

Disclaimer: Information contained in the report addresses environmental conditions only and is not the official South Florida Water Management District operations recommendation or decision.

M E M O R A N D U M

TO: John Mitnik, Chief, Operations, Engineering and Construction Bureau
Paul Linton, Chief, Operations Section

FROM: SFWMD Staff Environmental Advisory Team

DATE: March 13, 2019

SUBJECT: Weekly Environmental Conditions for Systems Operations

Summary

Weather Conditions and Forecast

The forecast is for scattered showers Tuesday and Wednesday and increasing rains Saturday and Sunday. Daytime heating will generate some light showers this afternoon mainly northeast of Lake Okeechobee and near the southwest coast. A weakening cold front is forecast to back in from the northeast Tuesday and Wednesday and generate some scattered light shower activity mainly north and northeast Tuesday evening and night and then mainly over the southern half of the District Wednesday as the boundary moves into the Keys and stalls. Dry air should filter in behind the front and limit shower development Thursday and Friday. The next cold front is forecast to push into the District from the northwest Saturday and slowly progress southward into the District Sunday before stalling across the southern end of the District Monday. Scattered moderate to locally heavy shower activity is expected with the front as it moves into the area. Upper level energy moving across the area is then forecast to generate a frontal wave propagating eastward along the boundary and bringing the potential for some heavy rains Tuesday and Wednesday of next week. While there remains some uncertainty with the details of this frontal wave, the heaviest activity would currently be expected to be across the southern half of the District.

Kissimmee

Tuesday morning stages were 56.6 feet NGVD (1.4 feet below schedule) in East Lake Toho, 53.8 feet NGVD (1.2 feet below schedule) in Toho, and 50.2 feet NGVD (0.8 feet below schedule) in Kissimmee-Cypress-Hatchineha; headwater stages were 46.4 feet NGVD at S-65A and 25.7 feet NGVD at S-65D. Tuesday morning discharges were 399 cfs at S-65, 300 cfs at S-65A, 508 cfs at S-65D and 353 cfs at S-65E. Dissolved oxygen concentration in the Kissimmee River averaged 5.4 mg/L for the week. Kissimmee River mean floodplain depth on Sunday was 0.32 feet.

Lake Okeechobee

Lake Okeechobee stage is 12.42 feet NGVD, decreasing 0.29 feet from the previous week. The Lake decreased into Beneficial Use and is 0.18 ft below the Base Flow sub-band. The Lake remains below the bottom of the ecological envelope (currently 1.15 ft below), which varies seasonally from 12.5 – 15.5 feet NGVD. Given the potential for above average rainfall associated with weak El Niño conditions this spring and the poor condition of SAV and EAV in the nearshore zone, these lower lake stages are ideal for vegetation recovery, but will reduce habitat for fish and wildlife in the near-term and encourage spread of invasive vegetation in the upper marsh.

Estuaries

Total inflow to the St. Lucie Estuary averaged 824 cfs over the past week with 566 cfs coming from Lake Okeechobee. Over the past week, salinity decreased in the estuary. The seven-day average salinity at the US1 Bridge is within the good range for adult eastern oysters. Total inflow to the Caloosahatchee Estuary averaged 1,868 cfs over the past week with 778 cfs coming from the Lake. Over the past week, salinity decreased in the estuary. The 30-day moving average surface salinity is 0.3 at Val I-75 and 2.6 at Ft. Myers. Salinity conditions between Val I-75 and Ft. Myers are good for tape grass. Salinity conditions are in the fair range for adult eastern oysters at Cape Coral and in the good range at Shell Point.

Stormwater Treatment Areas

Over the past week, the STAs/FEBs received approximately 17,800 acre-feet of Lake releases. The total amount of Lake releases sent to the STAs/FEBs in WY2019 (since May 1, 2018) is approximately 410,000 acre-feet. The total amount of inflows to the STAs in WY2019 is approximately 1,477,000 acre-feet. Most STA cells are at or near target depths. STA-1W Northern Flow-way is offline for STA-1W Expansion project construction activities, STA-1E Western Flow-way is offline for levee repairs in the West Distribution Cell, and STA-5/6 Flow-ways 2 and 3 are offline for the Restoration Strategies project to grade non-effective treatment areas. Operational restrictions are in place in STA-1E Central Flow-way for vegetation management activities and STA-3/4 Western Flow-way for a Restoration Strategies Science Plan study. This week, if Lake releases are sent to the WCAs and conditions allow, releases will be sent to the A-1 FEB and STA-2.

Everglades

The WCAs received little rainfall last week and stages responded by dropping on average 0.11 feet across the basins. Stage at the Everglades National Park (ENP) station increased 0.09 feet this week. Keeping rainfall runoff within the Everglades system, distributing it equally across the WCAs, and moving it south through the system when possible remains ecologically beneficial as the WCAs are at or near average stages for this time of year. Very little rainfall fell on Taylor Slough and Florida Bay this week. Depths in Taylor Slough remain above average for this time of year, especially in northern Taylor Slough. Average salinity increased slightly this week in Florida Bay, and continues to be above average for this time of year.

Supporting Information

KISSIMMEE BASIN

Kissimmee Basin Rainfall

The Upper Kissimmee Basin received 0.19 inches of rainfall in the past week and the Lower Basin received 0.05 inches (SFWMD Daily Rainfall Report 3/11/2018).

Upper Kissimmee Basin

Stages and departures in the Kissimmee Chain of Lakes (KCOL) are shown in **Table 1**. KCOL stage hydrographs with respective regulation schedules and rainfall are shown in Figures 1-7.

Table 1. Average discharge (cfs) for the preceding seven days, one-day stage (feet NGVD), and departures from KCOL flood regulation (R) or temporary schedules (T, A, or S). Provisional, real-time data are from SFWMD.
Report Date: 3/12/2019

| Water Body | Structure | 7-day Average Discharge (cfs) ¹ | Stage Monitoring Site ² | Lake Stage (feet) | Schedule Type ³ | Schedule Stage (feet) | Daily Departure (feet) | | | | | | |
|------------------------------------------|-----------|-----------------------------------------------------|---------------------------------------|----------------------|-------------------------------|-----------------------------|------------------------|--------|---------|---------|---------|--------|---------|
| | | | | | | | 3/10/19 | 3/3/19 | 2/24/19 | 2/17/19 | 2/10/19 | 2/3/19 | 1/27/19 |
| Lakes Hart and Mary Jane | S-62 | 10 | LKMJ | 60.7 | R | 61.0 | -0.3 | -0.3 | -0.2 | 0.0 | 0.0 | 0.0 | -0.1 |
| Lakes Myrtle, Preston, and Joel | S-57 | 1 | S-57 | 60.9 | R | 60.9 | 0.0 | -0.1 | -0.1 | 0.1 | 0.1 | 0.0 | -0.2 |
| Alligator Chain | S-60 | 0 | ALLI | 63.8 | R | 64.0 | -0.2 | -0.2 | -0.2 | -0.2 | -0.4 | -0.5 | -0.7 |
| Lake Gentry | S-63 | 0 | LKGT | 61.5 | R | 61.5 | 0.0 | -0.1 | 0.0 | 0.0 | 0.0 | -0.1 | -0.1 |
| East Lake Toho | S-59 | 31 | TOHOE | 56.6 | R | 58.0 | -1.4 | -1.4 | -1.2 | -1.0 | -0.8 | -0.8 | -0.5 |
| Lake Toho | S-61 | 217 | TOHOW, S-61 | 53.6 | R | 55.0 | -1.4 | -1.3 | -1.2 | -1.0 | -0.9 | -0.8 | -0.7 |
| Lakes Kissimmee, Cypress, and Hatchineha | S-65 | 513 | KUB011, LKISSB | 50.2 | R | 51.0 | -0.8 | -0.7 | -0.8 | -1.0 | -1.0 | -1.1 | -1.5 |

¹ Seven-day average of weighted daily means through midnight.

² Names of in-lake monitoring sites and structures used to determine lake stage; if more than one site is listed, an average is reported.

³ A = projected ascension line, R = USACE regulation schedule, S = temporary recession target line, T = temporary schedule, N/A= not applicable or data not available.
DATA ARE PROVISIONAL

Lower Kissimmee Basin

Discharges at Lower Basin structures are shown in Table 2. SFWDAT depth maps for the Phase I restoration area are shown in Figure 8. Kissimmee River floodplain stages at selected stations are shown in Figure 9.

Table 2. One-day and seven-day averages of discharge at S-65x structures, of dissolved oxygen concentration in the Phase I area river channel, and water depth in the Phase I area floodplain. Data are provisional real-time data from SFWMD.

Report Date: 3/12/2019

| Metric | Location | 1-Day Average | | Average for the Preceding 7-Days ¹ | | | | | | | | |
|--------------------------------|-----------------------|---------------|---------|-----------------------------------------------|---------|---------|---------|--------|---------|---------|---------|--------|
| | | 3/10/2019 | 3/10/19 | 3/3/19 | 2/24/19 | 2/17/19 | 2/10/19 | 2/3/19 | 1/27/19 | 1/20/19 | 1/13/19 | 1/6/19 |
| Discharge (cfs) | S-65 | 387 | 513 | 1,368 | 2,386 | 3,220 | 2,653 | 1,615 | 950 | 392 | 343 | 273 |
| Discharge (cfs) | S-65A ² | 298 | 409 | 1,190 | 2,280 | 3,154 | 2,472 | 1,517 | 764 | 306 | 261 | 194 |
| Discharge (cfs) | S-65D ² | 519 | 1,103 | 2,310 | 3,097 | 2,668 | 1,564 | 1,221 | 621 | 341 | 261 | 241 |
| Headwater Stage (feet NGVD) | S-65D ² | 25.59 | 25.72 | 25.76 | 25.77 | 25.81 | 25.82 | 25.90 | 26.00 | 25.94 | 25.91 | 25.86 |
| Discharge (cfs) | S-65E ² | 374 | 1,026 | 2,167 | 2,945 | 2,533 | 1,442 | 1,151 | 606 | 309 | 261 | 215 |
| Discharge (cfs) | S-67 | 0 | 51 | 30 | 53 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| DO (mg/L) ³ | Phase I river channel | 5.7 | 5.4 | 4.1 | 3.4 | 4.0 | 5.3 | 6.5 | 6.6 | 6.8 | 6.4 | 6.1 |
| Mean depth (feet) ⁴ | Phase I floodplain | 0.32 | 0.43 | 0.86 | 1.20 | 1.25 | 0.71 | 0.46 | 0.12 | 0.07 | 0.08 | 0.09 |

¹Seven-day average of weighted daily means through Sunday midnight.

²S-65A discharge combines S-65A with auxiliary structures; S-65D discharge combines discharge at S-65D, S-65DX1, and S-65DX2; S-65D stage averages stage at S-65D and S-65DX1; S-65E discharge combines S-65E and S-65EX1.

³DO is the average for sondes at PC62 and PC33.

⁴1-day spatial average from South Florida Water Depth Assessment Tool (SFWDAT).

DATA ARE PROVISIONAL; N/A indicates that data were not available.

KCOL Hydrographs (through Sunday midnight)

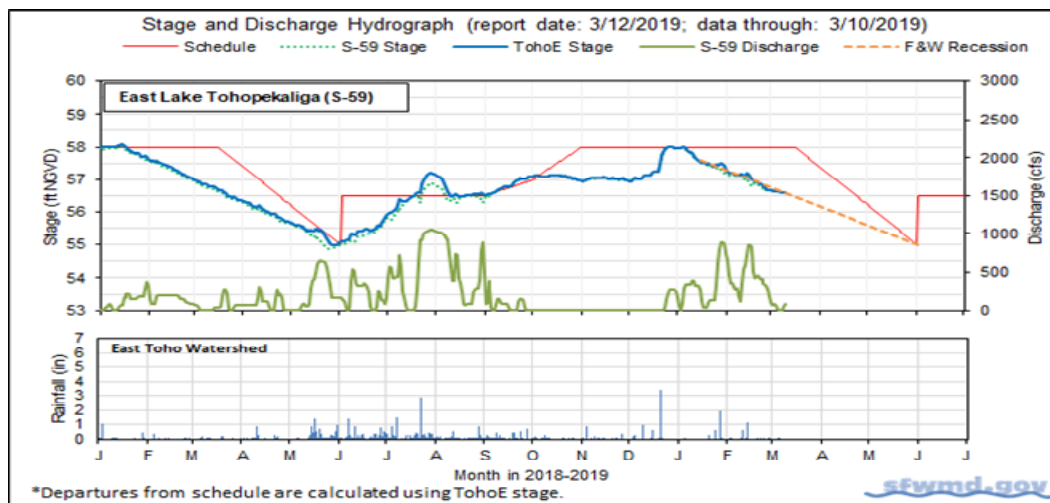


Figure 1.

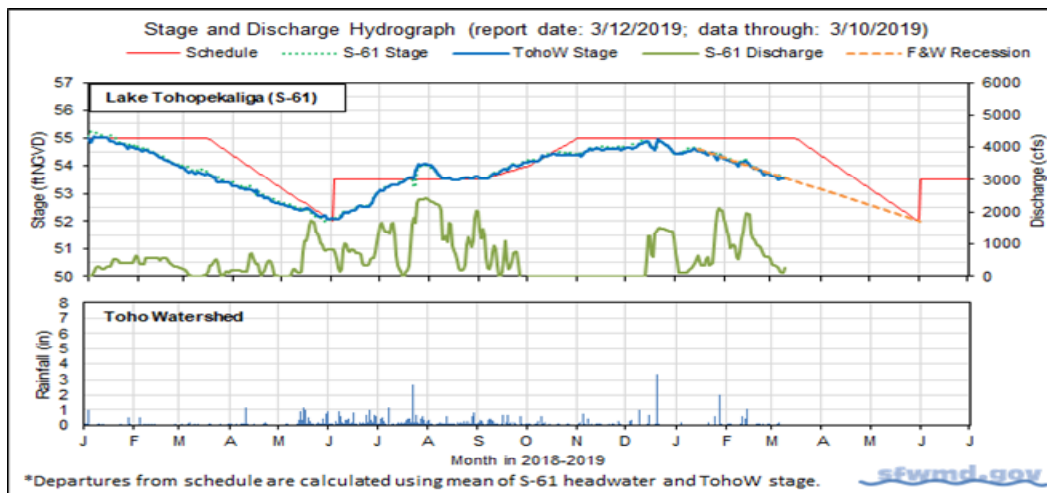


Figure 2.

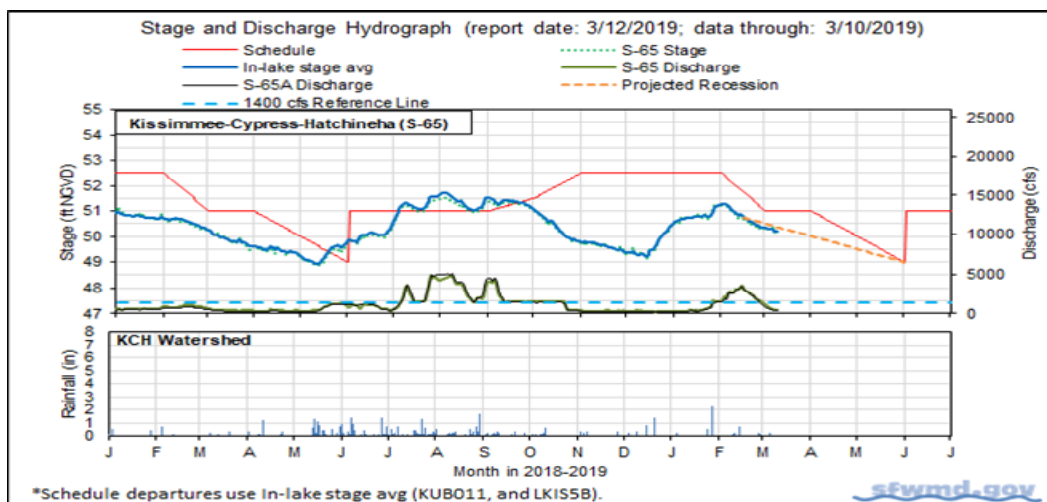


Figure 3.

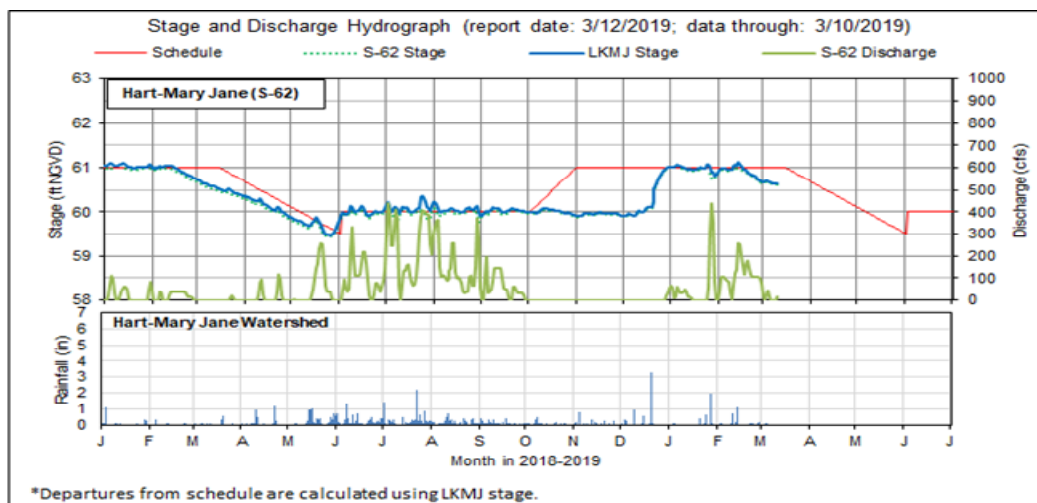


Figure 4.

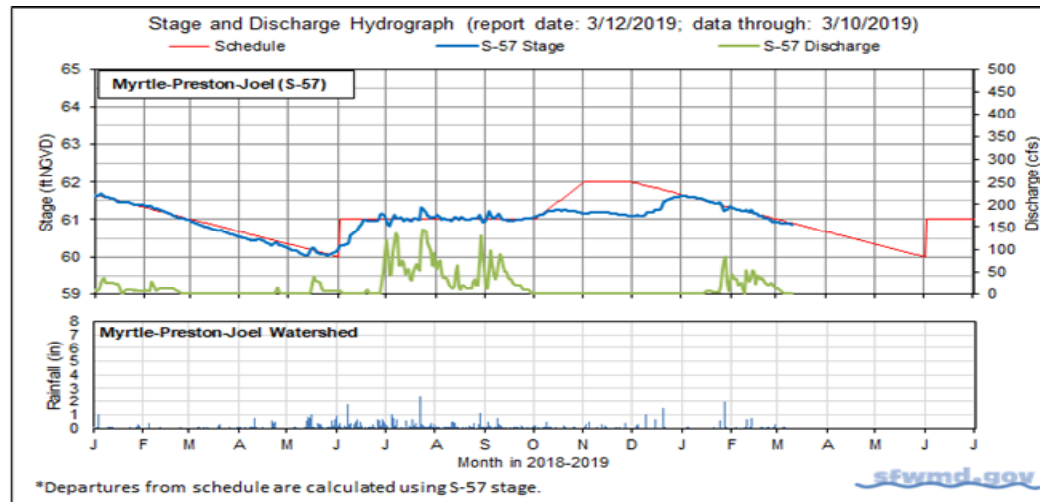


Figure 5.

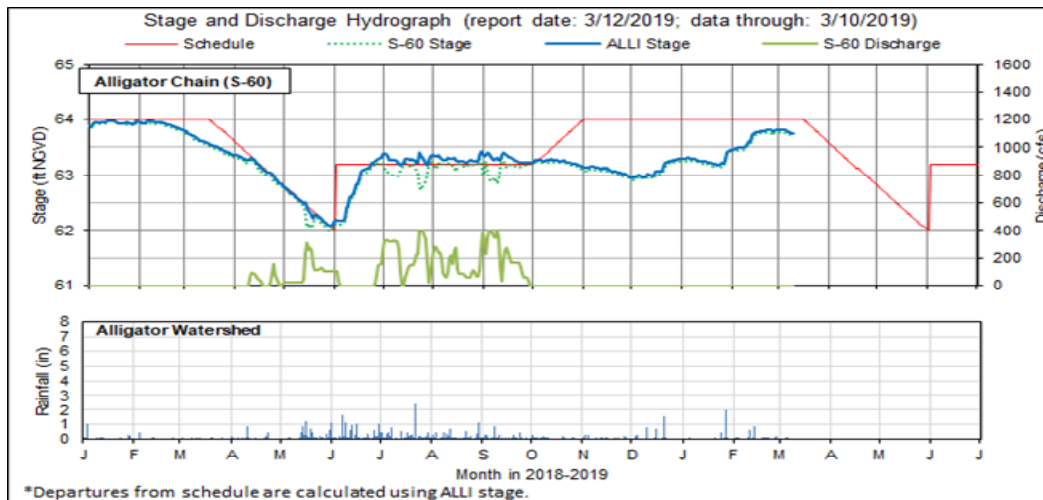


Figure 6.

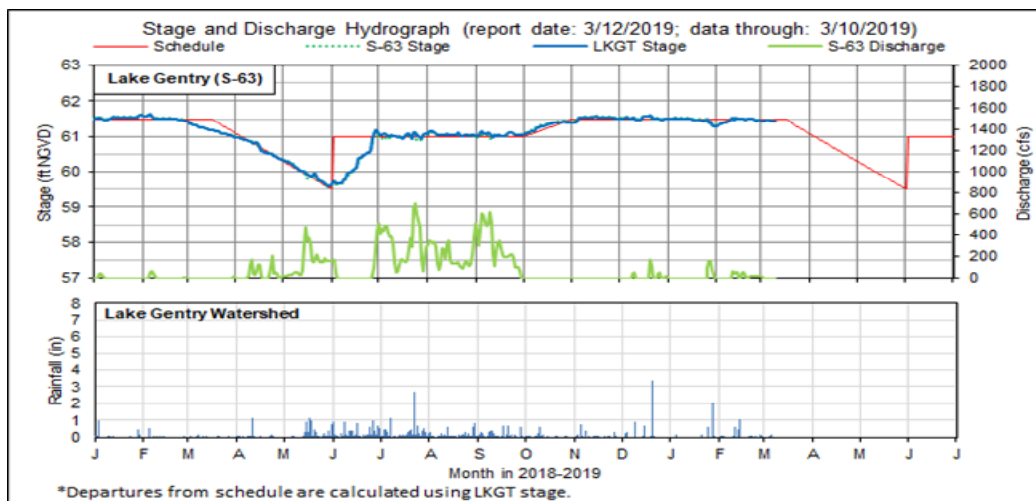


Figure 7.

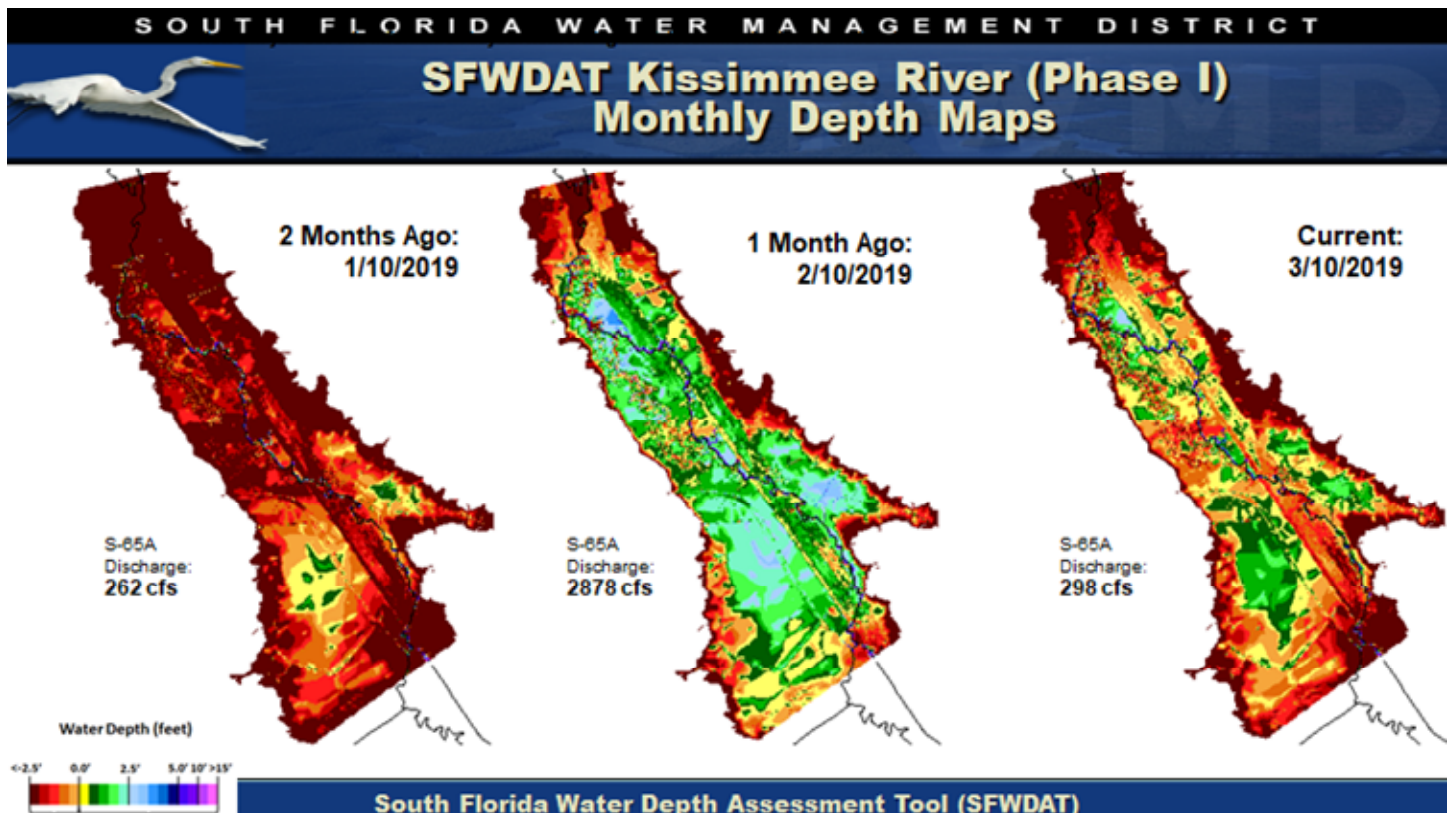


Figure 8. Phase I area floodplain water depths for this week, one month ago, and two months ago. Note that the WDAT color-coding has been modified to accommodate greater water depths; these maps are not directly comparable to Kissimmee Basin WDAT maps published prior to January 16, 2012.

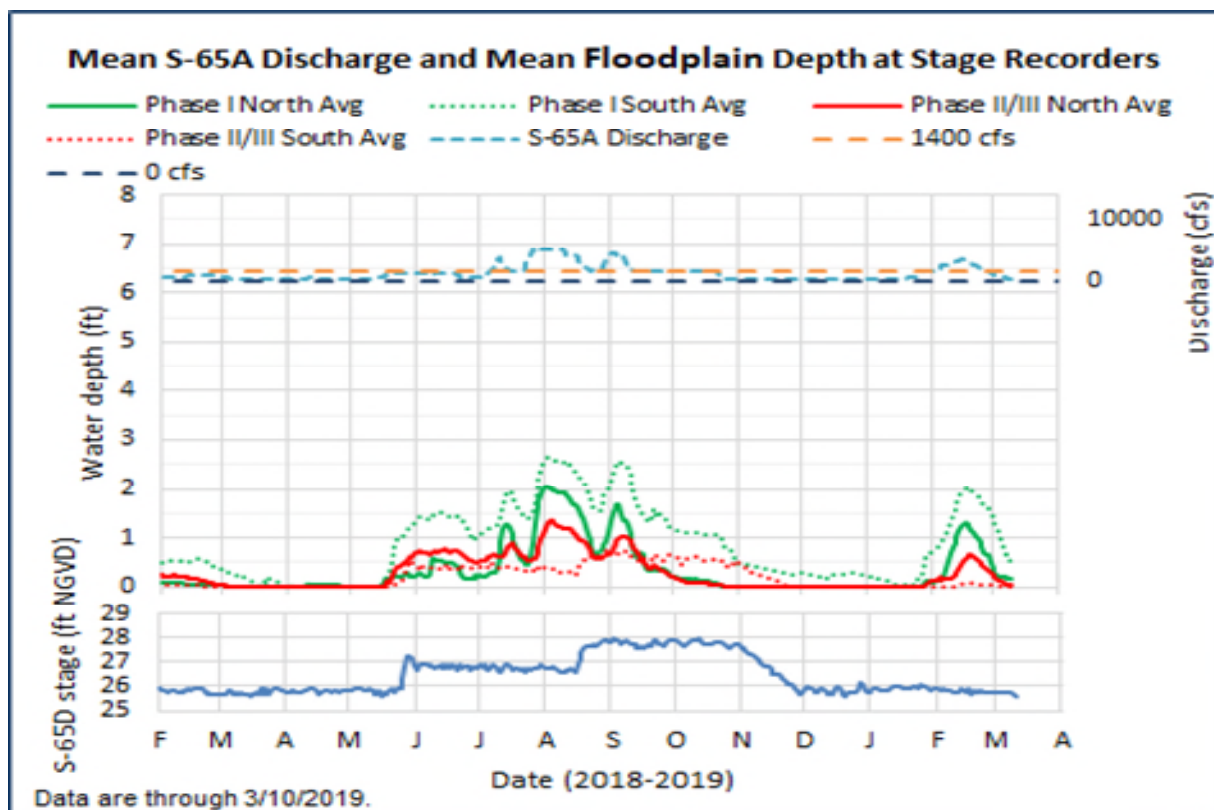


Figure 9. Mean water depth at stage recorders in the northern Phase I, southern Phase I, northern Phase II/III, and southern Phase II/III areas in relation to the S-65A discharge and S-65D headwater stage.

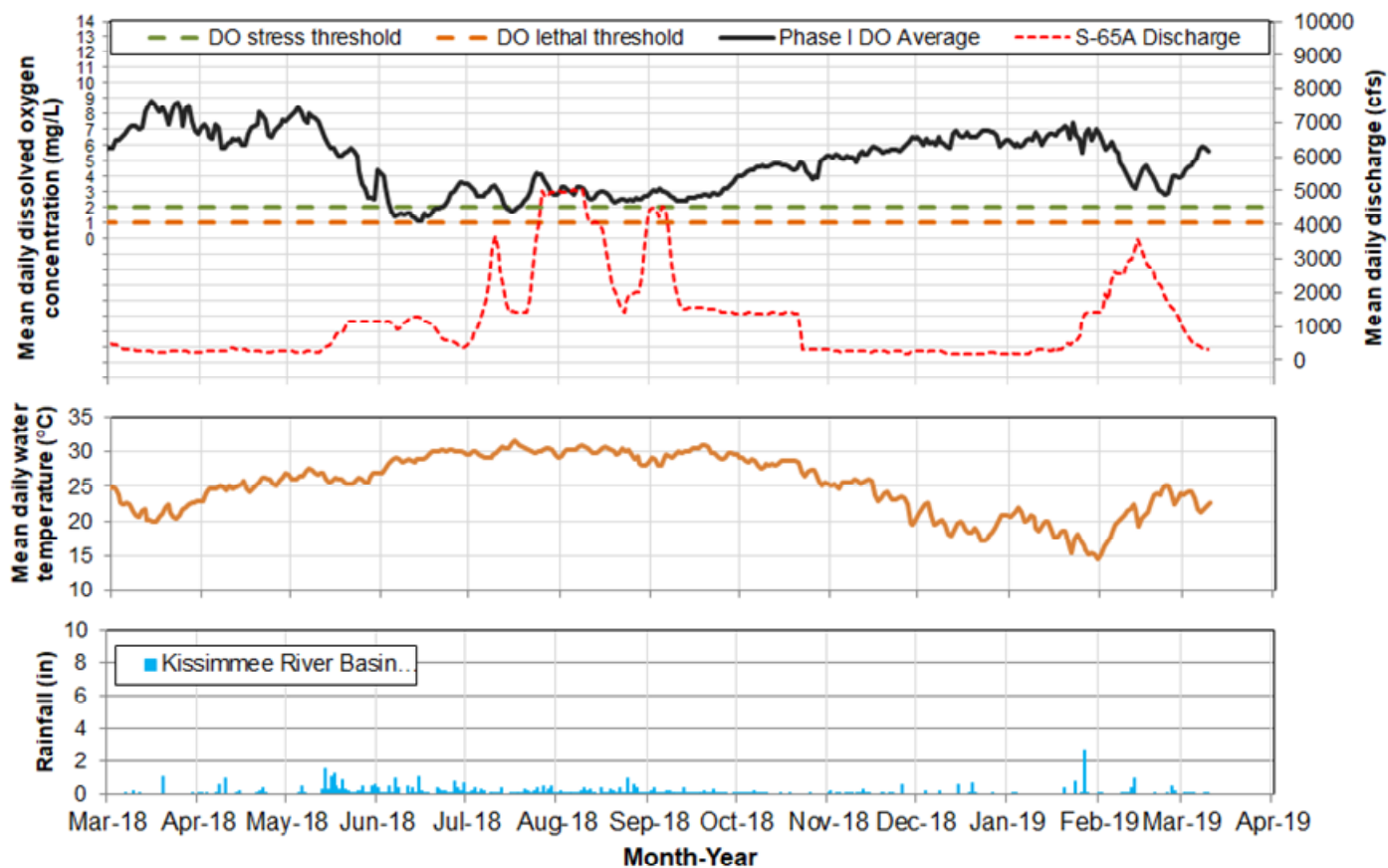


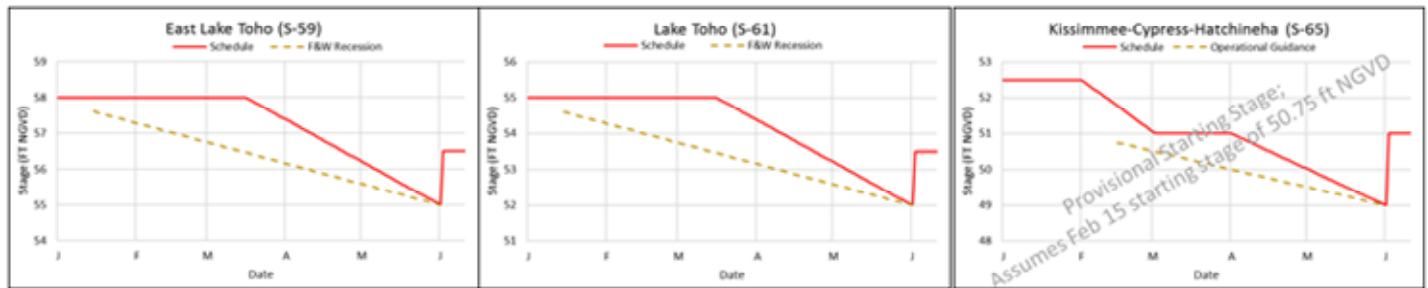
Figure 10. Mean daily dissolved oxygen, discharge, temperature and rainfall in the Phase I river channel.

Water Management Recommendations

Kissimmee Basin Adaptive Recommendations and Operational Actions

| Recommendation Date | Recommendation | Purpose | Outcome | Source | Report Date |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------------------|-------------|
| 3/11/2019 | No new recommendations. | | N/A | | 3/12/2019 |
| 3/4/2019 | No new recommendations. | | N/A | | 3/5/2019 |
| 2/26/2019 | No new recommendations. | | N/A | | 2/26/2019 |
| 2/19/2019 | No new recommendations. | | N/A | | 2/19/2019 |
| 2/10/2019 | Increase discharge at S-65 by 600 cfs. | To compensate for increased inflow and rain forecast for Tuesday. | Implemented | KB Ops/SFWMD Water Mgt | 2/12/2019 |
| 2/4/2019 | Increase discharge at S-65/S-65A to begin reducing KCH stage to reach 50.75 ft on 2/15/2019. | Reduce to the stage at which the seasonal recession will begin. | Implemented | KB Ops/SFWMD Water Mgt | 2/5/2019 |
| 1/26/2019 | Increase S65A discharge by a total of 350 cfs today, which will put S65A at 1,400 cfs. Continue to increase discharge as needed. | Moderate or stop the rise in Lake KCH preemptively before forecast rainfall and provide capacity at S65A for S65A basin runoff. | Implemented | SFWMD Water Mgt/KB Ops | 1/29/2019 |
| 1/22/2019 | No new recommendations. | | N/A | | 1/22/2019 |
| | Begin recessions on Lake Toho and East Lake Toho on Jan 15, with a continuous recession to the regulation dry season low (52.0 ft on Toho; 55.0 ft on East Lake) on May 31. The lines are represented graphically in the Dry Season Operations slides. | | | | |
| 1/15/2019 | Tentatively plan on a recession in Kissimmee-Cypress-Hatchineha starting on February 15 with a continuous recession to the dry season low (49 ft) on May 31. A provisional diagram is included in the Dry Season Operations slides; however, starting stage may change depending on conditions. | Slow recession rates in East Toho, Toho, and KCH to benefit fish and wildlife; as possible limit flow volume at S-65D to facilitate KRR construction. | N/A | KB Ops | 1/15/2019 |
| | Discharge and reversal guidelines are provided in the Dry Season Operations slides. | | | | |
| 1/4/2019 | Discontinue 54 foot stage reduction target in Lake Toho. | Lake Kissimmee has already risen by ~1.5 ft. | Implemented | SFWMD Water Mgt/KB Ops | 1/8/2019 |
| 12/14/2018 | Manage S-61 discharge to reduce stage in Lake Toho to 54 ft over the next 7-9 days. | Move water to KCH to reduce the rate of stage decline in KCH; reduce the head difference between S-61 headwater and tailwater. | N/A | SFWMD Water Mgt/KB Ops | 12/18/2018 |
| 12/10/2018 | Reduce S-65A discharge to 180 cfs. | Reduce rate of stage decline in lakes Kissimmee-Cypress-Hatchineha | N/A | SFWMD Water Mgt/KB Ops | 12/11/2018 |
| 12/3/2018 | No new recommendations. | | N/A | | 12/4/2018 |
| 11/26/2018 | No new recommendations. | | N/A | | 11/27/2018 |
| 11/19/2018 | No new recommendations. | | N/A | | 11/20/2018 |
| 11/12/2018 | No new recommendations. | | N/A | | 11/13/2018 |
| 11/2/2018 | Reduce S-65/S-65A discharge to approximately 250 cfs. | To conserve stage in Lake Kissimmee. | Implemented | SFWMD Water Mgt/KB Ops | 11/6/2018 |
| 10/30/2018 | No new recommendations. | | N/A | | 10/30/2018 |
| 10/22/2018 | Reduce S-65/S-65A discharge to approximately 300 cfs (minimum discharge) in one step of approximately 1100 cfs today. | Reduce rate of stage decline in lakes Kissimmee-Cypress-Hatchineha | Implemented | SFWMD Water Mgt/KB Ops | 10/23/2018 |
| 10/16/2018 | No new recommendations. | | N/A | | 10/16/2018 |
| 10/9/2018 | No new recommendations. | | N/A | | 10/9/2018 |
| 10/2/2018 | No new recommendations. | | N/A | | 10/2/2018 |
| 9/25/2018 | No new recommendations. | | N/A | | 9/25/2018 |
| 9/18/2018 | No new recommendations. | | N/A | | 9/18/2018 |
| 9/11/2018 | No new recommendations. | | N/A | | 9/11/2018 |
| 9/4/2018 | No new recommendations. | | N/A | | 9/4/2018 |
| 8/28/2018 | No new recommendations. | | N/A | | 8/28/2018 |
| 8/21/2018 | No new recommendations. | | N/A | | 8/21/2018 |
| 8/14/2018 | No new recommendations. | | N/A | | 8/14/2018 |
| 8/7/2018 | No new recommendations. | | N/A | | 8/7/2018 |
| 7/23/2018-7/24/2018 | Increase discharge from 1400 cfs to 3000 cfs, then 3200 cfs and 3500 cfs. | For flood control in Lake Kissimmee. | Implemented | SFWMD Water Mgt/KB Ops | 7/31/2018 |

Dry Season Operations Slide 1 - 2018-2019 (NOTE revised discharge table)



Other Considerations

- KCH starting stage may vary; the maximum is 50.75 ft NGVD on Feb 15.
- Maintain S65/S65A discharge of at least 300 cfs.
- If outlook is for extreme dry conditions meet with KB staff to discuss modifications to this plan.

Version 1: January 14 2019

Discharge Rate of Change Limits for S65/S65A (revised 1/14/19).

| Q (cfs) | Maximum rate of INCREASE (cfs/day) | Maximum rate of DECREASE (cfs/day) |
|-----------|------------------------------------|------------------------------------|
| 0-300 | 100 | -50 |
| 301-650 | 150 | -75 |
| 651-1400 | 300 | -150 |
| 1401-3000 | 600 | -300 |
| >3000 | 1000 | -1000 |

Figure 11A. Slide 1 of the 2018-2019 Dry Season Operations Plan for S-59, S-61, and S-65/S-65A.

Dry Season Operations Slide 2 - 2018-2019

East Lake (ELT) and Toho (WLT)

- **East Toho and Toho Recessions:**
 - Make releases to begin recessions on Jan 15 with lake stage approximately 0.4 ft below winter pool and continue to follow straight line recessions through May 31st to the extent practical
- **East Toho and Toho Stage Reversals :**
 - Adjust discharge to bring stage back to the recession line within about a week
 - Pre-storm releases may be used to lower stage below the recession line and create storage of about half of the forecast rain volume
 - If stage cannot be brought back to the recession line within about a week, the recession line may need to be reset following discussion with partner agencies
 - In general, the water released from ELT and WLT basins will be released to KHC (to the extent that hydraulic capacity is available) without consideration for Lake KHC stage. However, the priority of KCH is subject to change if more nesting occurs in KCH than Toho or East

Kissimmee-Cypress-Hatchineha (KCH)

- **KCH Recession:**
 - Begin recession on February 15 (subject to change) starting no higher than 50.75 feet
 - To the extent feasible considering discharge constraints, make releases to follow a straight-line recession through May 31
 - In general, use the available storage in Lake KCH to keep flow at S-65D below 1,000 cfs; when possible keep flow below 600 cfs
- **KCH Stage Reversals :**
 - To address reversals, in general increase flow by 100 cfs for every 0.1 foot of rise above the recession line (e.g. from 300 cfs at the line to 800 cfs at 0.5 feet above the line)

Figure 11B. Slide 2 of the 2018-2019 Dry Season Operations Plan for S-59, S-61, and S-65/S-65A.

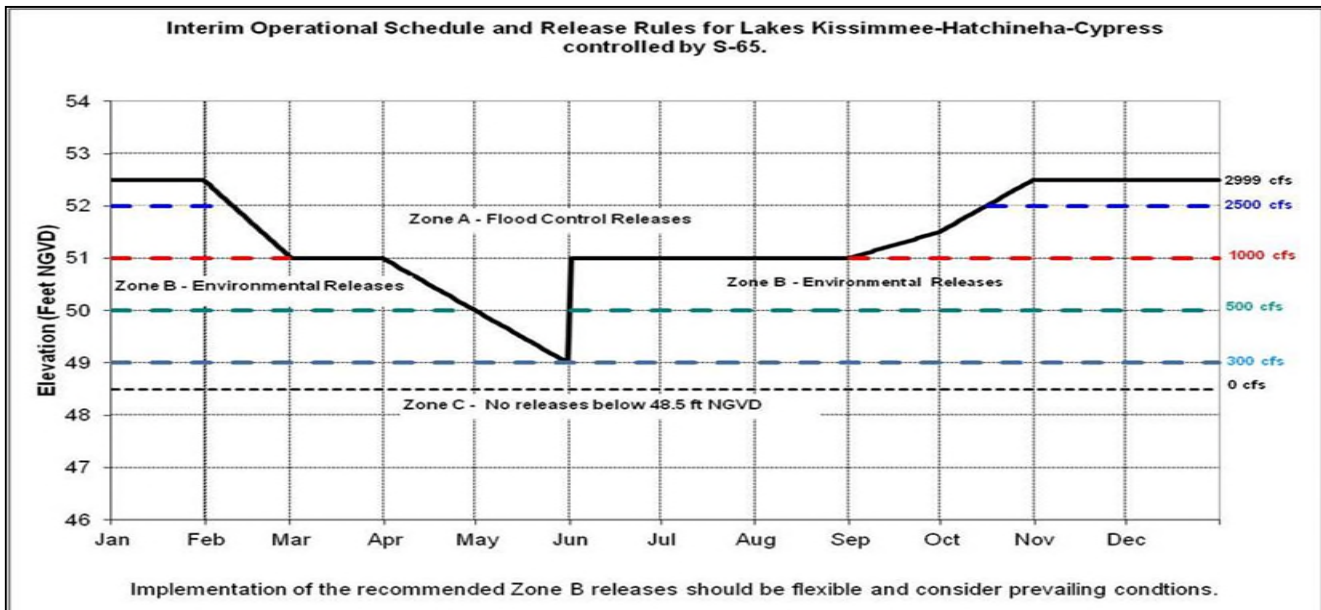


Figure 12. Interim operations schedule for S-65. The discharge schedule shown to the right has not been used in recent years.

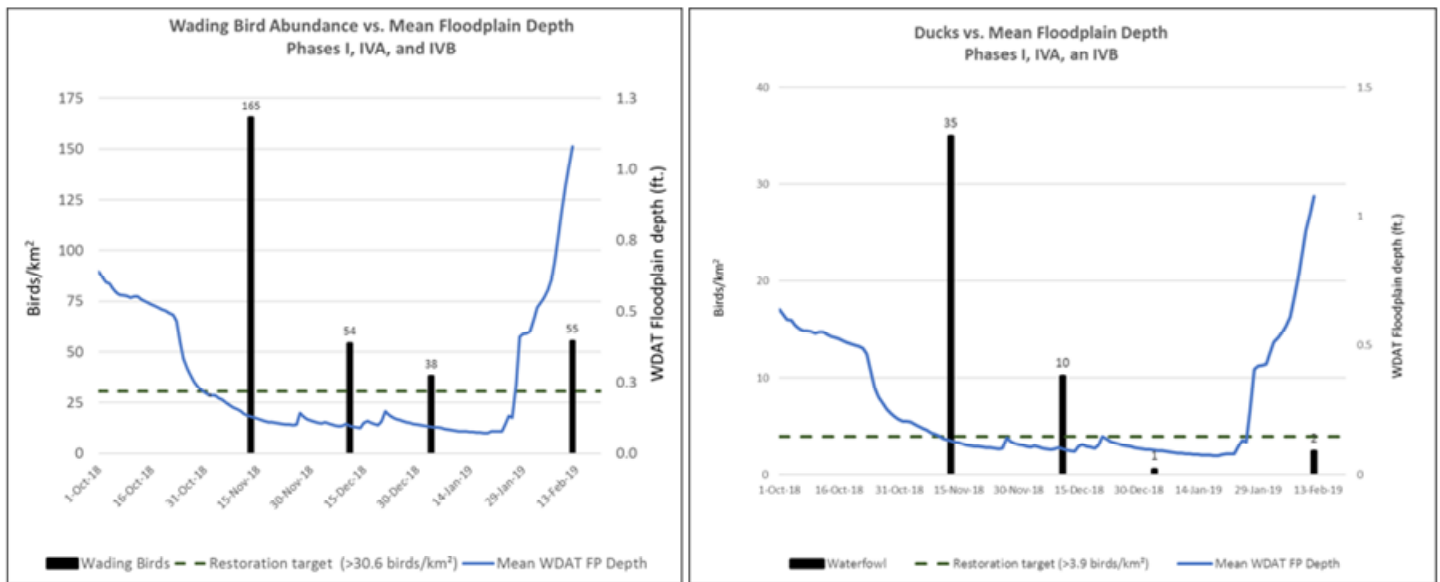


Figure 13. Kissimmee River Wading Bird and Waterfowl Surveys from November 2018 to February 2019.

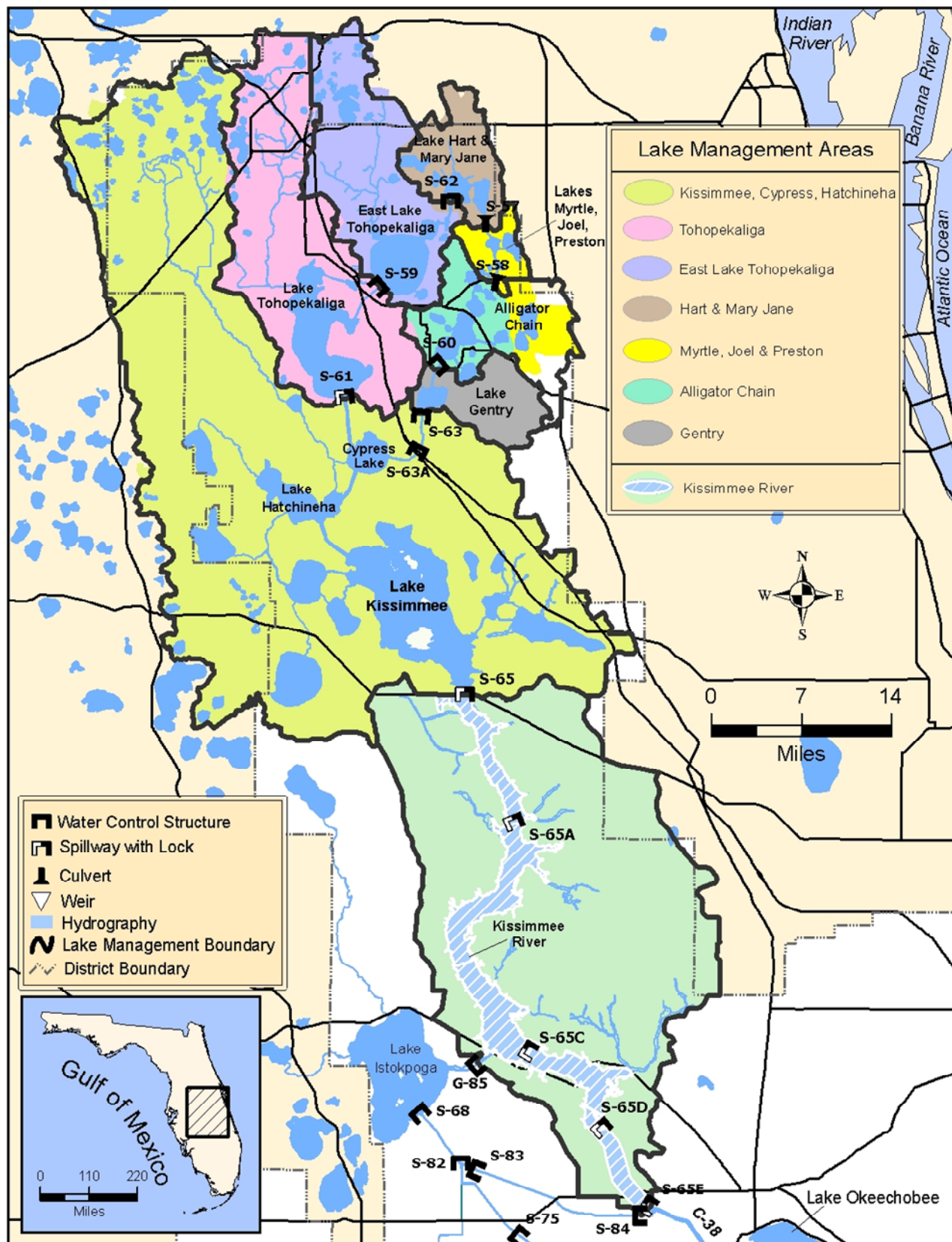


Figure 14. The Kissimmee Basin.

LAKE OKEECHOBEE

According to the USACE web site, Lake Okeechobee average daily lake stage is at 12.42 feet NGVD for March 11, 2019. This value is based on the use of four interior lake stations (L001, L005, L006 and LZ40) and three perimeter stations (S-308, S-4 and S-133). The Lake is now 0.28 feet lower than a month ago and 2.07 feet lower than a year ago when runoff from Hurricane Irma caused extreme high lake stages (Figure 1). The Lake is back in Beneficial Use and is 0.18 feet below the Base Flow sub-band (Figure 2). Lake stage was the lowest for this time of year since 2011, which followed a very dry rainy season in 2010 (Figure 3). According to RAINДАР, 0.01 inches of rain fell directly over the Lake and the entire watershed received approximately 0.05 inches during the week of March 5 - March 11, 2019 (Figure 4).

Average daily inflows (minus rainfall) to the Lake were lower than last week at 892 cfs, compared to 2,241 cfs. The inflows from the Kissimmee River decreased, dropping from 2,048 cfs to 858 cfs; inflows from the remaining structures were similar or slightly decreased from the previous week (Table 1).

Total outflows (minus evapotranspiration) increased from the previous week, going from 2,958 average daily cfs to 4,915 cfs this past week (Table 1). Outflows increased at S-77, S-308, S-351, S-352 and S-354. Outflows compared to the previous week increased west via S-77 from 735 cfs to 828 cfs, east via S-308 from 545 cfs to 767 cfs, and south through the S-350 structures from 1,670 cfs to 3,213 cfs. The corrected average daily evapotranspiration value for the week based on the L006 and LZ40 weather platform solar radiations was 0.06 inches this week.

Total lake inflows and outflows for the past week are detailed in Table 1, as well as the approximate change in lake stage from each major structure's total flows over the period. Figure 5 shows the combined average daily cfs for inflows and outflows for the Lake over the past eight weeks. These data are provisional and are subject to change.

February 2019 quarterly sampling of submerged aquatic vegetation (SAV) revealed similar trends over the past year with plants in sheltered areas and coverage at the eight sites with SAV remaining very sparse (Figure 6). No recovery has occurred in the southern or western nearshore regions. For comparison, in August 2017 (pre-Hurricane Irma) five of the nine sites around King's Bar and seven of the nine sites in Fisheating Bay had SAV, ten of which had moderate to dense coverage. Additionally, six of the fifteen sites in the southern region had SAV prior to Hurricane Irma. Recovery may be linked to the inability of light (Secchi to total depth ratio >0.5) to reach the lake bottom for plants, but light attenuation is trending slightly higher towards the 0.5 threshold in recent surveys (Figure 7).

The most recent satellite imagery (March 10, 2019) using NOAA's cyanobacteria monitoring product derived from EUMETSAT's Sentinel OLCI sensor data showed bloom potential is low for most of the Lake, continuing the trend of gradually reducing potential over the past several weeks (Figure 8).

Water Management Recommendations

Lake Okeechobee stage is 12.42 feet NGVD, decreasing 0.28 feet from the previous week and 0.29 feet for the past 30 days. The Lake has entered Beneficial Use and is 0.18 feet below the Base Flow sub-band. The Lake is also 1.15 feet below the bottom of the ecological envelope, which varies seasonally from 12.5 – 15.5 feet NGVD. Given the potential for above average rainfall associated with weak El Niño conditions this spring and the poor condition of SAV and EAV in the nearshore zone, lower lake stages are ideal for vegetation recovery but will reduce habitat for fish and wildlife in the near-term and encourage spread of invasive vegetation in the upper marsh.

Table 1. Average daily inflows and outflows and the approximate depth equivalents on Lake Okeechobee for various structures.

| INFLOWS | Previous Week Avg Daily cfs | Avg Daily Inflow cfs | Equivalent Depth Week Total (in) |
|------------------|-----------------------------|----------------------|----------------------------------|
| S65E & S65EX1 | 2048 | 858 | 0.4 |
| S71 & 72 | 0 | 0 | 0.0 |
| S84 & 84X | 158 | 7 | 0.0 |
| Fisheating Creek | 35 | 27 | 0.0 |
| S154 | 0 | 0 | 0.0 |
| S191 | 0 | 0 | 0.0 |
| S133 P | 0 | 0 | 0.0 |
| S127 P | 0 | 0 | 0.0 |
| S129 P | 0 | 0 | 0.0 |
| S131 P | 0 | 0 | 0.0 |
| S135 P | 0 | 0 | 0.0 |
| S2 P | 0 | 0 | 0.0 |
| S3 P | 0 | 0 | 0.0 |
| S4 P | 0 | 0 | 0.0 |
| L8 Backflow | | | |
| Rainfall | 812.3 | 44 | 0.0 |
| Total | 3053 | 937 | 0.4 |

| OUTFLOWS | Previous Week Avg Daily cfs | Avg Daily Outflow cfs | Equivalent Depth Week Total (in) |
|--------------|-----------------------------|-----------------------|----------------------------------|
| S77 | 735 | 828 | 0.4 |
| S308 | 545 | 767 | 0.3 |
| S351 | 661 | 1050 | 0.5 |
| S352 | 689 | 865 | 0.4 |
| S354 | 320 | 1298 | 0.6 |
| L8 Outflow | 14 | 107 | 0.0 |
| ET | 912 | 853 | 0.4 |
| Total | 3875 | 5767 | 2.6 |

Provisional Data

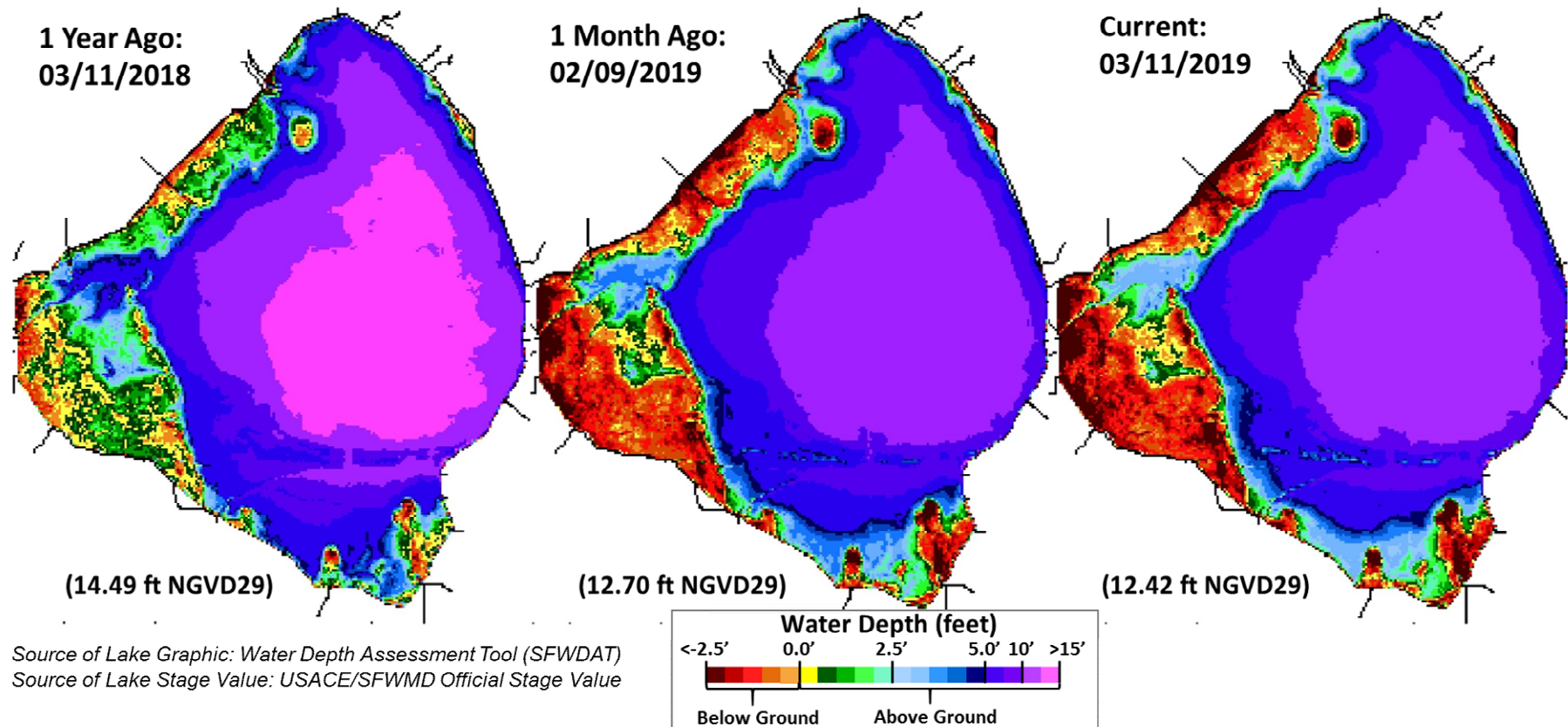
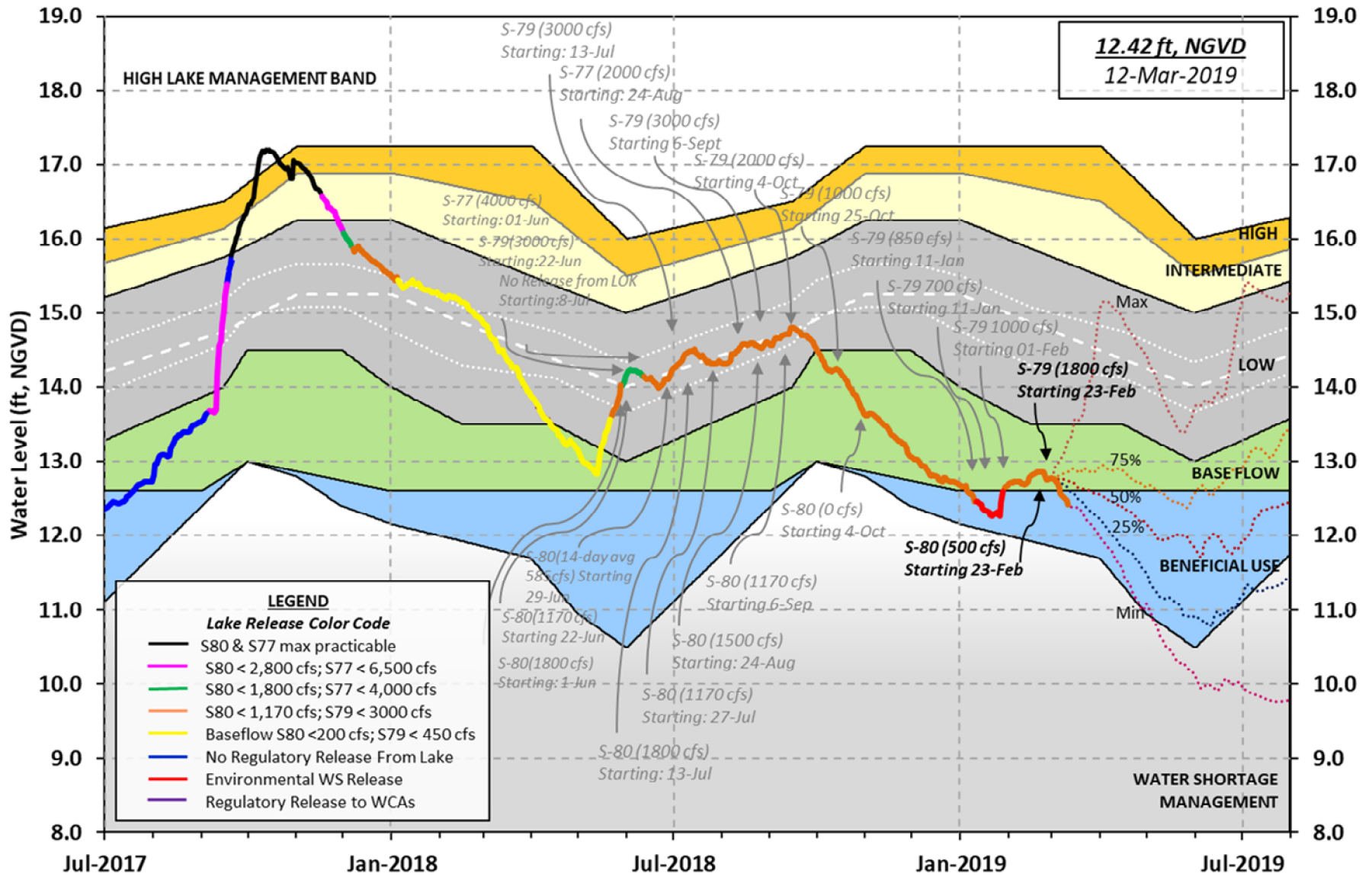


Figure 1. Water depth estimates on Lake Okeechobee based on the South Florida Water Depth Assessment Tool.

Lake Okeechobee Water Level History and Projected Stages



LORS-2008

Adopted by USACE 28-April-2008

Projected Stage Percentiles From
SFWMD-HESM Position Analysis

Figure 2. Recent Lake Okeechobee stage and releases, with projected stages based on a dynamic position analysis.

Lake Okeechobee Water Level Comparison

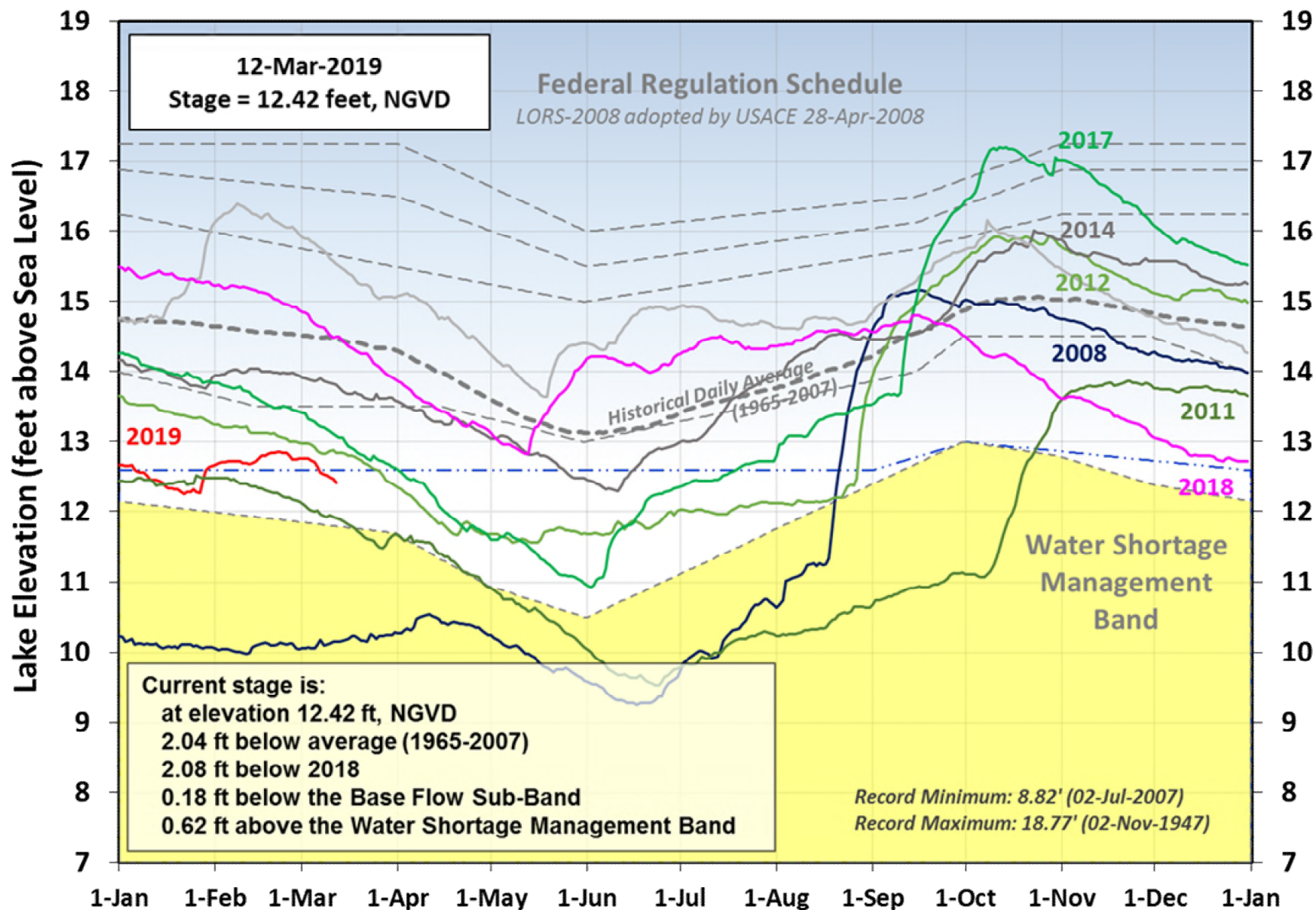


Figure 3. Select annual stage hydrographs for Lake Okeechobee from 2008 – 2019.

SFWMD PROVISIONAL RAINDAR 7-DAY BASIN RAINFALL ESTIMATES

FROM: 0515 EST, 03/05/2019 THROUGH: 0515 EST, 03/12/2019

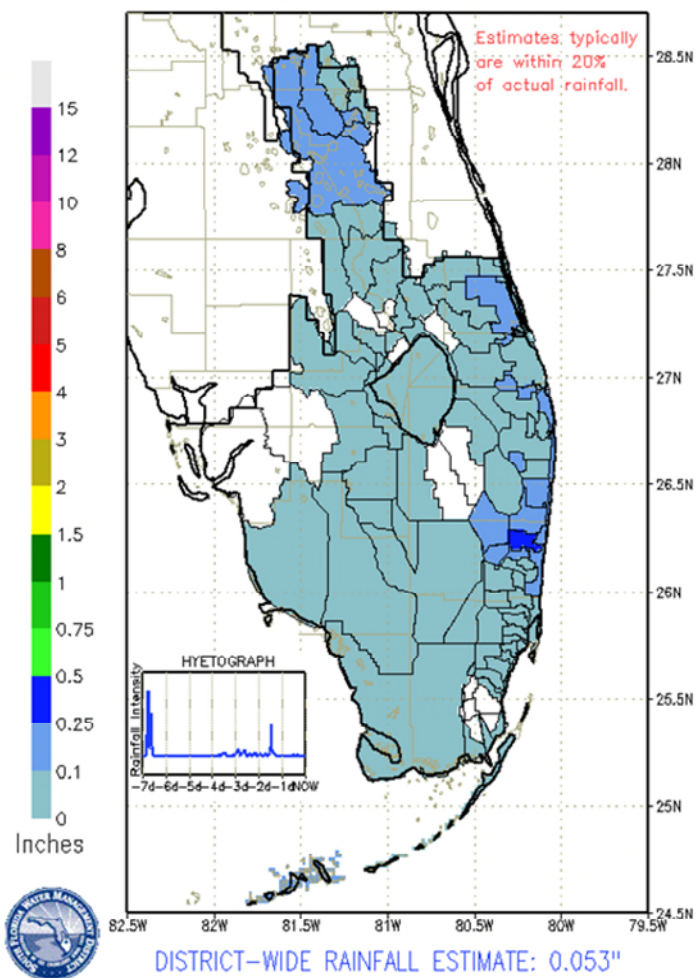


Figure 4. Rainfall estimates by basin.

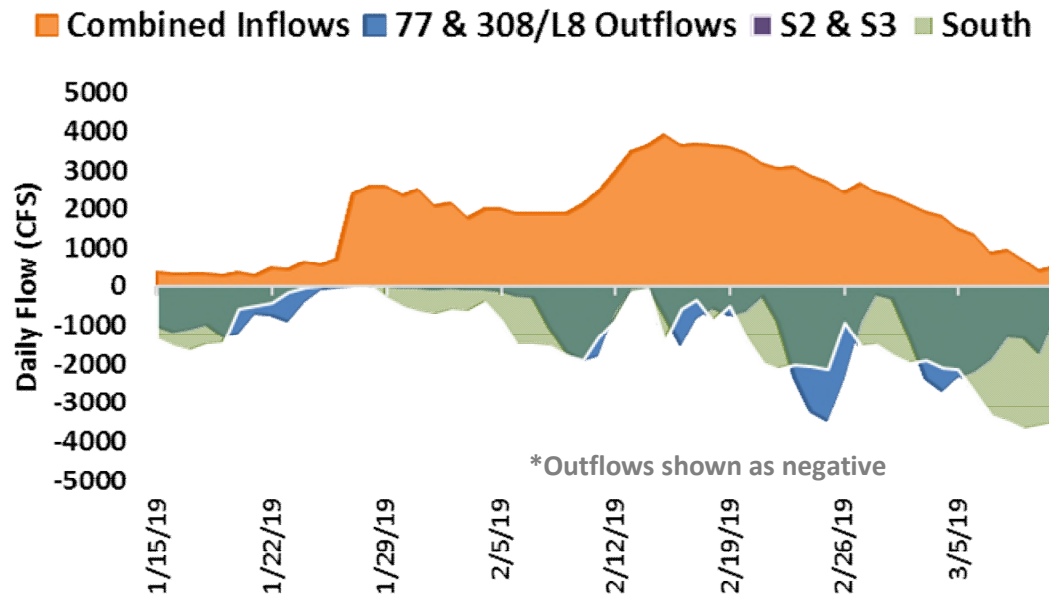


Figure 5. Major inflows (orange) and outflows (blue) of Lake Okeechobee, including the S-350 structures designated as South (green). The L-8 Canal flows through Culvert 10A are included as outflows when positive, and as inflows when backflowing into the lake. All inflows and outflows are shown as positive and negative, respectively, for visual purposes.

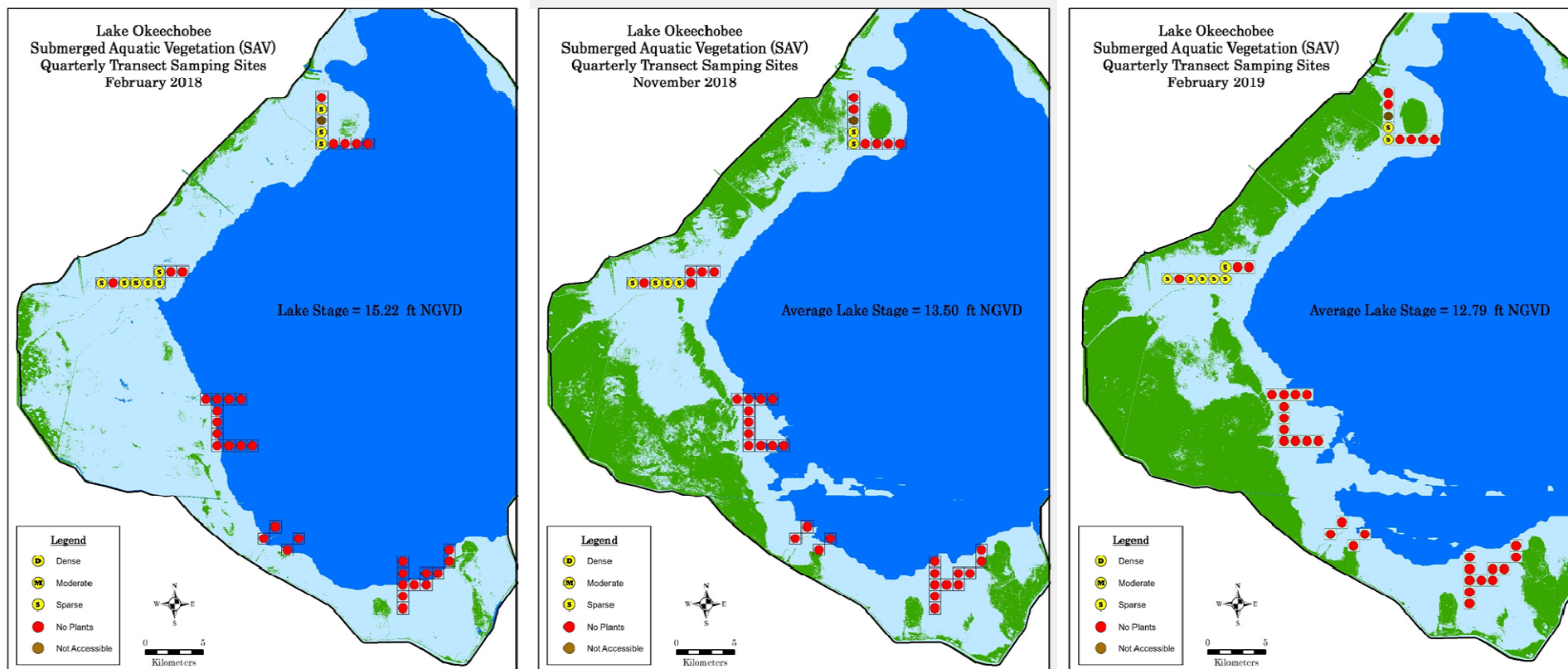
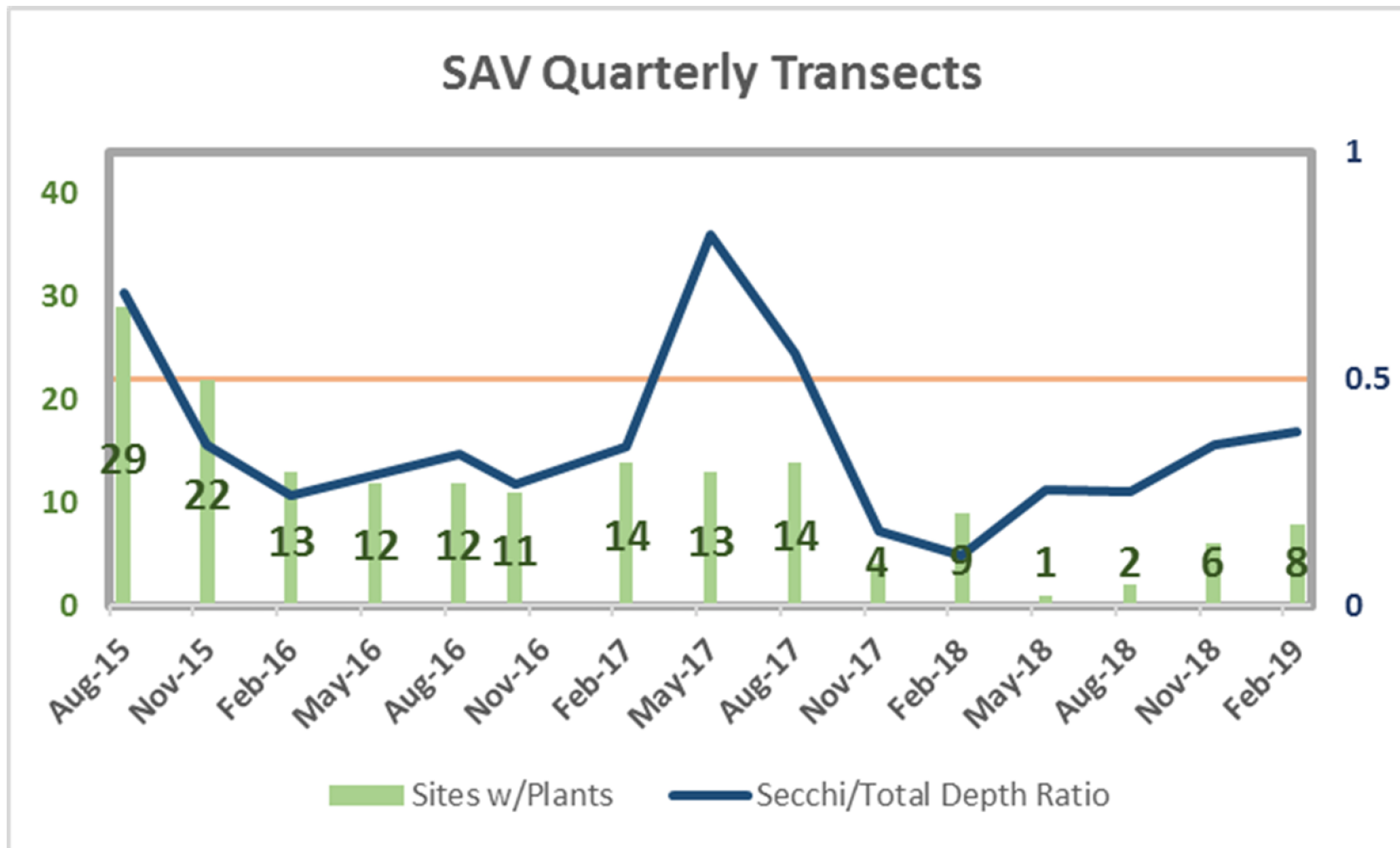
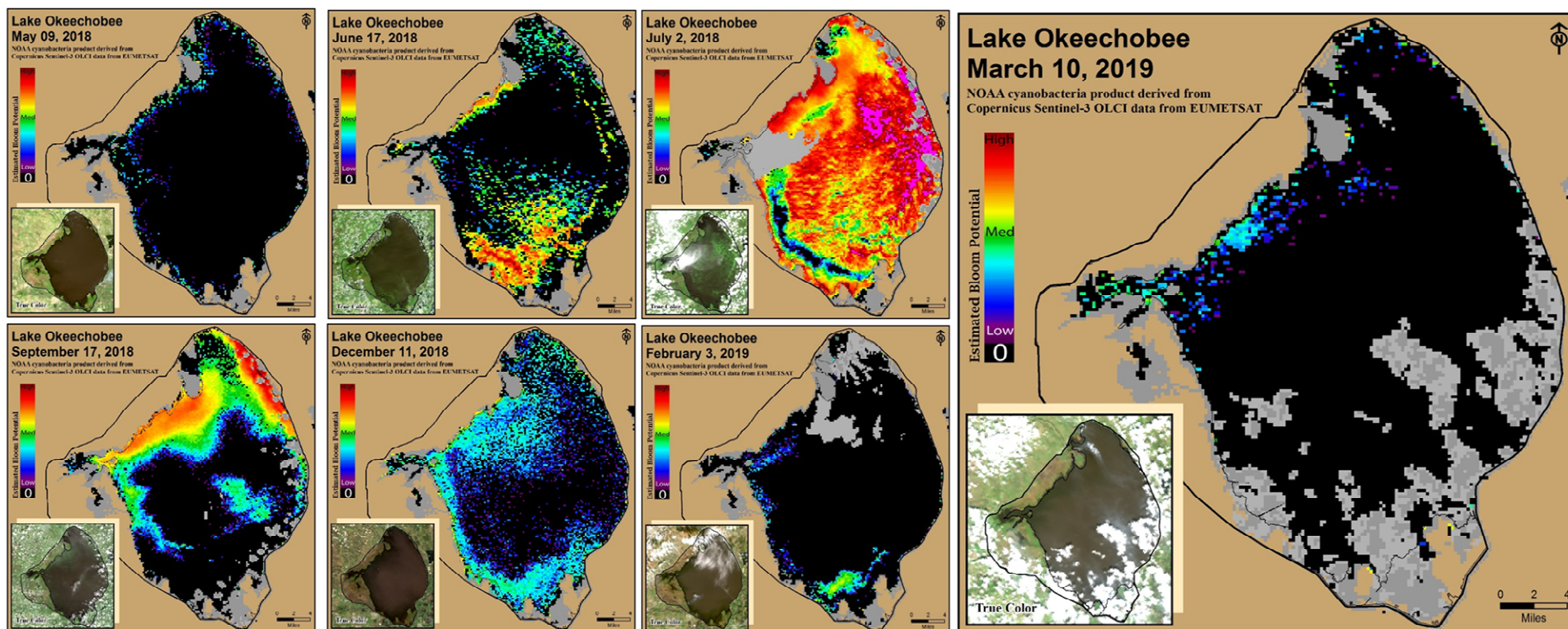


Figure 6. Submerged Aquatic Vegetation (SAV) sampled in February 2018, November 2018, and February 2019 at the 44 sentinel grid cells.



— SD:TD ratio > 0.5 = light penetration to bottom

Figure 7. SAV quarterly sites with plants present and Secchi to total depth ratio (SD:TD) from August 2015 to February 2019. Light penetrates to lake bottom with SD:TD > 0.5, which helps with SAV expansion.



NOAA cyanobacteria product derived from Copernicus Sentinel-3 OLCI data from EUMETSAT

Unvalidated and Experimental Data

Figure 8. Potential for cyanobacterial blooms on Lake Okeechobee based on NOAA's harmful algal bloom monitoring system derived from Copernicus Sentinel-3 OLCI data from EUMETSAT. Gray indicates cloud cover. All data are experimental and unvalidated at this point in product development

St. Lucie Estuary:

Last week total inflow to the St. Lucie Estuary averaged approximately 824 cfs (Figures 1 and 2) and last month inflow averaged about 669 cfs. Last week's provisional averaged inflows from the tidal basin and the structures are shown in Table 1.

Table 1. Weekly average inflows (data are provisional).

| Location | Flow (cfs) |
|------------------------------------------|------------|
| Tidal Basin Inflow | 125 |
| S-80 | 608 |
| S-308 | 767 |
| S-49 on C-24 | 0 |
| S-97 on C-23 | 0 |
| Gordy Rd. structure on Ten Mile Creek | 91 |

Over the past week, salinity decreased throughout the estuary (Table 2, Figures 3 and 4). The seven-day moving average salinity of the water column (an average of the surface and bottom salinity) at the US1 Bridge is estimated to be between 10 and 26. Salinity conditions in the middle estuary are within the good range for adult eastern oysters (Figure 3).

Table 2. Seven-day average salinity at three monitoring sites in the St. Lucie Estuary. Current average is in bold face type, previous average in parentheses. The envelope reflects the preferred salinity range for adult eastern oysters (*Crassostrea virginica*) in the middle estuary.

| Sampling Site | Surface | Bottom | Envelope |
|------------------|--------------------|-----------------------------------------------|-----------------|
| HR1 (North Fork) | 13.0 (13.7) | 13.7 (15.0) | NA ¹ |
| US1 Bridge | 14.1 (14.9) | 11.7 ² (13.5 ²) | 10.0-26.0 |
| A1A Bridge | 21.4 (22.4) | 25.3 (26.8) | NA ¹ |

¹Envelope not applicable and ²Questionable.

Caloosahatchee Estuary:

Last week total inflow to the Caloosahatchee Estuary averaged approximately 1,868 cfs (Figures 5 and 6) and last month inflow averaged about 2,075 cfs. Last week's provisional averaged inflows from the structures are shown in Table 3.

Table 3. Weekly average inflows (data is provisional).

| Location | Flow (cfs) |
|--------------------|------------|
| S-77 | 828 |
| S-78 | 1236 |
| S-79 | 1698 |
| Tidal Basin Inflow | 170 |

Over the past week, surface salinity remained about the same throughout the estuary (Table 4, Figures 7 & 8). The seven-day average salinity values are estimated to be within the fair range for adult eastern oysters at Cape Coral and within the good range at Shell Point (Figure 9). Salinity values were not available at Sanibel. The 30-day moving average surface salinity is 0.3 at Val I-75 and 2.6 at Ft. Myers. Salinity conditions between Val I-75 and Ft. Myers are good for tape grass.

Table 4. Seven-day average salinity at six monitoring stations in the Caloosahatchee Estuary. Current average is in bold face type, previous average in parentheses. The envelope reflects the preferred salinity range for tape grass (*Vallisneria americana*) at Val I-75 and for adult eastern oysters (*Crassostrea virginica*) elsewhere.

| Sampling Site | Surface | Bottom | Envelope |
|-----------------------|-------------------------------|--------------------|----------------------|
| S-79 (Franklin Lock) | 0.2 (NR ³) | 0.2 (NR) | NA ¹ |
| Val I75 | 0.3 (0.3) | 0.3 (0.3) | 0.0-5.0 ² |
| Ft. Myers Yacht Basin | 1.6 (2.4) | 2.0 (3.9) | NA |
| Cape Coral | 8.2 (8.8) | 10.8 (12.0) | 10.0-30.0 |
| Shell Point | 20.0 (21.9) | NR (NR) | 10.0-30.0 |
| Sanibel | NR (NR) | NR (NR) | 10.0-30.0 |

¹Envelope not applicable, ²Envelope is based on a 30-day average, and ³Not Reporting.

Forecast of surface salinity (Table 5 and Figure 10) at Val I-75 for the next two weeks using the autoregression model (Qiu and Wan, 2013) coupled with a linear reservoir model for the tidal basin predicts daily salinity ranging from 1.2 to 3.5 at the end of the next two weeks for pulse release at S-79 ranging from 0 to 1800 cfs and Tidal Basin inflows of 190 cfs.

Table 5. Predicted salinity at Val I-75 at the end of forecast period

| Scenario | Q79 (cfs) | TB runoff (cfs) | Daily salinity | 30 day mean |
|----------|-----------|-----------------|----------------|-------------|
| A | 0 | 190 | 3.5 | 1.1 |
| B | 300 | 190 | 3.0 | 1.0 |
| C | 450 | 190 | 2.4 | 0.9 |
| D | 650 | 190 | 1.8 | 0.8 |
| E | 1800 | 190 | 1.2 | 0.5 |

Red tide

The Florida Fish and Wildlife Research Institute reported on March 8, 2019, that *Karenia brevis*, the Florida red tide dinoflagellate, was observed at background concentrations in one sample collected offshore of Lee County and was not observed in samples collected from St. Lucie, Martin, Palm Beach, or Broward counties (no samples were collected from Miami-Dade County). Respiratory irritation was reported over the past week in Lee County.

Water Management Recommendations

Lake stage is in the Beneficial Use sub-band of 2008 LORS. Tributary hydrological conditions are normal. The 2008 LORS recommends no release at S-79 and S-80. Given the current estuarine conditions, there are no ecological benefits to the upper estuary associated with freshwater releases from Lake Okeechobee, but some benefits may accrue to areas further downstream.

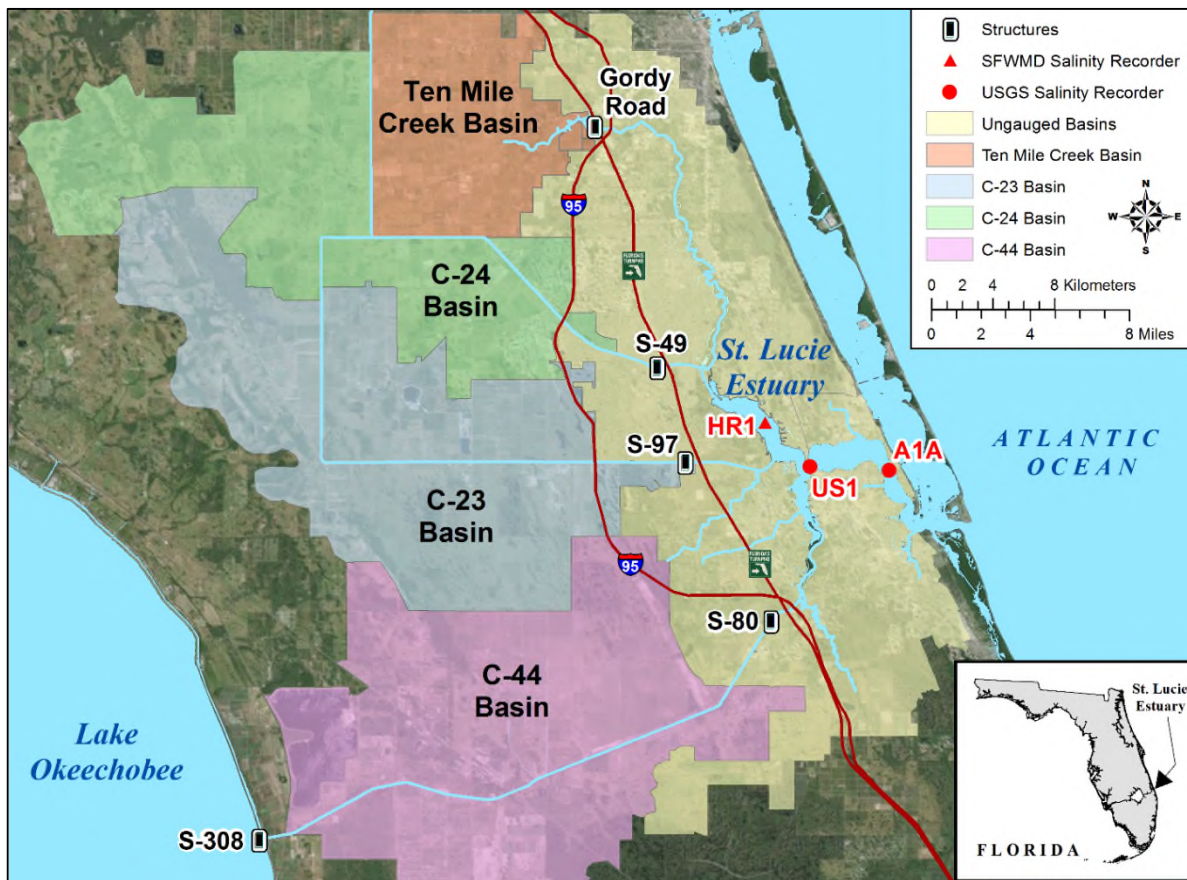


Figure 1. Basins, water control structures, and salinity monitoring for the St. Lucie Estuary.

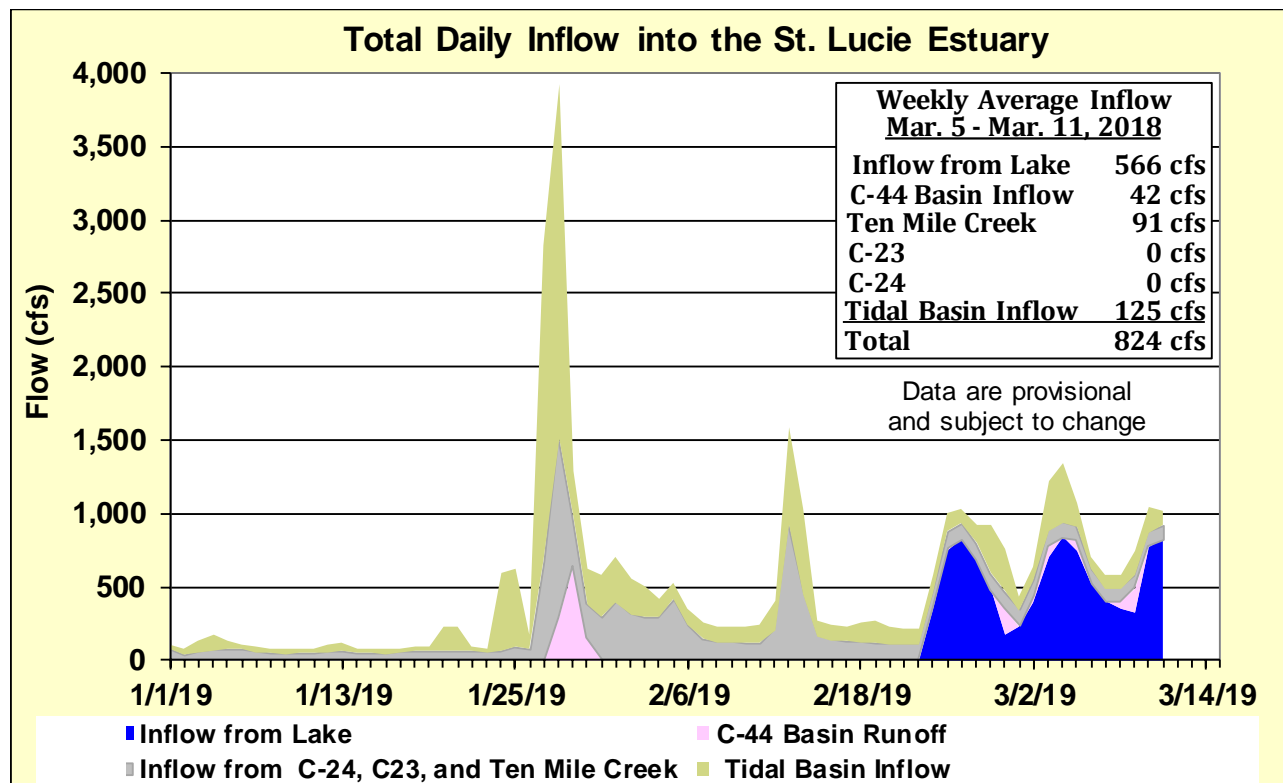


Figure 2. Total daily inflows from Lake Okeechobee and runoff from the C-44, C-23, C-24, Ten Mile Creek, and tidal basins into the St. Lucie Estuary.

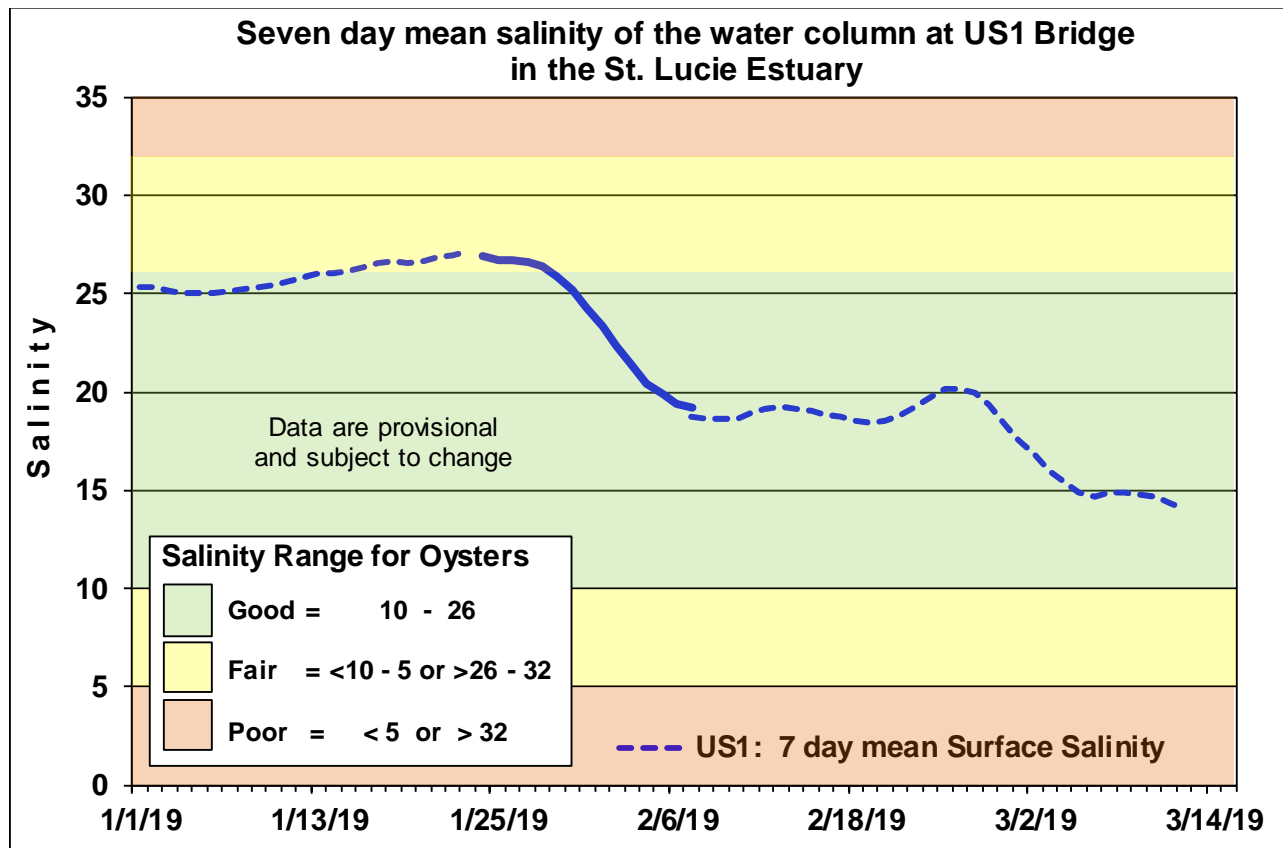


Figure 3. Seven-day mean salinity of the water column at the US1 Bridge.

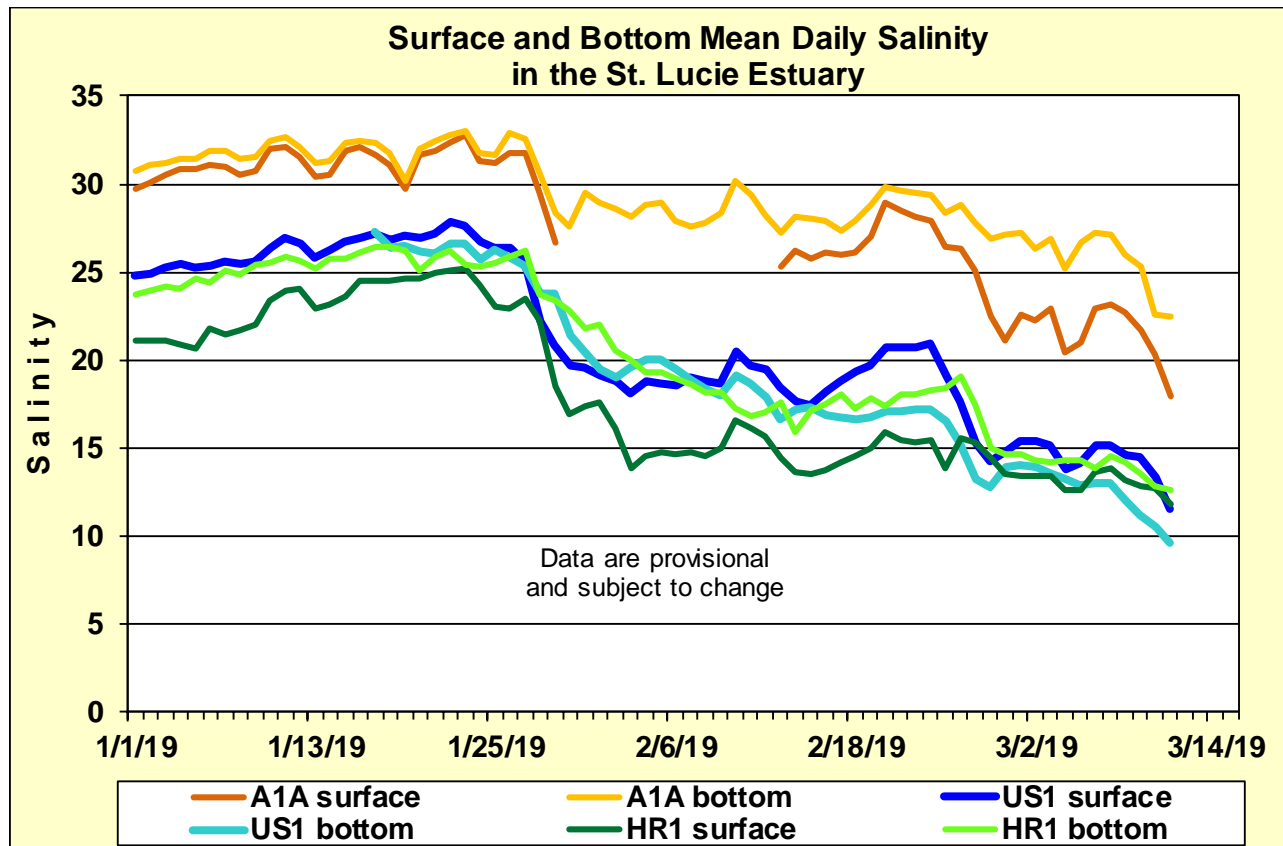


Figure 4. Daily mean salinity at the A1A, US1 and estimated HR1 stations.

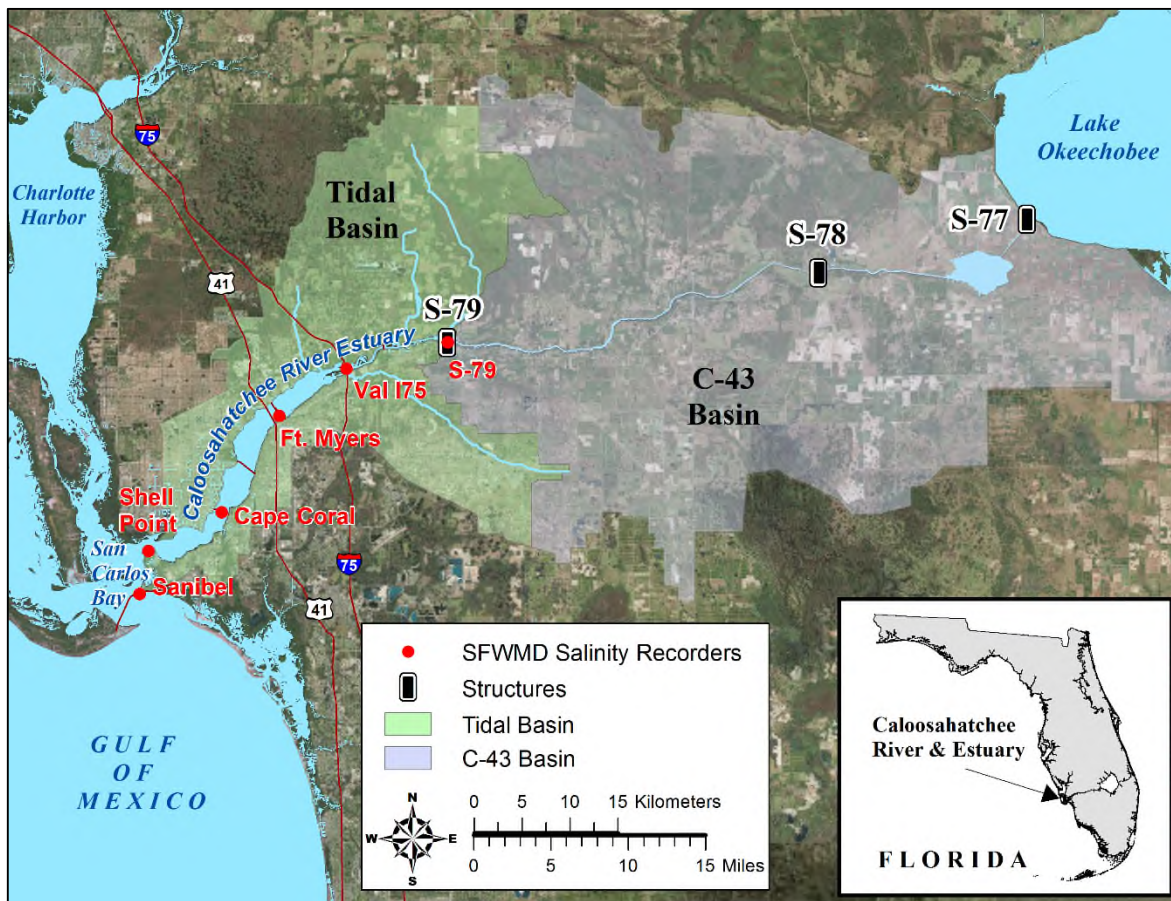


Figure 5. Basins, water control structures, and salinity monitoring for the Caloosahatchee Estuary.

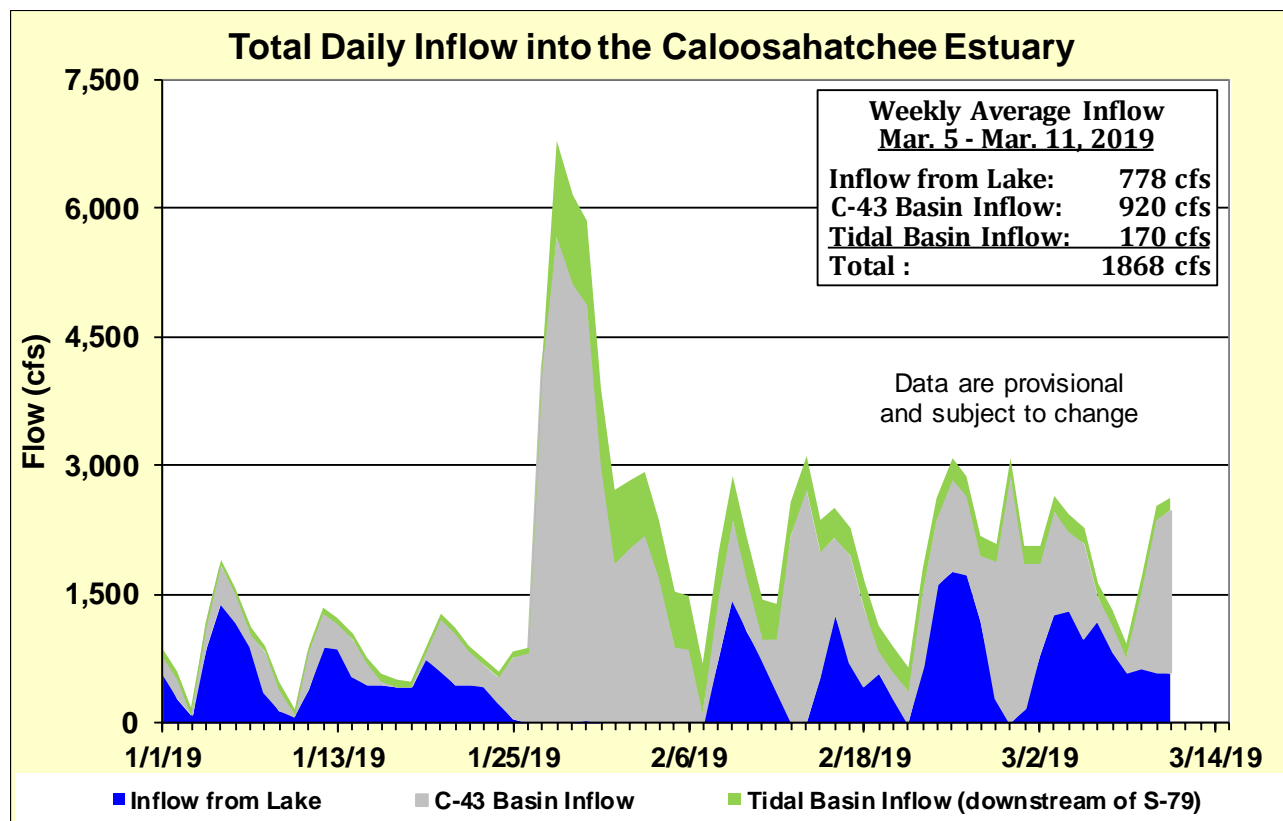


Figure 6. Total daily inflows from Lake Okeechobee, runoff from the C-43 basin, and tributaries in the tidal basin into the Caloosahatchee River Estuary.

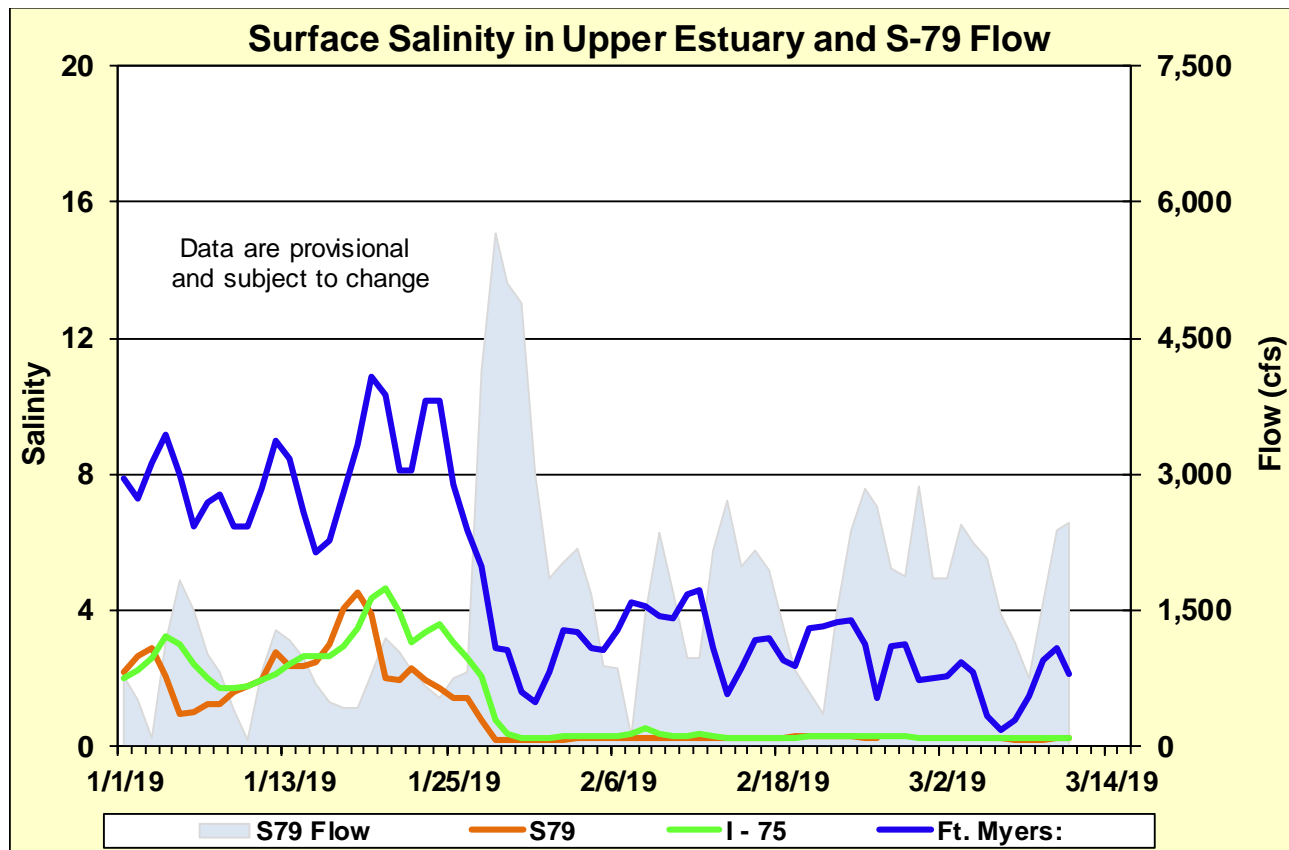


Figure 7. Daily mean flows at S-79 and salinity at upper estuary monitoring stations.

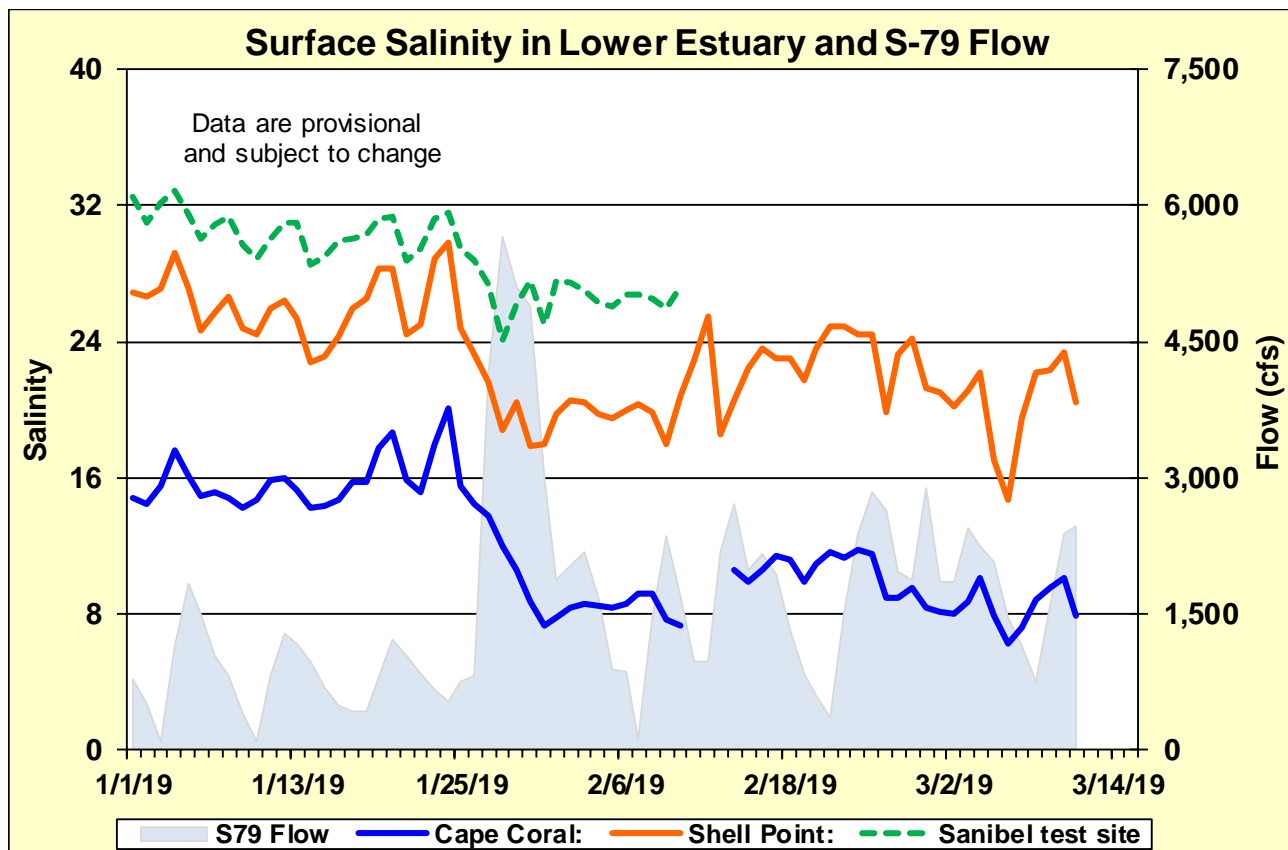


Figure 8. Daily mean flows at S-79 and salinity at lower estuary stations.

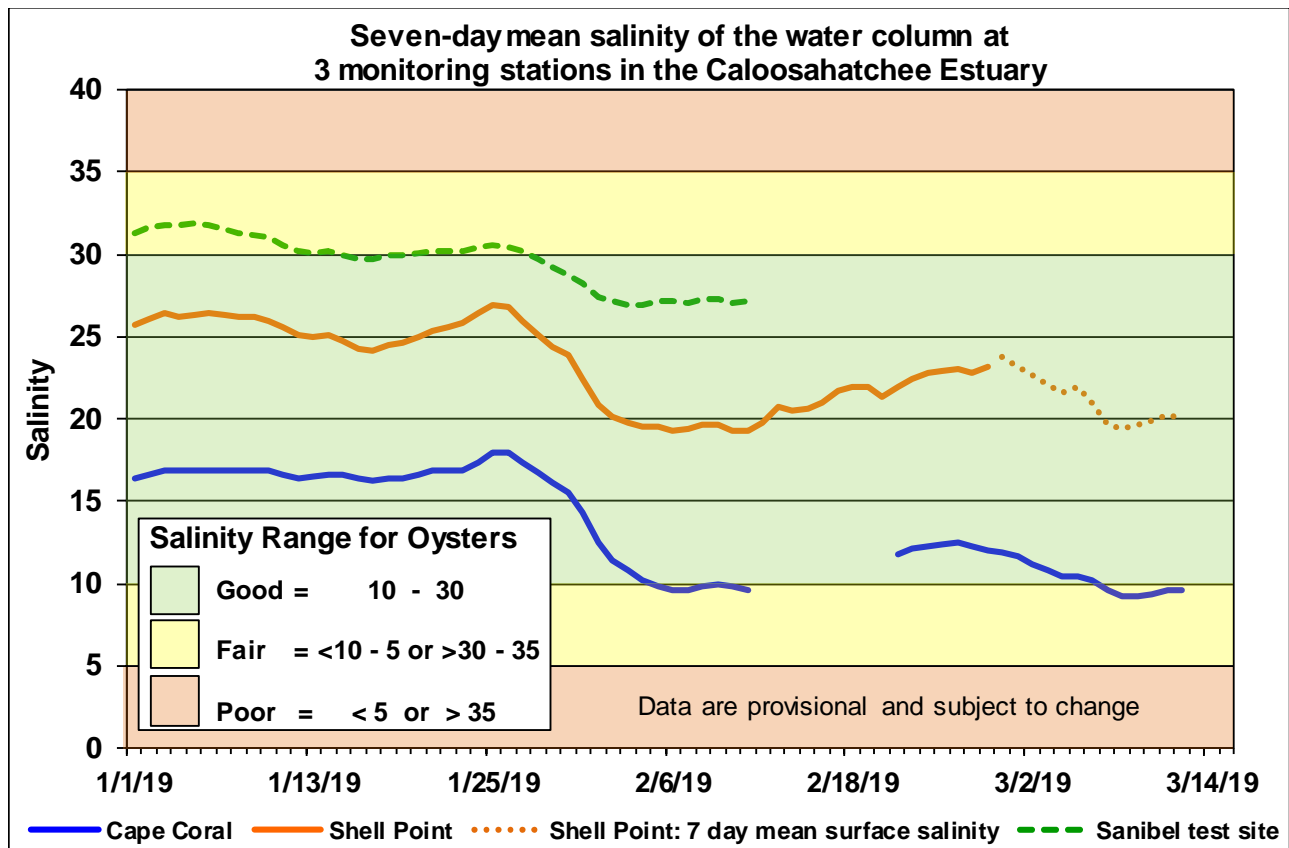


Figure 9. Seven-day mean salinity at Cape Coral, Shell Point, and Sanibel monitoring stations.

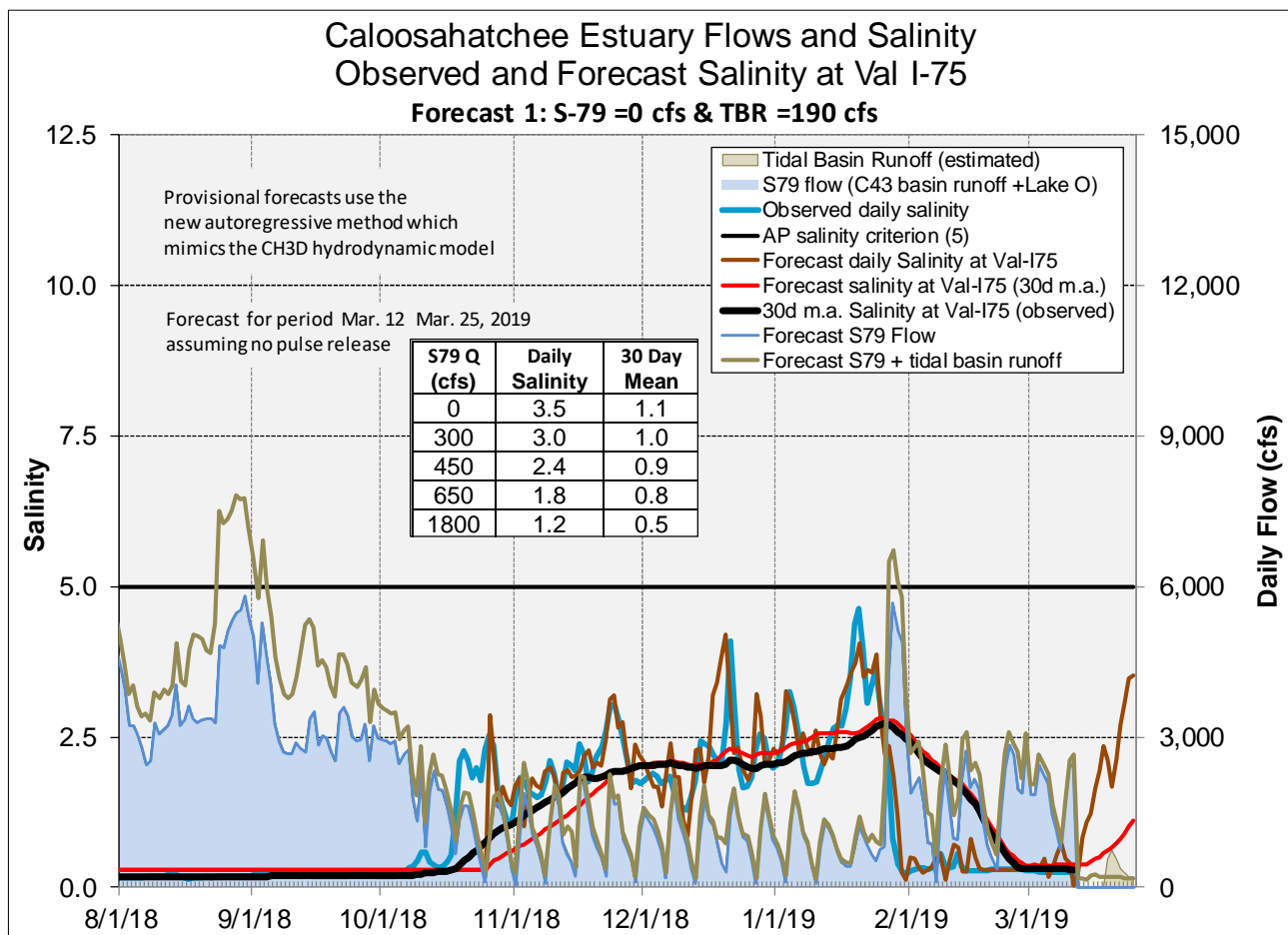
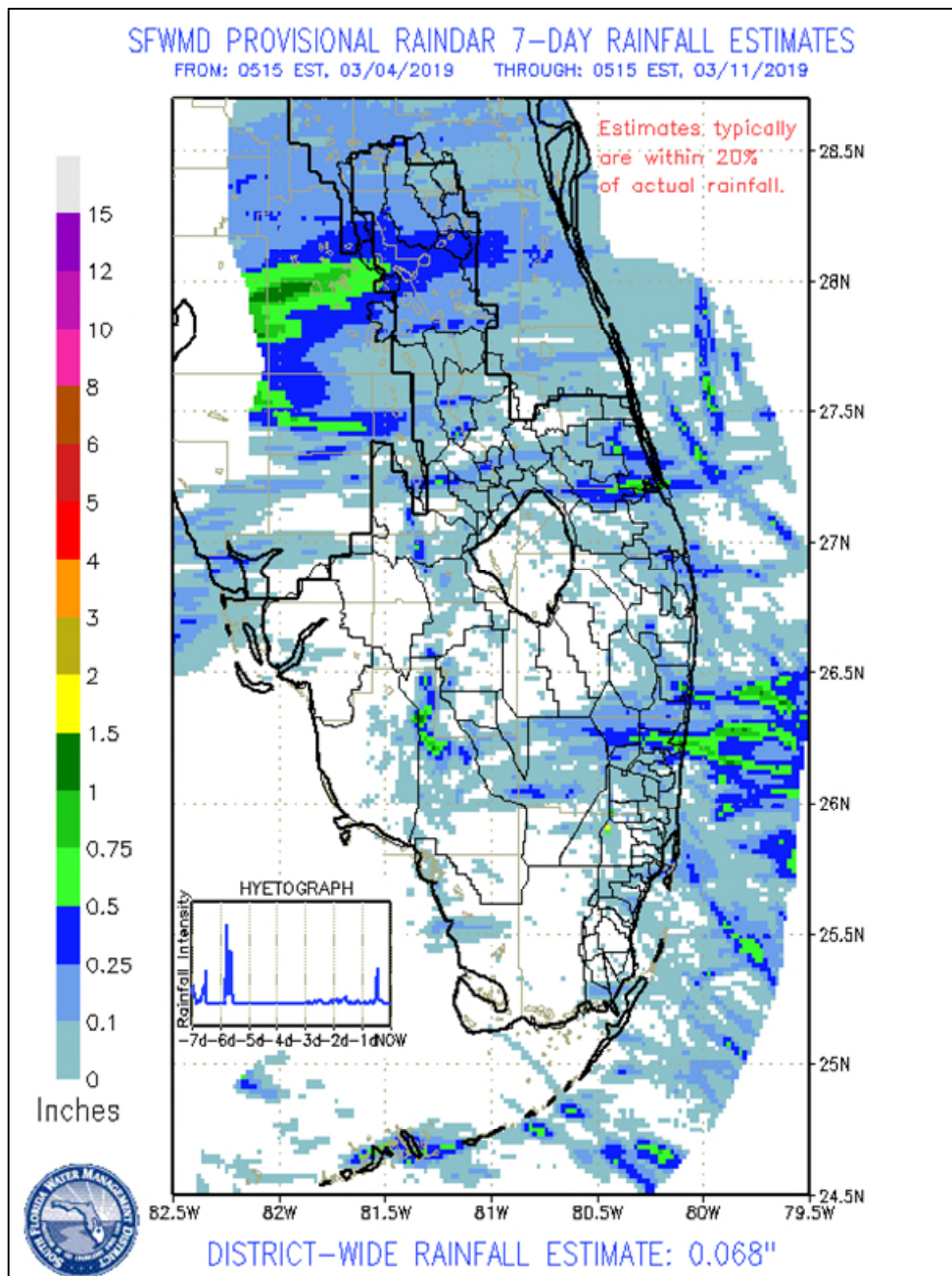


Figure 10. Forecasted Val I-75 surface salinity assuming no pulse release at S-79.

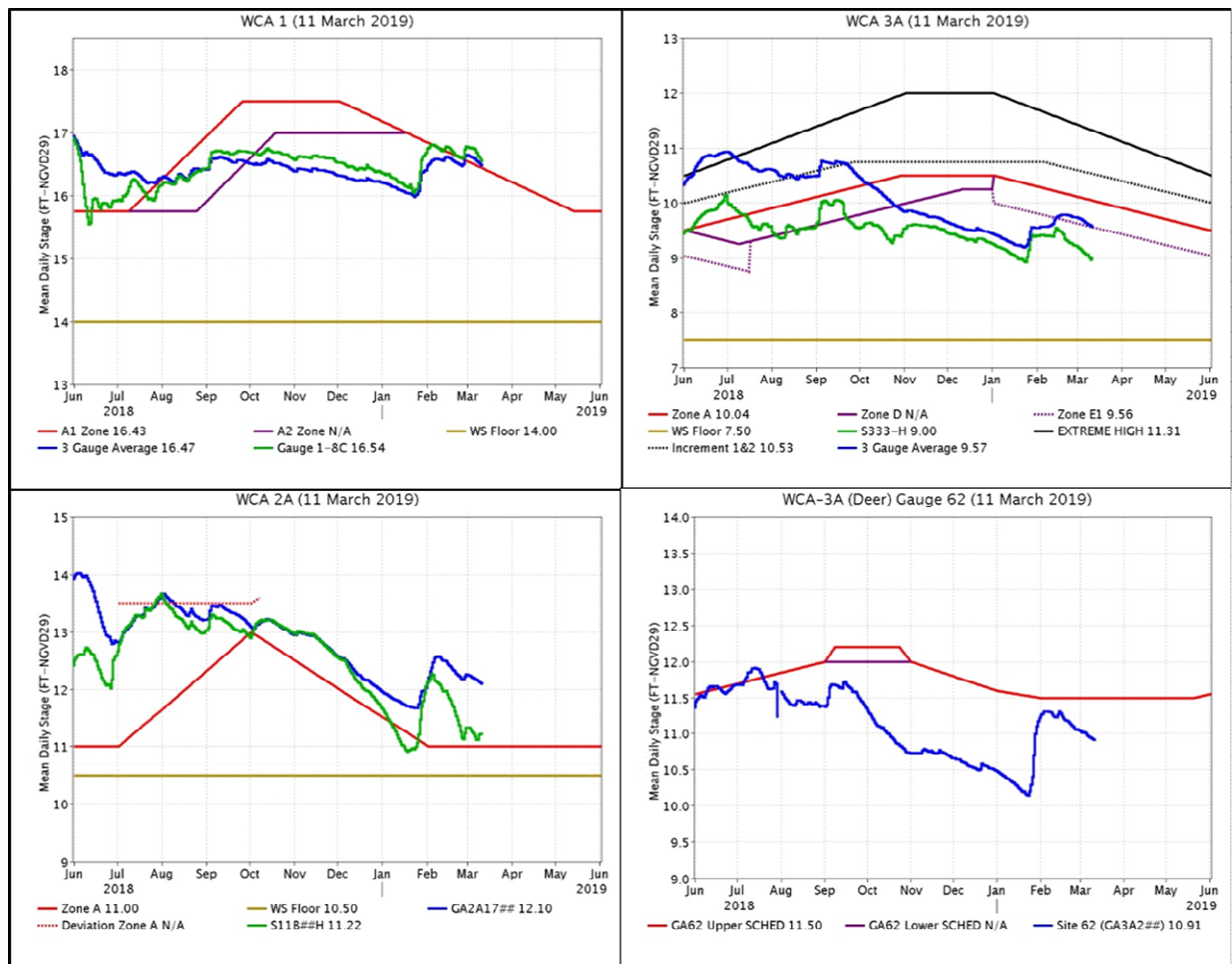
EVERGLADES

At the gauge locations monitored for this report, stages fell across the WCAs but rose at the ENP station. The most extreme individual gauge changes within the WCAs ranged from -0.18 feet (WCA-1) to +0.09 feet (ENP SRS). Pan evaporation was estimated at 1.52 inches this week (+0.07 inches).

| Everglades Region | Rainfall (Inches) | Stage Change (feet) |
|------------------------------|------------------------------|------------------------------------|
| WCA-1 | 0.04 | -0.13 |
| WCA-2A | 0.20 | -0.13 |
| WCA-2B | 0.17 | -0.15 |
| WCA-3A | 0.07 | -0.12 |
| WCA-3B | 0.02 | -0.07 |
| ENP | <0.01 | +0.09 |



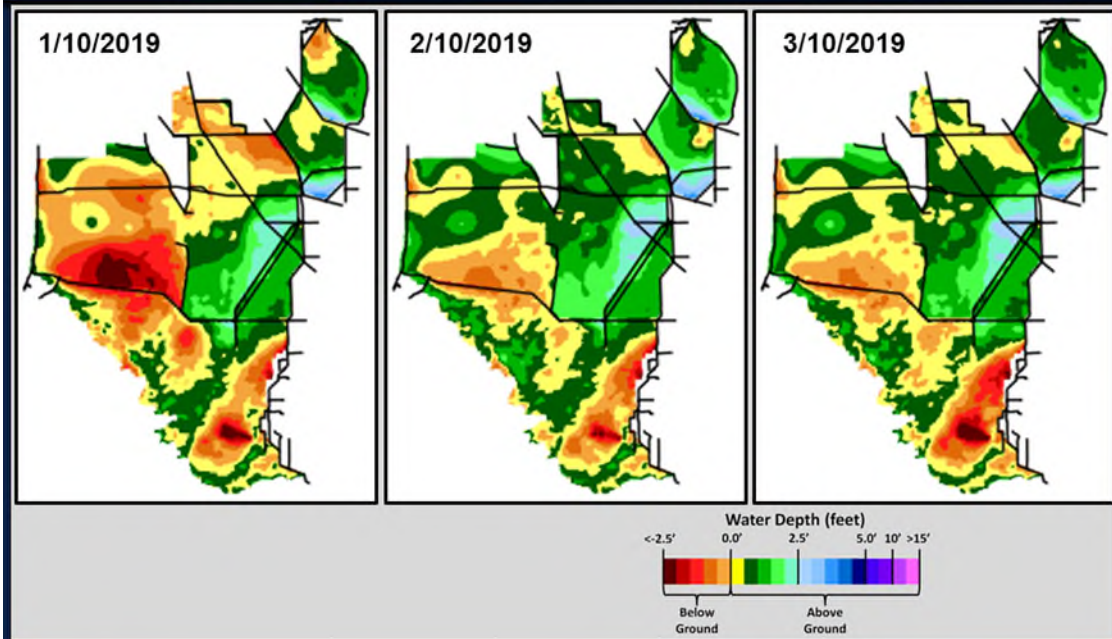
Regulation Schedules: WCA1: Gauge 1-8C is 0.11 feet above the Zone A1 regulation line. The three-gauge average is 0.08 feet below the canal stage. WCA2A: S-11B Headwater stage remains 0.22 feet above the Zone A regulation line. WCA-3A: The three-gauge average stage is 0.01 feet above Zone E1 regulation line and is following the line. WCA-3A at gauge 62 (Northwest corner) is 0.59 feet below the Upper Schedule and continues receding at 0.08 feet per week on average over the last three weeks.



Water Depths and Changes: The WDAT tool for spatial interpolation of depth monthly snapshots indicates a gradual drying down of WCA-3A North and WCA-2A, with WCA-1 slightly deeper than one month ago. Depth conditions south and west of the WCAs appear to be relatively stable, and the western basin depths are similar to a month ago. WDAT difference output indicates that water depths increased in key areas across the Everglades over the month. These changes reflect the management goal of moving water through the Everglades system and south. The “1 Year” inset shows the difference between current depth conditions and the unusually high-water conditions a year ago. Higher depths in northeastern WCA-3A and lower depths in WCA-3A South are ecologically favorable as they will protect peat soils in the north of WCA-3A and moderate the flooding of tree islands in the south.



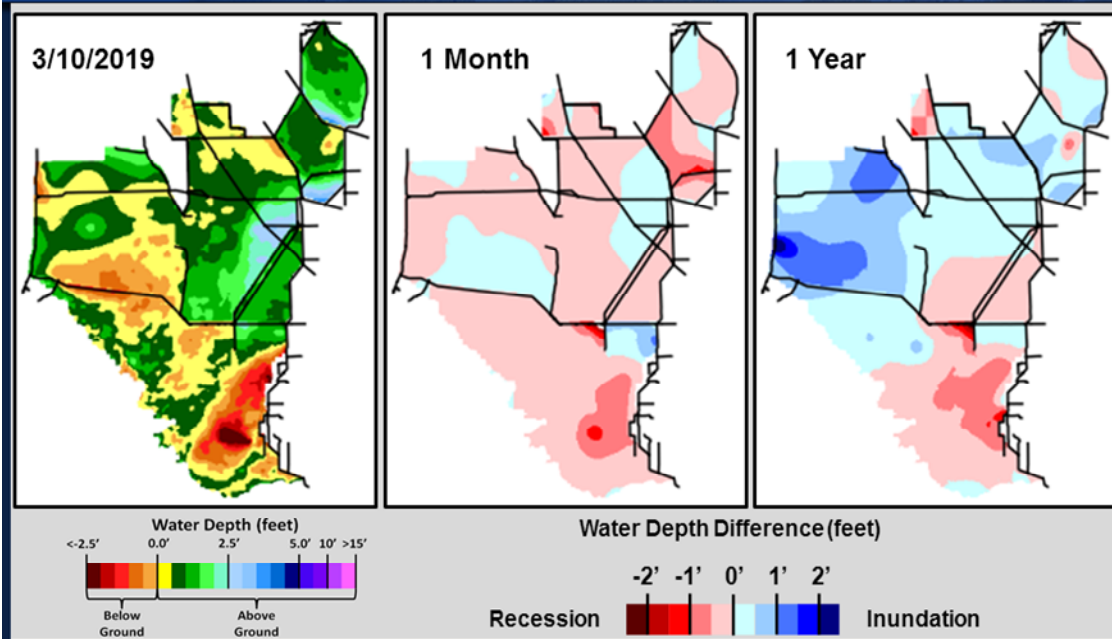
SFWDAT Water Depth Monthly Snapshots



South Florida Water Depth Assessment Tool (SFWDAT)



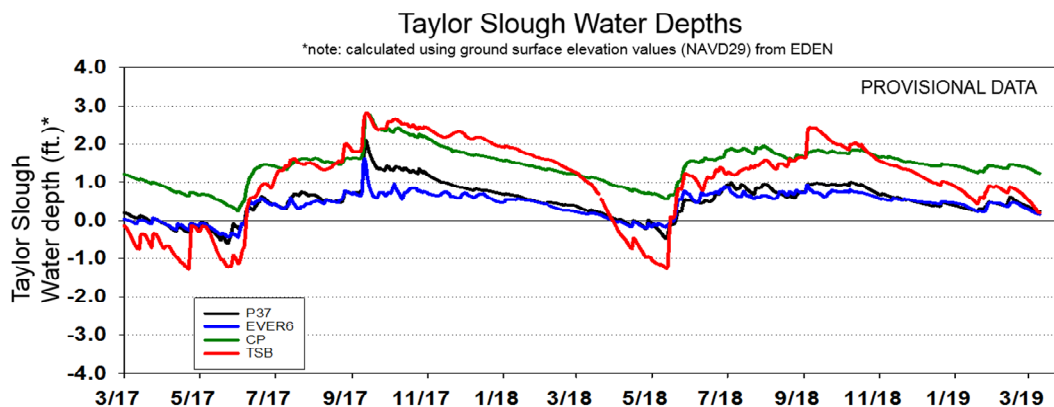
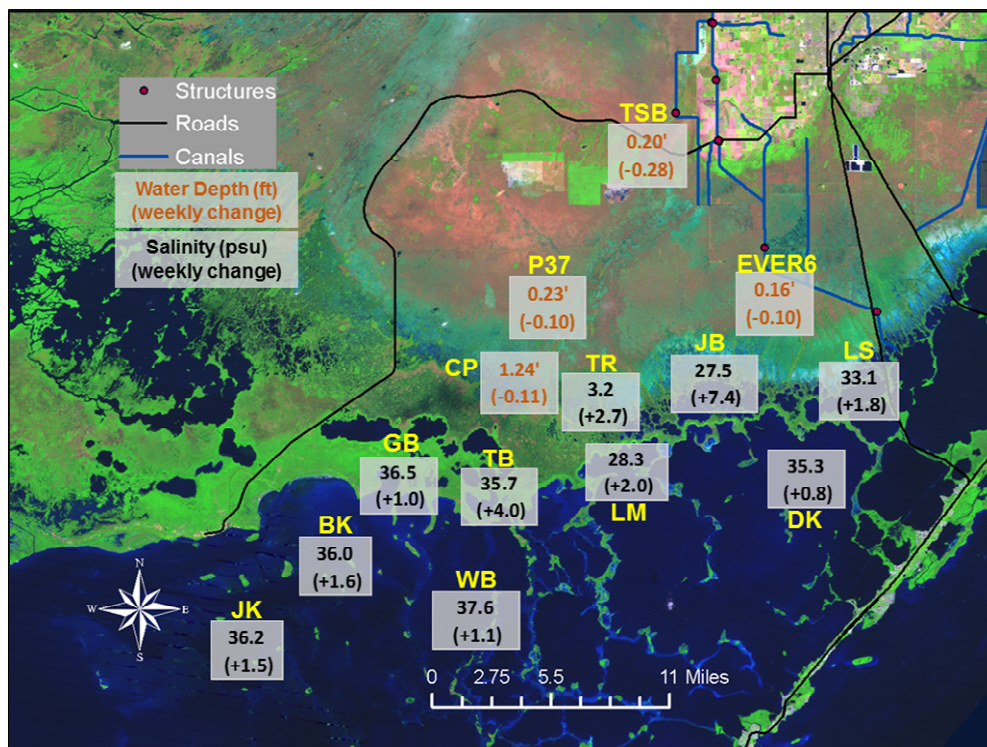
SFWDAT Everglades Difference Maps (Present - Past)

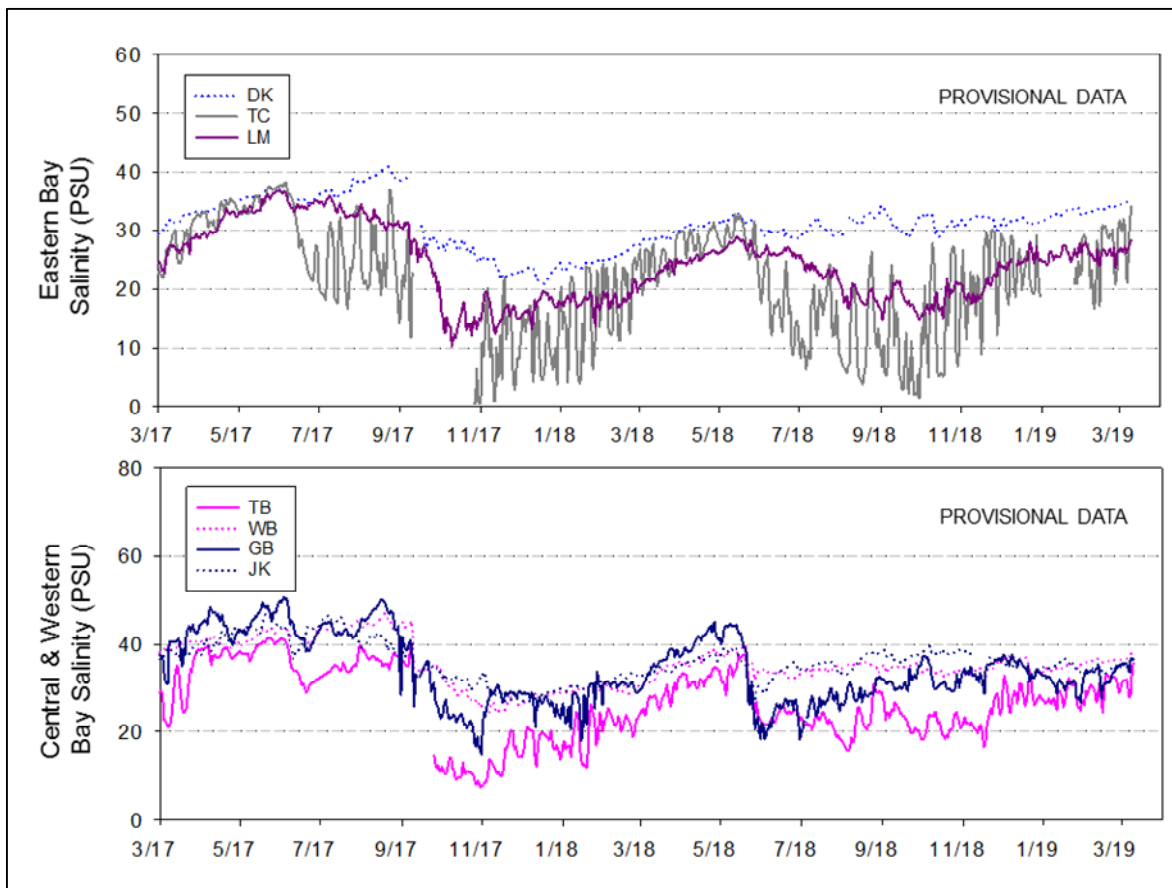


South Florida Water Depth Assessment Tool (SFWDAT)

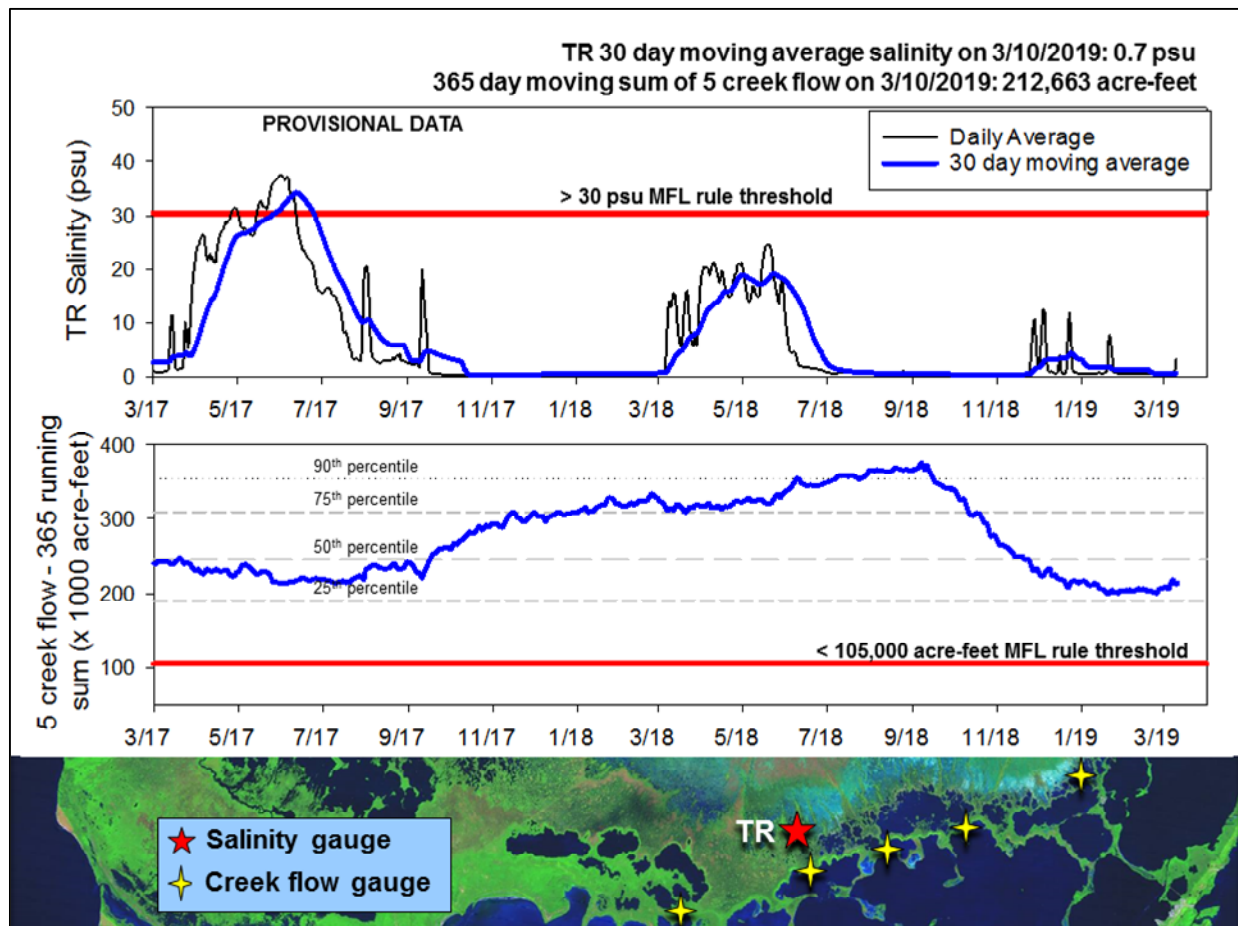
Taylor Slough Water Levels: Almost no rain fell on Taylor Slough and Florida Bay this past week allowing water depths to continue decreasing an average of 0.13 feet. Water depths averaged 0.45 feet across Taylor Slough by Sunday. Conditions are 3.5 inches above average for this time of year with northern Taylor Slough staying the furthest from average (5.5 inches above).

Florida Bay Salinities: Average salinity in Florida Bay increased 2 psu from last week with individual station changes ranging from an increase of 1 psu to 7 psu. Daily average salinities ranged from 28 psu in the northeast to 38 psu in the central bay and are still about 4.5 psu above average for this time of year.





Florida Bay MFL: Salinity in the mangrove zone stayed at 0.6 psu for most of the week with a sudden increase to 3.3 psu on Sunday. The 30-day moving average increased to 0.7 psu as a result. The weekly cumulative flow from the five creeks denoted by yellow stars on the map totaled about -1,100 acre-feet with the negative flows starting on Friday, March 8, 2019. The 365-day moving sum of flow from the five creeks (tracked as part of the Florida Bay MFL criteria) has increased slightly to 212,663 acre-feet (less than the long-term average of 257,628 acre-feet but above the 25th percentile). Creek flow is provisional data from the USGS and is highly variable.



Water Management Recommendations

Keeping rainfall/freshwater in the Everglades system while protecting a dry season recession is a priority. Discharges into northern WCA-3A, Holey Land and Rotenberger remain ecologically beneficial and an ecological priority.

Very low numbers of wading birds have been noted foraging in the WCAs and expectations are for lower than average nesting success. Discharges into WCA-3A North continue to have ecological benefit as white ibis begin to nest at the Alley North colony within that basin. WCA-2A has the potential to support nesting colonies in WCA-1 and WCA-3A. A careful stage recession is recommended in WCA-2A with the goal to reach suitable wading bird foraging depths within the next month but not too quickly as to over drain the area.

Recession rates at the four main gauges in WCA-3A and at the single gauge location in WCA-2A are slightly higher (0.12 feet last week on average) than the maximum recession rate determined to be optimal for wading bird foraging (0.09 feet per week).

More specific recommendations appear in the summary table below. The red text represents new or modified information or recommendations.

SFWMD Everglades Ecological Recommendations, March 12th, 2019 (red is new)

| Area | Weekly change | Recommendation | Reasons |
|-------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| WCA-1 | Stage decreased by 0.13' | Maintain depths at regulation schedule. | Protect upstream/downstream habitat and wildlife. |
| WCA-2A | Stage decreased by 0.13' | Moderate ascension rates as possible, manage recession rates not to exceed the recommended max rate for optimal wading bird foraging of -0.09 ft per week. | Protect conditions that provide wading bird foraging habitat later into the nesting season. |
| WCA-2B | Stage decreased by 0.15' | Maintain depths at regulation schedule. | Protect upstream/downstream habitat and wildlife. |
| WCA-3A NE | Stage decreased by 0.11' | Maintain depths at regulation schedule. Moderate recession rates not to exceed the recommended max rate for optimal wading bird foraging of -0.09 ft per week. | Protect habitat including <u>peat soil</u> development, tree islands and wildlife. |
| WCA-3A NW | Stage decreased by 0.11' | Maintain depths at regulation schedule. Moderate recession rates not to exceed the recommended max rate for optimal wading bird foraging of -0.09 ft per week. | |
| Central WCA-3A S | Stage decreased by 0.11' | Maintain depths at regulation schedule. Moderate recession rates not to exceed the recommended max rate for optimal wading bird foraging of -0.09 ft per week. | Protect upstream/downstream habitat and wildlife. |
| Southern WCA-3A S | Stage decreased by 0.14' | | |
| WCA-3B | Stage decreased by 0.07' | Maintain depths at regulation schedule. Moderate recession rates to the extent possible. | Protect upstream/downstream habitat and wildlife. |
| ENP-SRS | Stage increased by 0.09' | Make discharges to the Park according to the 2012 WCP rainfall plan. | Protect upstream/downstream habitat and wildlife. |
| Taylor Slough | Stage changes ranged from -0.10' to -0.28' | Move water southward as possible | When available, provide freshwater buffer for downstream conditions. Decrease potential for high phosphorus input to ENP. |
| FB- Salinity | Salinity changes ranged +0.8 to +7.4 psu | Move water southward as possible | When available, provide freshwater to maintain low salinity buffer and promote water movement. |