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M E M O R A N D U M

TO: John Mitnik, Interim Assistant Executive Director, Executive Office Staff

FROM: SFWMD Staff Environmental Advisory Team

DATE: July 24, 2019

SUBJECT: Weekly Environmental Conditions for Systems Operations

Summary

Weather Conditions and Forecast

A deep-layered trough of low pressure digging into the eastern United States today has caused the subtropical ridge of high pressure that has been rather dominant over the District since last week to weaken and shift eastward. Meanwhile, Tropical Depression Three, located just offshore the east-central coast of Florida this morning, should move northward and then north-northeastward around the retreating mid-level ridge, taking it away from the area without producing any meaningful effects. A deep layer of moisture, with relative humidity's around or greater than 70% in the low- to mid-levels of the atmosphere and precipitable water values of around 1.9", as well as sufficient daytime heating would normally result in enhanced rain chances and a good coverage of rainfall across the area. However, unimpressive instability as well as subsidence (large-scale sinking and warming) associated with the nearby tropical cyclone should have some suppressing effect on shower and thunderstorm activity today across the District compared to the previous couple of days. The model guidance today is in poor agreement with regard to what the favored areas would be for rains this afternoon to early evening, but with a prevailing deep layer of southwesterly steering winds, a lack of much organized activity would conceptually be expected over the southwest. The most recent model runs have had a little more consistency in calling for scattered rains from the west-central coast of Florida and generally north and west of Lake Okeechobee through portions of the Kissimmee Valley, with widely scattered showers and thunderstorms near or along the southeast coast. Overall, the total District rainfall is forecast to be near but likely under the daily climatological value of 0.22" and much less than the previous two days. The digging trough in the eastern U.S. should allow for a general cooling aloft and a resulting increase of instability as moisture levels remain at or above normal, both large-scale conditions that would favor enhanced rain chances and rain coverage across the District. The southwesterly wind flow forecast to prevail ahead of the trough over the area would also tend to favor greater rains from north and west of Lake Okeechobee to south and east of Lake Okeechobee to the east coast, a reversal of the pattern seen the previous week. The forecast after Thursday becomes much less certain and the confidence is unfortunately rated as low. The models indicate that the subtropical ridge of high pressure should try to rebuild over the southern half of the District by the weekend, which would cause a shift of the rains away from the east coast toward the central and western interior while the Kissimmee Valley to around Lake Okeechobee remains relatively active. For the week ending next Tuesday morning, the deterministic total QPF is 1.6" and just above the long-term mean for the third week of July. The probabilistic model output is in general agreement with the median solution of near normal rainfall but suggest a broader range of possible outcomes, with rainfall most likely ranging from 80-130% normal.

Kissimmee

Tuesday morning stages were 56.1 feet NGVD (0.4 feet below schedule) in East Lake Toho, 53.2 feet NGVD (0.3 feet below schedule) in Toho, and 49.9 feet NGVD (1.1 feet below schedule) in Kissimmee-Cypress-Hatchineha; headwater stages were 46.3 feet NGVD at S-65A and 25.8 feet NGVD at S-65D.

Tuesday morning discharges were 834 cfs at S-65, 852 cfs at S-65A, 1570 cfs at S-65D and 1343 cfs at S-65E. Dissolved oxygen concentration in the Kissimmee River averaged 3.3 mg/L for the week through Sunday. Kissimmee River mean floodplain depth on Sunday was 0.5 feet. Recommendations this week: Hold KCH stage steady until the risk of an exceedance of the 0.5 ft max rise per 14 days has passed or the stage starts to decline. If KCH stage starts to decline, ramp down at 150 cfs/day over several days to 750 cfs. Balance rate of rise in KCH against the reduction of flow at S65A.

Lake Okeechobee

Lake Okeechobee stage is 11.52 feet NGVD, increasing 0.05 feet from the previous week, 0.25 ft over the previous month, and is 2.82 ft below the stage one year ago. The Lake dropped into the Water Shortage Band on July 19, 2019. The lake remains below the bottom of the ecological envelope (currently 0.48 feet below), which varies seasonally from 12.5 – 15.5 feet NGVD (+/- 0.5 ft) but has been rising steadily towards it throughout the rainy season. Lake stage ascension rates remain important to the continued recovery of SAV and EAV (Submerged and Emergent Aquatic Vegetation) in the nearshore zone; high ascension rates will stress newly established plants and could dramatically reduce the beneficial effects that low lake stages have had on these communities. Water quality data from early June shows some of the best results since at least 2012, as bioavailable forms of nitrogen and phosphorus were relatively low, as were Chlorophyll *a* and turbidity. This suggests SAV regrowth and ephiphytic algae have been soaking up nutrients and suppressing blooms (as of June) due to low lake stages maximizing light penetration and recovery of submerged plants and attached algae. The latest estimate of cyanobacteria bloom coverage on the lake (July 19) shows algal bloom potential remains somewhat elevated in the northern portions of the lake, though values appear to have diminished somewhat from last week.

Estuaries

Total inflow to the St. Lucie Estuary averaged 375 cfs over the past week with no flow coming from Lake Okeechobee. Over the past week, there were little changes of salinity in the estuary in terms of seven-day average. 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 1,716 cfs over the past week with only 57 cfs coming from the Lake. Over the past week, seven-day average salinity barely changed throughout the estuary. The 30-day moving average surface salinity is 0.3 at Val I-75 and 1.5 at Ft. Myers. Salinity conditions between Val I-75 and Ft. Myers are good for tape grass. Salinities are in the good range for adult eastern at Shell Point and Sanibel. 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 the areas further downstream.

Stormwater Treatment Areas

Over the past week, approximately 200 acre-feet of Lake Okeechobee water was delivered to the STAs. The total amount of Lake releases sent to the STAs/FEBs in WY2020 (since May 1, 2019) is approximately 7,400 acre-feet. The total amount of inflows to the STAs in WY2020 is approximately 264,000 acre-feet. All STA cells are at or above target depths. STA-1W Northern Flow-way is offline for STA-1W Expansion project construction activities 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-5/6 Flow-ways 1 and 4 to facilitate the Restoration Strategies grading project in Flow-ways 2 and 3, in STA-1E Western Flow-way following levee repairs in the West Distribution Cell, and in STA-1E Central Flow-way and STA-2 Flow-way 3 for vegetation management activities. This week, if 2008 LORS recommends Lake releases to the WCAs and the conditions allow, releases will be sent to STA-2.

Everglades

Dry conditions led to a recession in stage consistent across the Everglades over the last week. WCA-1 and WCA-2A remain above schedule but trending towards the regulation lines. WCA-3A remains in Zone E1 and stages fell consistently at the gauge locations within that basin. Stages in Taylor Slough remain higher than the historical average for this time of year, yet salinity conditions downstream in Florida Bay increased slightly on average last week. The flow from the five creeks calculated as part of the FI Bay MFL is 50% of typical flows for this time of year.

Supporting Information

KISSIMMEE BASIN

Kissimmee Basin Rainfall

The Upper Kissimmee Basin received 0.46 inches of rainfall in the past week and the Lower Basin received 0.59 inches (SFWMD Daily Rainfall Report 7/21/2019).

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: 7/23/2019

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)						
							7/21/19	7/14/19	7/7/19	6/30/19	6/23/19	6/16/19	6/9/19
Lakes Hart and Mary Jane	S-62	153	LKMJ	60.0	R	60.0	0.0	0.1	0.0	-0.4	-0.3	-0.5	-0.7
Lakes Myrtle, Preston, and Joel	S-57	0	S-57	60.2	R	61.0	-0.8	-0.7	-0.9	-1.2	-1.1	-1.1	-1.3
Alligator Chain	S-60	0	ALLI	62.5	R	63.2	-0.7	-0.7	-0.8	-1.0	-1.0	-1.0	-1.3
Lake Gentry	S-63	0	LKGT	59.6	R	61.0	-1.4	-1.3	-1.4	-1.5	-1.4	-1.4	-1.6
East Lake Toho	S-59	116	TOHOE	56.0	R	56.5	-0.5	-0.7	-0.7	-1.0	-1.1	-1.4	-1.6
Lake Toho	S-61	498	TOHOW, S-61	53.2	R	53.5	-0.3	-0.4	-0.5	-0.8	-1.0	-1.1	-1.4
Lakes Kissimmee, Cypress, and Hatchineha	S-65	1,110	KUB011, LKIS5B	49.9	R	51.0	-1.1	-1.1	-1.6	-1.4	-1.4	-1.9	-2.1

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: 7/23/2019

Metric	Location	1-Day Average		Average for the Preceding 7-Days ¹								5/19/19
		7/21/2019	7/21/19	7/14/19	7/7/19	6/30/19	6/23/19	6/16/19	6/9/19	6/2/19	5/26/19	
Discharge (cfs)	S-65	1,043	1,110	548	287	400	106	165	284	319	596	984
Discharge (cfs)	S-65A ²	1,032	1,123	749	387	673	1,014	255	215	244	456	815
Discharge (cfs)	S-65D ²	1,409	1,396	1,020	1,288	1,801	975	290	222	329	706	920
Headwater Stage (feet NGVD)	S-65D ²	25.82	25.78	25.81	25.70	25.84	25.80	25.84	25.78	25.79	25.80	25.82
Discharge (cfs)	S-65E ²	1,183	1,250	944	1,158	1,606	903	331	208	313	591	810
Discharge (cfs)	S-67	90	92	97	92	62	96	22	0	0	0	79
DO (mg/L) ³	Phases I & II/III river channel	3.6	3.3	3.3	1.8	0.0	3.0	5.9	5.7	6.0	6.7	5.9
Mean depth (feet) ⁴	Phase I floodplain	0.55	0.55	0.46	0.46	0.82	0.39	0.13	0.06	0.07	0.11	0.16

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)

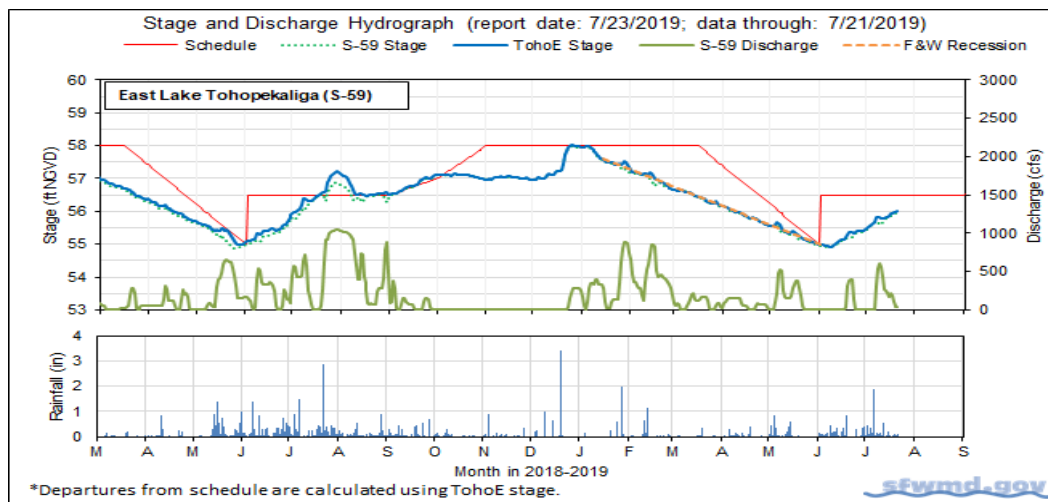


Figure 1.

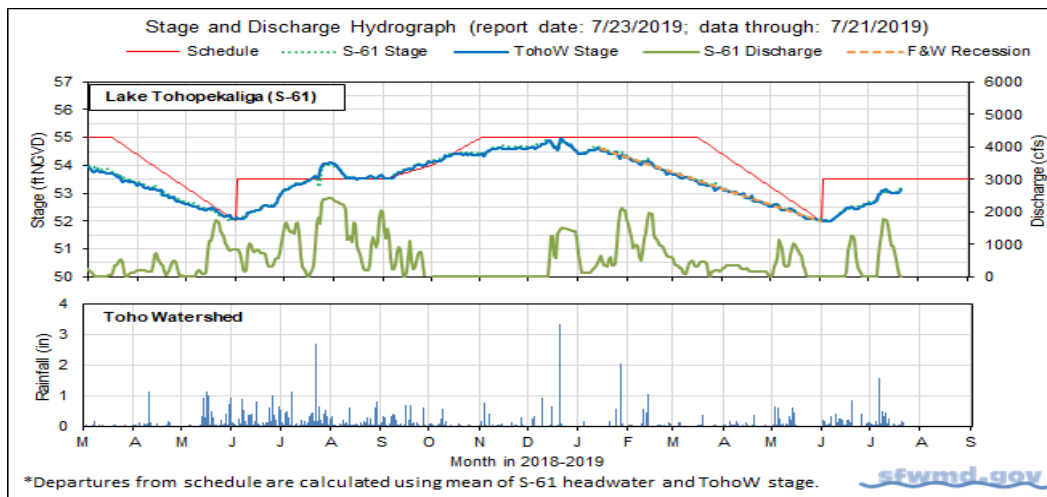


Figure 2.

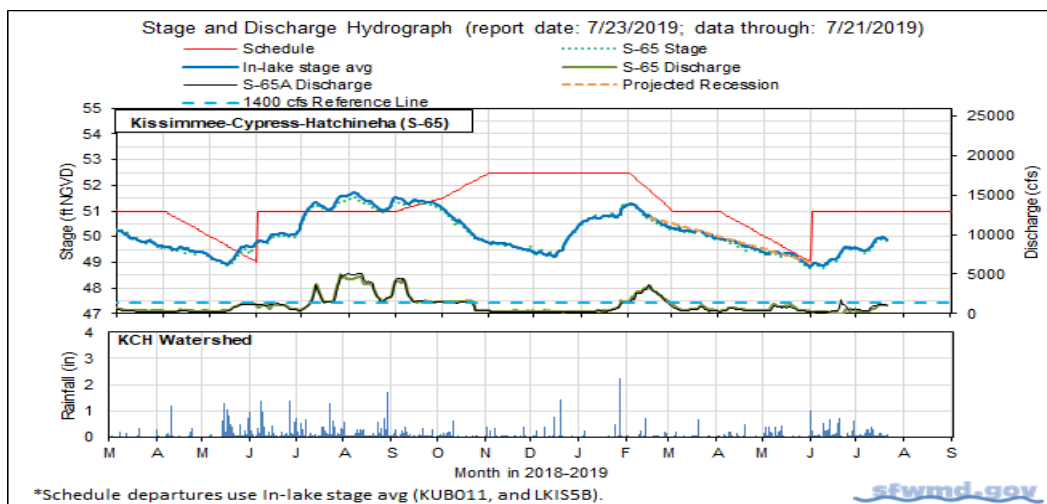


Figure 3.

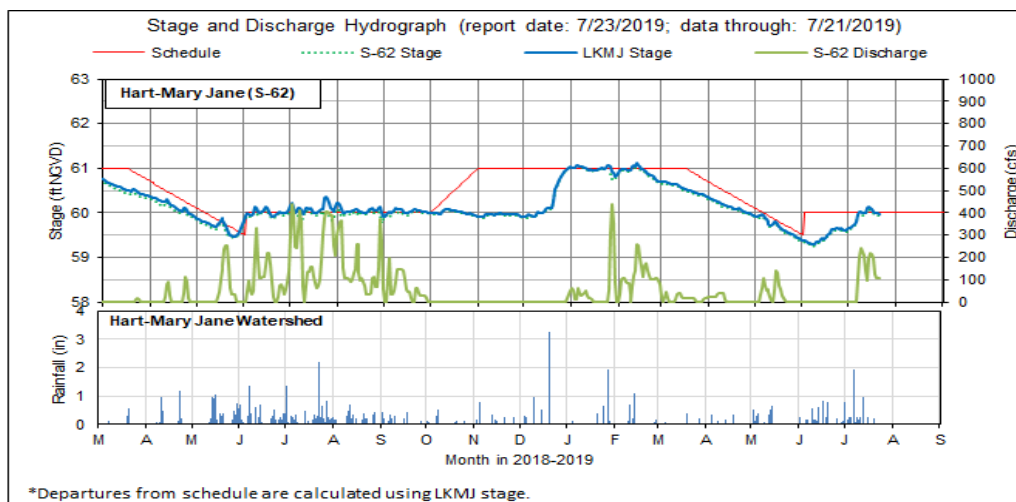


Figure 4.

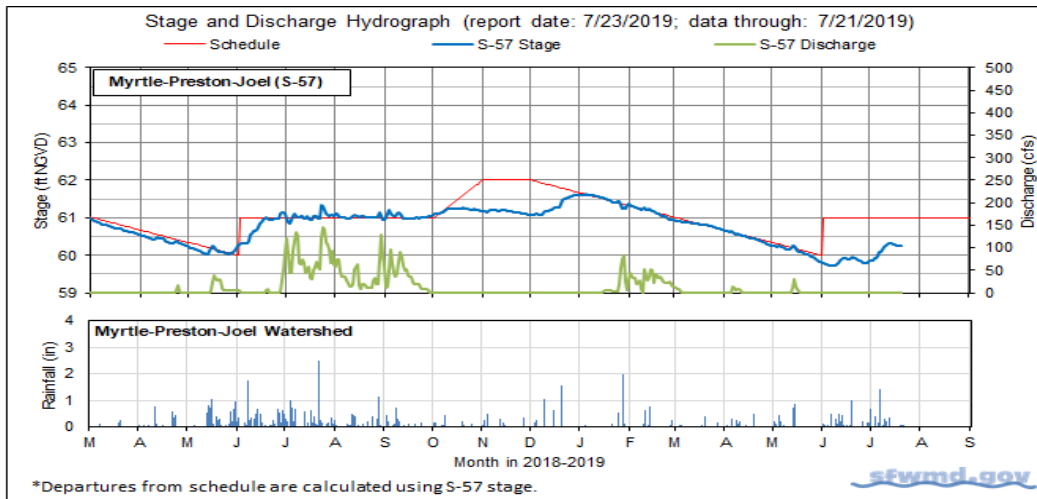


Figure 5.

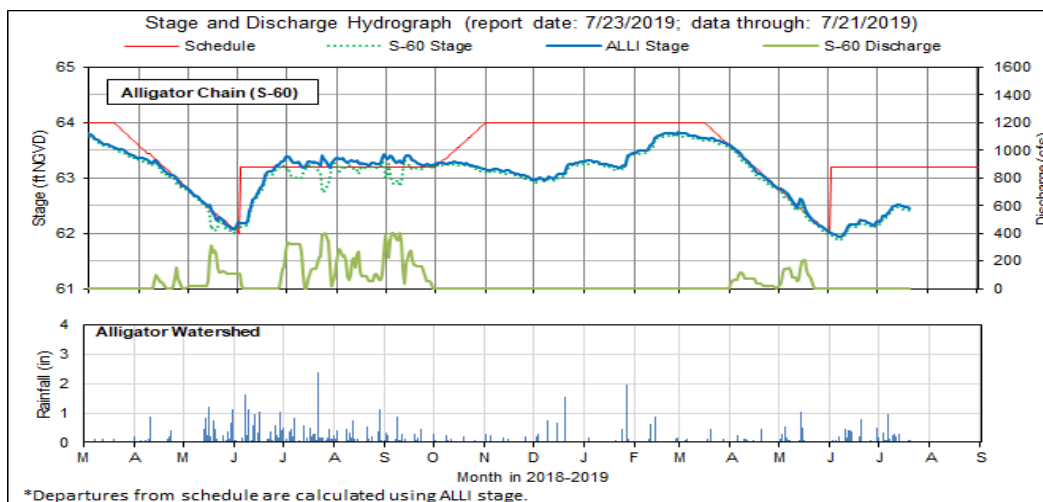


Figure 6.

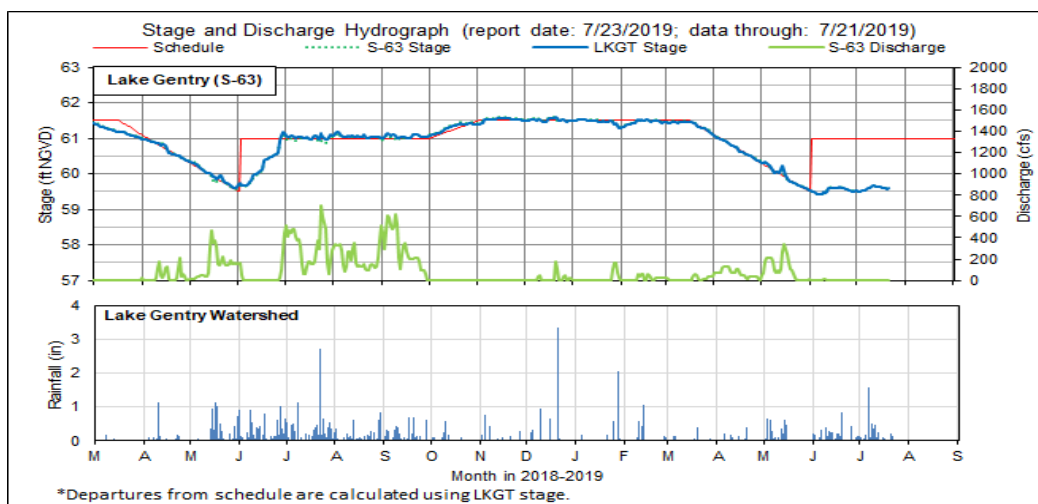


Figure 7.

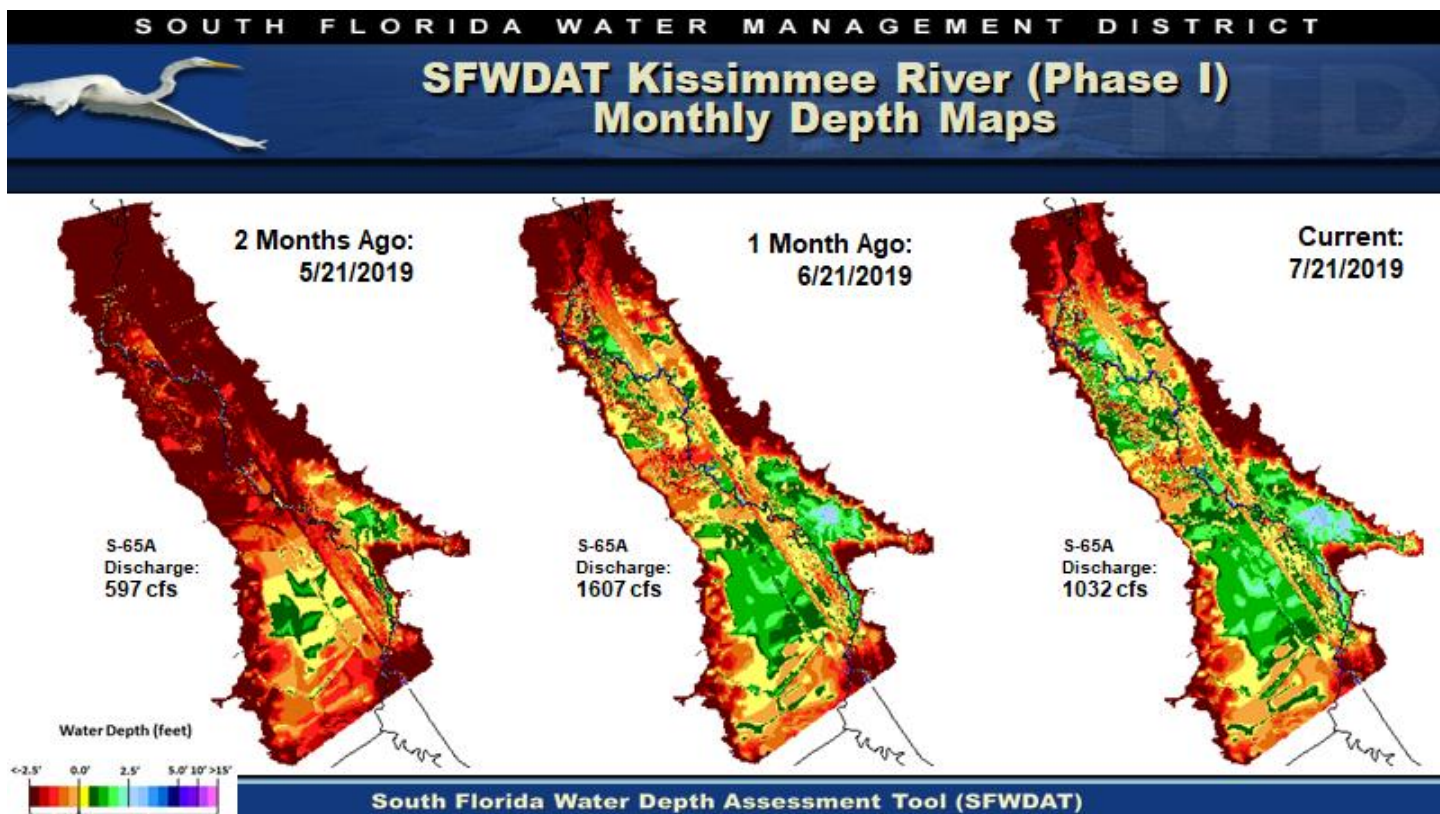


Figure 8. Phase I area floodplain water depths for this week, one month ago, and two months ago. Note that the WDAT color-coding has been modified to accommodate greater water depths; these maps are not directly comparable to Kissimmee Basin WDAT maps published prior to January 16, 2012.

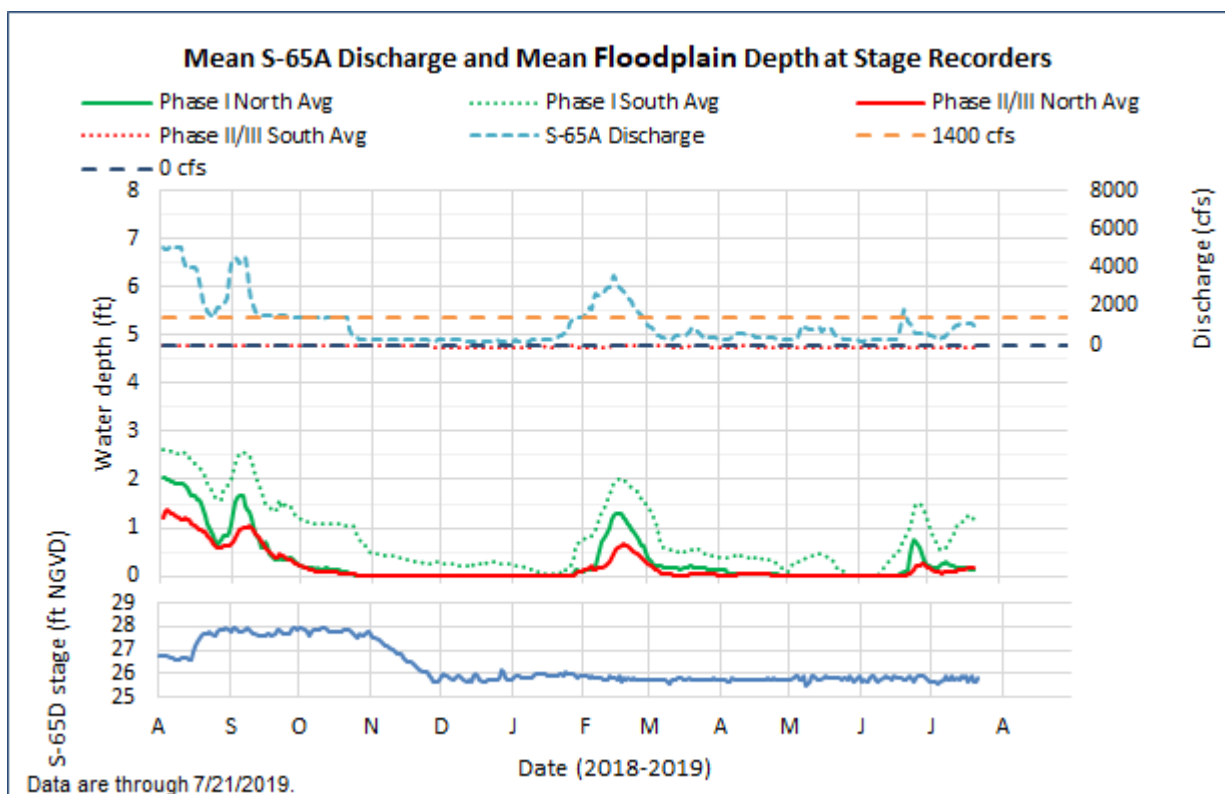
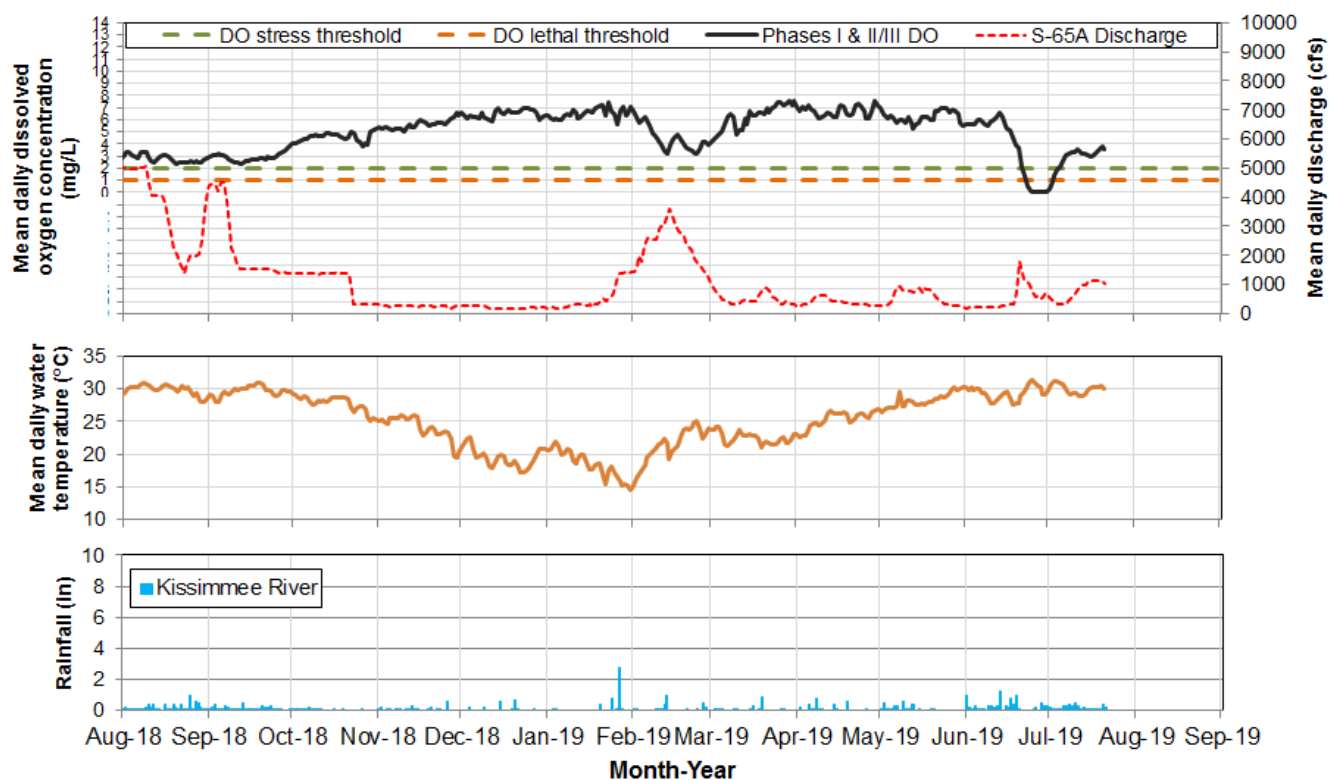


Figure 9. Mean water depth at stage recorders in the northern Phase I, southern Phase I, northern Phase II/III, and southern Phase II/III areas in relation to the S-65A discharge and S-65D headwater stage.



Report Date: 7/23/2019; data are through: 7/21/2019.

Figure 10. Mean daily dissolved oxygen, discharge, temperature and rainfall in the Phases I/II/III river channel.

Water Management Recommendations

Kissimmee Basin Adaptive Recommendations and Operational Actions

Recommendation Date	Recommendation	Purpose	Outcome	Source	Report Date
7/18/2019	a) Hold KCH stage steady until the risk of an exceedance of the 0.5 ft max rise per 14 days is past OR stage starts to decline. b) If KCH stage starts to decline, ramp down at 150 cfs/day over several days to 750 cfs. If this doesn't stop the decline we will regroup to discuss options.	Balance rate of rise in KCH against reduction of flow at S65A to avoid reducing flow to minimum until it is necessary.	Implemented	KB Ops/SFWMD Water Management	7/23/2019
7/14/2019	Do not increase S-65/S-65A flow today	Control rate of stage rise in KCH while addressing DO sag concerns.	Implemented	SFWMD Water Management/KB Ops	7/16/2019
7/12/2019	Postpone second 150 cfs increase today (total 150 cfs).	Control rate of stage rise in KCH while addressing DO sag concerns.	Implemented	KB Ops	7/16/2019
7/11/2019	Increase S-65/S-65A by 300 cfs tomorrow (double the rampup guidelines) in two increments of 150 cfs	Control rate of stage rise in KCH while addressing DO sag concerns.	Implemented	KB Ops	7/16/2019
7/11/2019	Increase S-65/S-65A flow by 150 cfs today (double the rampup guidelines).	Control rate of stage rise in KCH while addressing DO sag concerns.	Implemented	KB Ops	7/16/2019
7/10/2019	Increase S-65/S-65A flow by 150 cfs today (double the rampup guidelines).	Control rate of stage rise in KCH while addressing DO sag concerns.	Implemented	KB Ops	7/16/2019
7/8/2019	No new recommendations.		N/A		7/9/2019
6/27/2019	Continue discharge reductions at S-65A at up to double the normal rampdown rate, as possible.	Reduce river channel stage to allow DO recovery.	TBD	KB Ops	7/2/2019
6/27/2019	Manage S65 discharge to slow stage ascension to the extent possible.	Slow the rate of stage ascension in KCH.	TBD	KB Ops	7/2/2019
6/24/2019	Continue discharge reductions at S-65A at up to double the normal rampdown rate, as possible.	Reduce river channel stage to allow DO recovery.	Implemented	KB Ops	6/25/2019
6/21/2019	Reduce discharge at S-65A to below 1400 cfs as soon as possible.	Reduce chance of DO crash given the need for continued high discharge.	Implemented	KB Ops	6/25/2019
6/19/2019	Start flood control measures as headwater stage at S-65A reaches 47 ft	Avoid flooding in Pool A.	Implemented (flow increased to 2000 cfs)	SFWMD Water Management/KB Ops	6/25/2019
6/17/2019	If needed, double rates of discharge increase for S-65/S-65A up to 150 cfs/day.	Slow rate of rise in KCH if necessary.	TBD	KB Ops	6/18/2019
6/17/2019	Increase flow at S-61.	Slow Lake Toho ascension rate	Implemented	KB Ops	6/18/2019
6/13/2019	Increase discharge at S-65A. Double the rate of discharge increase if necessary to maintain headwater at S-65A.	Purpose: Control stage in Pool A due to heavy rain overnight in Pool A basin.	Implemented	Water Management/KB Ops	6/18/2019
6/1/2019	Begin implementation of the 2019 Wet Season Discharge Plan for S-65/S-65A (see figure).	Provide variable flow from S-65/S-65A to balance Kissimmee River and Headwaters Lakes objectives, including Kissimmee River floodplain inundation, moderate rates of change in discharge, and controlled rate of stage rise in the lakes.	Planned	KB Ops	6/11/2019
5/31/2019	Reduce S-65 flow by 100 cfs over 2 days (5/31 and 6/1) to about 280 cfs.	Slow rate of stage decline in KCH while sustaining about 150 cfs at S-65A. (Note: Unexpected rainfall late on 6/1 allowed S-65A discharge to be returned to about 220 cfs on 6/2).	Implemented	KB Ops/SFWMD Water Management	6/4/2019
5/28/2019	No new recommendations.		N/A		5/28/2019
5/20/2019	No new recommendations.		N/A		5/21/2019
5/13/2019	No new recommendations.		N/A		5/14/2019
5/6/2019	Due to the rainfall, increase S65-A to 1000 cfs today in two increments and increase flow at S-65 accordingly. We will reassess the rise in KCH stage tomorrow 5/7.	Short-term goals: try to keep S65-A discharge at or below 1000 cfs for KR fish sampling this week and next, while keeping the reversal in KCH less than about 0.4 ft.	Implemented	KB Ops	5/7/2019
4/29/2019	No new recommendations.		N/A		4/30/2019
4/23/2019	No new recommendations.		N/A		4/23/2019
4/15/2019	No new recommendations.		N/A		4/16/2019
4/8/2019	No new recommendations.		N/A		4/9/2019
4/1/2019	No new recommendations.		N/A		4/2/2019
3/25/2019	No new recommendations.		N/A		3/26/2019

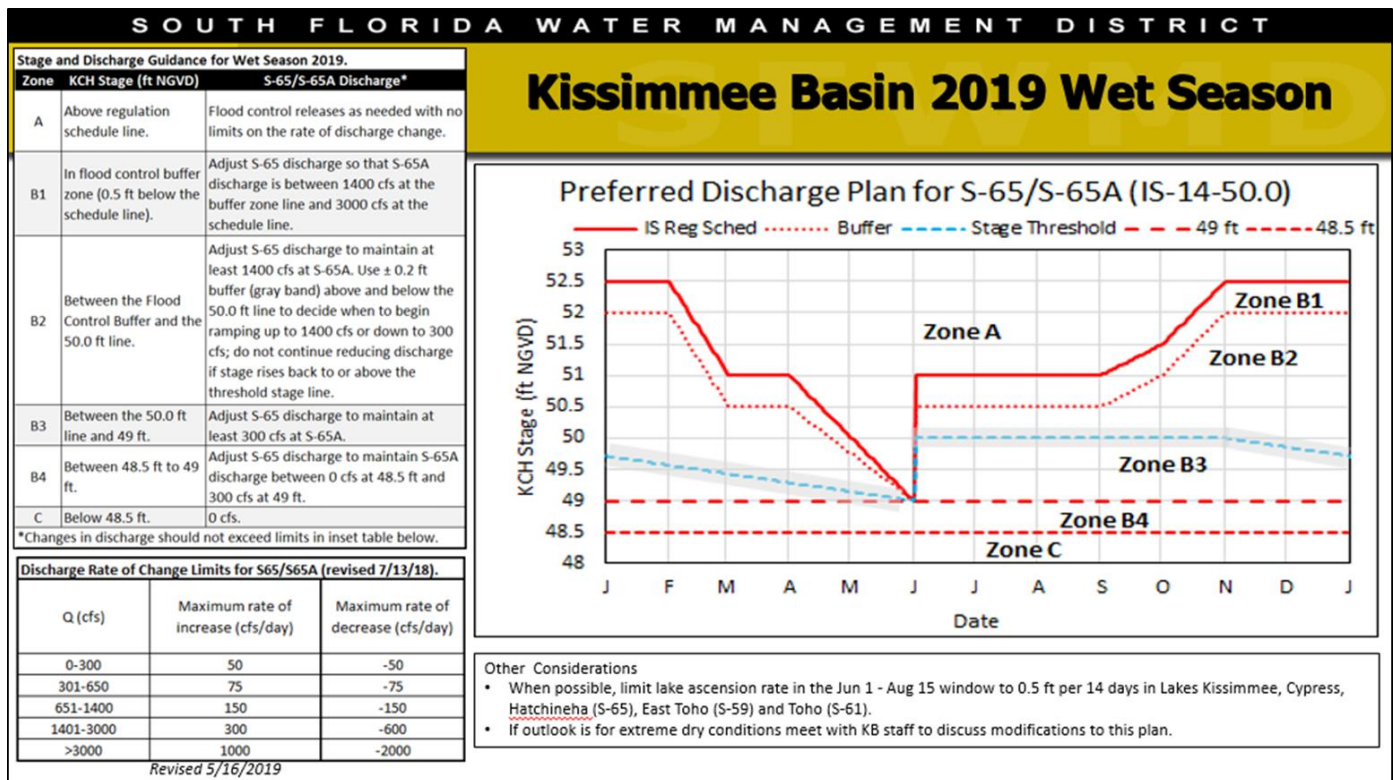


Figure 11. The 2019 Wet Season Discharge Plan for S-65/S-65A.

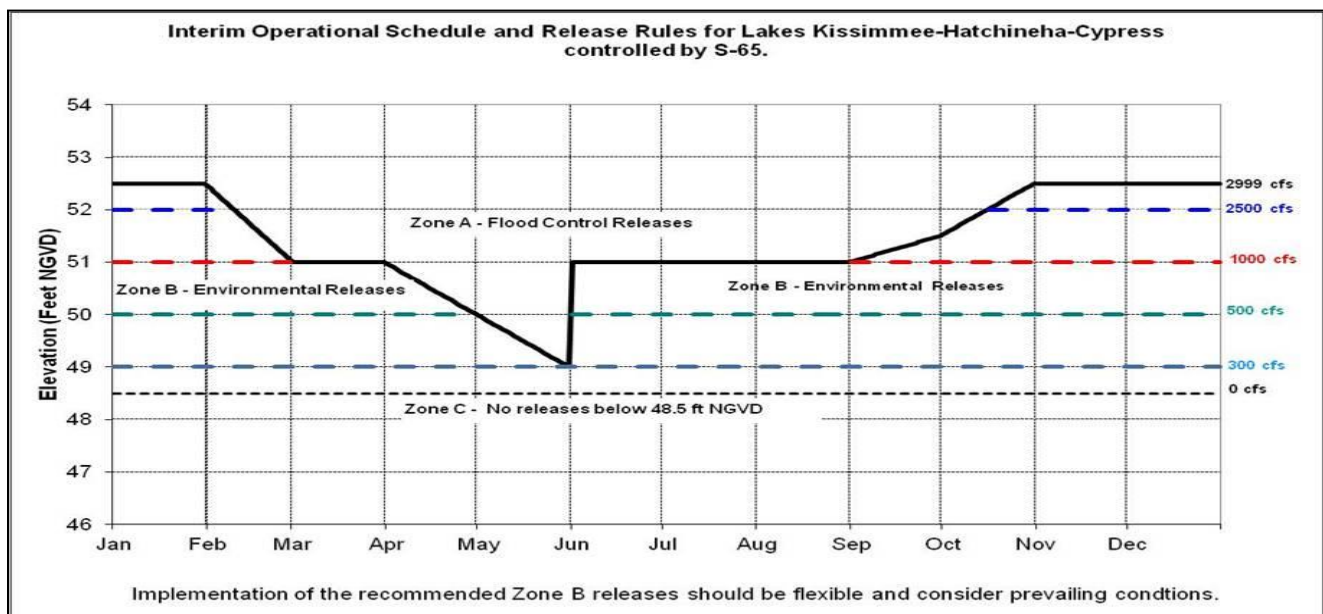


Figure 12. Interim operations schedule for S-65. The discharge schedule shown to the right has not been used in recent years.

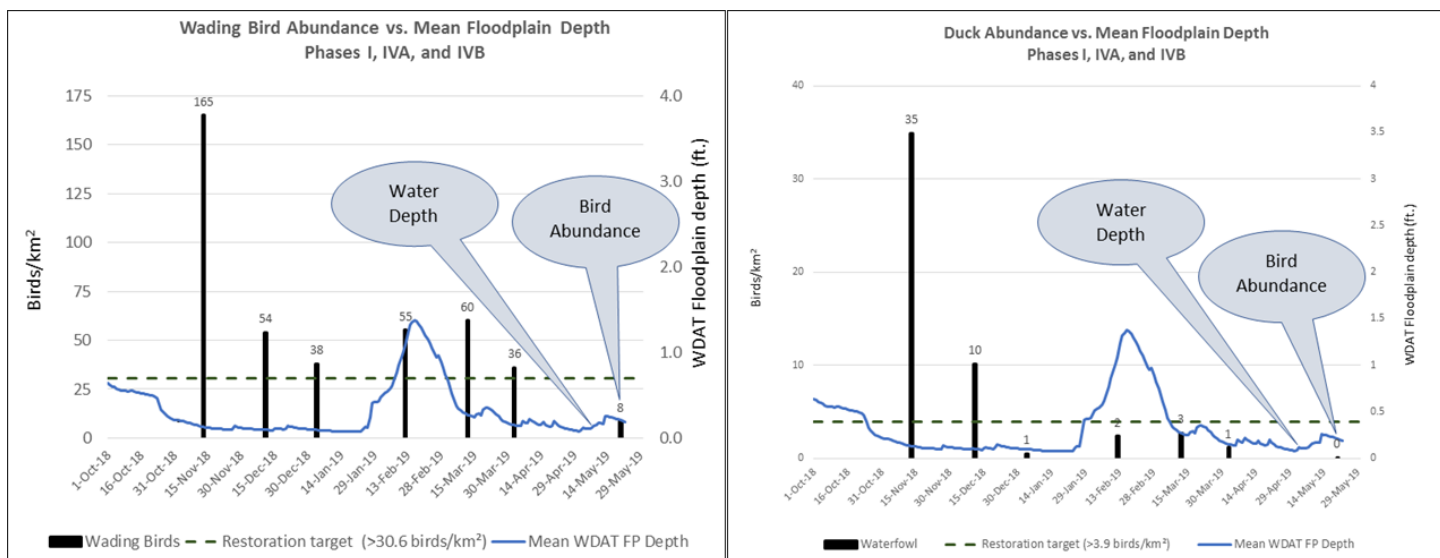


Figure 13. Kissimmee River Wading Bird and Waterfowl Surveys from November 2018 to May 2019.

Table 3. Upper Kissimmee Basin Snail Kite Survey Update
Survey 4: May 19-21, 2019

WATERBODY	KITES	TOTAL NESTS	SUCCESSFUL	ACTIVE
East Toho	2	4	0	2
Toho	97	55	19	11
Kissimmee	225	55	7	30
KCOL Total	324	114	26	43

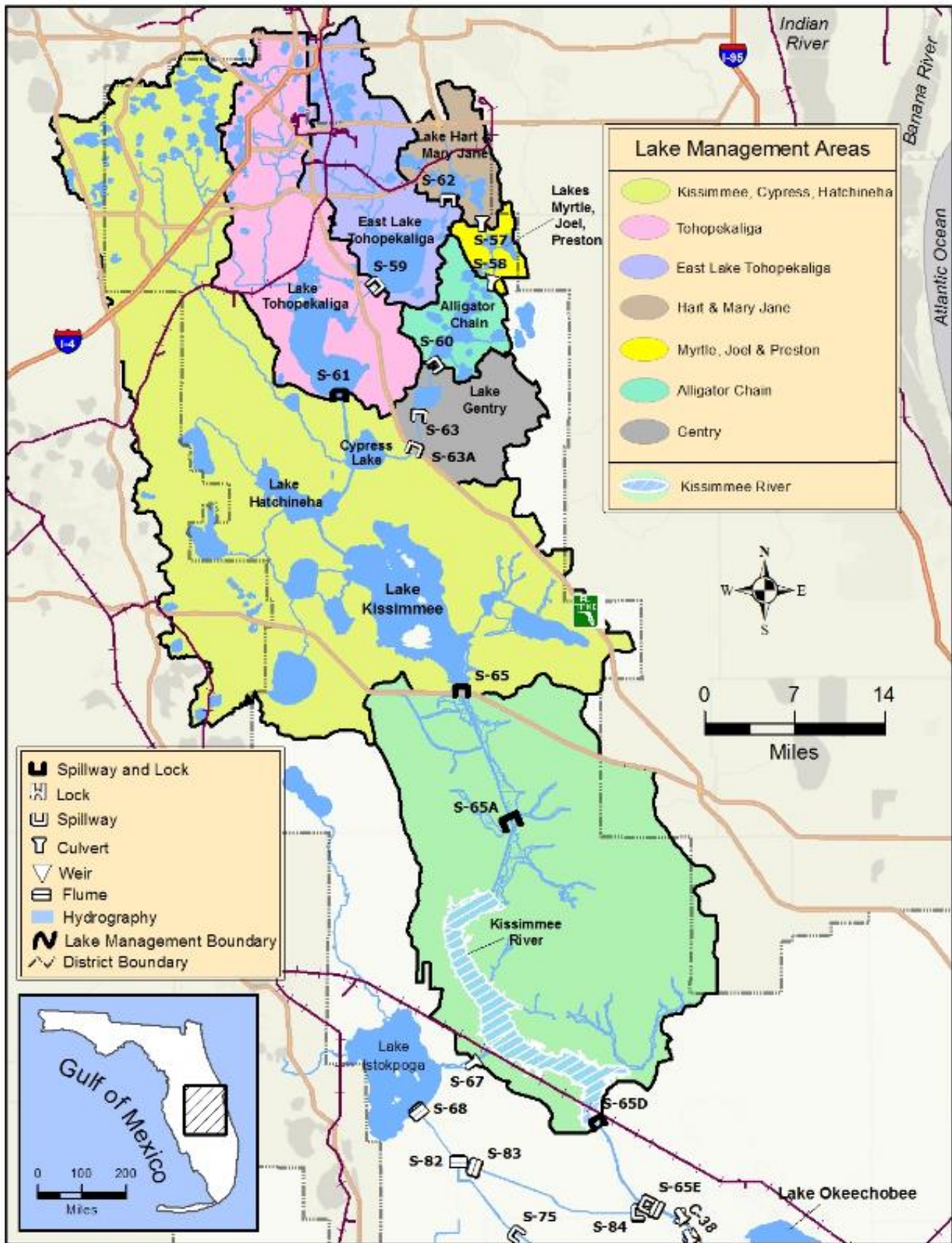


Figure 14. The Kissimmee Basin.

LAKE OKEECHOBEE

According to the USACE web site, Lake Okeechobee average daily lake stage is at 11.52 feet NGVD for July 22, 2019 increasing 0.05 feet from the previous week. 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 0.25 feet higher than a month ago and 2.8 feet lower than a year ago (Figure 1) when stages were about a foot above the top of the preferred ecological envelope (Figure 2). The Lake dropped into the Water Shortage sub-band on July 19, 2019 after roughly paralleling it for a few weeks (Figure 3). Lake stage is currently at the lowest level for this time of year since 2011 but is still over a foot above those stages (Figure 4). According to RAINДАР, during the week of July 16 to July 22, 2019, 0.87 inches of rain fell directly over the Lake, compared to 1.44 inches the previous week. Most of the watershed received similar amounts of rainfall, though some southern basins received between 1.5 – 3.0 inches (Figure 5).

The average daily inflows (minus rainfall) to the Lake were very similar to the prior week at 1,723 cfs. The inflows from the Kissimmee River (S-65E) increased slightly from 1,003 cfs to 1,273 cfs, while those from Lake Istokpoga (via S-84 and S71) decreased, going from 537 cfs to 351 cfs (Table 1).

Outflows from the Lake resumed after a week of no flows, averaging just 329 daily cfs. Outflows (minus evapotranspiration) were primarily south through the S-350 structures (272 cfs) though some flow (57 avg daily cfs) was released west through the S-77 to accommodate a flow-through algal collection experiment conducted by the USACE. The corrected average daily evapotranspiration value for the week based on the L006 and LZ40 weather platform solar radiation declined slightly from the previous week to 0.14 inches.

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 6 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.

Water quality samples collected on June 4th – 5th found the highest values of Chlorophyll a (Chla) in the northern portion of the lake, as would be suggested by satellite imagery from June 3, 2019, with the exception of CLV10A, which is on the eastern shore (Figure 7). Three of nine stations in the nearshore zone had Chla values of near 20 µg/L or more, which were the northern-most stations. Only one station had a value above what the District considers bloom density, or 40 µg/L, which was a pelagic station in the north of the lake (L001). Two of six stations had a microcystin value above the detection limit of 0.20 µg/L; one was the nearshore station KISSR0.0 at the mouth of the Kissimmee River, with a value of 0.31 µg/L, and the other was station CLV10A with a value of 0.40 µg/L.

Other water quality parameters, including bioavailable forms of nutrients (Dissolved Inorganic Nitrogen [DIN] and Soluble Reactive Phosphorus [SRP]), and measures of light penetration (turbidity) showed that conditions are good on the Lake relative to recent years (Figure 8). Nutrient availability is relatively low in the both the pelagic and nearshore zones, while Chla and turbidity are also relatively low. This means phytoplankton blooms are not the cause for lower nutrient levels, and high turbidity is not suppressing phytoplankton growth. Rather, low lake stages are driving substantial nutrient uptake through recovery of SAV and epiphytic algae (algae attached to plants and sediment) communities that are benefitting from high light penetration in the nearshore zone. This regrowth is competing with phytoplankton for nutrients and is likely responsible for lower bloom activity on the lake relative to recent years. Additionally, a lack of major rain events this wet season has likely reduced nutrient runoff into the lake this summer, further reducing bloom activity.

The most recent viable satellite imagery (July 19, 2019) using NOAA's cyanobacteria monitoring product derived from EUMETSAT's Sentinel 3a OLCI sensor data showed bloom potential remains

elevated in northern portions of the lake but is possibly less dense (Figure 9). For this time of year, bloom conditions appear better than they have been since at least 2016, based on comparison of satellite imagery from similar dates (Figure 10). Note that lower apparent bloom coverage in 2018 was due to high turbidity and followed a massive bloom just weeks prior. NOAA released a web product that shows the most recent six images of cyanobacteria bloom coverage on the Lake that uses a similar satellite (Sentinel 3b vs 3a) than the above product so there are additional dates that imagery may be available. This product shows a later image (July 21 vs July 19) with similar results as described above, and is available at <https://coastalscience.noaa.gov/research/stressor-impacts-mitigation/hab-monitoring-system/cyanobacteria-algal-bloom-satellite-lake-okeechobee-fl/>.

Water Management Recommendations

Lake Okeechobee stage is 11.52 feet NGVD, increasing 0.05 feet from the previous week, 0.25 ft over the previous month, and is 2.82 ft below the stage one year ago. The Lake dropped into the Water Shortage Band on July 19, 2019. The lake remains below the bottom of the ecological envelope (currently 0.48 feet below), which varies seasonally from 12.5 – 15.5 feet NGVD (+/- 0.5 ft) but has been rising steadily towards it throughout the rainy season. Lake stage ascension rates remain important to the continued recovery of SAV and EAV (Submerged and Emergent Aquatic Vegetation) in the nearshore zone; high ascension rates will stress newly established plants and could dramatically reduce the beneficial effects that low lake stages have had on these communities. Water quality data from early June shows some of the best results since at least 2012, as bioavailable forms of nitrogen and phosphorus were relatively low, as were Chlorophyll *a* and turbidity. This suggests SAV regrowth and ephytic algae have been soaking up nutrients and suppressing blooms (as of June) due to low lake stages maximizing light penetration and recovery of submerged plants and attached algae. The latest estimate of cyanobacteria bloom coverage on the lake (July 21) shows algal bloom potential remains somewhat elevated in the northern portions of the lake, though values appear to have diminished somewhat from last week.

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 Flow cfs	Equivalent Depth Week Total (in)
S-65E & S-65EX1	1003	1273	0.6
S-71 & S-72	78	0	0.0
S-84 & S-84X	459	351	0.2
Fisheating Creek	58	52	0.0
S-154	0	0	0.0
S-191	23	0	0.0
S-133 P	24	7	0.0
S-127 P	26	4	0.0
S-129 P	25	2	0.0
S-131 P	17	2	0.0
S-135 P	33	9	0.0
S-2 P	0	0	0.0
S-3 P	0	0	0.0
S-4 P	0	0	0.0
L-8 Backflow	51	22	0.0
Rainfall	2992	1808	0.9
Total	4789	3531	1.7

OUTFLOWS	Previous week Avg Daily CFS	Avg Daily Flow cfs	Equivalent Depth Week Total (in)
S-77	0	57	0.0
S-308	0	0	0.0
S-351	0	87	0.0
S-352	0	127	0.1
S-354	0	58	0.0
L-8 Outflow			
ET	2380	2001	1.0
Total	2380	2329	1.1

Provisional Data

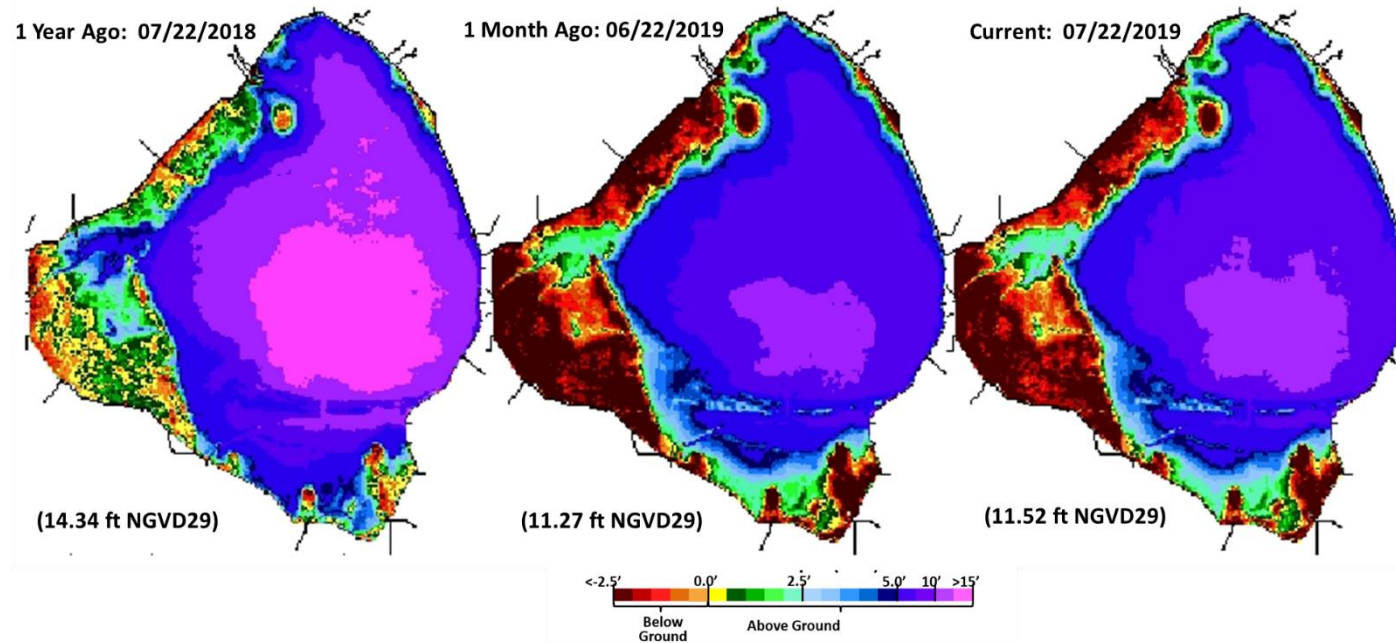


Figure 1. Water depth estimates on Lake Okeechobee based on the South Florida Water Depth Assessment Tool.

Lake Okeechobee Stage vs Ecological Envelope

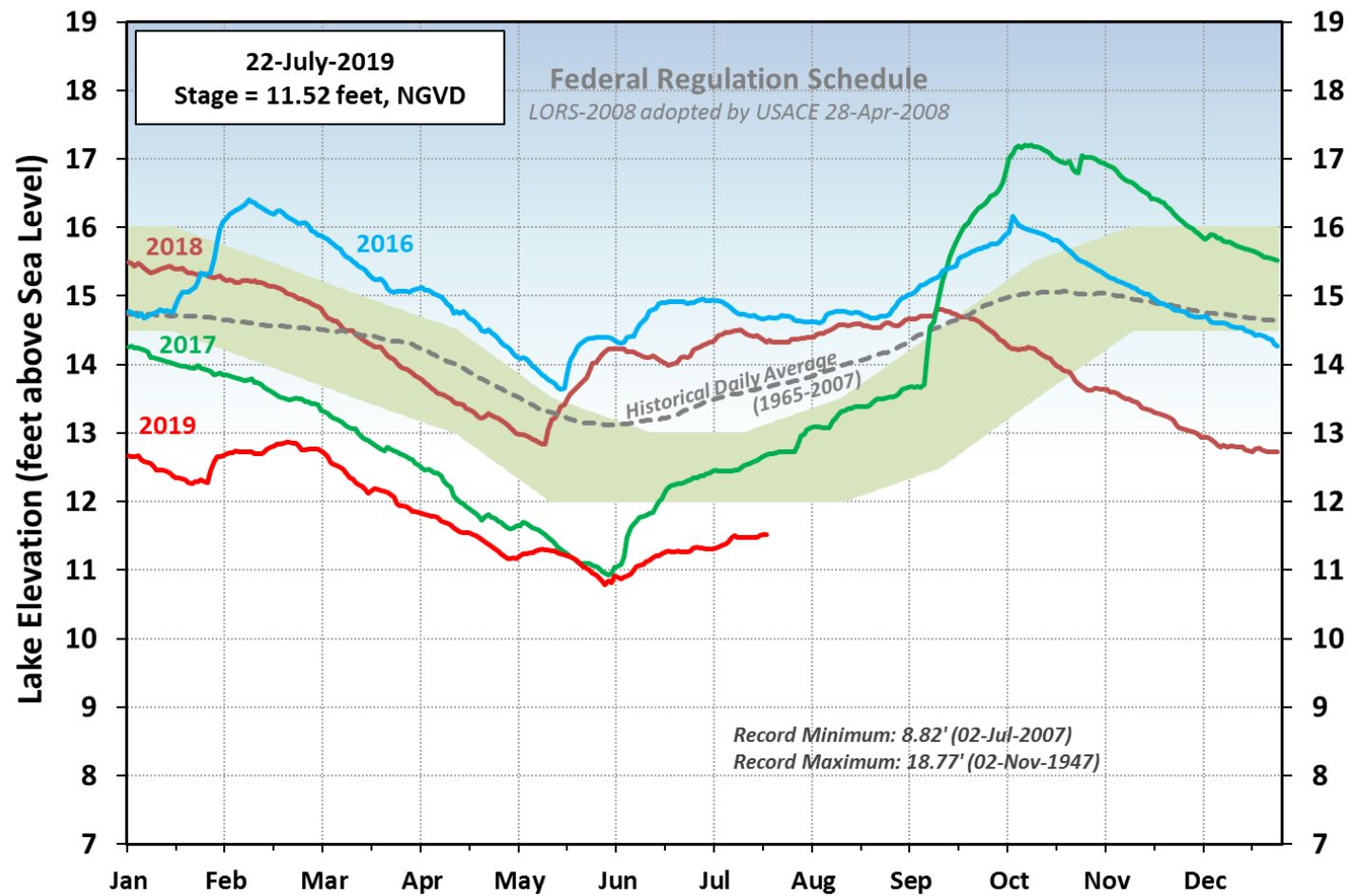


Figure 2. Select annual stage hydrographs for Lake Okeechobee in comparison to the Ecological Envelope.

Lake Okeechobee Water Level History and Projected Stages

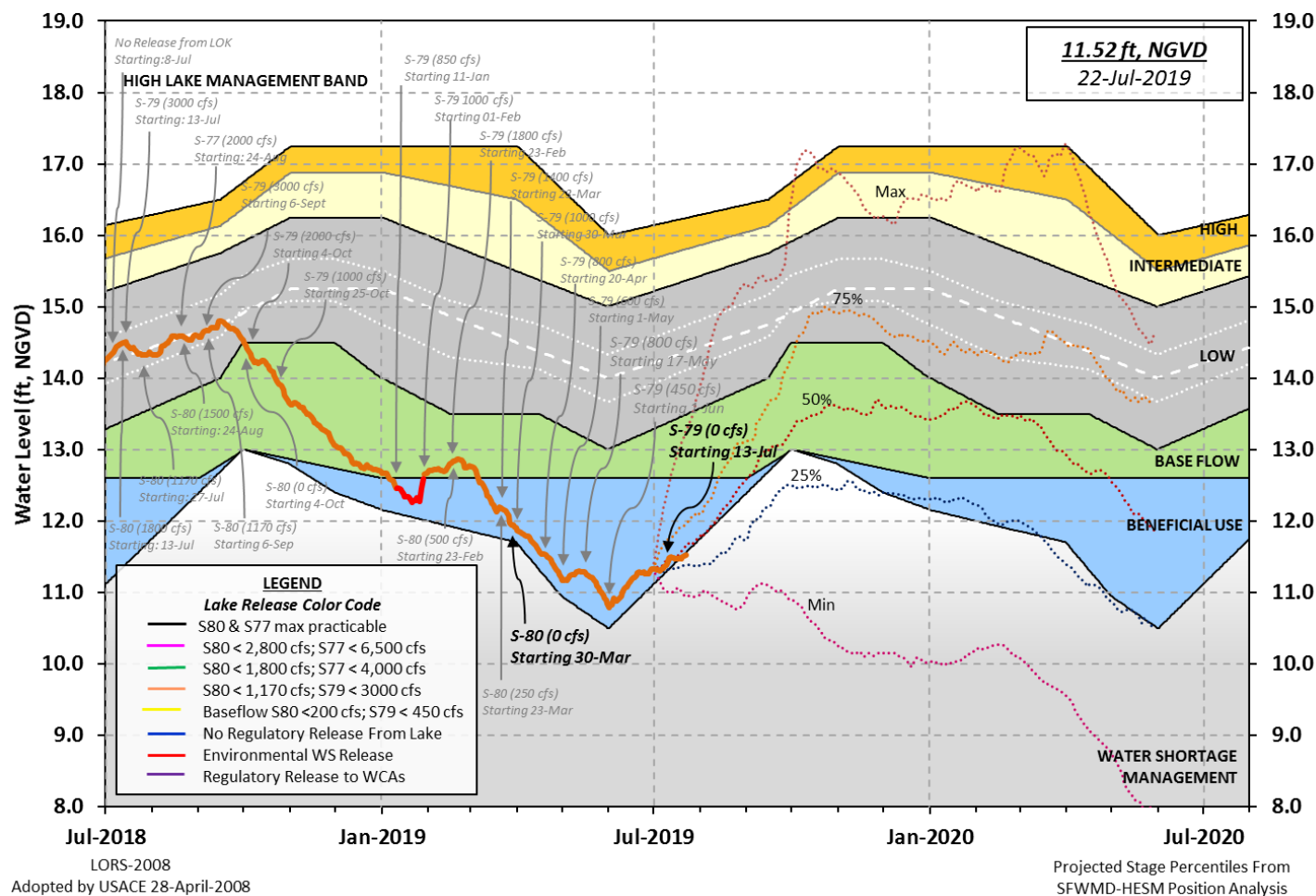


Figure 3. Recent Lake Okeechobee stage and releases, with projected stages based on a dynamic position analysis.

Lake Okeechobee Water Level Comparison

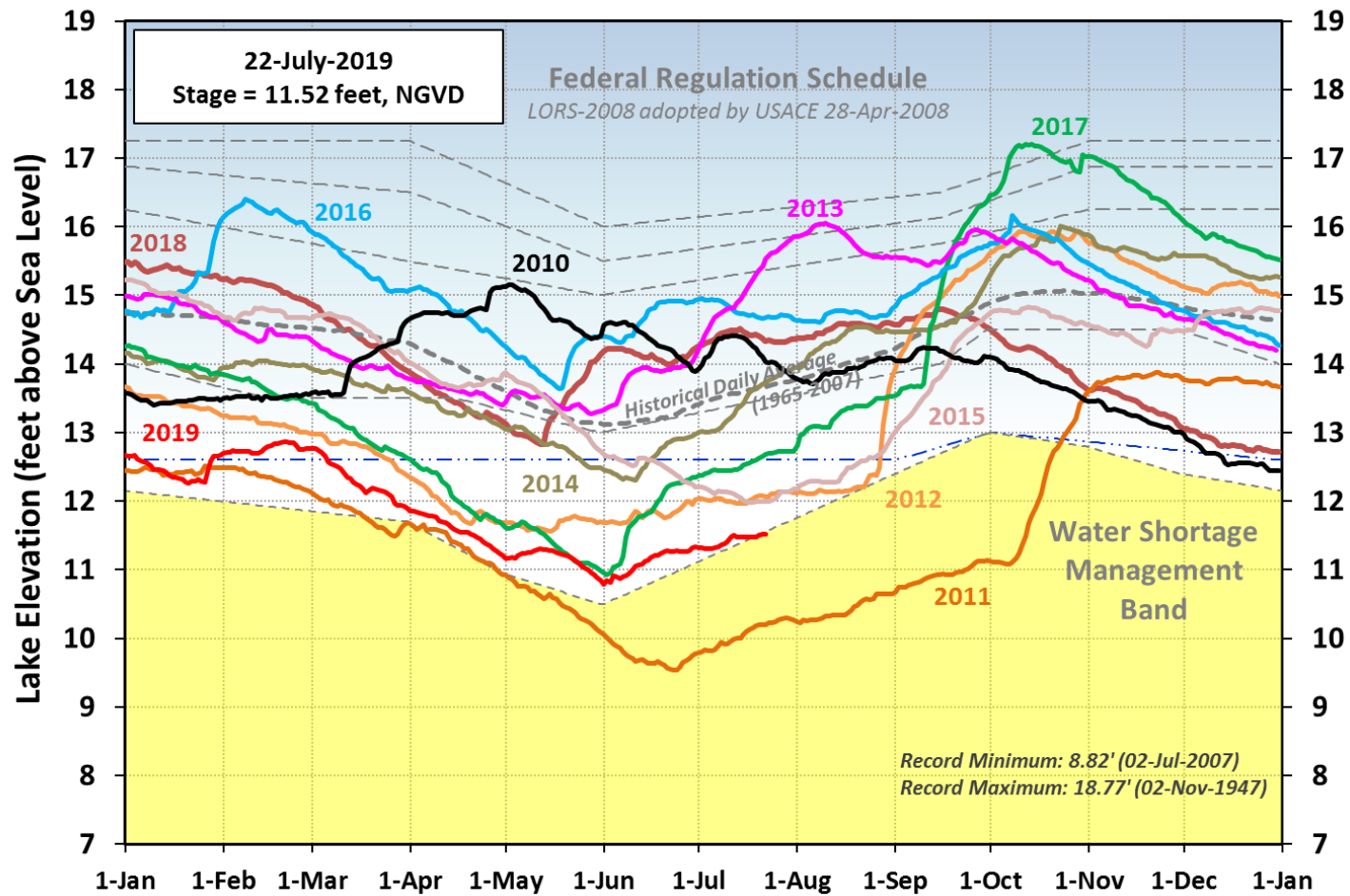


Figure 4. Select annual stage hydrographs for Lake Okeechobee from 2010 – 2019.

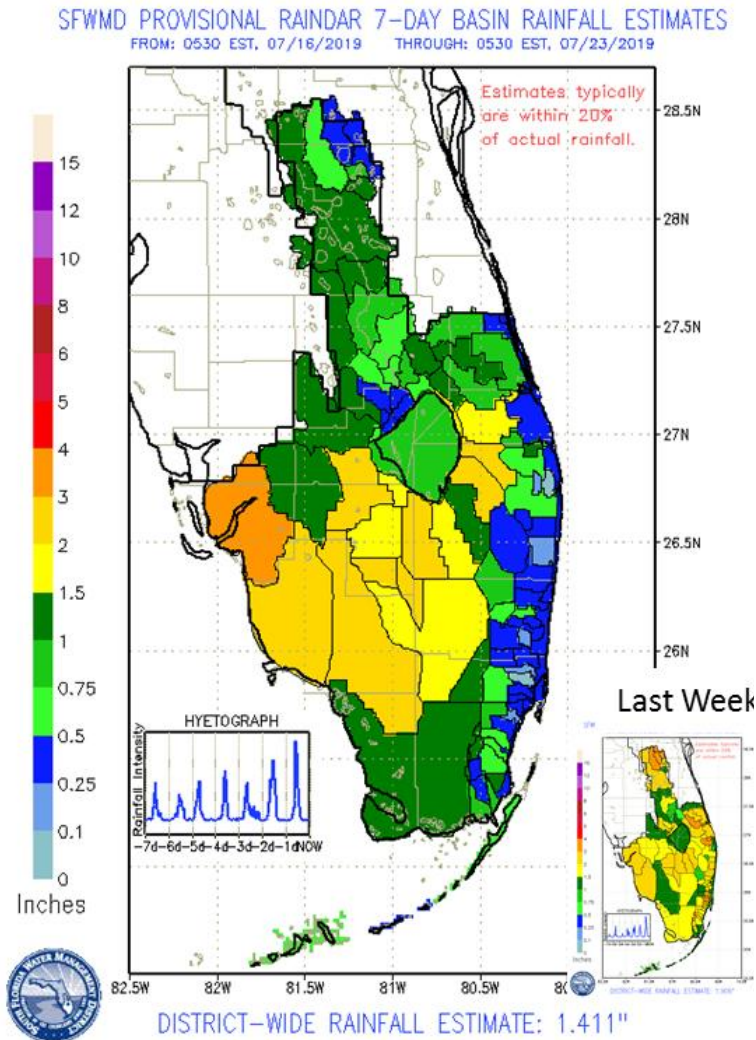


Figure 5. Rainfall estimates by basin.

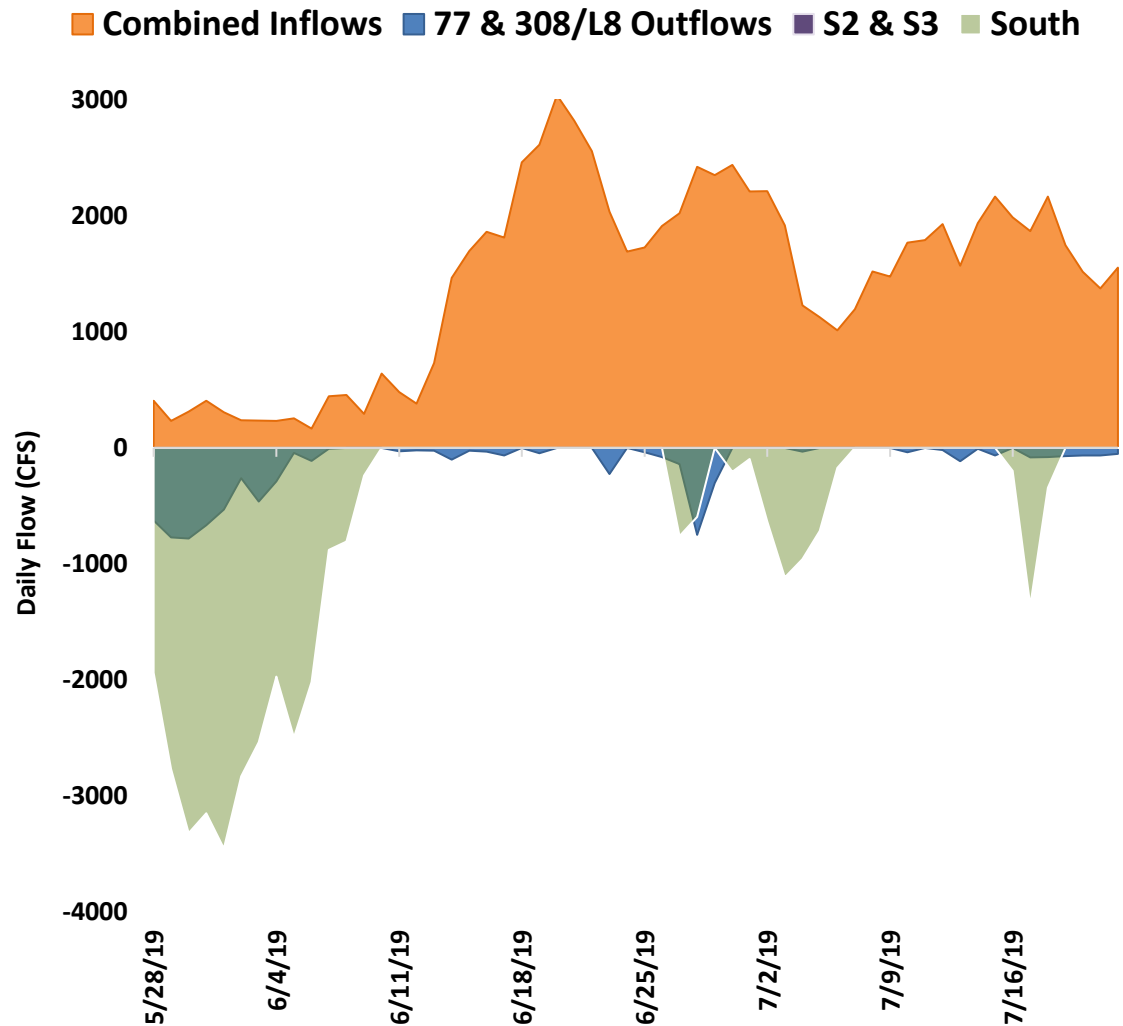


Figure 6. Major inflows (orange) and outflows (blue) of Lake Okeechobee, including the S-350 structures designated as South (green). The L-8 Canal flows through Culvert 10A are included as outflows when positive, and as inflows when backflowing into the lake. All inflows and outflows are shown as positive and negative, respectively, for visual purposes. Outflows through the S-77 and S-308 structures are shown based on their downstream gauges to account for lock openings for navigation.



June 4 - 5, 2019		
Site	Chlorophyll <i>a</i> (µg/L)	Microcystin (µg/L)
Nearshore Stations		
KISSR0.0	31.3	0.31
L005	7.7	BDL
LZ2	30.3	BDL
LZ25A	3.0	
PALMOUT	3.7	
PELBAY3	2.9	
POLE3S	3.8	
POLESOUT	19.6	BDL
RITTAE2	1.7	
Pelagic Stations		
L001	43.0	
L004	6.3	
L006	16.7	
L007	7.9	
L008	17.1	
LZ30	8.3	BDL
LZ40	10.1	
CLV10A	22.8	0.40

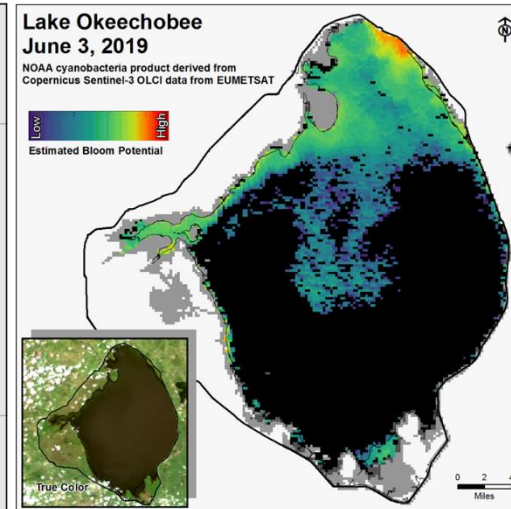


Figure 7. Chlorophyll *a* (µg/L) and microcystin (µg/L) values for nearshore and pelagic stations for June 2019. SFWMD classifies an algal bloom as having Chla values >40 µg/L. Microcystin values <0.20 µg/L are below the detection limit (BDL). The image on the right is an estimate of cyanobacteria density (bloom potential) from roughly the same time as samples were collected and is based on NOAA's harmful algal bloom monitoring system derived from Copernicus Sentinel-3 OLCI data from EUMETSAT.

Average June Water Quality 2008 - 2019

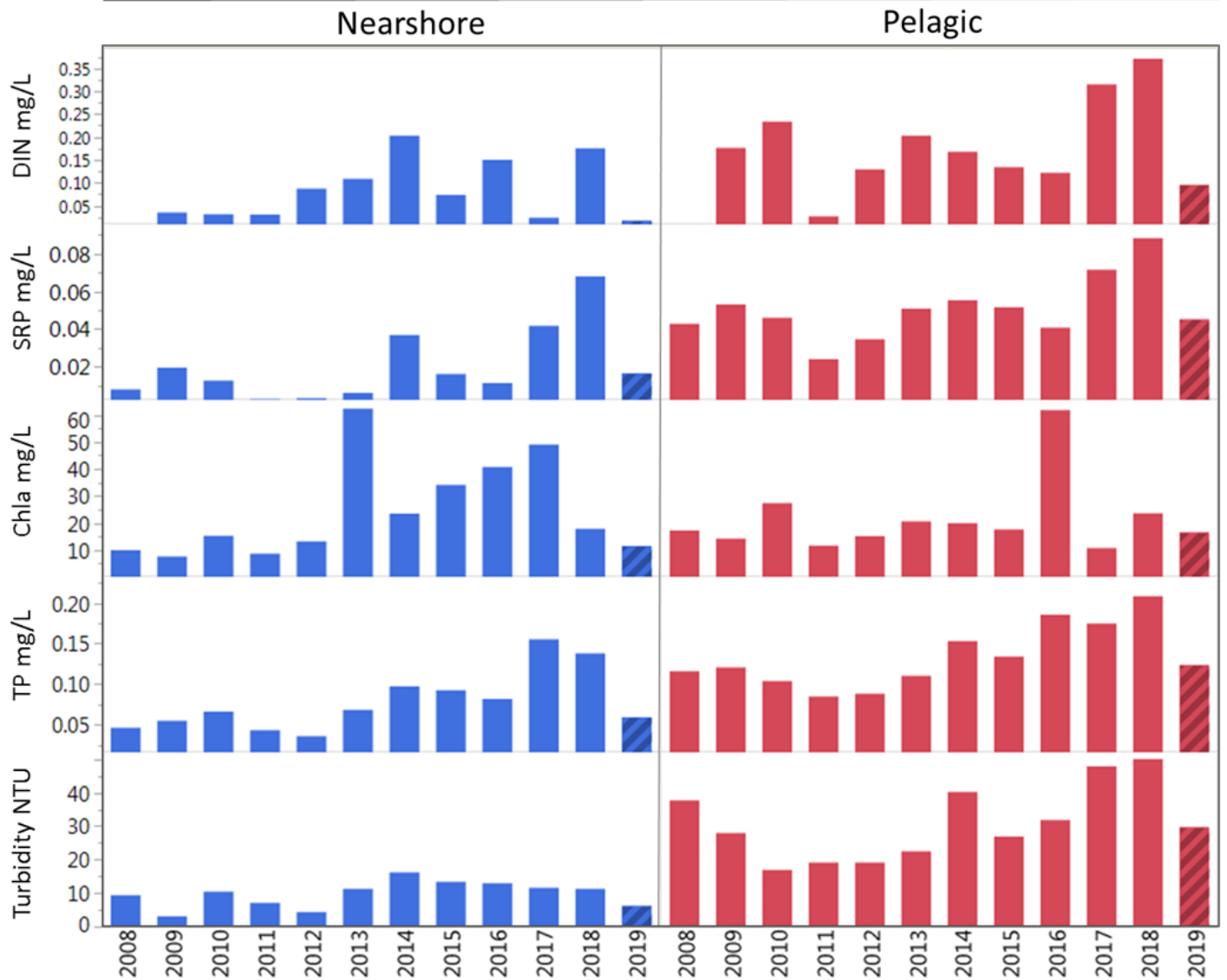


Figure 8. Average June values for several parameters in nearshore and pelagic stations from 2008 - 2019. Dissolved Inorganic Nitrogen (DIN), Soluble Reactive Phosphorus (SRP), Chlorophyll a (Chla), Total Phosphorus (TP), and turbidity values are shown, from top to bottom.

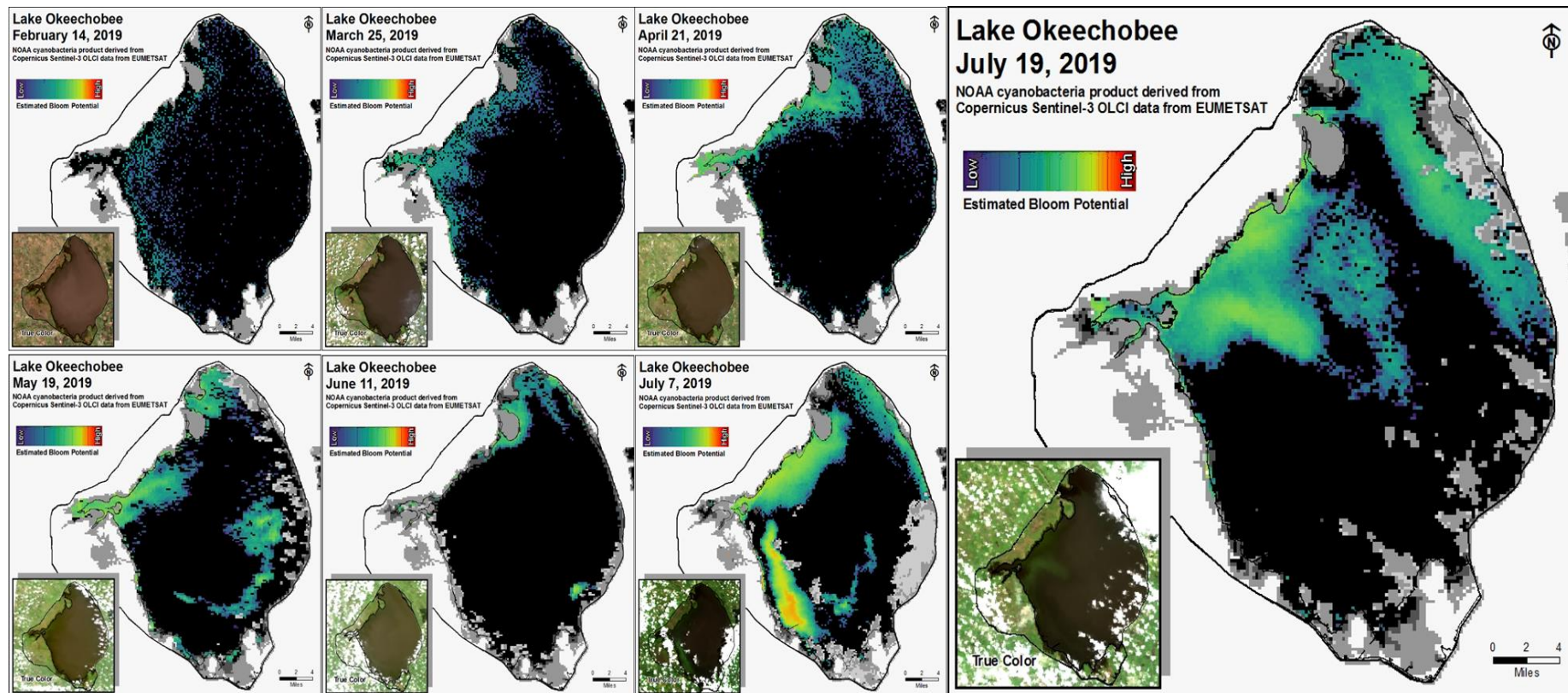


Figure 9. Potential for cyanobacterial blooms on Lake Okeechobee over the past few months, based on NOAA's harmful algal bloom monitoring system derived from Copernicus Sentinel-3 OLCI data from EUMETSAT. Gray indicates cloud cover.

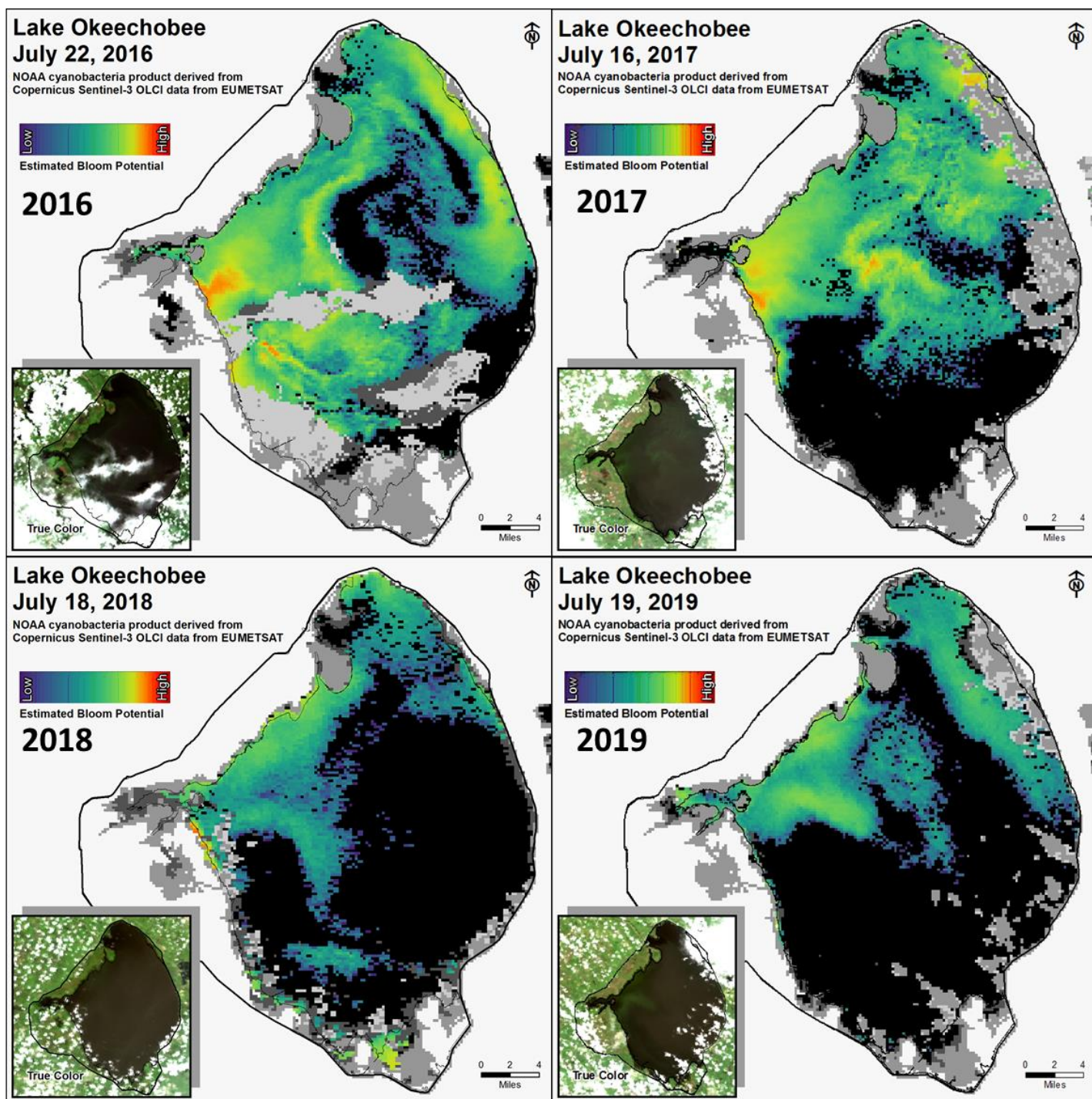


Figure 10. Potential for cyanobacterial blooms on Lake Okeechobee compared to the same time over the past several years, based on NOAA's harmful algal bloom monitoring system derived from Copernicus Sentinel-3 OLCI data from EUMETSAT. Gray indicates cloud cover.

ESTUARIES

St. Lucie Estuary:

Last week total inflow to the St. Lucie Estuary averaged approximately 375 cfs (Figures 1 and 2) and last month inflow averaged about 573 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	238
S-80	0
S-308	0
S-49 on C-24	40
S-97 on C-23	10
Gordy Rd. structure on Ten Mile Creek	87

Over the past week, salinity increased at A1A Bridge and remained about the same throughout the rest of the estuary (Table 2, Figures 3 and 4). The seven-day moving average of the water column (an average of the surface and bottom salinity) at the US1 Bridge is estimated to be 18.3. 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)	11.6 (11.9)	16.3 (17.1)	NA ¹	
US1 Bridge	17.7 (17.7)	19.0 (18.3)	10.0-26.0	
A1A Bridge	27.4 (26.1)	29.1 (27.6)	NA ¹	

¹Envelope not applicable.

Caloosahatchee Estuary:

Last week total inflow to the Caloosahatchee Estuary averaged approximately 1,716 cfs (Figures 5 and 6) and last month inflow averaged about 1,839 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	57
S-78	274
S-79	1407
Tidal Basin Inflow	309

Over the past week, salinity increased at Ft. Myers Yacht Basin and remained about the same throughout the rest of the estuary (Table 4, Figures 7 & 8). The seven-day average salinity values are estimated to be within the good range for adult eastern oysters at Shell Point and Sanibel and unknown at Cape Coral (Figure 9). The 30-day moving average surface salinity is 0.3 at Val I-75 and 1.5 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)	0.3 (0.3)	0.3 (0.3)	NA ¹
Val I75	0.3 (0.3)	0.3 (0.3)	0.0-5.0 ²
Ft. Myers Yacht Basin	1.1 (0.7)	1.5 (0.8)	NA
Cape Coral	EM ³ (~8.3)	EM (~9.4)	10.0-30.0
Shell Point	20.8 (20.9)	22.6 (22.7)	10.0-30.0
Sanibel	28.2 (28.8)	28.8 (29.5)	10.0-30.0

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

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 0.6 to 2.8 at the end of the next two weeks for pulse release at S-79 ranging from 0 to 800 cfs and Tidal Basin inflows of 235 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	235	2.8	0.9
B	300	235	2.0	0.6
C	450	235	1.4	0.5
D	650	235	0.9	0.4
E	800	235	0.6	0.3

Red tide

The Florida Fish and Wildlife Research Institute reported on July 19, 2019, that *Karenia brevis*, the Florida red tide dinoflagellate, was not observed in samples collected from Lee, St. Lucie, Martin, Palm Beach or Miami-Dade counties (no samples from Broward County).

Water Management Recommendations

Lake stage is in the Water Shortage 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.

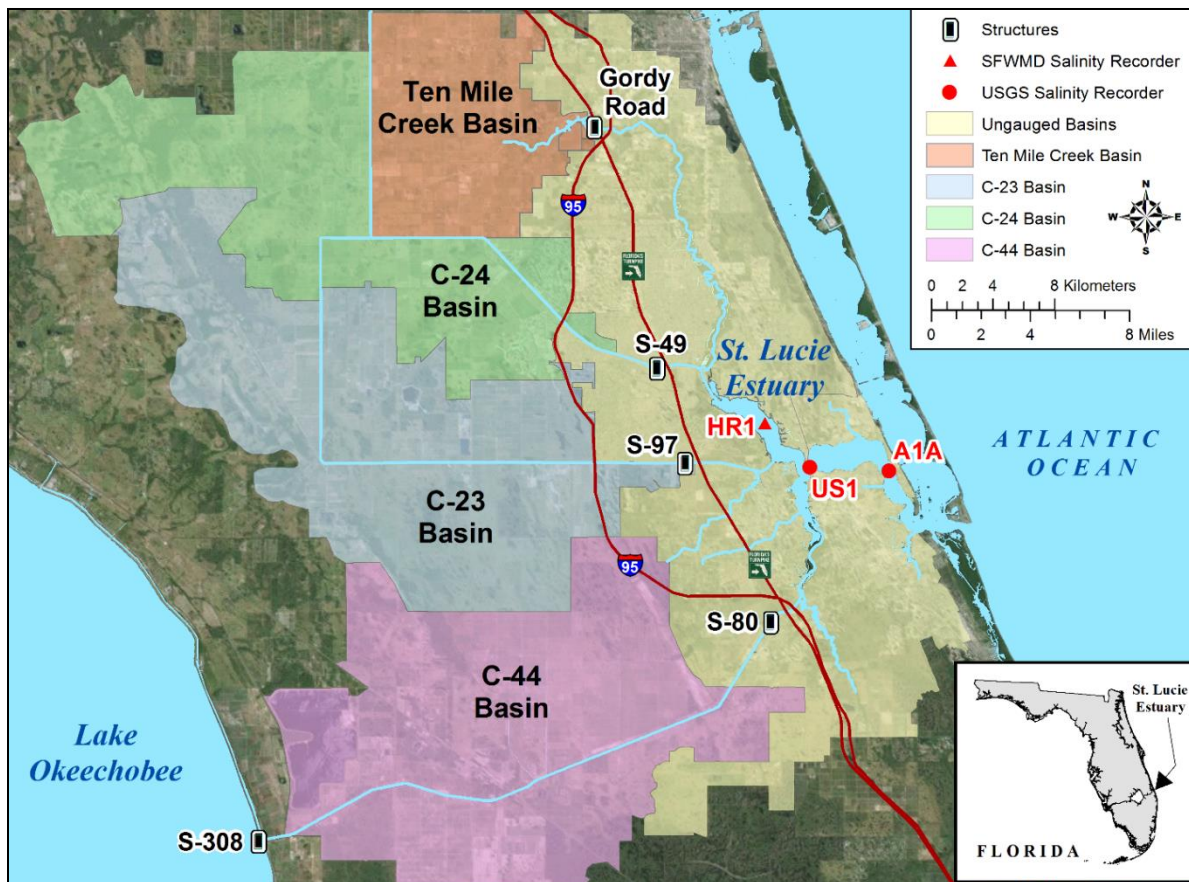


Figure 1. Basins, water control structures, and salinity monitoring for the St. Lucie Estuary.

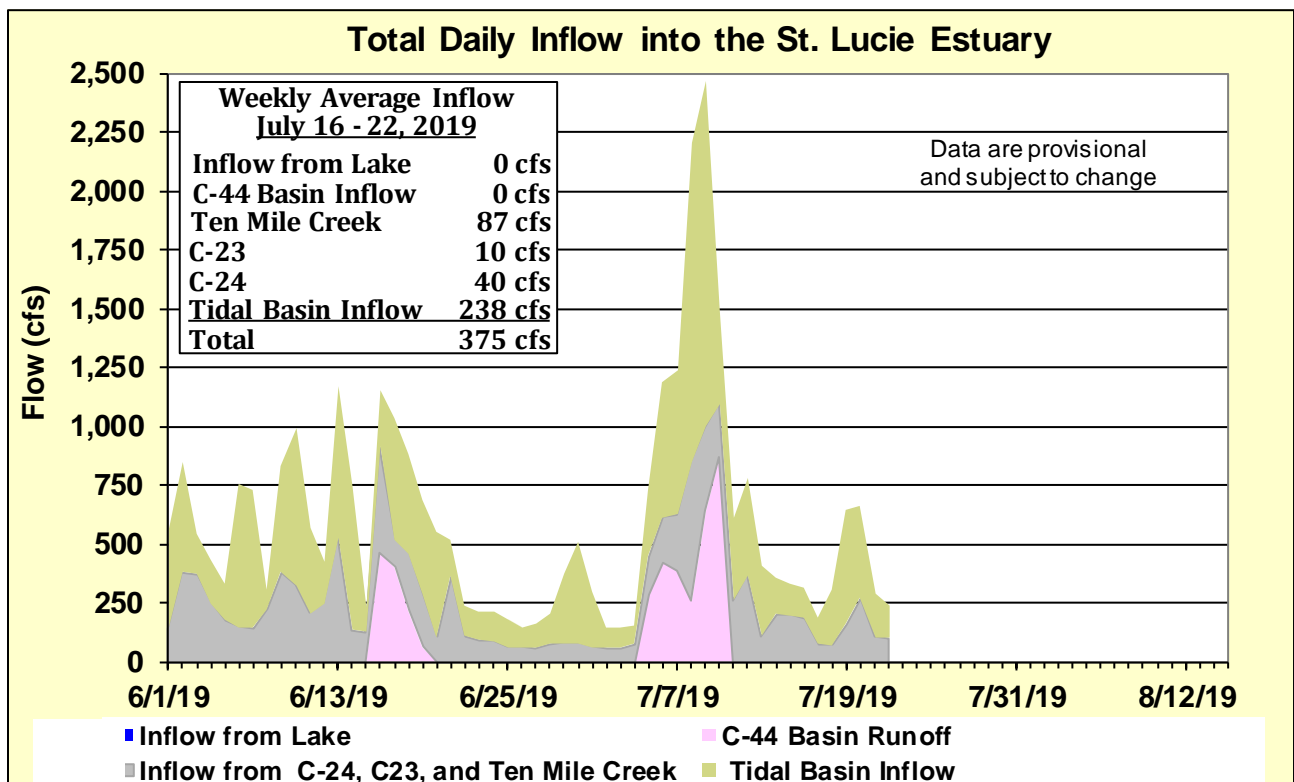


Figure 2. Total daily inflows from Lake Okeechobee and runoff from the C-44, C-23, C-24, Ten Mile Creek, and tidal basins into the St. Lucie Estuary.

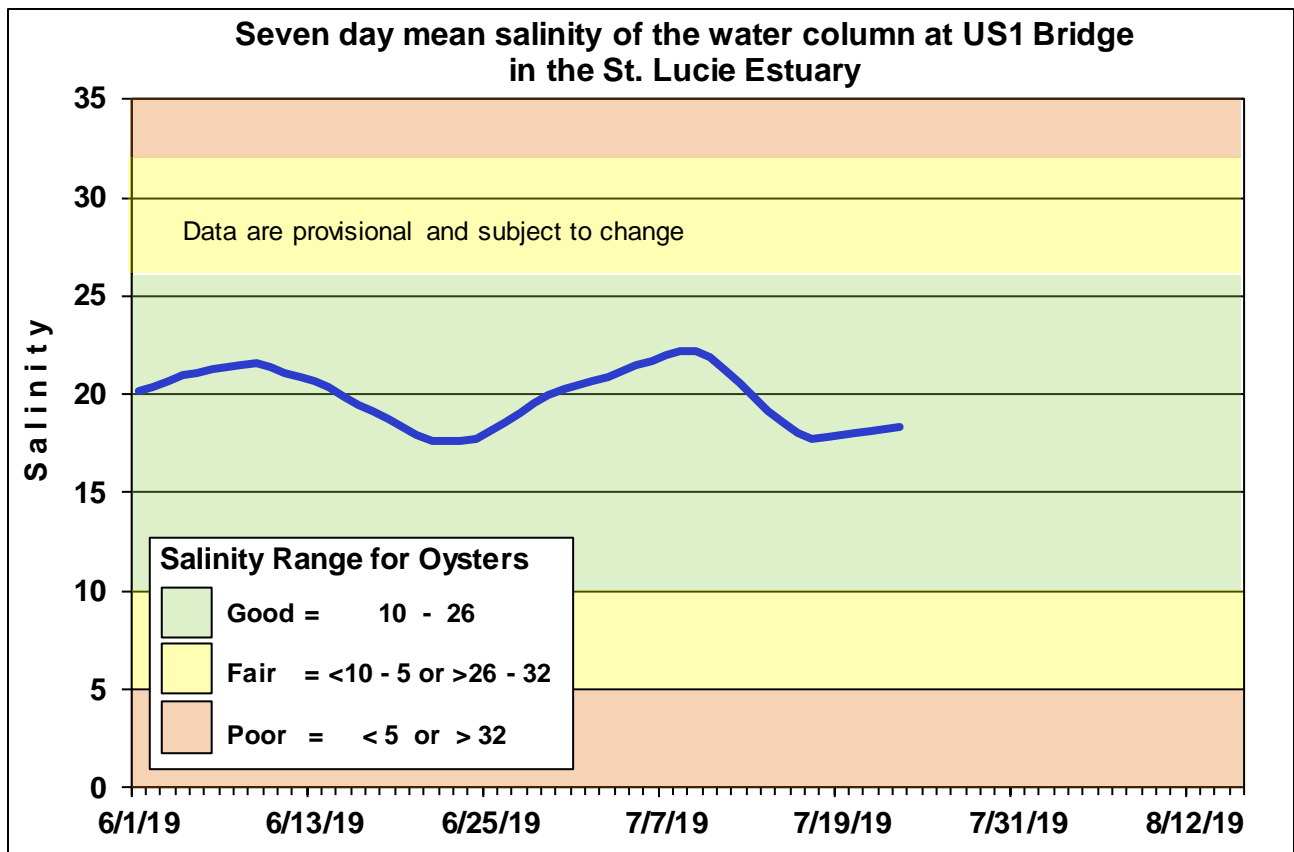


Figure 3. Seven-day mean salinity of the water column at the US1 Bridge.

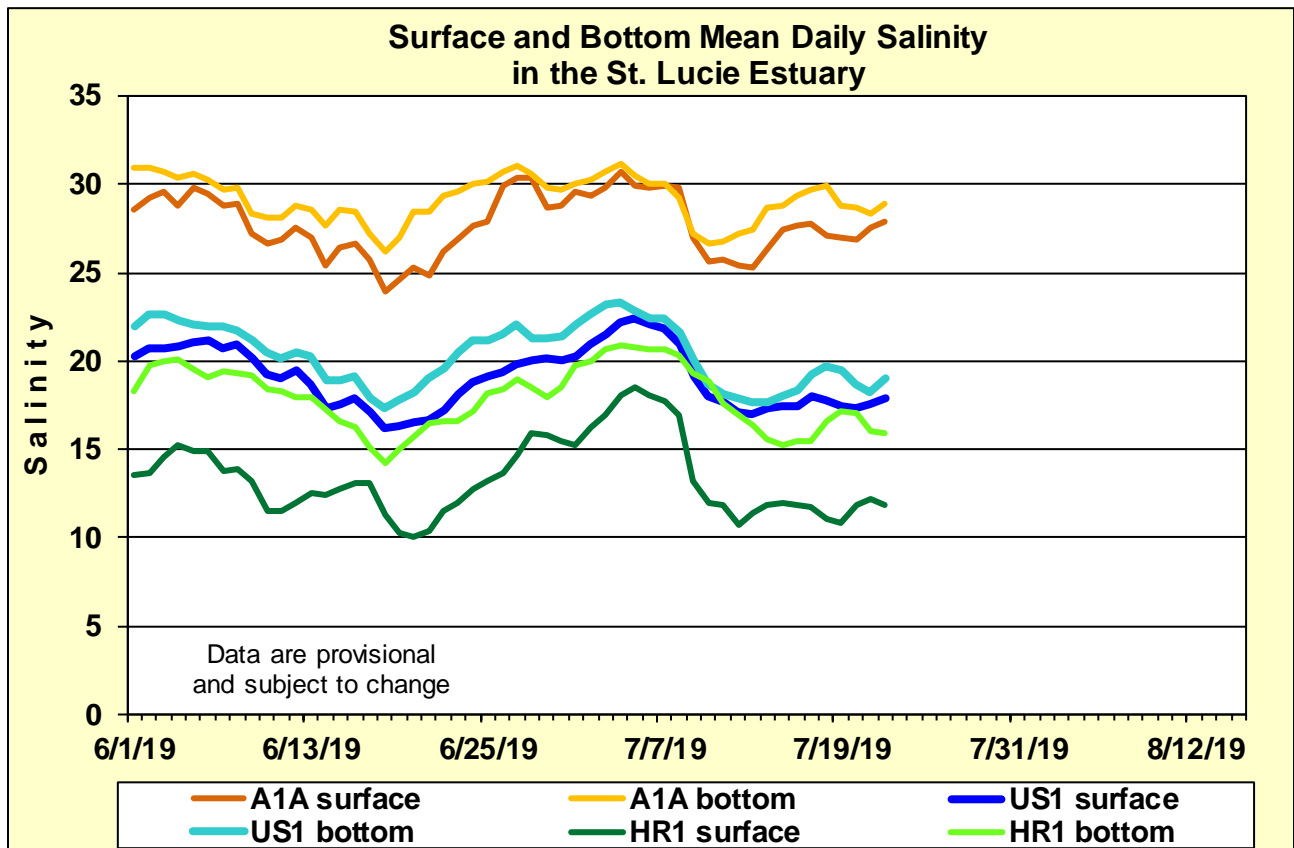


Figure 4. Daily mean salinity at the A1A, US1 and estimated HR1 stations.

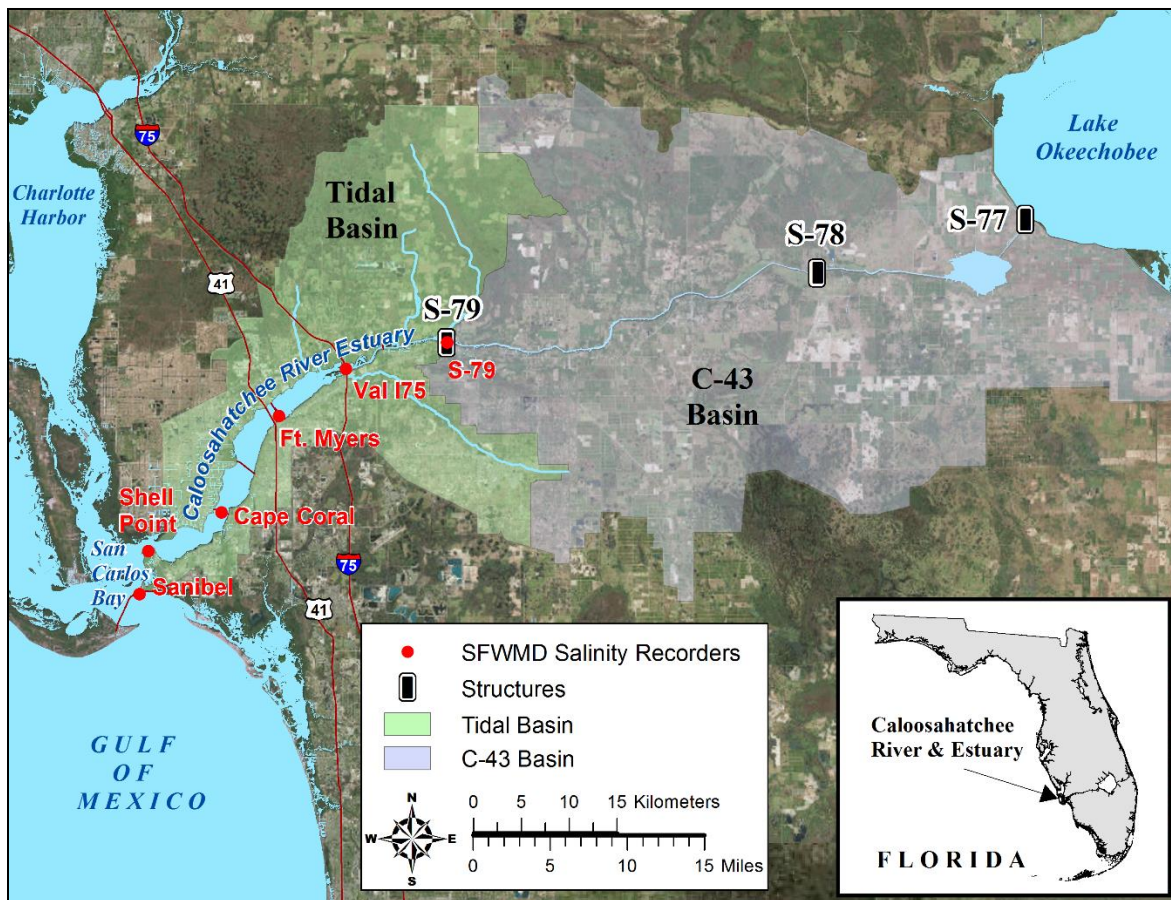


Figure 5. Basins, water control structures, and salinity monitoring for the Caloosahatchee Estuary.

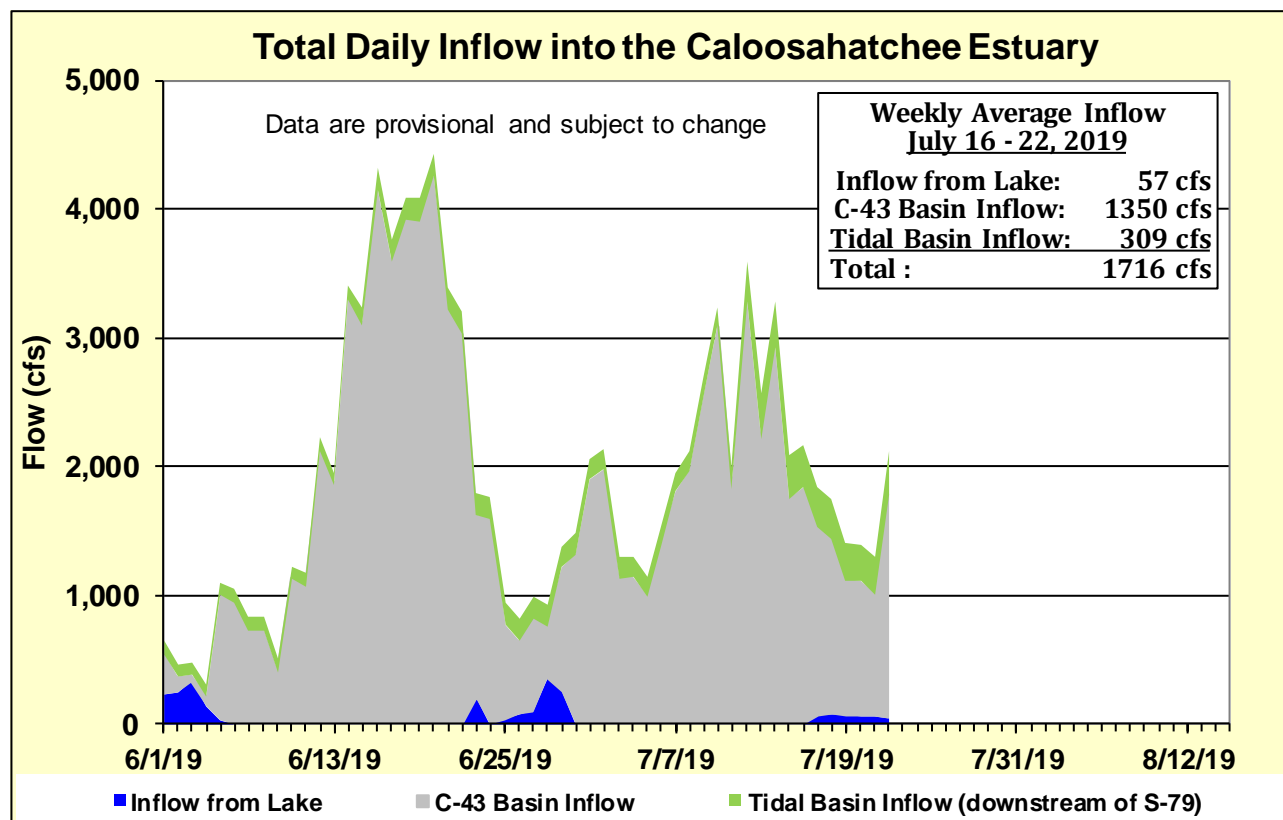


Figure 6. Total daily inflows from Lake Okeechobee, runoff from the C-43 basin, and tributaries in the tidal basin into the Caloosahatchee River Estuary.

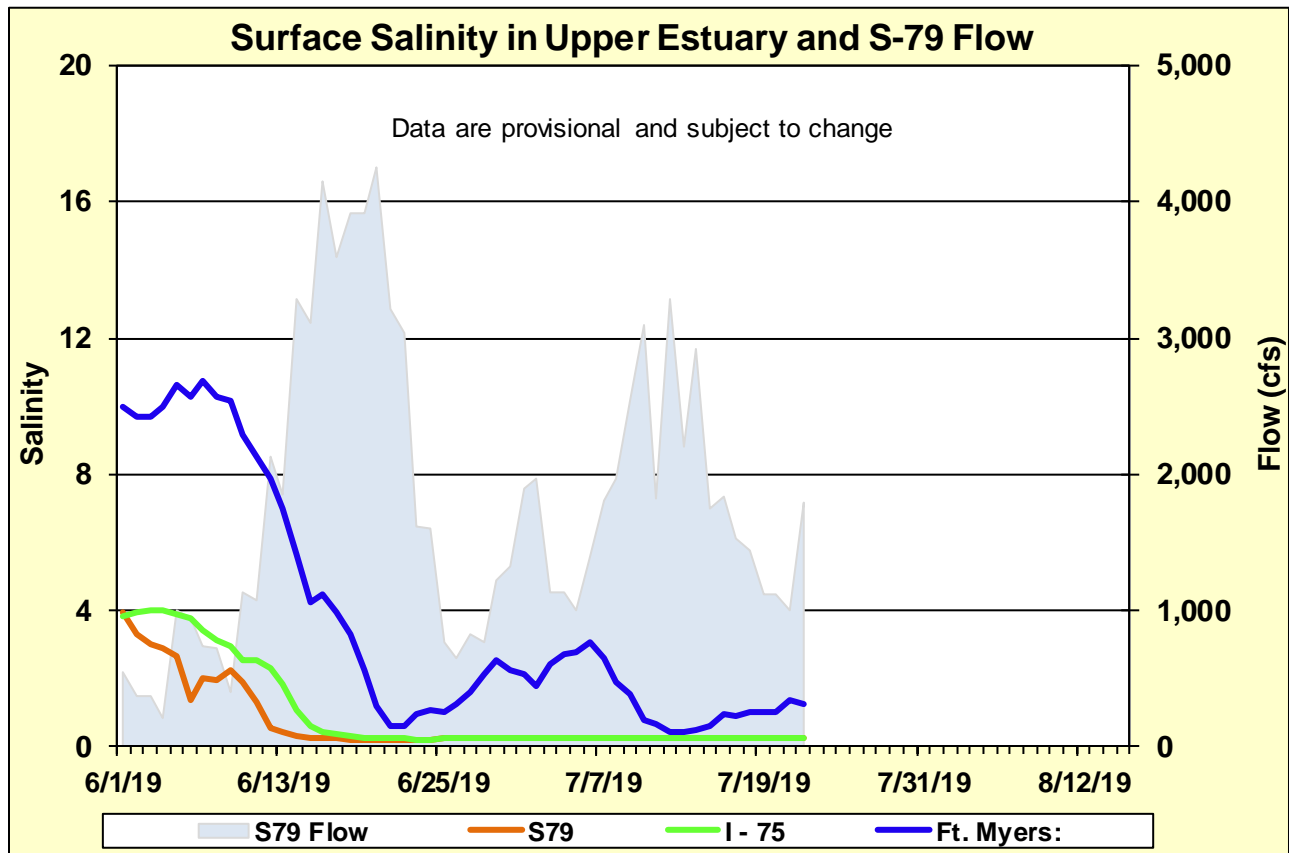


Figure 7. Daily mean flows at S-79 and salinity at upper estuary monitoring stations.

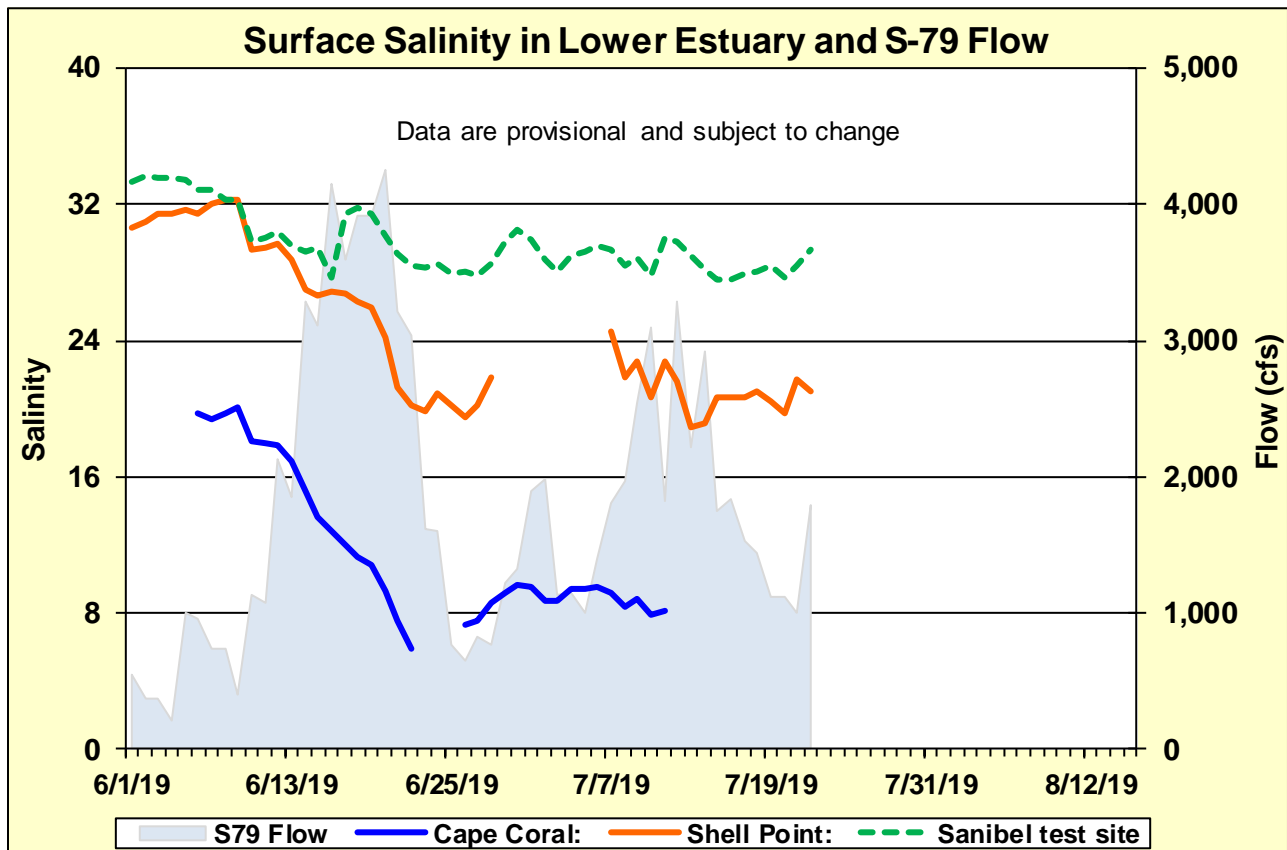


Figure 8. Daily mean flows at S-79 and salinity at lower estuary stations.

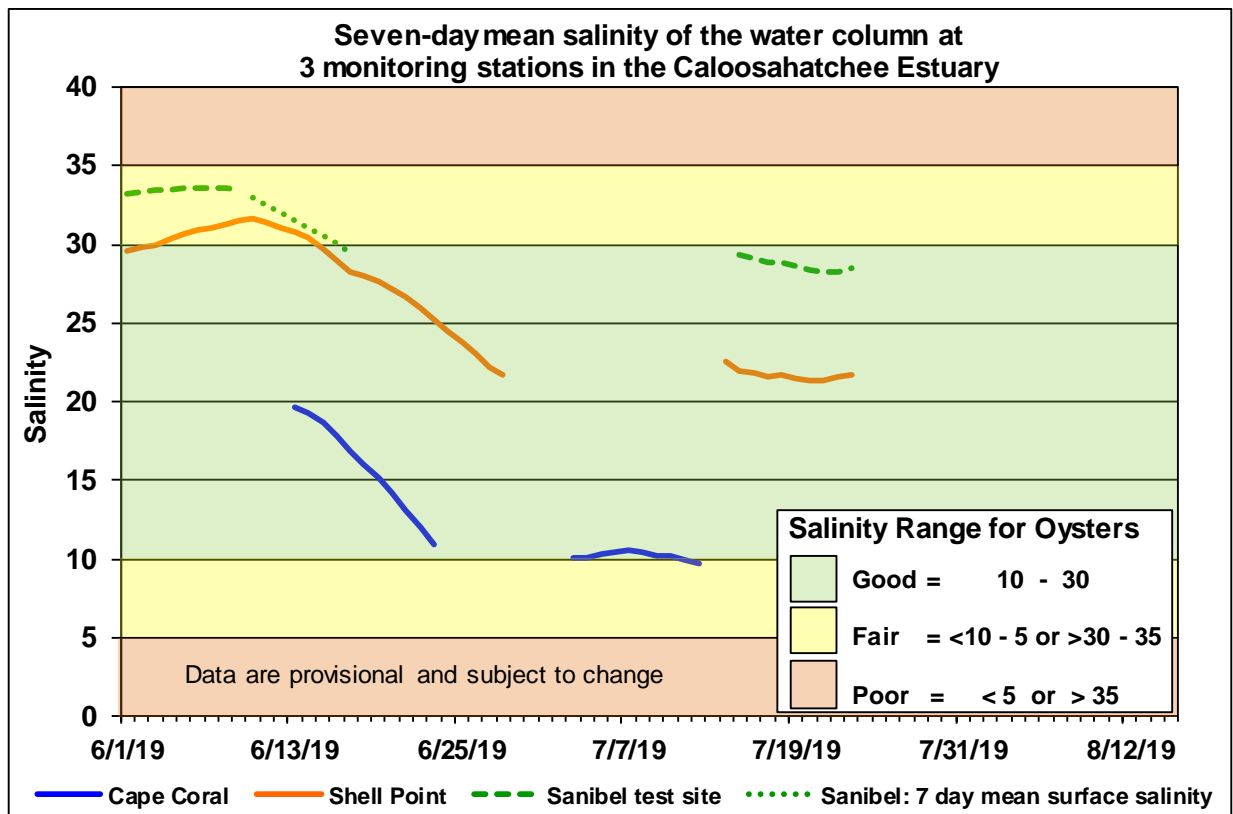


Figure 9. Seven-day mean salinity at Cape Coral, Shell Point, and Sanibel monitoring stations.

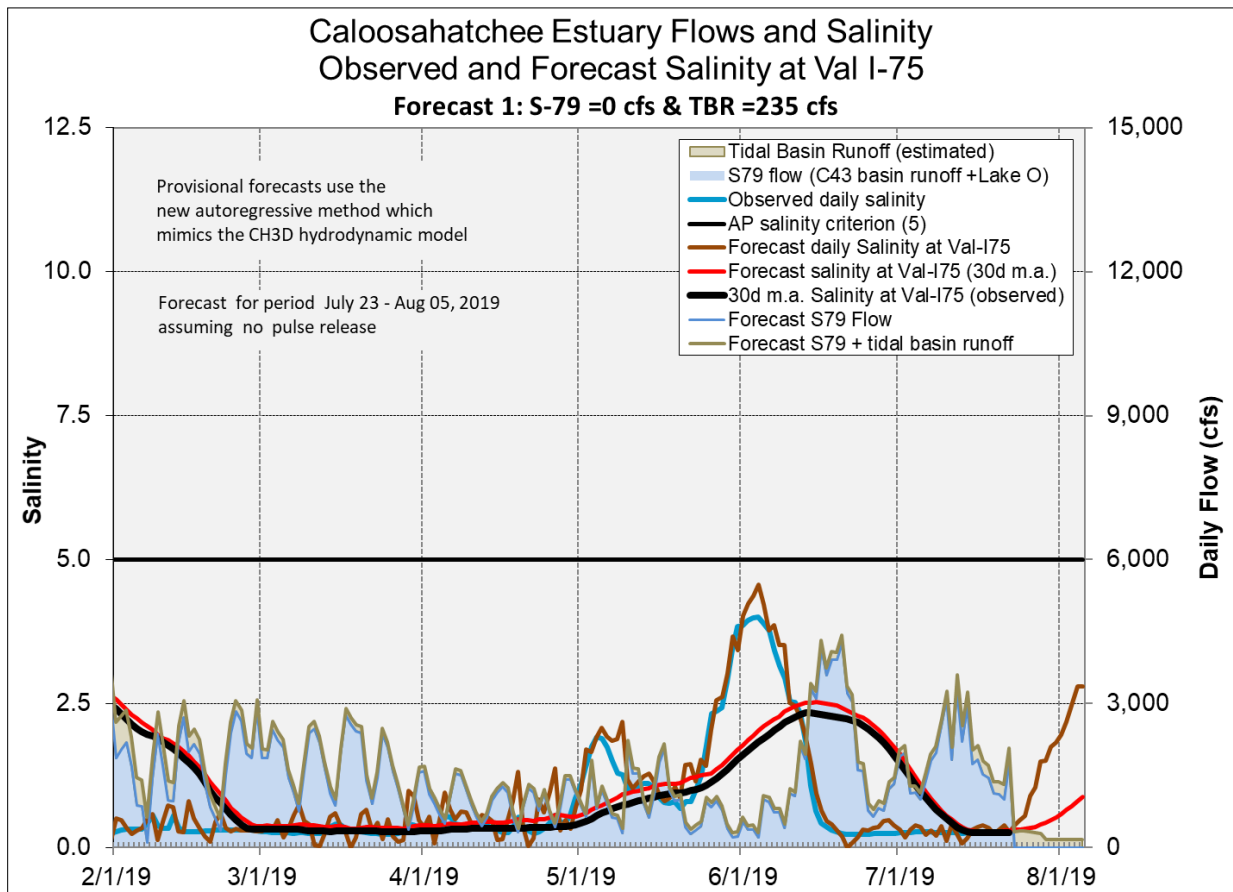
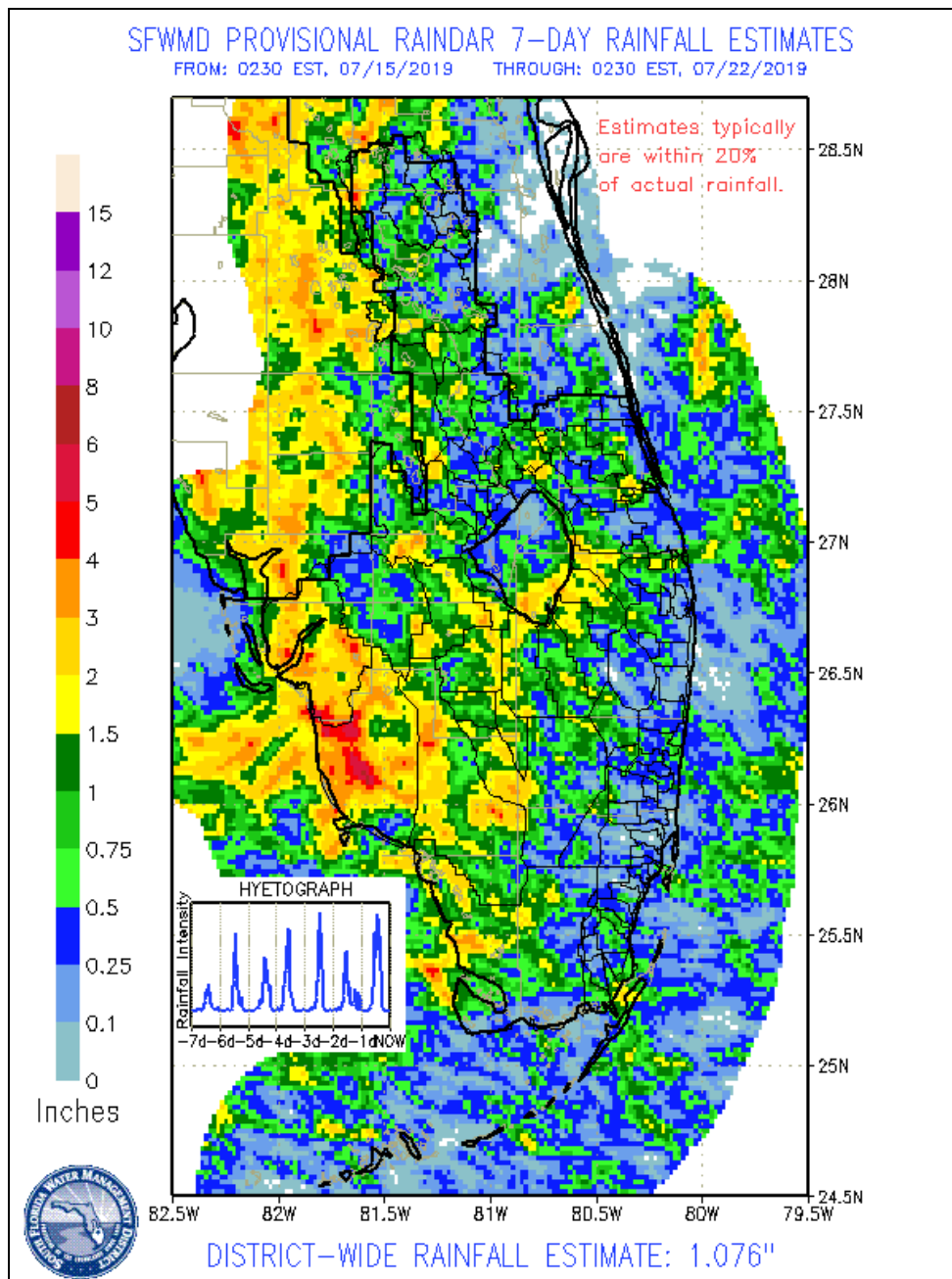


Figure 10. Forecasted Val I-75 surface salinity assuming no pulse release at S-79.

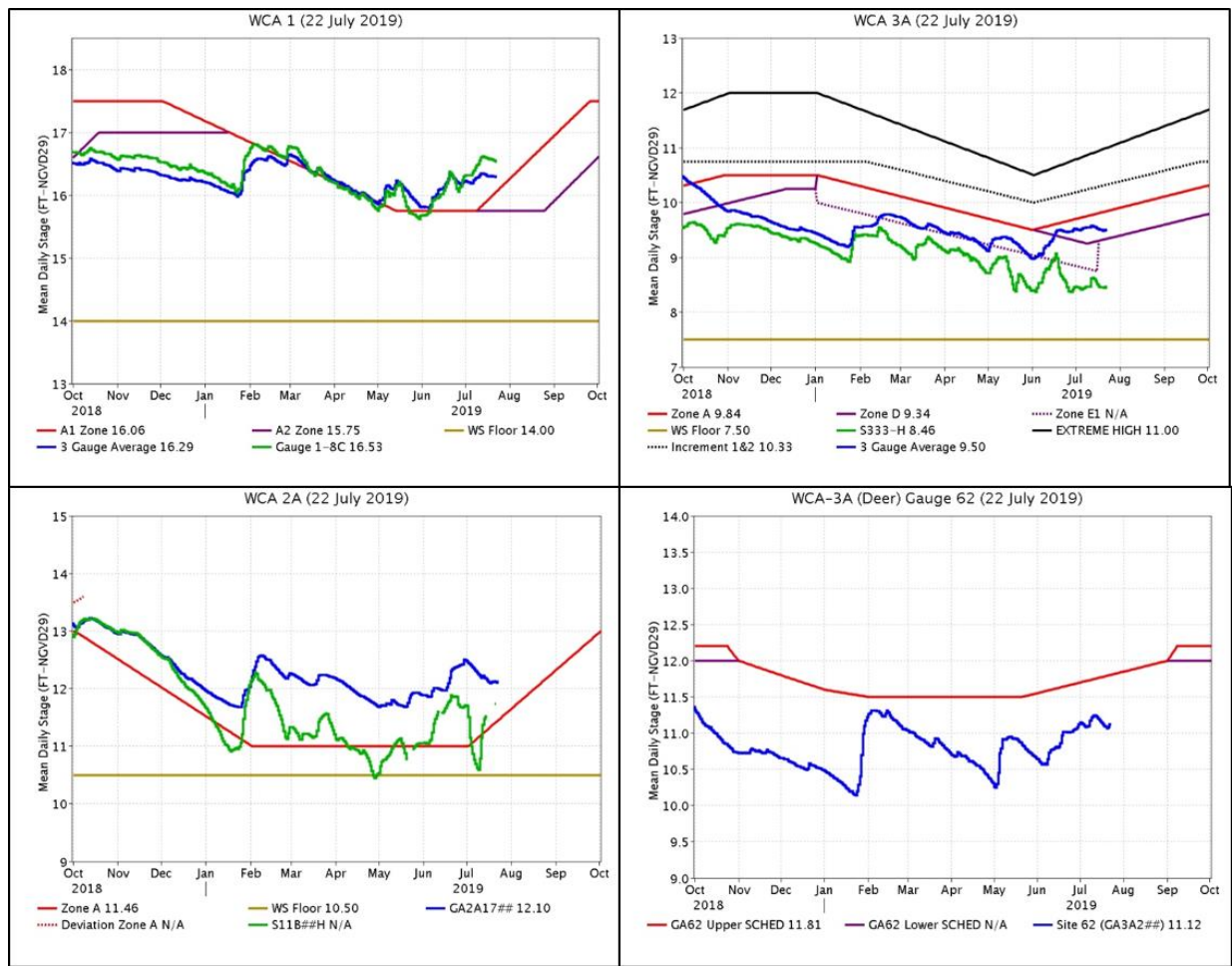
EVERGLADES

At the gauges monitored for this report the stages in the Everglades decreased on average 0.05 feet this past week. Individual gauge changes ranged from -0.07 feet (WCA-3A NW) to +0.01 feet (WCA-1). Pan evaporation was estimated at 1.77 inches this week which is greater than the estimated 1.08 inches of rain for the corresponding period.

Everglades Region	Rainfall (Inches)	Stage Change (feet)
WCA-1	0.30	-0.03
WCA-2A	0.76	-0.04
WCA-2B	0.62	-0.04
WCA-3A	0.95	-0.06
WCA-3B	0.95	-0.05
ENP	0.91	-0.06



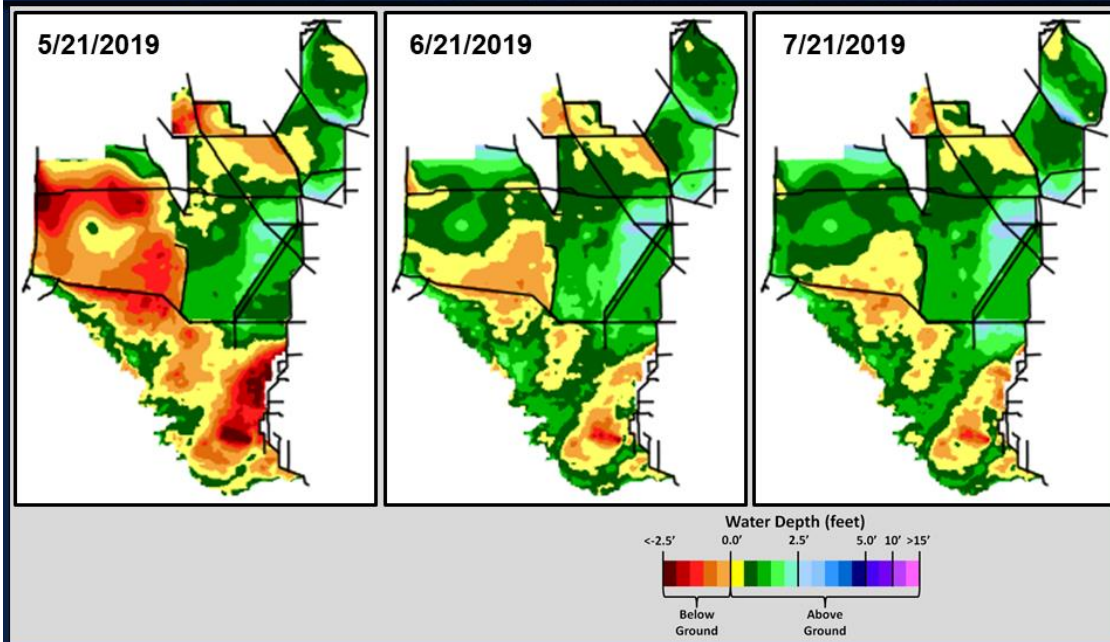
Regulation Schedules: WCA-1: The three-gauge average continues to trend towards the Zone A1 line this week, currently 0.23 feet above the A1 Zone regulation line. WCA-2A: Gauge 2A-17 stage continues its trend towards the rising Zone A regulation line, now 0.64 feet above. WCA-3A: The three-gauge average stage began trending towards the Zone D regulation line, currently 0.16 feet above. WCA-3A at gauge 62 (northwest corner) remains below schedule at 0.69 feet below the rising limb of the upper schedule.



Water Depths and Changes: The WDAT tool for spatial interpolation of depth monthly snapshots indicate stages in northeastern WCA-3A North have been increasing slowly. Conditions in WCA-1 look typical to wet for this time of year as ponding depths are reached in the southern end of that basin. WCA-2A depths look typical to wet and stages are above ground throughout. Stages in WCA-3A South continue to build along the northern reach of the L-67 levees. WDAT difference maps show that stage changes were mixed within WCAs 1 and 2A with differences that look to be due to increases or decreases in perimeter canal stage. Changes within WCA-3A were mixed. Stages in NE SRS are ascending. We are mostly drier than last year at this time when the area was under a high-water emergency order for conditions in WCA-3A.



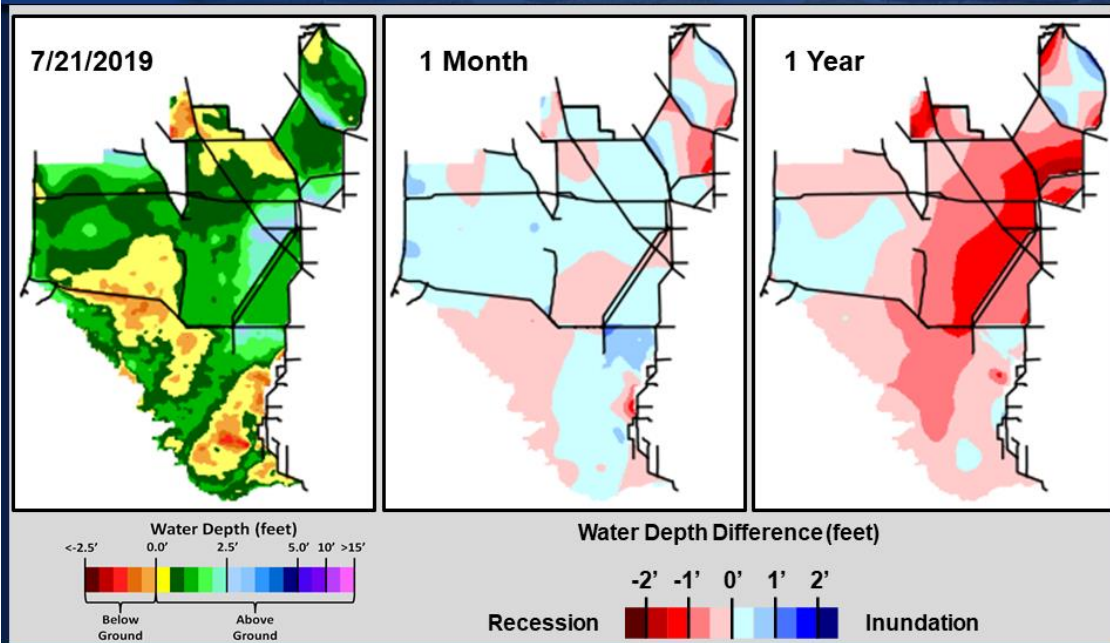
SFWDAT Water Depth Monthly Snapshots



South Florida Water Depth Assessment Tool (SFWDAT)



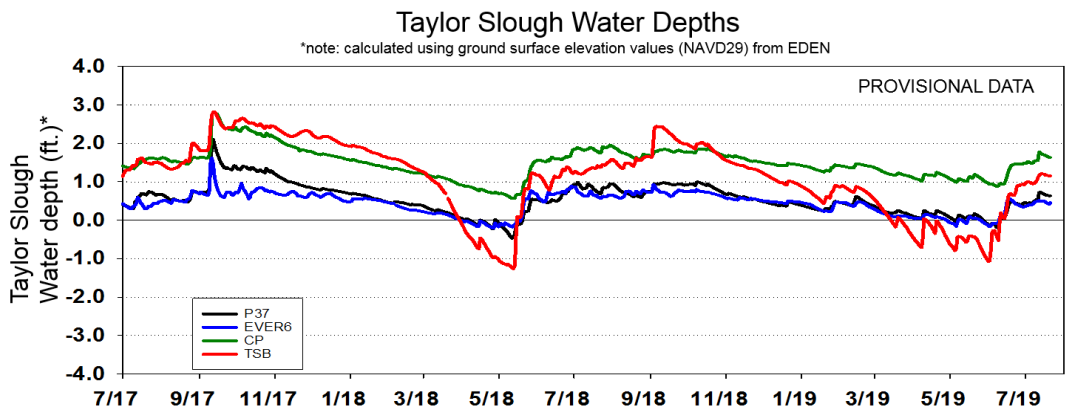
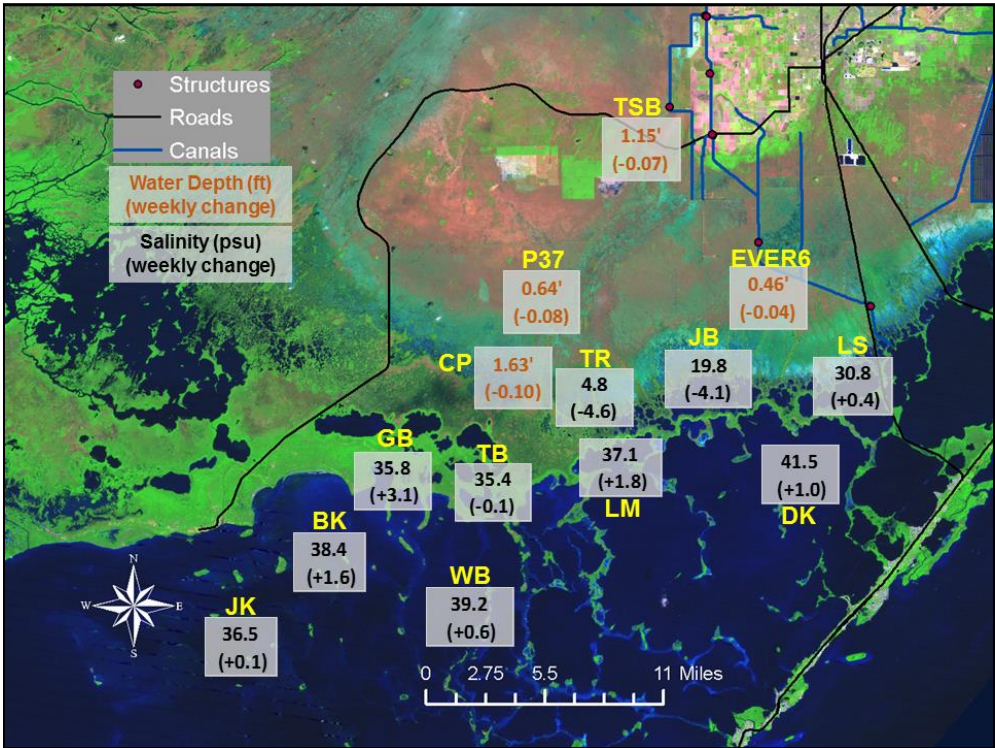
SFWDAT Everglades Difference Maps (Present – Past)

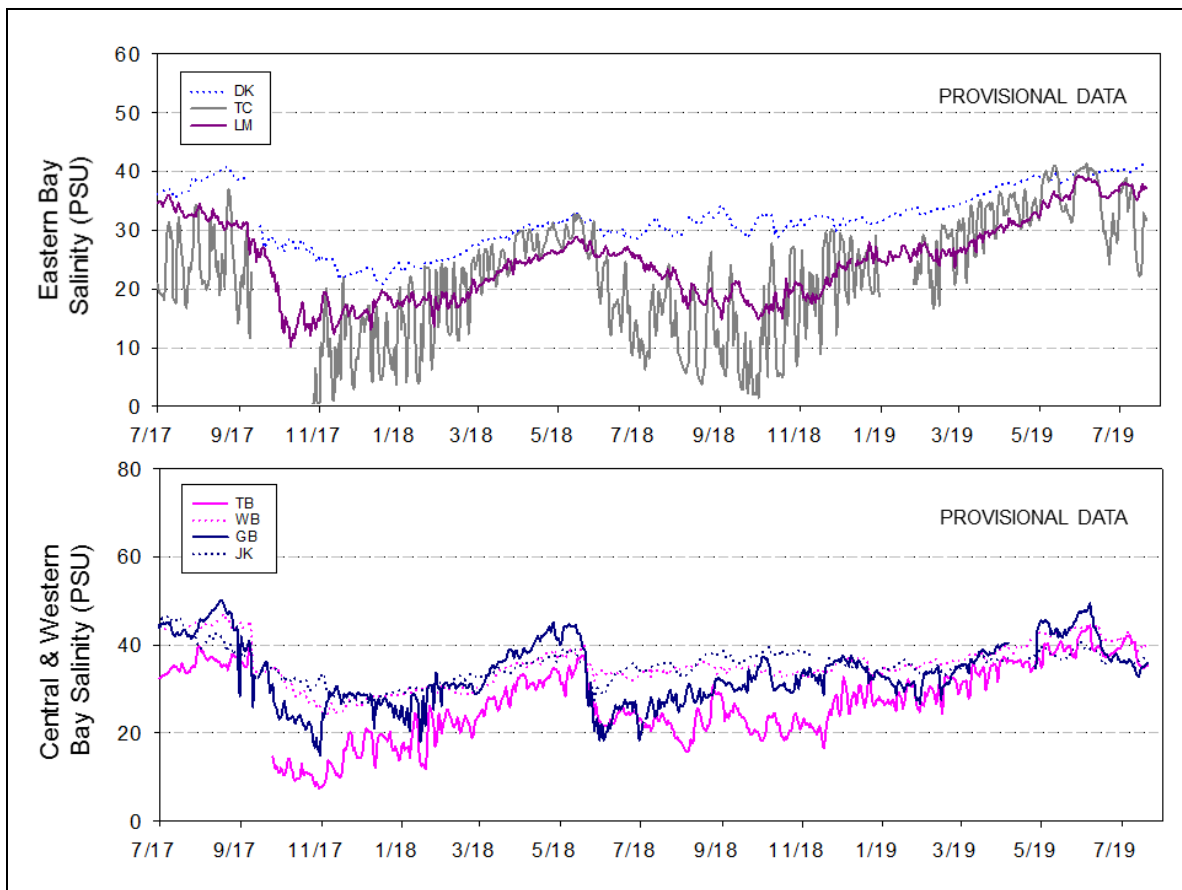


South Florida Water Depth Assessment Tool (SFWDAT)

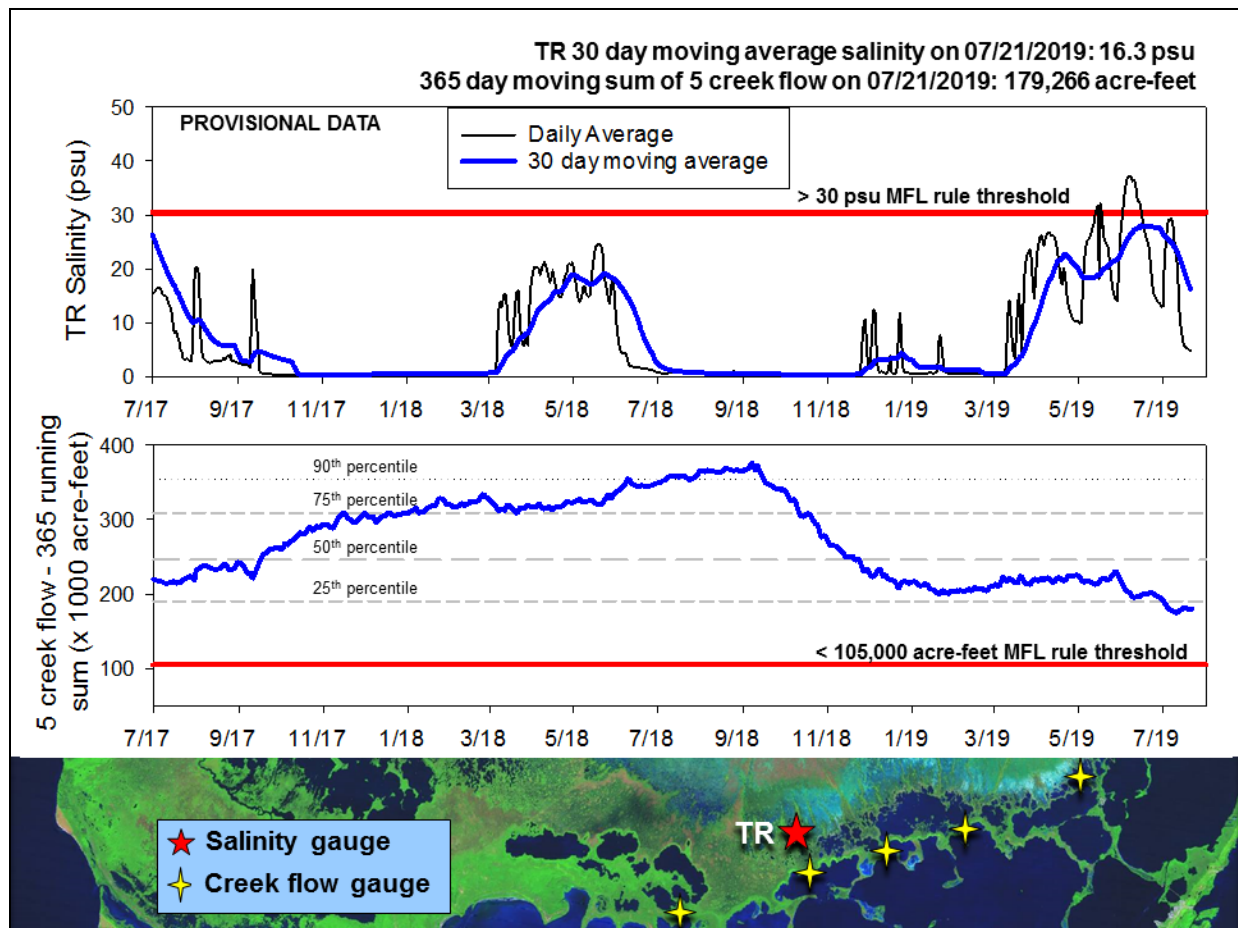
Taylor Slough Water Levels: An average of only 0.5 inches of rain fell over Taylor Slough and the ENP panhandle this past week, and stages decreased 0.07 inches as a result. Stages are still 2 inches higher than average for this time of year. TPO4 levels at S328 have decreased further to 5 ug/L after the structure has been open for 2 weeks.

Florida Bay Salinities: Average salinity in Florida Bay was 35 psu, up 1 psu from last week. The nearshore area is still elevated in the 20-37 psu range and needs to decrease to near 25 psu to prevent additional stress to the system.





Florida Bay MFL: Salinity at the TR station in the mangrove zone (tracked for the Florida Bay MFL) decreased from 9 psu to 5 psu this past week. The 30-day moving average decreased 5 psu to end the week at 16.3 psu. The weekly flow from the 5 creeks feeding Florida Bay was 4,000 acre-feet which is half of expected conditions for this time of year. The 365-day moving sum of flow from the five creeks (tracked as part of the Florida Bay MFL criteria) stayed nearly the same this week at 179,266 acre-feet which is still less than the 25th percentile (190,165 acre-feet). Creek flow is provisional data from the USGS and is highly variable.



Water Management Recommendations

Within the WCAs the area with the lowest stage (in fact the region remains below ground) is north eastern WCA-3A North. Raising the stage in that location would protect the sensitive peat soils in that region from oxidation and wildfire. With the Water Conservation Areas, a rate of ascension less than 0.25 feet per week or less than 0.5 feet per 2 weeks is the general ecological recommendation. Moving water towards Taylor Slough and Florida Bay will freshen salinity conditions within the nearshore areas of Florida Bay and decrease the currently stressful conditions for seagrasses and fauna. More specific recommendations appear in the summary table below. The red text represents new or modified information or recommendations.

SFWMD Everglades Ecological Recommendations, July 22nd, 2019 (red is new)

Area	Weekly change	Recommendation	Reasons
WCA-1	Stage decreased by 0.03'	Manage for a rate of ascension less than +0.25' per week, or less than +0.5 per 2 weeks.	Protect tree islands, upstream/downstream habitat and wildlife. Protect conditions for apple snail reproduction.
WCA-2A	Stage decreased by 0.04'	Manage for a rate of ascension less than +0.25' per week, or less than +0.5 per 2 weeks.	Protect upstream/downstream habitat and wildlife. Protect conditions for apple snail reproduction.
WCA-2B	Stage decreased by 0.04'	Maintain depths at regulation schedule. Manage for a rate of ascension less than +0.25' per week, or less than +0.5 per 2 weeks.	Protect upstream/downstream habitat and wildlife. Protect conditions for apple snail reproduction.
WCA-3A NE	Stage decreased by 0.05'	Maintain depths at regulation schedule. Manage for a rate of ascension less than +0.25' per week, or less than +0.5 per 2 weeks.	Protect tree islands, upstream/downstream habitat and wildlife. Protect conditions for apple snail reproduction.
WCA-3A NW	Stage decreased by 0.07'	Maintain depths at regulation schedule. Manage for a rate of ascension less than +0.25' per week, or less than +0.5 per 2 weeks.	
Central WCA-3A S	Stage decreased by 0.05'	Maintain depths at regulation schedule. Manage for a rate of ascension less than +0.25' per week, or less than +0.5 per 2 weeks.	Protect tree islands, upstream/downstream habitat and wildlife. Protect conditions for snail kite nesting.
Southern WCA-3A S	Stage decreased by 0.06'		
WCA-3B	Stage decreased by 0.05'	Manage for a rate of ascension less than +0.25' per week, or less than +0.5 per 2 weeks.	Protect upstream/downstream habitat and wildlife. Protect conditions for apple snail reproduction.
ENP-SRS	Stage decreased by 0.06'	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 -0.04'	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 -4.1 to +3.1 psu	Move water southward as possible	When available, provide freshwater to maintain low salinity buffer and promote water movement.