0	9	NA	NA
STATION: PR01														
Dissolved Oxygen Percent Saturation	%	See footnote [b]	12	76%	76%	12%	58%	68%	78%	84%	95%	NA	0	0%
pH		6.5 ≤ pH ≤ 8.5	12	7.79	7.79	0.22	7.50	7.60	7.80	8.00	8.10	NA	0	0%
Specific Conductance	µS/cm	None	12	20,188	25,504	14,878	2,742	15,315	26,774	31,750	58,332	NA	NA	NA
Salinity		None	12	12.0	15.7	10.0	1.4	8.4	16.4	19.7	38.9	NA	NA	NA
Temperature	°C	None	12	26.5	26.7	3.3	20.3	24.3	27.0	29.8	31.6	NA	NA	NA
Color	PCU	None	12	10	11	2	7	9	10	12	15	0	NA	NA
Total Ammonia Nitrogen	mg/L	None	11	0.062	0.070	0.035	0.029	0.046	0.063	0.093	0.145	0	NA	NA
Nitrate + Nitrite	mg/L	None	12	0.747	1.135	0.661	0.009	0.662	1.130	1.481	2.374	0	NA	NA
Total Nitrogen	mg/L	See footnote [d]	12	1.60	1.71	0.60	0.70	1.26	1.72	2.12	2.90	0	NA	NA
Total Phosphorus	mg/L	See footnote [d]	12	0.008	0.008	0.001	0.006	0.007	0.008	0.009	0.011	0	NA	NA
Total Suspended Solids	mg/L	None	12	3.4	3.4	0.7	3.0	3.0	3.0	4.0	5.0	10	NA	NA

a. Key to Units: % - percent; °C – degrees Celsius; µS/cm – microsiemens per centimeter; mg/L – milligrams per liter; PCU – platinum-cobalt units.
b. DO percent saturation values for each station must not be below 42% more than 10% of the time.
c. NA – Not applicable.
d. Station BB53 is located in Biscayne Bay open water on the border of the "South Central Inshore" region of the Biscayne Bay nutrient criteria area. According to Section 62-302.532, F.A.C., estuary-specific nutrient criteria are expressed as open water, area-wide (i.e., multiple station) averages. Because station BB53 by itself cannot provide an area-wide annual geometric mean, it cannot be used to evaluate compliance with the nutrient criteria for Biscayne Bay. For stations MI01, MW01, and PR01, the estuary-specific nutrient criteria do not apply because these stations are not located in the Biscayne Bay nutrient criteria area.