

# Appendix D5

Technical Memorandum



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**Subject** TWA 20TW0002949 P274 Little Manatee River  
System MFLs Development Support  
Task 4.4 –Navigation Deliverable

**Attention** Kym Holzwart, Southwest Florida Water  
Management District

**From** Mike Wessel, Janicki Environmental, Inc.

**Date** March 24<sup>th</sup>, 2021

**Through** James Greco, Jacobs Engineering Group

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Dear Kym – On behalf of Janicki Environmental, Inc. (JEI) and Jacobs Engineering Group, we present this technical memorandum (TM) in fulfillment of Task 4.4 of Task Work Order Number 20TW0002949 describing an evaluation of the Navigation Water Resource Value. We hope that this will serve the Southwest Florida Water Management District (District) well in its efforts to develop minimum flows for the Little Manatee River. Please feel free to contact us for any reason.

## 1. Background:

This TM describes an assessment of the depth of water required for navigation by canoes and kayaks within the upper portion of the Little Manatee River (Upper Little Manatee River). Navigation is among ten Water Resource Values (WRVs) identified in the State Water Resource Implementation Rule (62-40 F.A.C.) for consideration when establishing minimum flows or minimum water levels. This evaluation is not meant to support a primary criterion for establishing minimum flows but rather as a post-hoc evaluation of the potential effects of a considered minimum flow on navigation as supplementary information. Methods used for the analyses were adopted from other efforts to evaluate site specific navigation requirements in Florida river systems (SJRWMD 2017, ATM and JEI 2017, HSW, 2021).

Navigation has been defined as the safe passage for legal operation of vessels requiring sufficient water depth, sufficient channel width, and appropriate water velocities (SJRWMD 2017, ATM and JEI 2017). In the Little Manatee River, the river is generally too shallow for commercial vessels east of US Highway 41; however, there is vibrant ecotourism and recreational boating throughout the river. The Little Manatee River below US Highway 301 is a designated paddling trail, and Canoe Outpost operates a canoe and kayak rental operation with guided tours. Above US Highway 301 (the focus of this evaluation), the river narrows and shallows (<https://www.paddleflorida.net/little-manatee-paddle.htm>). There is a launch site for canoes and kayaks at the State Road 579 bridge (Figure 1), about 6.5 miles upstream of the US Highway 301 bridge that is used by Canoe Outpost and individuals as a put-in site. Above State Road 579 (Reach 6; Figure 1), the river is characterized by bottomland hardwood swamp with shallow depths, and emergent and fallen trees within the river channel, which is not consistently maintained for navigation. However, under certain flow and water level conditions, it is possible to put in at Leonard Lee Road (Figure 1) and canoe downstream. If the water is too high, overhanging and fallen vegetation will limit recreational navigation in this stretch of the river. If the water is too low, depth will be insufficient for canoeing or kayaking.

For the purpose of this evaluation, the critical depth for navigation is defined as a water depth of 0.5 feet, which was identified as the typical draft of a canoe in the minimum flow evaluation for the Lower Santa Fe River (HSW 2021) and verified as a reasonable estimate of the maximum draft of a recreational canoe (<https://boatbuilders.glen-l.com/51934/approximating-displacement-canoes-kayaks/>). The District was interested in evaluating the potential effects of the proposed minimum flows on the water depth at various representative locations throughout the main stem of the Upper Little Manatee River using the existing Hydrologic Engineering Centers River Analysis System (HEC-RAS) model originally developed for the Little Manatee River by ZFI (2010) as reported in Hood et al. (2011) and subsequently improved as reported in JEI (2018). The HEC-

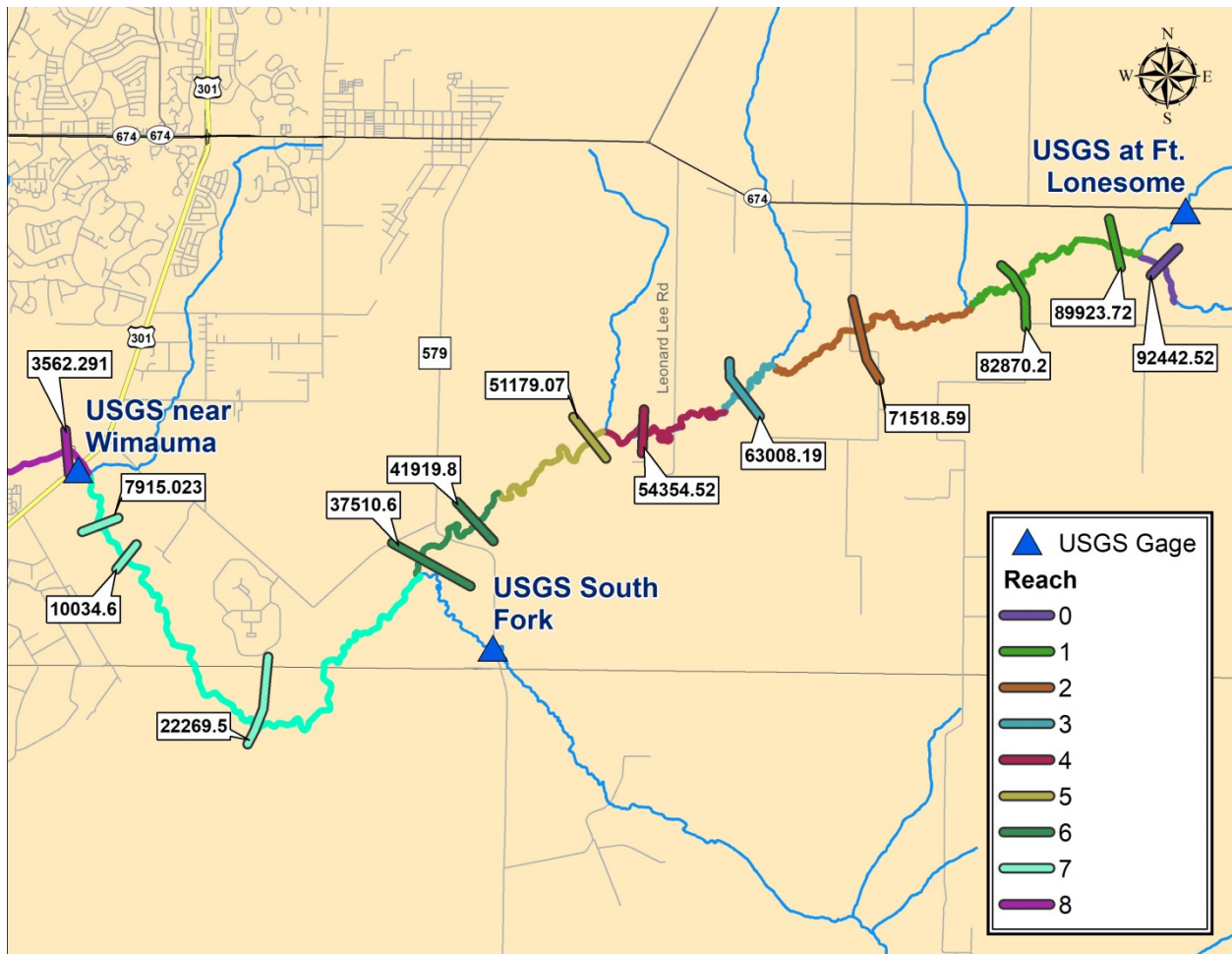
RAS model was used to identify flows at the U.S. Geological Survey (USGS) gage near Wimauma, FL (No. 02300500) that result in critical depths required for navigation. The critical depth is defined as a HEC-RAS model “hydraulic depth” of 0.5 feet. Hydraulic depth is referred to as “water depth” or “depth” for the remainder of this document.

## **2. Methods:**

The HEC-RAS model flow profiles were updated using the Baseline flow record for the period of record from April 1939 through December 2019. After consulting with the District, 13 HEC-RAS model cross-sections were identified and deemed representative for evaluating the effects of flow reductions on navigation in the Upper Little Manatee River System (Figure 1). The selected stations were determined based on the following process:

- Hydraulic grade line (HGL) review: an effort was taken to ensure that streambed and HGL factors such as high head loss, subcritical flow, and steep gradients were considered in the selection of the cross-sections.
- Distance from bridges: cross-sections immediately upstream/downstream of a bridge were actively avoided.
- Proximity to SEFA transect locations: an effort was made to have as much overlap as possible with existing SEFA transects.
- Distribution along the main branch: from conversations and review of the Silver River report, the analysis of velocities along the entire river was needed. Therefore, the distribution shown in Figure 1 was based on the distributing cross-section evaluations throughout the system.
- Cross-sections relevant to previous evaluations: cross-sections relevant to predetermined thresholds for fish passage and wetted perimeter from JEI (2018) were chosen.
- A cross-section in the most upstream reach: The District requested a cross-section from the most upstream reach be included.

These cross-sections were evaluated for this task, as well as for another task evaluating the effects of the proposed minimum flows on the sediment and detrital transport WRVs.



**Figure 1. Location of cross-sections used in the evaluation of the Navigation Water Resource Value for the Upper Little Manatee River.**

The HEC-RAS model output for these cross-sections contained a hydraulic (water) depth estimate for each flow profile, and these profiles were used to identify the flow at the USGS Gage No. 02300500 that results in the critical water depth of 0.5 feet at each of the 13 cross sections. In some cases, interpolation was required to identify the lowest flow associated with the critical water depth. In these cases, nonlinear interpolation using a locally weighted (LOESS) regression across the flow–depth relationship was used to identify the flow resulting in a water depth of 0.5 feet.

The District provided the proposed minimum flows to evaluate the potential effects of flow reductions on the Navigation WRV as defined by the 0.5 feet water depth. The proposed minimum flows are based on flows at USGS Gage No. 02300500 and defined as a reduction from a Baseline condition described in JEI (2018).

The proposed minimum flows for the Upper Little Manatee River are as follows:

- 10% allowable flow reduction when flows are less than or equal to 35 cubic feet per second (cfs)

- 20% allowable flow reduction when flows are greater than 35 cfs and less than or equal to 72 cfs
- 13% allowable flow reduction when flows are greater than 72 cfs and less than or equal to 174 cfs
- 11% allowable flow reduction when flows are greater than 174 cfs

The period of record for evaluation was April 1, 1939 through December 31, 2019. Each date in the period of record was evaluated to determine whether the flow at USGS Gage No. 02300500 would result in a water depth less than the critical value (an “Event”) at each of the 13 cross sections under the Baseline and proposed minimum flows conditions. The difference in the number of events between the Baseline and proposed minimum flows conditions was then totaled and expressed as the number of Events and the percent difference in Events between the Baseline and proposed minimum flows conditions. Cross-sections are referred to as “stations” throughout the remainder of this document.

### **3. Results:**

The water depth plotted as a function of the flow profile for each station by reach is provided in Figure 2. The broken horizontal reference line in the figure indicates the critical depth of 0.5 feet. The flow profile associated with the critical depth was station dependent and could be anywhere along the flow profile curve indicating some stations rarely exceeded the water depth (e.g., Reach 0), while other stations routinely exceeded the water depth (e.g., Reach 5) under the Baseline condition. The identified critical flow values indicating the flow corresponding to a water depth of 0.5 feet for each station are listed in the right column of Table 1 along with the associated reach, flow profile range, depth range, and flow range bracketing the critical depth value. Three stations were always above the critical depth value of 0.5 feet (shaded rows in Table 1) and were, therefore, not further considered.

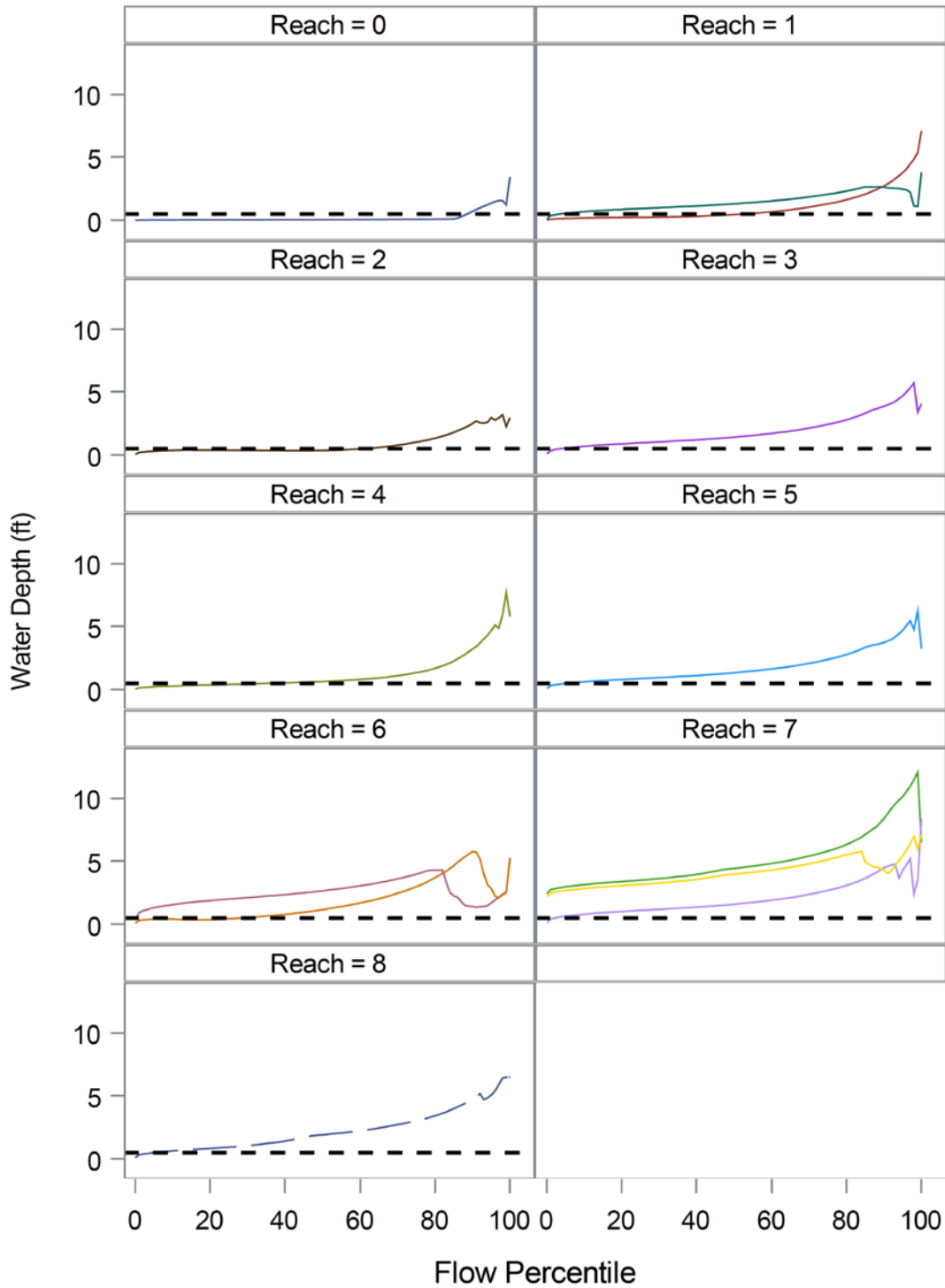


Figure 2. Water depth as a function of flow profile under the Baseline condition for 9 reaches in the Upper Little Manatee River. Horizontal reference line indicates a water depth of 0.5 feet. Multiple colored lines indicate station within Reaches 3, 6, and 7.

**Table 1. HEC-RAS model cross sections (stations) of interest with profile, depth and flow ranges bracketing the critical water depth under the Baseline condition. The critical flow (right column) is used to evaluate the effects of the proposed minimum flows scenarios on the Navigation Water Resource Value in the Upper Little Manatee River. Shaded rows are stations always above a water depth of 0.5 feet.**

Reach	Station	Profile Range (flow percentile)		Depth Range (ft)		Flow Range (cfs)		Critical Flow (cfs)
0	92442.52	88	89	0.43	0.57	314.45	343.62	330
1	82870.2	51	52	0.48	0.5	56	58	58
1	89923.72	3	4	0.49	0.53	9.2	10.57	10
2	71518.59	60	61	0.49	0.51	75	77.6	77
3	63008.19	3	4	0.47	0.52	9.2	10.57	11
4	54354.52	33	34	0.49	0.5	35	36	36
5	51179.07	4	5	0.47	0.51	10.57	11.99	12
6	37510.6							
6	41919.8	27	28	0.48	0.5	30.09	31	31
7	10034.6							
7	22269.5	1	2	0.43	0.5	6.1	7.8	8
7	7915.02							
8	3562.291	4	5	0.48	0.52	10.57	11.99	12

A total of 29,495 days in the period of record were used for comparison. The difference in exceedance rate between the Baseline and proposed minimum flows was less than 10 percentage points for all stations evaluated (Table 2). For example, for Reach 0 Station 92442.52, 88.5% of the days were below 0.5 feet under the Baseline scenario and 89.8% under the proposed minimum flows scenario, for a difference of 1.28 percentage points. The most sensitive station to flow reductions was Station 54354.52 in Reach 4, with an increase in Events from 33.7% under the Baseline to 43.0% under the proposed minimum flows, a difference of 9.31 percentage points. The next most sensitive station was station 41919.8 in Reach 6, with a difference of 8.6 percentage points. Station 41919.8 is the same station that was identified as most limiting for fish passage and wetted perimeter criteria as part of the re-evaluation for the Upper Little Manatee River (JEI 2018). The other stations evaluated for the Navigation WRV had smaller differences in exceedance rate as a function of the flow reduction scenario and generally few Events under either the Baseline or proposed minimum flows evaluation.

**Table 2. Results of proposed minimum flows scenarios on the number of days below the critical water depth (0.5 feet) for the Navigation Water Resource Value in the Upper Little Manatee River based on 10 representative stations from the HEC-RAS model output. Three stations with water depths that always exceed the critical water depth are not listed. Difference in Exceedance Rate is in units of “percentage points” which are dimensionless. Period of evaluation is April 1,1939 to December 31, 2019.**

Reach	Station	No. Events Baseline	No. Events Proposed Minimum Flows	Exceedance Rate Baseline (%)	Exceedance Rate Proposed Minimum Flows (%)	Difference in Exceedance Rate	Difference in # of Events Expressed Per Year
0	92442.52	26110	26486	88.52	89.8	1.28	4.70
1	82870.2	15300	17366	51.87	58.88	7.01	25.83
1	89923.72	1040	1409	3.53	4.78	1.25	4.61
2	71518.59	17885	19047	60.64	64.58	3.94	14.53
3	63008.19	1213	1683	4.11	5.71	1.6	5.88
4	54354.52	9933	12681	33.68	42.99	9.31	34.35
5	51179.07	1471	1924	4.99	6.52	1.53	5.66
6	41919.8	8154	10680	27.65	36.21	8.56	31.58
7	22269.5	609	807	2.06	2.74	0.68	2.48
8	3562.29	1471	1924	4.99	6.52	1.53	5.66

#### **4. Summary:**

This evaluation used representative stations identified in a collaboration meeting with the District to evaluate the potential effects of the proposed minimum flows on the ability to navigate the Upper Little Manatee River System with a canoe or kayak. The results suggested that navigation as defined for this analysis in the Upper Little Manatee River would not be substantially affected by the proposed minimum flows. Differences in exceedance rate were less than 10 percentage points based on the number of days with water depth below the critical threshold of 0.5 feet expected for the most sensitive station. The two most sensitive stations identified for the Navigation WRV were previously identified as most sensitive for the Wetted Perimeter and Fish Passage evaluations (JEI 2018) indicating consistency among results in evaluations related to water depth and effects on the wetted channel area.



## **5. References:**

Applied Technology and Management, Inc. (ATM) and Janicki Environmental, Inc. (JEI) 2017. Evaluation of the Effects of Hypothetical Flow Reductions on Water Resource Values of Silver Springs and the Silver River, Marion County. Appendix E: Minimum Flows Determination for Silver Springs, Marion County, Florida. Prepared for St. Johns River Water Management District, Palatka, Florida.

HSW Engineering, Inc. 2021. Minimum Flows and Minimum Water Levels Re-evaluation for Lower Santa Fe and Ichetucknee River and Priority Springs. Prepared for Suwannee River Water Management District, Live Oak, Florida.

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