Appendix H

FINAL PEER REVIEW REPORT

REEVALUATION OF MINIMUM FLOWS FOR THE LITTLE MANATEE RIVER SYSTEM

AGREEMENT NUMBER: 19CN0001936

SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT
2379 BROAD STREET
BROOKSVILLE, FLORIDA 34604

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1.0 INTRODUCTION

1.1 BACKGROUND AND SYSTEM DESCRIPTION

The Southwest Florida Water Management District (SWFWMD) contracted with an independent panel of experts to provide a technical peer review of the proposed Recommended Minimum Flows for the Little Manatee River Draft Report. The Peer Review Panel includes:

- Dr. Steven Peene (Panel chair)
- John Loper
- Russ Frydenborg

The Little Manatee River is a minimally disturbed blackwater river in Southwest Florida. The river and watershed are located in the southern end of Hillsborough County and the northern portion of Manatee County, as shown in Figure 1-1. The river extends over 40 miles from the headwaters near Fort Lonesome down to Tampa Bay near Ruskin. The downstream estuarine portion of the river ranges from the mouth at Tampa Bay to where the river crosses US 301, where the primary flow gage for the system is located (02300500). Above US 301, the river branches into two primary forks, the North Fork and the South Fork. Multiple additional tributaries drain to the system as shown in Figure 1-1.

A total of three flow gage stations are located along the system (see green squares in Figure 1-1). The primary station, and the one upon which the minimum flows and levels (MFLs) are developed, is located at the break between the lower, estuarine and upper, freshwater portion of the river where it crosses US 301 (02300500). Other flow gages are shown within the South and North Forks. Additionally, in support of the MFLs and model development, continuous gages that collected water levels, temperature and conductivity (for salinity) were installed in the lower estuarine portion of the river from 2004 to 2005. The station locations are shown as red circles.

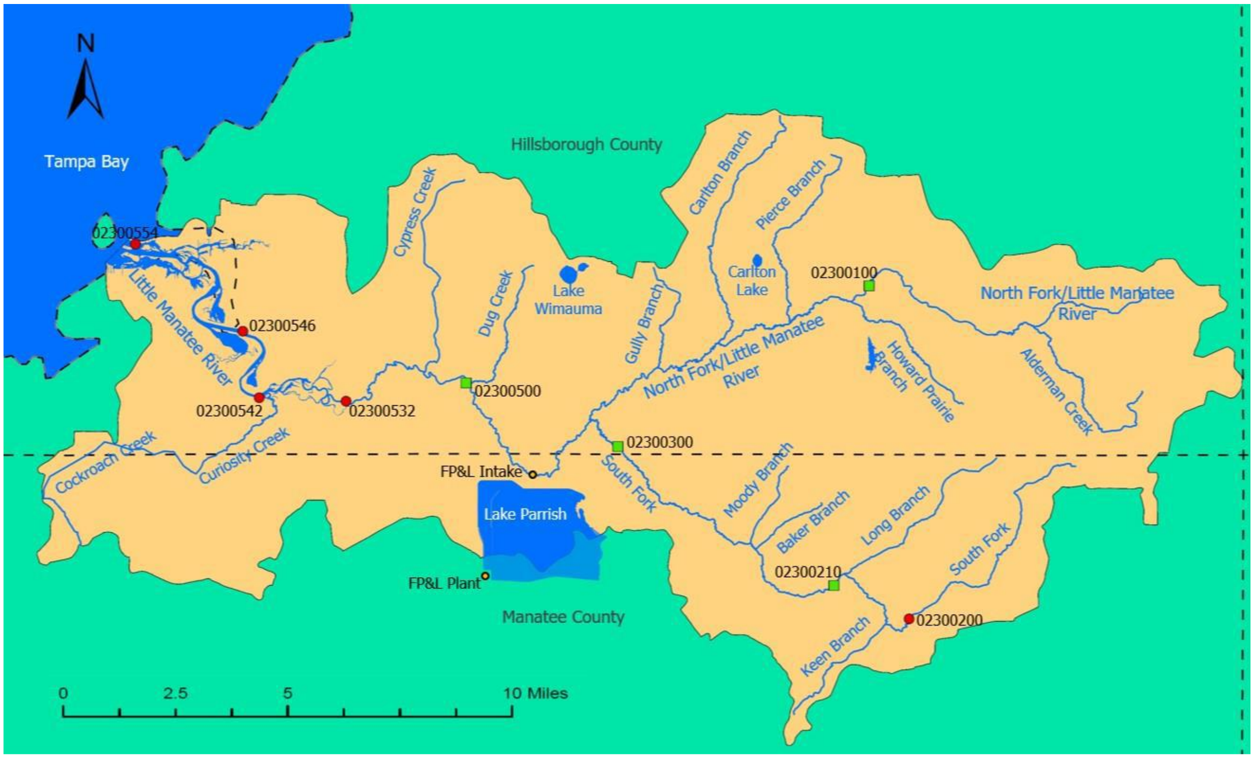

Figure 1-1. The Little Manatee River System and Watershed (SWFWMD, 2021).

For the MFLs, the system is divided into two sections, the Upper and Lower River. The Upper River extends from where the river crosses US 301 [U.S. Geological Survey (USGS) 02300500] up to the headwaters of the North and South Forks. The Lower River extends from the US 301 crossing down to the mouth at Tampa Bay. Analyses were performed to define allowable flow reductions within each of the two segments. Presently, there is one withdrawal located on the river. This is the Florida Power and Light (FPL) intake that pumps water from the river into Lake Parrish for use as cooling water.

Key components of the MFL development were various mechanistic and empirical models developed to provide physical data (salinity, water levels, flows) under baseline and flow reduction scenarios. The models included an initial Environmental Fluid Dynamics Code (EFDC) model of the lower river, a logistic regression model to project salinity in the Lower River, and a Hydrologic Engineering Centers River Analysis System (HEC-RAS) model to project flows and water levels in the Upper River. In addition to the physical models, significant biological data collection efforts were undertaken for both the Upper and Lower River to support MFL development and environmental effects models developed to determine how anthropogenic flow reductions may adversely affect sensitive biological attributes.

Draft MFLs presented within the report were based on allowance of a 15 percent reduction in critical habitats (estuarine and freshwater) based on changes in the flow conditions. The MFLs were established by three flow blocks, Block 1 [<35 cubic feet per second (cfs)], Block 2 (35 cfs to 72 cfs), and Block 3 (>72 cfs). Table 1, from the draft MFL document, outlines the MFLs established for each flow block and for the Upper and Lower River. The document also assessed the flow reductions in consideration of the 10 Environmental Values. This document was reviewed in the fall of 2021 and an initial peer review report was provided.

	Block 1 (< 35 cfs)	Block 2 (> 35 cfs and < 72 cfs)	Block 3 (> 72 cfs)
Upper Little Manatee River (Headwaters to Highway 301)	90% of the flow on the previous day	80% of the flow on the previous day	87% of the flow on the previous day when the previous day's flow was > 72 cfs and ≤ 174 cfs, or 89% of the flow on the previous day when the previous day's flow was > 174 cfs
Lower Little Manatee River (Highway 301 to Tampa Bay)	90% of the flow on the previous day	80% of the flow on the previous day	70% of the flow on the previous day
Upper and Lower Little Manatee River	No surface water withdrawals are permitted when flows are ≤ 35 cfs		

Table 1. Draft MFLs by Flow Block for the Upper and Lower Little Manatee River System (SWFWMD, 2021)

Following submission of comments provided by the Peer Review Panel in November of 2021, the District conducted multiple additional studies and provided a response document to the Peer Review Panel entitled *Southwest Florida Water Management District Draft Response to the Initial Peer Review of the Recommended Minimum Flows for the Little Manatee River, September 2021 Draft Report*. This document is included as Appendix A. Additionally, the District provided a revised MFLs document entitled *Recommended Minimum Flows for the Little Manatee River Revised Draft Report* along with other supporting material. Public meetings were held on July 5th and July 12th, 2023, where the Peer Review Panel provided review, discussion and input on the responses and additional documentation provided. Following those meetings, on July 22nd, 2023 a revised report was provided by the District entitled *2nd Revised Draft Report on Recommended Minimum Flows for the Little Manatee River*. Tables 2 and 3 summarize the MFL determinations from the revised report.

Upper Little Manatee River			
Flow-Based Block	**If Previous Day's Flow, Adjusted for Upstream Withdrawals, is:**	**Minimum Flow is:**	**Potential Allowable Flow Reduction is:**
1	≤29 cfs	Flow on Previous Day	0 cfs
2	>29 cfs and ≤33 cfs	29 cfs	Flow on Previous Day Minus 29 cfs
	>33 cfs and ≤96 cfs	88 Percent of Flow on Previous Day	12 Percent of Flow on Previous Day
3	>96 cfs and ≤224 cfs	87 Percent of Flow on Previous Day	13 Percent of Flow on Previous Day
	>224 cfs	90 Percent of Flow on Previous Day	10 Percent of Flow on Previous Day

Table 2. Revised MFLs by Flow Block for the Upper Little Manatee River System (SWFWMD, 2023)

Lower Little Manatee River			
Flow-Based Block	**If Previous Day's Flow, Adjusted for Upstream Withdrawals, is:**	**Minimum Flow is:**	**Potential Allowable Flow Reduction is:**
1	≤29 cfs	Flow on Previous Day	0 cfs
2	>29 cfs and ≤33 cfs	29 cfs	Flow on Previous Day Minus 29 cfs
	>33 cfs and ≤96 cfs	87 Percent of Flow on Previous Day	13 Percent of Flow on Previous Day
3	>96 cfs and ≤123 cfs	84 cfs	Flow on Previous Day Minus 84 cfs
	>123 cfs	68 Percent of Flow on Previous Day	32 Percent of Flow on Previous Day

Table 3. Revised MFLs by Flow Block for the Lower Little Manatee River System (SWFWMD, 2023)

1.2 REGULATORY BASIS FOR MFL AND PEER REVIEW

Florida Statutes (F.S.) mandate that SWFWMD must establish MFLs for state surface waters and aquifers within its boundaries for the purpose of protecting the water resources and the ecology of the area from "significant harm." Section 373.042, F.S., provides that the minimum flow for a given watercourse is the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area, and the minimum water level is the level of groundwater in an aquifer and the level of surface water at which further withdrawals would be significantly harmful to the water resources or ecology of the area.

Section 373.042, F.S., also provides that MFLs shall be calculated using the best information available, that the Governing Board shall consider and may provide for non-consumptive uses in the establishment of MFLs and, when appropriate, MFLs may be calculated to reflect seasonal variation. The law also requires that when establishing MFLs, changes and structural alterations to watersheds, surface waters, and aquifers shall also be considered (Section 373.0421, F.S.). The State Water Resource Implementation Rule (Chapter 62-40, Florida Administrative Code) includes additional guidance for establishing MFLs, providing that "…consideration shall be given to the protection of water resources, natural seasonal fluctuations in water flows or levels, and environmental values associated with coastal, estuarine, aquatic, and wetlands ecology, including:

a) Recreation, in and on the water;
b) Fish and wildlife habitats and the passage of fish;
c) Estuarine resources;
d) Transfer of detrital material;
e) Maintenance of freshwater storage and supply;
f) Aesthetic and scenic attributes;
g) Filtration and absorption of nutrients and other pollutants;
h) Sediment loads;
i) Water quality; and
j) Navigation."

Section 373.042, F.S., also addresses independent scientific peer review of MFLs, specifying the review of all scientific or technical data, methodologies, and models, including all scientific and technical assumptions employed in each model, used to establish a minimum flow or minimum water level.

1.3 DOCUMENTS AND DATA UTILIZED IN THE PEER REVIEW

The following documents and data were provided to the panel members to be utilized in the initial peer review conducted in the fall of 2021.

- MFLs Report: Recommended Minimum Flows for the Little Manatee River Draft Report (2021)

- Appendix A: Proposed Minimum Flows and Levels for the Little Manatee River – Peer Review DRAFT Report (2011)
- Appendix B: Review of Minimum Flows and Levels for the Little Manatee River, Florida (2012)
- Appendix C: Reevaluation of the Proposed Minimum Flows for the Upper Segment of the Little Manatee River, DRAFT REPORT (2018)
- Appendix D1: Technical Memorandum – Water Quality (2020)
- Appendix D2: Technical Memorandum – Hydrodynamic Modeling (2021)
- Appendix D3: Technical Memorandum – LOESS and EFF Modeling (2021)
- Appendix D4: Technical Memorandum – Sediment and Detrital Transport (2021)
- Appendix D5: Technical Memorandum – Navigation (2021)
- Appendix E: Recommended Minimum Flows for the Little Manatee River Estuary DRAFT REPORT (2018)
- Appendix F: Analysis of Benthic Community Structure and its Relationship to Freshwater Inflows in the Little Manatee Estuary (2008)
- Appendix G: Characterization of Woody Wetland Vegetation Communities along the Little Manatee River (2008)
- Appendix H: Instream Habitat Modeling in the Little Manatee River. Update using System for Environmental Flow Analysis (SEFA) (2021)
- Hydrodynamic Modeling of the Little Manatee River, (Huang and Liu, 2007)
- Estimating the Un-Gaged Inflows In the Little Manatee River Basin, Florida (Interra, 2006)
- Little Manatee River Watershed Master Plan Update (Jones Edmunds, 2015)
- Little Manatee River Watershed Management Plan (PBS&J, 2002)
- HEC-RAS Modeling of the Little Manatee River (ZFI, 2010)
- HEC-RAS Model files
- EFDC Model Input files for baseline run
- HEC-RAS Transect files
- Freshwater Inflow Effects on Fishes and Invertebrates in the Little Manatee River Estuary; an Update of Data Analyses (Peebles, 2008)
- SWFWMD Internal Memos
- Public Comments

The following documents and data were provided to the panel members to be utilized in the final peer review conducted in July-August 2023 including material provided in response to discussion comments from Public Meetings.

- Draft Response to the Initial Peer Review of the Recommended Minimum Flows for the Little Manatee River, September 2021, Draft Report
- Recommended Minimum Flows for the Little Manatee River Revised Draft Report, June 2023
- Appendices A through J of revised report
- Recommended Minimum Flows for the Little Manatee River 2nd Revised Draft Report
- Revised District Response to John Loper's Comment No. 9
- Revised End of Section 6.3
- Revised Figures 6-20, 6-21, and 6-22
- Revised HEC-RAS Modeling Section Write Up
- Revised Table 5-1 and Associated Text
- Public Comments

1.4 PEER REVIEW PANEL SCOPE AND APPROACH

For the initial report (Phase I), the Peer Review Panel was scoped to complete the following tasks as part of the MFLs Peer Review:

- Review draft of the Recommended Minimum Flows for the Little Manatee River along with supporting documentation
- Participate in Public Meetings including:
    - Kickoff Virtual Meeting (October 5, 2021)
    - Web-Meetings (October 20, 27 and November 3, 2021)
- Post written review comments and collaborate with other panelists to develop a single peer review panel report
- Review and provide support in development of meeting agendas and meeting summaries

For the final report (Phase II), the Peer Review Panel was scoped to complete the following tasks as part of the MFLs Peer Review:

- Review draft of the District responses to comments provided in the initial peer review report
- Review revised Recommended Minimum Flows for the Little Manatee River along with supporting documentation
- Participate in Public Meetings including:
  - Web-Meetings (July 5, July 12, 2023)
- Post revised written detailed and general review comments and collaborate with other panelists to finalize comments and determine District responsiveness to initial comments
- Review and provide support in development of meeting agendas and meeting summaries

Following the process outlined above, the subsequent sections present the final determination and comments of the Peer Review Panel.

2.0 REVIEW OF REVISED MFL REPORTS AND SUPPORTING DOCUMENTATION AND DISTRICT RESPONSES TO INITIAL COMMENTS

The following sections provide general and detailed comments on the MFLs report and supporting documentation provided by SWFWMD for use by the Peer Review Panel. Section 2.1 presents the narrative discussions of key aspects of the MFLs by the Panel provided in the Initial Peer Review Report followed by evaluations of the District's responses to the comments. Section 2.2 provides detailed comments in tabular format. The tables provide for the following.

- Panel member providing the comment;
- identification of what document and location within the document to which the comment pertains;
- identification if the comment directly and materially affects the conclusions of the report;
- the specific comment;
- the reviewers' recommended corrective action;
- the District response to the comment; and
- a determination if the District response is sufficient.

2.1 GENERAL COMMENTS

Specific components of the MFLs report and supporting documentation were identified by the Peer Review Panel as critical in the MFLs development. The following components were identified for specific review and discussion or were general items to address:

- Significant harm;
- Development of baseline flow record;
- HEC-RAS modeling;
- Biology data and System for Environmental Flow Analysis (SEFA) in the Upper River;
- EFDC Model;
- Salinity Regression Modeling;
- Biological data and biological assessment Lower River;
- Flow blocks (Upper River); and

- Flow blocks (Lower River).

The following sections present the reviewers' initial comments on these items followed by the review of the adequacy of the District response (provided in Appendix A).

2.1.1 SIGNIFICANT HARM

2.1.1.1 <u>Initial Comment</u>

The introduction provides three critical assumptions: "1. Alterations to hydrology will have consequences for the environmental values listed in Rule 62-40.473, F.A.C., and Section 1.2.2 of this report; 2. Relationships between some of these altered environmental values can be quantified and used to develop significant harm thresholds or criteria that are useful for establishing minimum flows and minimum water levels; and 3. **Alternative hydrologic regimes** may exist that differ from non-withdrawal impacted conditions **but are sufficient to protect water resources and the ecology of these resources from significant harm**."

The report states, "Criteria for developing minimum flows are selected based on their relevance to environmental values identified in the Water Resource Implementation Rule and confidence in their predicted responses to flow alterations. The District uses a weight-of-evidence approach to determine if the most sensitive assessed criterion is appropriate for establishing a minimum flow, or if multiple criteria will be considered collectively."

SWFWMD indicated that when natural breakpoints in environmental data were not available, they use a **15% habitat or resource-reduction standard as a criterion for significant harm**. This was partially based on peer review panel recommendations associated with minimum flows development for the Upper Peace River (SWFWMD 2002). In considering the Physical Habitat Simulation (PHABSIM) model, the Upper Peace River peer reviewers noted that "in general, instream flow analysts consider a loss of more than 15% habitat, as compared to undisturbed or current conditions, to be a significant impact on that population or assemblage" (Gore et al. 2002).

The Little Manatee MFLs report presents additional literature to support the 15% change criterion that could be applied to a number of metrics (e.g., wetted area, habitat guild, oligohaline salinity zone area, etc.). The report also states that, "More than 20 peer review panels have evaluated the District's use of the 15% standard for significant harm. Although

many have questioned its use, they have generally been supportive of the use of a 15% change criterion for evaluating effects of potential flow reductions on habitats or resources when determining minimum flows." While the panel agrees that the 15% threshold is based on a sound scientific evaluation and represents a reasonable management decision, we would offer the U.S. Environmental Protection Agency (EPA) Biological Condition Gradient (BCG) model as a potential source of support for this decision. What follows is a brief description of the BCG conceptual model.

The EPA has outlined a tiered system of aquatic life use designation, along a Biological Condition Gradient (BCG), that illustrates how ecological attributes change in response to increasing levels of human disturbance (Davies and Jackson, 2006). The BCG is a conceptual model that assigns the relative health of aquatic communities into one of six categories, from natural to severely changed (Figure 2-1). The model is based in fundamental ecological principles and has been extensively verified by aquatic biologists throughout the U.S. (FDEP, 2011).

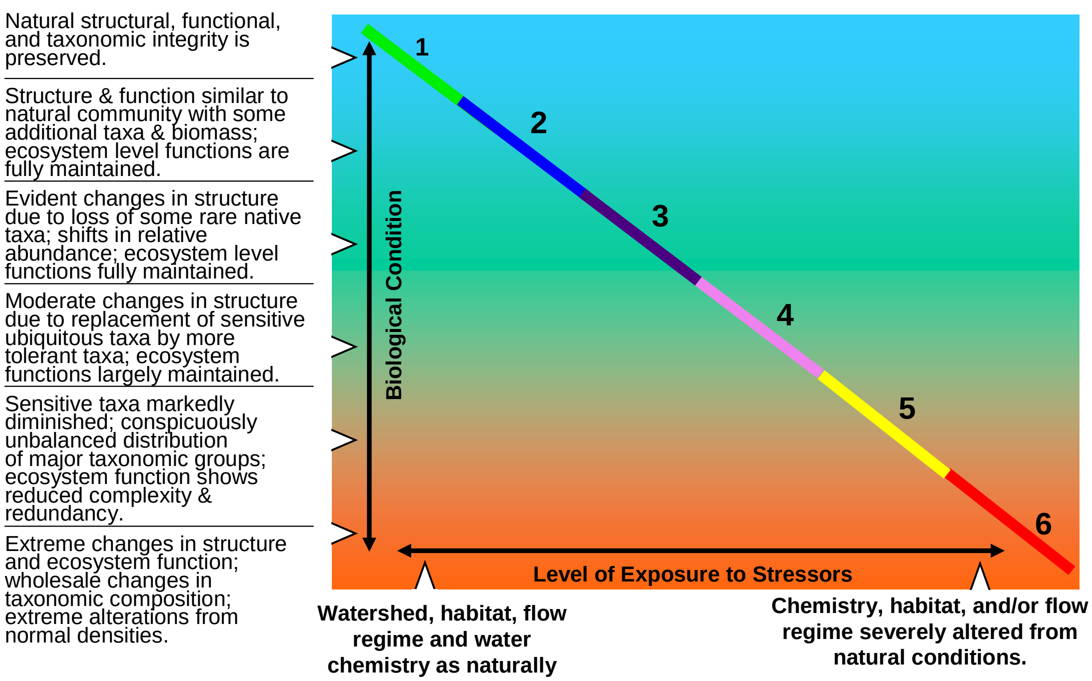

Figure 2-1. The Biological Condition Gradient Model (from Davies and Jackson 2006).

FDEP conducted a BCG exercise to calibrate scores for the Stream Condition Index (SCI) in 2006 (FDEP, 2012). Twenty-two experts examined taxa lists from 30 stream sites throughout Florida, 10 in each Ecoregion, that spanned the range of SCI scores. Without any knowledge of the SCI scores, they reviewed the data and assigned each macroinvertebrate community a BCG score from 1 to 6, where 1 represents natural or native condition and 6 represents a condition severely altered in structure and function from a natural condition. Experts independently assigned a BCG score to each site, and then were able to discuss their scores, rationale, and could opt to change their scores based on arguments from other participants (Delphi approach). At the conclusion of the workshop, FDEP regressed the mean BCG score given to each stream against the SCI score for that site (Figure 2-2).

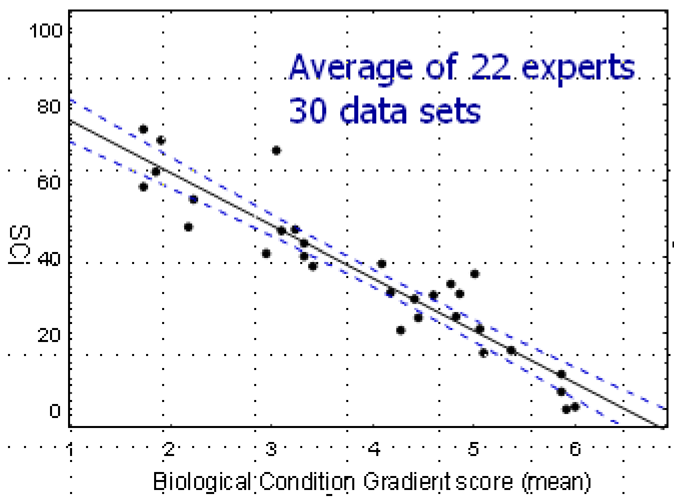

Figure 2-2. Regression Line with 90% Confidence Interval Showing the Relationship between the Mean BCG Score and SCI Score. The "exceptional" threshold was established at 64 and above, based on the score associated with a BCG 2. Based on an additional EPA analysis, the impairment threshold was an average SCI of 40, with no score below 35 during the past two sampling events.

This indicated that Florida riverine invertebrate metrics were responding predictably to human disturbance, and that the use of benthic invertebrates to assess the condition of Florida systems is consistent with the concepts in EPA's Biological Condition Gradient. Based on this (in part), Chapter 62-302, F.A.C. prohibits a 20 point drop in exceptional SCI scores, and Chapter 62-303, F.A.C. lists any stream with an SCI score of <40 as impaired.

The BCG utilizes biological attributes of aquatic systems that respond predictably to increasing human disturbance, and hydrologic modification was one component of the Human Disturbance Gradient used for metric selection. These BCG attributes may be inferred via the community composition data. The biological attributes considered in the BCG are:

- Historically documented, sensitive, long-lived or regionally endemic taxa;
- Sensitive and rare taxa;
- Sensitive but ubiquitous taxa;
- Taxa of intermediate tolerance;
- Tolerant taxa;
- Non-native taxa;
- Organism condition;
- Ecosystem functions;
- Spatial and temporal extent of detrimental effects; and
- Ecosystem connectance (FDEP, 2011).

The gradient represented by the BCG has been divided into six levels (tiers) of condition that were defined via a consensus process (Davies and Jackson, 2006) using experienced aquatic biologists from across the U.S., including Florida representatives. The six tiers are as follows:

- Native structural, functional, and taxonomic integrity is preserved; ecosystem function is preserved within range of natural variability;
- Virtually all native taxa are maintained with some changes in biomass and/or abundance; ecosystem functions are fully maintained within range of natural variability;
- Some changes in structure due to loss of some rare native taxa; shifts in relative abundance of taxa but sensitive–ubiquitous taxa are common and abundant; ecosystem functions are fully maintained through redundant attributes of the system;
- Moderate changes in structure due to replacement of some sensitive–ubiquitous taxa by more tolerant taxa, but reproducing populations of some sensitive taxa are maintained; overall balanced distribution of all expected major groups; ecosystem functions largely maintained through redundant attributes;
- Sensitive taxa are markedly diminished; conspicuously unbalanced distribution of major groups from the expected; organism condition shows signs of physiological stress; system function shows reduced complexity and redundancy; increased buildup or export of unused materials; and

- Extreme changes in structure; wholesale changes in taxonomic composition; extreme alterations from normal densities and distributions; organism condition is often poor; ecosystem functions are severely altered (Davies and Jackson, 2006).

The six levels described above can be used to correlate biological index scores or other management tools with biological condition, as part of calibrating an index or assessing the management decision (Figure 2-2). Once the correlation is established, a determination is made as to which biological condition represents attainment of the Clean Water Act (CWA) goal according to paragraph 101(a)(2) related to aquatic life use support, “protection and propagation of fish, shellfish, and wildlife”, or in the case of MFLs, protecting against significant harm. Many groups of experts have provided opinions that human activities should not cause the biological condition to drop more than two categories, and in no case should anthropogenic activities reduce the condition to less than 4.

Suggestion: **For future MFLs**, SWFWMD scientists should assess how much the biological condition gradient category of the waterbody in question would be reduced at the 15% MFL reduction threshold compared to baseline conditions. Perhaps the BCG approach can provide an additional, nationally recognized method of support for the 15% reduction threshold.

2.1.1.2 Review of District Responses

As indicated in previous peer review comments (2021 report), SWFWMD provided the legal basis and a sound scientific rationale for defining significant harm as it applies to Minimum Flows and Levels development. Where breakpoints in the data do not occur, a 15% reduction threshold (in habitat or other biological attribute) is applied by SWFWMD to the most sensitive component of the ecosystem to prevent significant harm. In the revised MFLs report for the Little Manatee River and estuary, SWFWMD continued to provide multiple studies to support the use of the 15% reduction threshold. In their responses, SWFWMD agreed to consider using the EPA Biological Condition Gradient in the future to further support this significant harm threshold in the context of a nationally applicable conceptual model. This comment is therefore resolved.

Flow Blocks

SWFWMD provided updated flow blocks that included protection of biological communities during transitional periods between flow blocks. Based upon panel requests, SWFWMD provide a detailed explanation behind the basis for each transitional criterion. This comment is therefore resolved.

2.1.2 DEVELOPMENT OF BASELINE FLOW RECORD

2.1.2.1 Initial Comment

Development of a baseline flow record is necessary to identify and/or estimate a long-term flow record that is relatively unimpacted by surface water withdrawals, groundwater withdrawals, and the impacts of land use changes. This flow record is then used as the basis for evaluating the effects of flow reductions on the metrics used to determine the point at which significant environmental harm occurs. The measured streamflow at the USGS Wimauma gage, which has daily flow records dating back to April 1939, was used for this purpose. The period of time before 1977 was identified in the current MFLs draft report as relatively free from anthropogenic influences. A statistical change-point analysis conducted by Janicki Environmental, Inc. (JEI) determined that a change in the rainfall-flow relationship occurred around this time. The change in this relationship was attributed primarily to agricultural practices, although mining, urbanization, and surface water withdrawals undoubtedly have played a role.

Following the change-point analysis, the baseline flow record was then extended post-1976 using a regression analysis to estimate the rainfall-flow relationship in the absence of anthropogenic influences.

FP&L Withdrawals

Florida Power and Light is permitted to withdraw 10% of the river flow to augment its cooling water reservoir when flows are above 40 cfs at the Wimauma gage. The intake is located approximately 3.5 river miles upstream of the Wimauma gage. Also at this location is a spillway and outfall channel which evidently serves as an emergency outlet. This most likely is only used during extended periods of above-average rainfall. According to data presented in Appendix C, withdrawals started in or around 1977, which coincides roughly with the change point identified in the statistical analysis. The baseline flow record therefore does not include the effects of these withdrawals, which is appropriate. It is assumed these withdrawals will be counted towards the allowable reductions upon implementation of the proposed MFLs.

Agricultural Irrigation

The 2011 draft MFLs study assumed a constant value of 15 cfs for the contribution of agricultural practices including irrigation, use of plastic mulch, etc. on streamflow at the Wimauma gage. The current MFLs study employed a more sophisticated statistical approach to estimating the excess streamflow caused by agricultural irrigation. In the Myakka River Watershed Initiative (Interflow Engineering, 2008), an integrated groundwater/surface water model was used to show that excess agricultural flows occur throughout the year, with the largest flows occurring early in the wet season (July), due to elevated water tables early in the wet season following farm irrigation during the preceding dry season, and suppression of evapotranspiration (ET) during the non-growing months of June and July, with ET suppressed due to bare fields largely covered with plastic mulch. The excess flows taper off in August and September and remain relatively low throughout the dry season. The current draft MFLs report compares the Upper Myakka River excess flows to the excess flows estimated in the Little Manatee River Watershed, estimated from a predictive regression equation, and suggests a similar pattern in the Little Manatee River Watershed. The graph (Figure 5-3) shows Little Manatee peak excess flows in August and remaining higher in September than in July, but the overall pattern is similar. This is a better approach than assuming a constant value throughout the year in the 2011 MFLs study.

One potential flaw in the approach is that the changes in streamflow caused by the active phosphate mining in the watershed was not considered as an additional anthropogenic effect on the rainfall-streamflow relationship. All bias in the residuals between the predicted and observed flows post-1976 was ultimately attributed to agricultural practices. The report further concludes that agricultural excess flows are trending towards zero. That may be the case, however, an alternative or additional explanation may be that the agricultural excess flows are being partially offset by a decrease in streamflow from actively mined areas, which have been increasing in spatial coverage over the past 20+ years.

Phosphate Mining

Active phosphate mines are effectively severed from the watershed through the construction of ditch and berm systems designed to capture all stormwater runoff within the mine, for rainfall events up to and including the 100-year design storm. The ditch and berm systems are in place for the duration of mining and reclamation; discharge of stormwater is only allowed via FDEP-permitted outfalls. These discharges tend to be relatively infrequent and typically occur only during the wettest months of the year, since the mining operation is water-intensive and much of the rain that falls within the footprint of the active mine is used as process water. One such outfall exists within the Little Manatee Watershed – Mosaic site D-001 located within the headwaters of the river. Although the daily discharges from this outfall through 2009 are reported in Appendix C, no effort was made to account for potential effects of mining on historical flows. The ramifications of not accounting for the changes in flow due to mining separately are probably negligible for the purposes of the MFLs proposed for the Little Manatee River, however, because the regression method used to extend the baseline flow record developed for the current draft MFLs study corrects for all the anthropogenic influences post 1976.

2.1.2.2 Review of District Responses

Recommendation from Peer Review Report: The general comments on this section were provided for informational purposes and contained no recommendations.

District Response: District staff appreciate the comments and information.

Review of Response: Comment can be closed with a suggested editorial revision: revise text in Section 2.5 (bottom of second paragraph on page 41), which states that excess agricultural flows "…decreased to zero after 2000 because of decreases in active agricultural lands and implementation of agricultural BMPs in the watershed." This should state that excess flows *began trending toward zero after 2000*, to be consistent with Section 5.2 (refer to Figure 5-3 on page 124 of the revised document).

2.1.3 HEC-RAS MODELING

2.1.3.1 Initial Comment

The HEC-RAS model is a very important tool used in estimating minimum flow requirements in the upper (non-tidal) segment of the Little Manatee River. The results of the model are used to determine fish passage and wetted perimeter requirements, inundation of snag habitat, navigability, and inundation frequency/duration of riverine vegetation and floodplains. Digital HEC-RAS model input files were obtained and reviewed as part of this peer review effort.

Cross Section Representation

The HEC-RAS model used for this study largely replaced an earlier HEC-RAS model developed by ZFI (2010) for an earlier draft of this MFL study (Hood, et al., 2011). One of the concerns identified by reviewers of the ZFI model was that little or no survey information was used to develop the river cross sections. According to the ZFI report, the cross sections were based on topographic contours and a digital elevation model (DEM) rather than field survey.

The draft MFLs report cites a Stormwater Management Model (SWMM) developed in support of a Watershed Management Plan (WMP) update prepared for Hillsborough County as the source of cross section information used in the HEC-RAS model. According to the MFLs report, the SWMM model "…was based on survey data and was assumed to provide the best available information on the flow-stage relationships at various cross sections in the Upper Little Manatee River." According to the report documenting the WMP update (Jones Edmunds, 2015), no surveys were conducted within the main river channel and within the domain of the HEC RAS model developed in support of the proposed MFLs (i.e., from the Fort Lonesome USGS gage downstream to US Hwy 301). The 2015 WMP update evidently reused cross section information from an older SWMM model developed by PBS&J as part of an earlier version of the WMP (PBS&J, 2002).

A review of the HEC-RAS digital model input shows that practically all the river cross sections are represented with idealized flat bottoms. From field observations, this does not capture the cross-sectional variability in channel depth at many locations (e.g., at channel bends). This raises the question of how many of the source cross sections were surveyed and thus merited additional investigation into the sources of cross section data used in the model.

According to the earlier 2002 WMP report, cross sectional information for the Little Manatee River main channel were taken from a 1992 update to the Flood Insurance Rate Map (FIRM) study [Federal Emergency Management Agency (FEMA), 1992]. However, the field survey of cross sections of the main channel for the 1992 update was reportedly performed in the mid-1970s for an earlier FEMA mapping effort. A very limited field survey (two cross sections) of the main channel was conducted for comparison to the 1970s data as part of the 2002 WMP study, but both cross sections were miles downstream of US Hwy 301, outside the domain of the subject HEC-RAS model. So, in the best-case scenario, the cross sections from the most recent SWMM model were indeed based on survey, but that survey probably dates to the mid-1970s. And without access to the original 1970s field survey notes, it is impossible to know how many of the modeled cross sections were originally surveyed. It is not uncommon in flood studies to employ a combination of surveyed cross sections and approximated cross sections.

Another concern is that because the 1970s cross sections have been used and re-used several times for different modeling efforts, the spatial integrity may have been compromised as the cross sections were ported from one modeling platform to another and later to yet another. SWMM assumes prismatic cross sections with a single representative cross section used for each computational link, while HEC-RAS (and its predecessor, HEC-2) assumes non-prismatic sections (different cross sections used to represent each end of the computational link). Porting the cross sections from SWMM to HEC-RAS requires the modeler to assume a single location for each cross section in the prismatic SWMM links, which may extend several hundred feet longitudinally.

<u>Recommendation</u>: The uncertainty introduced by the questionable cross section data has repercussions for all evaluations that rely on the HEC-RAS results, including, but not limited to, the wetted perimeter analysis, the fish passage criterion, and navigability. Figure 4-1 of the draft MFLs report shows the locations of 10 vegetation transects with field surveyed cross sections tied into NAVD88. These were apparently not used in the HEC-RAS model. It is recommended to provide a comparison of these with the nearest HEC-RAS cross sections. Then, characterize the level of accuracy of the modeled cross sections and its ramifications on the reliability of the model output for the MFL analyses.

<u>Suggestion</u>: While the imported SWMM model cross sections are probably an improvement over the cross sections estimated from the DEM by ZFI for the previous iteration of the HEC-RAS modeling for the 2011 MFL study, a new field survey of the river channel (to supplement the 10 cross sections noted above) should be collected to support future updates to the MFLs.

Model Calibration and Flow Apportionment

The flow apportionment by reach originally developed by ZFI was retained by JEI in the current HEC-RAS model setup. The flow apportionment ratio, which is used to apportion flows recorded at the USGS Wimauma gage to the other reaches, is shown in Table 5-1. It is not clear from either the main MFL report, its appendices, or the ZFI (2010) report how the flow apportionment was determined. The ZFI report describes how the earlier HEC-RAS model was calibrated and verified to two extreme rainfall events and used in the simulation of design storm events.

Evidently, the HEC-RAS model was not calibrated to a long-term period of record that includes a range of high and low flows. If the flow apportionment ratios were developed based on the extreme (high) rainfall event simulations, the ratios may not be appropriate for the low and mid-range flows used to establish Block 1 and Block 2 MFL criteria. This is because the relative flow contributions of different parts of the watershed to the total flow at the Wimauma gage can change based on hydrologic flow regime. The draft MFLs report does acknowledge this phenomenon in at least one location, at the upstream end of the model where flows are recorded at the Fort Lonesome gage so direct comparisons can be made to the total flows at the Wimauma gage.

2.1.3.2 <u>Review of District Responses</u>

<u>Cross Section Representation</u>

<u>Recommendation from Peer Review Report</u>: The uncertainty introduced by the questionable cross section data has repercussions for all evaluations that rely on the HEC-RAS results, including, but not limited to, the wetted perimeter analysis, the fish passage criterion, and navigability. Figure 4-1 of the draft MFLs report shows the locations of 10 vegetation transects with field surveyed cross sections tied into NAVD88. These were apparently not used in the HEC-RAS model. It is recommended to provide a comparison of these with the nearest HEC-RAS cross sections. Then, characterize the level of accuracy of the modeled cross sections and its ramifications on the reliability of the model output for the MFL analyses.

<u>District Response</u>: A detailed investigation of the ZFI (2010) HEC-RAS model (ZFI 2010) indicated that the 10 surveyed vegetation transects are included in that model. As a result of

numerous discussions and model results comparisons with John Loper and District staff, it was decided that using the ZFI model for the instream analyses [e.g., low-flow threshold development, System for Environmental Flow Analysis (SEFA)] and using the SWMM HEC-RAS model for the floodplain inundation analysis was an acceptable solution. The revised draft report includes details of the methods and results associated with the updated analyses.

Review of Response: While it is not ideal to have to rely on two separate riverine hydraulic models with different geometries (one for low to mid-range flows and one for high flows), the work-around implemented by District staff appropriately uses the best currently available data for analyses of the two flow regimes. The updated approach and documentation sufficiently address the primary issue raised in the peer review general comment.

The draft peer review report goes further to include a suggestion that future updates to the MFLs for Upper Little Manatee River should include a new field survey of the river channel to supplement the 10 surveyed cross sections referenced in the comment and response. While not a recommendation for the current study, a more comprehensive future field survey could provide input to a single hydraulic model, suitable for both low and high flows, with surveyed cross sections of the main river channel augmented with LiDAR- based floodplain topography.

Model Calibration and Flow Apportionment

Recommendation from Peer Review Report: No specific recommendation was made. The peer review report commented that It is not clear from either the main MFLs report, its appendices, or the ZFI (2010) report how the flow apportionment was determined.

District Response: No response to this was provided in the June 2023 draft response document. However, this comment was discussed in the 7/12/2023 Peer Review Panel meeting, wherein District staff explained the process for estimating the flow apportionment, agreed to provide additional text documenting the procedure and mentioning uncertainty associated with it.

Review of Response: On July 17, 2023 District staff provided a 6-page PDF of the revised HEC-RAS modeling section of the report to the Peer Review Panel for review. This revised document states that the flow apportionment ratios were developed from the HEC-HMS 10-year, 25-year, 50-year, and 100-year design storm results. The document also now acknowledges that using such rare, high intensity design rainfall events for flow apportionment introduces uncertainty into the results, because smaller rain events may produce different spatial patterns of runoff.

2.1.4 BIOLOGY DATA AND SYSTEM FOR ENVIRONMENTAL FLOW ANALYSIS (SEFA) IN THE UPPER RIVER

2.1.4.1 Initial Comment

The biological information for the upper Little Manatee River presented in the MFLs report addressed previous peer review comments concerning a need for more extensive faunistic studies of the river. In response, SWFWMD obtained benthic macroinvertebrate SCI data from FDEP and also obtained fish community data via a field survey conducted by the Florida Fish and Wildlife Conservation Commission (FWC) in late 2020. Fish data from museum records was also reviewed as part of the SEFA analysis.

The floodplain vegetation of the upper river was characterized as part of the SWFWMD's minimum flows development process (PBS&J 2008, Appendix G). Relationships among vegetation, soils, and elevation in wetlands were evaluated at ten study transects. Communities found included:

- Willow Marsh: Carolina willow (*Salix caroliniana*), popash (*Fraxinus caroliniana*) and Dahoon holly (*Ilex cassine*);
- Tupelo Swamp: swamp tupelo (*Nyssa aquatica*), an obligate wetland species, and slash pine (*Pinus elliottii*), a facultative wetland species; and
- Hardwood Swamp: swamp bay (*Magnolia virginiana*), an obligate wetland species, and water oak (*Quercus nigra*), a facultative wetland species.

Wetlands did not appear to be well developed along the upper river, and the three wetland classes present were characterized by species with somewhat lower inundation requirements. There was no consistent steep increase in cumulative wetted perimeter coincident with a particular shift in vegetation classes along the upper river transects.

Since 2015, approximately 200 taxa of benthic macroinvertebrates have been collected from the US Highway 301 location. The mean SCI score for the Upper River (n = 12) was 55, a value that indicates a healthy, well-balanced community at the existing water withdrawal conditions (Table 2-1).

Table 2-1. Stream Condition Index Data for the Little Manatee River from FDEP

Date	FDEP LIMS ID	Variable Name	Result
1/23/2015	1147639	SCI_2012	30
1/22/2015	1232845	SCI_2012	72
1/23/2015	1312457	SCI_2012	67
1/23/2015	1389059	SCI_2012	43
1/23/2015	1466871	SCI_2012	60
1/22/2015	1553243	SCI_2012	68
1/16/2015	1648970	SCI_2012	51
10/14/2015	1725280	SCI_2012	61
3/21/2016	1760010	SCI_2012	53
6/14/2016	1782696	SCI_2012	24
3/13/2018	1955765	SCI_2012	68
10/31/2019	2078357	SCI_2012	67
		Mean	55.3

Recommendation: Include the SCI results and mean score in the MFLs report and provide evidence that the existing consumptive use has not caused significant harm to the invertebrate community

An electrofishing survey was conducted by the FWC on September 10, 2020 in about 0.5 mile (0.6 km) of the river upstream of the US Highway 301 Bridge (Nagid and Tuten, 2020) at four locations. Sixteen species of freshwater and marine fish were collected by the FWC, mostly freshwater species typical of southwest Florida river systems, although two non-native, freshwater species and three marine species were collected. An additional taxa list was provided based on museum collections.

The fish and invertebrate taxa identified as inhabiting the Upper River supported the use of the 25 species and habitat guilds used for the SEFA evaluation.

SWFWMD conducted a SEFA evaluation to characterize the potential effects of flow reductions on a suitability index for instream habitat. SWFWMD collected physical habitat data on substrate and cover and combined this with depth and velocity from the HEC-RAS model and habitat suitability curves to develop an area-weighted habitat index for selected fish and aquatic macroinvertebrates. SEFA used cross-sectional elevation profiles, water surface elevation, velocity, and substrate/cover types at specific locations across the channel, along with suitability profiles for water depth, velocity, and substrate/cover for selected fish and aquatic macroinvertebrates. These data were used to derive a taxon-specific area weighted suitability (AWS) for each flow rate. Baseline flows were compared to various flow reduction scenarios to determine the 15% loss of habitat associated with decreases in flows.

A set of 25 habitat suitability curves corresponding to species, life history stages, larger taxonomic groups of fish and aquatic macroinvertebrates, and habitat guilds was used for the SEFA analysis. Substrate and cover observations were made at 21 cross sections grouped into 7 sites in the Upper River. These transects also represented an increased sampling effort in response to previous peer review comments. The SEFA Block 1 flows included the 0 to 33rd percentile flows, which equals flows 1 to 21 cfs at the reference reach and 1 to 35 cfs at the gage reach. The SEFA Block 2 flows corresponded to the 34th to 60th percentile flows, equaling >21 cfs to 44 cfs at the reference reach and >35 to 72 cfs at the USGS gage. The time series of habitat relationships by AWS were condensed into median values for each habitat suitability group. Model runs were compared, and maximum flow reduction scenarios were identified that corresponded to reductions in median values of less than 15% loss compared to the baseline condition.

Results of the SEFA analysis for Block 1 indicated that the most sensitive habitat suitability group is the deep-fast (DPFA) habitat guild, which experienced a 15% loss in median habitat at baseline flow reductions greater than 10%. For Block 2, the most sensitive habitat suitability group was the Ephemeroptera (mayflies) and Trichoptera (caddisflies) (ETs) group, which experienced a 15% loss in median habitat at baseline flow reductions greater than 20%.

Recommendation:

The panel agreed that the additional data gathered by the SWFWMD was sufficient to support the SEFA approach. The SEFA evaluation was environmentally relevant and provided a sound basis for minimum flows in the upper river.

2.1.4.2 Review of District Responses

The panel continues to support the use of the HEC-RAS model to determine critical flows/levels associated with fish passage and floodplain inundation and use of the System for Environmental Flow Analysis (SEFA) model for establishing maximum acceptable reductions in flows/levels to protect the most sensitive habitats/guilds/species found in the upper river.

The panel agrees with the importance of fish passage as a low flow threshold and that floodplain inundation criteria are needed to protect the recurrence of intermittent high flows that provide support for wetland vegetation, biogeochemical processes, and habitat quality in the upper river. Use of the HEC-RAS model and calculation of percent-of-flow reduction curves were scientifically defensible methods for establishing allowable flow reduction criteria for Block 3 related to ensuring floodplain inundation occurrences.

The panel is pleased that SWFWMD provided the FDEP Stream Condition Index data as one indication that a healthy, well-balanced community of sensitive invertebrates (including caddisflies in the family Hydropsychidae) exists in the upper river under the current flow regime (which includes FPL withdrawals).

To characterize the potential effects of flow reductions on instream habitats in the upper river, SWFWMD collected physical habitat data on substrate and cover and combined this information with depth and velocity from the 2010 HEC-RAS model to develop an area-weighted habitat index (AWS) using the SEFA software. Habitat suitability for 35 habitats/guilds/species expected to occur in the upper river was calculated from cross-sectional elevation profiles, water surface elevation, velocity, and substrate/cover types at specific locations across the channel.

Reach habitat curves were imported to R from the SEFA software and joined to flow time series to create reach habitat time series for each flow reduction scenario. Time series of AWS were condensed into mean values for each habitat suitability group and flow reduction scenario for flows up to 96 cfs, the threshold between Block 2 and Block 3, were evaluated. Four of the 35 assessed groups, including the net-spinning caddisflies (Hydropsychidae or HYDR), the deep-fast guild (DPFA), total invertebrates (TINV), and adult Bluegill (BLUA), showed at least 15 percent loss of habitat with up to 25 percent loss of flow. All other groups were either less sensitive or had insufficient habitat at less than 1 AWS at the 29 cfs fish passage flow.

The most sensitive group was the Hydropsychidae (net-spinning caddisflies), which exhibited a 15 percent loss in mean habitat associated with flow reductions greater than 12 %. Based upon peer review panel requests, the revised report included an explanation that the calculation of Hydropsychidae habitat included sand/woody debris as part of the flow/velocity/cross section analysis. This comment is therefore resolved.

2.1.5 HYDRODYNAMIC (EFDC) MODELING

2.1.5.1 Initial Comment

An EFDC model was utilized to simulate the changes in salinity in the estuarine portion of the Little Manatee River (below the crossing at 301). This model was one of two methods utilized for defining the changes in salinity in the estuarine portion of the Little Manatee River. Salinity changes in the river were a key aspect driving the MFL determinations, therefore, the accurate simulation of those changes is very important.

The model was developed and calibrated between 2005 and 2007 (Huang and Liu, 2007). The model was developed and calibrated using data collected in 2004 and 2005 at four stations located from the mouth of the Little Manatee River to below US 301. The model extents are from the mouth up to 301, and the upstream boundary includes the measured freshwater inflow at 301.

The EFDC model provided output from 2000 through 2004 (some portions of 2005 were simulated but not used in the analyses) to provide baseline salinity conditions and then salinity conditions under flow withdrawal scenarios from 5% up to 40% in increments of 5%. In work completed for this MFL development, some modifications were made to the code to provide more accurate output of hourly salinity and depth/level data to provide more accurate calculations of the salinity volumes. This update created more accurate output. The model output was processed to provide volumes and areas for each 1 ppt increment of salinity isopleths. These volumes and areas were then evaluated to see what level of flow reduction would create a 15% change in the habitat volume and area under varying conditions. The following identifies findings and recommendations on the EFDC model.

General Findings: A number of issues are raised below relative to the EFDC model development, documentation and application. These issues bring into question the use of the model (as it stands) for performing the simulations used to assess potential changes in area and volume of salinity habitat. A series of recommendations are provided below to help in determining the model's suitability as it stands at present. The final determination on model suitability will then be assessed based on the results of the requested analyses as part of the Final Peer Review Report.

Model Documentation

Within the original document and appendices there was insufficient documentation on the model development, calibration and application. While the main report and some of the appendices provided limited information on the model development and application, no complete report was provided. The MFLs document referenced a report of the model (Huang and Liu, 2007), but this report was not included as part of the supporting documentation. The Huang and Liu report was provided by District staff to the Peer Review Panel upon request. An additional report (Interra, 2006), which outlined the development of the ungaged flows below US 301, was also referenced but not included in the MFLs documentation. The Interra report was provided by District staff upon request. Additionally, some aspects of the model development were not well documented in the Huang and Liu report. This included how depths/elevations within the model were developed and the source of the bathymetry data used to develop the depths in the model. Subsequent discussions with District consultants identified a report that outlined the bathymetric survey work performed on the lower portions of the river. Additionally, no documentation was provided on how the EFDC model downstream boundary conditions were developed for the MFL reduction scenarios, which went from 2000 to 2005. Data collection at the location of the downstream boundary condition only occurred from mid-2004 through 2005. Subsequent investigations and discussions with District staff identified that the unmeasured portion of the simulations utilized regressions between salinity and flow developed by HSW around 2007, but there is no documentation of that as part of the MFLs documentation. District staff provided various reports and information relative to the regressions and how they were utilized to develop the boundary conditions.

Recommendation:

As part of the MFLs documentation, an appendix should be created that includes all the reports and other information that document the development and calibration of the EFDC model. This includes the model calibration as well as the MFL reduction baseline scenario from 2000 to 2005. Where no specific reports exist (i.e., for how bathymetric data were interpolated onto the model grid) the District should provide text and figures to supplement the reports provided so that in the end, complete documentation of the EFDC model is included as part of the supporting documentation for the proposed MFLs.

Physical Representation of Estuarine Portion of the Little Manatee River

For mechanistic models of this type, a key aspect is that the grid developed provides a reasonable and accurate physical representation of the system. Figure 2-3 presents the EFDC model grid overlain onto an aerial of the estuarine portion of the Little Manatee River. The program utilized to transform the available model input files into a representation of the grid in some areas is not completely accurate, but overall, the recreated grid represents what is in the model.

Examination of the grid in relation to the shoreline of today shows areas where the physical representation does not match the actual conditions horizontally. This is especially evident in the area between the mouth up to US 41. This can be seen in the figure as well as in the original grid plots presented within the Huang and Liu report. In this area the sinuosity of the channel is not represented. Upstream of US 41 while the grid does generally follow the primary river channel, the grids extend outside of the channel into tidal marsh areas and in some instances upland areas. Figure 2-4 presents the depths as represented in the model. Examination of this figure identifies that the model, in a number of areas, is flat across the cross sections with no true channel geometry defined. This is most likely not an accurate representation of the overall system geometry.

One aspect of the model is that there is no wetting and drying being simulated. Examination of the model input files indicates this function is turned off. Wetting and drying is where the model simulates areas of tidal marsh that flood and drain throughout the tidal cycle. Examination of the aerial photographs indicates there are potentially significant areas of tidal marsh adjacent to the system. While the model does include some side storage areas, it would appear that overall, a number of areas are not being simulated. This would relate to the accuracy of the tidal prism being simulated.

Figure 2-3. Model Grid Overlain onto Aerial Photography

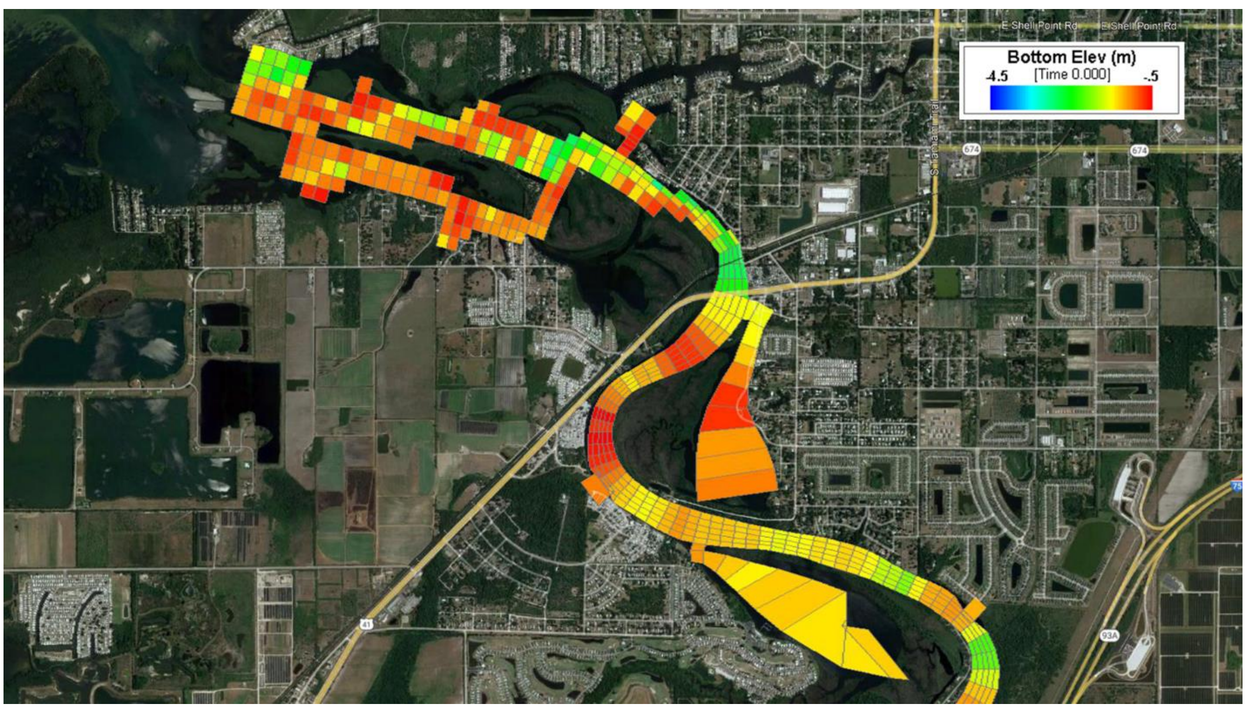

Figure 2-4: Model Bathymetry Overlain onto Aerial Photography

Recommendation:

The model is utilized to calculate area and volume changes, so an analysis should be conducted to provide a comparison of the model areas and volumes with the actual volumes and areas in the system. A recommendation would be to calculate the longitudinal cumulative volume and area from the river mouth in the model (by river mile) up to US 301 versus actual inundated volume and area calculated from available shoreline, light detection and ranging (LiDAR), and bathymetric data. This should include adjacent tributaries as well as potential areas for flooding and drying in the adjacent marsh areas.

Model Calibration

The datasets utilized to calibrate the model had good temporal and spatial coverage. Having three continuous monitoring stations with data over a 2-year period provides ample data to calibrate the model. Given the age of the dataset it would have been good to see some more recent datasets utilized to either recalibrate or check the model performance under present conditions. One point to note on the data collection is that the upstream station below US 301 (532) did not have conductivity measurements. This is the station just upstream of the braided area and, based on material presented in the main document and appendices, an area that much of the time is experiencing the lower salinity conditions that drove the MFL.

As discussed above, the model calibration is presented in the Huang and Liu report (2007). This report needs to be provided as part of the overall model documentation as it is the only relatively complete documentation. Based upon the presentation of graphs and statistics within the MFLs report documents and the Huang and Liu report (2007) the calibration looks good. For the periods where the model data are presented against the measured continuous salinities, temperatures, and water levels, the agreement is good both graphically and statistically. The plots showing the comparisons of the measured and simulated continuous salinities shows that the model is capturing the characteristics of the salinity changes and the responses under different tidal and freshwater inflow conditions.

Model Boundary Condition Location

Generally, for hydrodynamic model development it is recommended that boundary conditions in the model be located such that they are well outside of the areas that the model is being used for. The model boundary is located at the mouth of the river and this is an area being evaluated.

Flow reduction is the parameter change being evaluated by the model and it is likely that the salinity levels at the mouth would change (on average) if there is a net overall reduction in flow. As such, some evaluation or sensitivity analysis should be performed using the model and available data to show how potential changes in the flow would impact the boundary conditions and ultimately the MFL determinations.

Recommendation: Using the updated salinity regressions derived by Janicki, estimate the average net change in salinity at the boundary under the flow reduction where the 15% change in habitat was seen (21% reduction) for the habitat volume and area calculations. Apply this net change in salinity to the boundary condition in the model and rerun the simulations and recalculate the volume and area changes from the baseline condition to determine the impact on the volume and area changes of the response at the boundary.

Model Boundary Condition Time Series for MFL Scenarios

For the MFL baseline run and the flow reduction runs it was determined that the boundary conditions in the model are a mixture of measured data (for the period from around March 2004 through 2005) and data generated from regressions developed by HSW. This was not documented in any of the supporting materials. Figure 2-5 presents a plot of the surface and bottom salinities for 60 days where the measured data were utilized. Figure 2-6 presents a plot of the surface and bottom salinities where the boundaries were derived from the HSW regression. Examination of the plots shows two things. First, it appears for the boundaries created using the HSW regression, an error was made and the bottom and surface salinities appear to have been flipped. Second, the overall behavior of the boundary in the regressed condition does appear to match that seen in the measured data. It should be noted that for the MFLs, the HSW regressions were updated and per the documentation provided improved.

Recommendations: Runs should be performed to determine if the error is fixed if it would change the results of the simulations. It is likely that this error will not have a significant impact on the overall calculations due to the generally small degree of stratification in the system, but the District must determine the defensibility of carrying this error forward if the analyses are not fully redone with the fixed boundary condition. Additionally, the regression utilized for the generation of the boundary conditions should be utilized to calculate the boundary condition during the period of the measured data and the two compared. This will allow for an assessment of the reasonableness of the created boundary for MFLs determination.

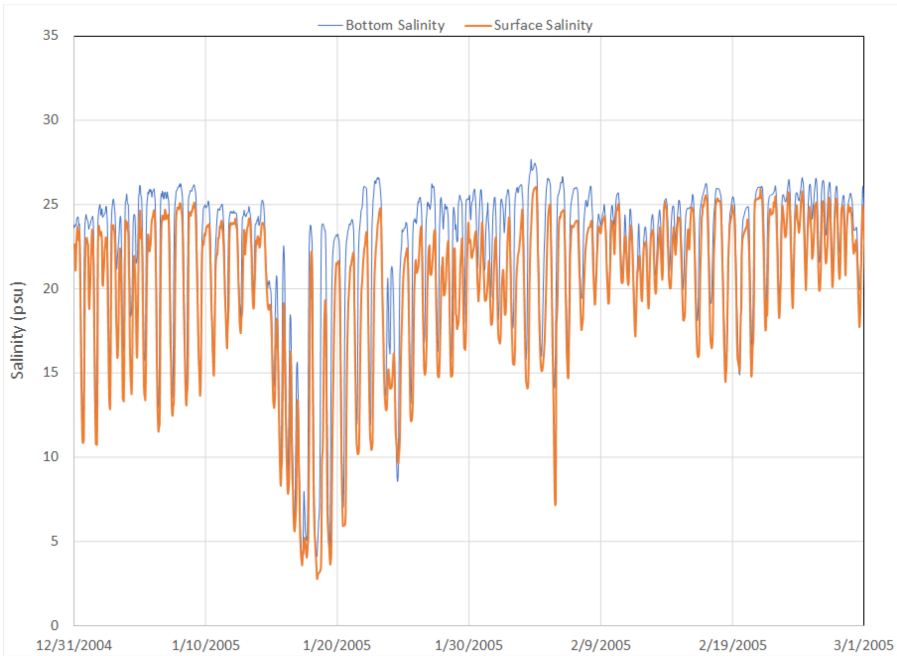

Figure 2-5: Measured Surface and Bottom Salinity Boundary Condition

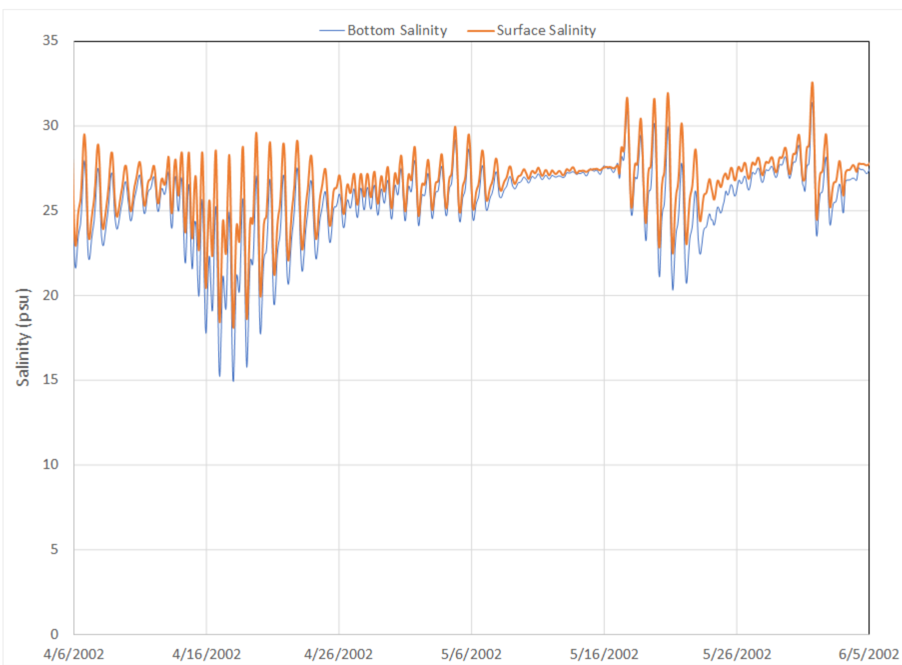

Figure 2-6: Created Surface and Bottom Salinity Boundary Condition

2.1.5.2 Review of District Responses

Model Documentation

Recommendation from Peer Review Report: As part of the MFLs development report documentation, an appendix should be created that includes all the reports and other information that document the development and calibration of the EFDC model. This includes the model calibration as well as the flow reduction baseline scenario from 2000 to 2005. Where no specific reports exist (i.e., for how bathymetric data were interpolated onto the model grid), the District should provide text and figures to supplement the reports provided so that in the end, complete documentation of the EFDC model is included as part of the supporting documentation for the lower river minimum flows development.

District Response: An improved and updated EFDC model for the Lower Manatee River was developed using newly surveyed bathymetry data and available light detection and ranging (LiDAR) data. The simulation domain of the new model was extended from the mouth of the Little Manatee River into Tampa Bay, with the downstream boundary conditions being specified with model results of another hydrodynamic model for Tampa Bay. The new EFDC model was calibrated and verified for the same time period as that in Huang and Liu (2007). The peer review panel's concerns regarding the old EFDC model for the Lower Little Manatee River have been resolved with the development of the updated EFDC model. Details about the updated model, as well as detailed model documentation, are included in the revised draft report and new appendices.

Review of Response: The improved and updated EFDC model addresses the issues raised. The extension of the model boundary conditions, the improved resolution and representation and of the shoreline and bathymetry and the identification of the associated data sources are all good. Appendix L was provided which presents the model documentation. Following review of Appendix L which includes documentation on the model development, calibration and application, a determination is made that the documentation is sufficient and addresses the comment provided.

Physical Representation of Estuarine Portion of the Little Manatee River

Recommendation from Peer Review Report: The model is utilized to calculate area and volume changes, so an analysis should be conducted to provide a comparison of the model areas and volumes with the actual volumes and areas in the system. A recommendation would be to calculate the longitudinal cumulative volume and area from the river mouth in the model (by river mile) up to US Highway 301 versus actual inundated volume and area calculated from available shoreline, LiDAR, and bathymetric data. This should include adjacent tributaries as well as potential areas for flooding and drying in the adjacent marsh areas.

District Response: Comparisons of cumulative volume and area for the updated EFDC model, including adjacent tributaries, are included in an appendix (JEI 2023) of the revised draft report. The updated model also simulates wetting and drying. The slight over-representation of the river width in the upstream area of the Lower Little Manatee River was corrected in the post-processing when salinity habitats were calculated.

Review of Response: Within Appendix L graphics are provided that present by river mile the bottom surface area and volume as represented in the model in comparison to actual bottom area and volume based on available data. These comparisons, along with the finer grid resolution provided, demonstrate that the model is reasonably representing the physical conditions in the system and addresses the comment provided.

EFDC Model Calibration

Recommendation from Peer Review Report: No specific recommendations were provided as overall the old EFDC model calibration statistics were reasonable.

District Response: District staff appreciates the comment.

Review of Response: While no response was provided, the calibration statistics for the new EFDC model were presented within the main report as a summary table. The statistics generally look reasonable. Appendix L provides more detailed statistics and graphical comparisons demonstrates that the model calibration is reasonable for water level, salinity and temperature. The model is able to reasonably simulate the changes in salinity at the stations where data were available under varying freshwater inflow and tidal forcing conditions. This is accomplished even with the moving of the downstream boundary condition out into the bay, and using model simulation data at the boundary which itself would contain some error. The original model had similar response and statistics using measured salinity at the mouth of the Little Manatee. This supports the improved nature and robustness of the updated model. No resolution was needed for this comment.

EFDC Model Boundary Condition Location

Recommendation from Peer Review Report: Using the updated salinity regressions derived by JEI, estimate the average net change in salinity at the boundary under the flow reduction where the 15 percent change in habitat was seen (21 percent reduction) for the habitat volume and area calculations. Apply this net change in salinity to the boundary condition in the model and rerun the simulations and recalculate the volume and area changes from the baseline condition to determine the impact on the volume and area changes of the response at the boundary.

District Response: This problem is minimized in the updated EFDC model for the Lower Manatee River by extending the open boundary from the mouth of the river into Tampa Bay.

Review of Response: Based on the graphics provided in the main document, the extension of the grid into Tampa Bay looks sufficient to address the concern raised. Based on the results presented in Appendix L and the discussions above, the revised boundary condition addresses the comment provided and provides for a much more robust model for performing the MFL determinations on salinity change.

EFDC Model Boundary Condition Time Series for Minimum Flows Development Scenarios

Recommendation from Peer Review Report: Runs should be performed to determine if the error is fixed if it would change the results of the simulations. It is likely that this error will not have a significant impact on the overall calculations due to the generally small degree of stratification in the system, but the District must determine the defensibility of carrying this error forward if the analyses are not fully redone with the fixed boundary condition. Additionally, the regression utilized for the generation of the boundary conditions should be utilized to calculate the boundary condition during the period of the measured data and the two compared. This will allow for an assessment of the reasonableness of the created boundary for MFL determination.

District Response: This problem does not exist in the new EFDC model simulations. The salinity boundary conditions in the updated model are from another hydrodynamic model for Tampa Bay and not from the HSW regressions.

Review of Response: The error in the boundary condition pointed out in the original comment does not exist in the new model. Review of Appendix L has demonstrated that the new model boundary condition addresses the comment provided above.

2.1.6 SALINITY REGRESSION MODELING

2.1.6.1 Initial Comment

For the lower portion of the Little Manatee River, an analysis was described that utilized a LOESS salinity-flow regression model to predict salinity changes due to flows. This model was described in conjunction with the EFDC model discussed above. For the habitat suitability analyses using an Environmental Favorability Function (EFF) the salinity regression model was used to project salinity changes under flow reductions and resultant evaluations of percent change in habitat for various fish species. The evaluation examined if the changes in salinity projected by the regression model under different flow reduction scenarios would create more than a 15% negative change.

First, it would always be best to utilize a well-developed and sufficiently calibrated hydrodynamic model that accurately represents the system extents and geometry in order to project salinity changes. This is recognized within the appendix documentation where it is identified that a mechanistic model would be the “Gold Standard” for such an evaluation. Such a model would provide for projections of salinities over a more 2-D spatial extent rather than be limited to a more simplistic longitudinal projection which occurs through use of the regression model. Per the documents, the limited timeframe of the EFDC model application (2000 to 2005) relative to available data from 2015-2019 identified the need for an alternate method for projecting salinity changes under this later time frame.

Examination of the documentation on the development of the salinity regression model identified that previous work was completed to develop regressions between flows and salinity for the system. This work was updated such that data through 2019 was utilized. The data came from long-term monitoring along the system. The available data for the regression modeling was relatively robust and represented a reasonable dataset for development of such a regression. Examination of plots presented in the main document and appendices provides a demonstration of the accuracy of the regression model under various flow conditions. Figure 2-7 below presents a plot of the final regression against the available data (right) versus previous regressions prior to the update. The plots show that the updates to the original regressions represented a significant improvement. Examination of the results does show that the revised regression has somewhat of an overprediction bias at the lower salinity levels and somewhat of an underprediction bias in the upper salinities. Figure 2-8 presents comparisons of the salinity projection contours under different flow conditions and location along the river. The results show that the regression model does well in representing the conditions along the overall flow gradient and longitudinally and in some aspects provides a more accurate representation of the data than the EFDC model. Based on the evaluation of the model, the determination is that the regression (within some of the limitations of this type of regression modeling) is sufficient for use in the MFLs development.

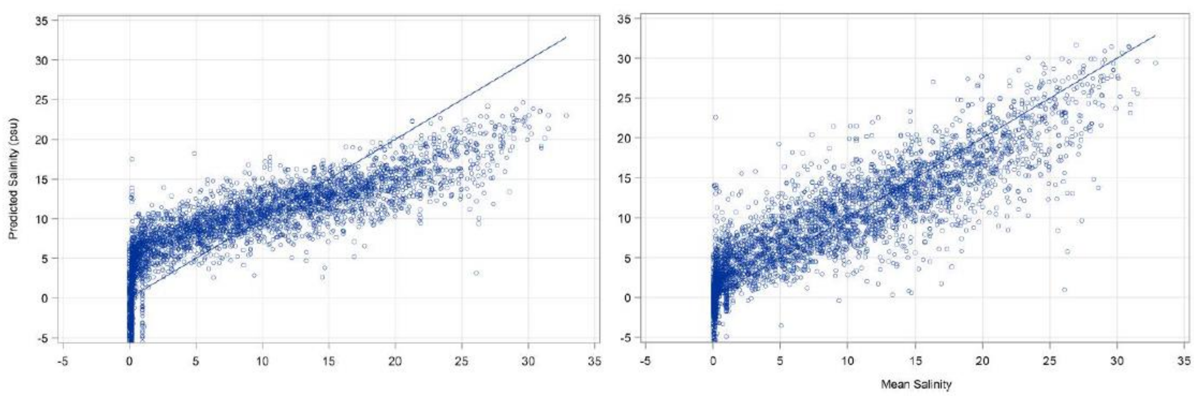

Figure 2-7. Comparison of Original Least Squares Regression to Update LOESS Regression

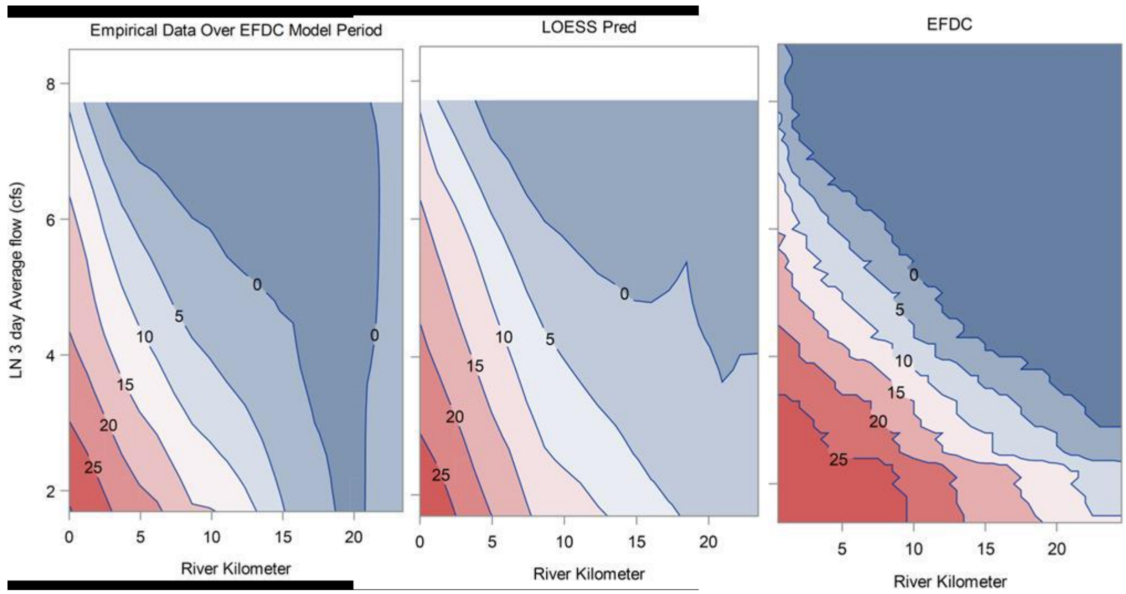

Figure 2-8. Contour Plots of Empirical Data, LOESS Projection, EFDC Projection for EFDC Time Period

2.1.6.2 <u>Review of District Responses</u>

<u>Determination from Peer Review Report</u>: The peer review report determined that for the purposes of the EFF analyses, the salinity regression modeling was reasonable. The report did identify some aspects of overprediction and under prediction at the two ends but the regression was deemed sufficient. It was identified that the "Gold Standard" would be to use the hydrodynamic model per the appendix documentation.

<u>District Response</u>: District staff appreciates the comment. Note that the revised draft report includes updated EFF analyses.

<u>Draft Review of Response</u>: As no specific recommendation was made in the peer review report, the response is sufficient. Discussions during the Peer Review Panel meetings addressed some follow up questions identified.

2.1.7 BIOLOGICAL DATA AND BIOLOGICAL ASSESSMENT LOWER RIVER

2.1.7.1 <u>Initial Comment</u>

The MFLs report provided benthic macroinvertebrate community data from a study conducted by Grabe and Janicki (2008, Appendix F), fish and nekton data from the FWC's long-term Fisheries-Independent Monitoring (FIM) program, and fish data from a study conducted by Dutterer (2006).

The panel agreed that a robust invertebrate and fish community data set was available for the estuarine portion of the river. It was striking that location in the river (river Km) was the single abiotic variable with the highest Spearman rank correlation coefficient to changes in multivariate community structure, suggesting salinity as the principal driver. Examination of the taxa list revealed that the many of the organisms present are adapted to thrive in low but variable salinity. The Little Manatee estuary, which yielded 1,855,578 individuals from 136 taxa (caught in 2,447 seine hauls between 1996 and 2019) and 371,478 individuals (117 taxa) from 1,724 trawls over the same period of record, represents an extremely valuable estuarine habitat. Ichthyoplankton data also indicated that the estuary is a high functioning nursery area. The panel found that SWFWMD's MFL goal to maintain the 1-2 psu habitat conditions associated with salinity-sensitive taxa was an appropriate target.

Residence Time and Low Salinity Habitat in Little Manatee River Estuary

At low to moderate flows, water residence time at the area most likely to support taxa favoring 1-2 psu salinities (river kilometer 15-19) ranges from 1 to 5.6 days (Fig 2-9). This indicates that a fairly narrow, transient area exists that is capable of supporting the taxa that require the 1-2 psu salinity range. This short resident time area is critical for the protection of these salinity-sensitive organisms. For example, Peebles (2008) found that the highest community heterogeneity was associated with higher river flows and lower salinities, indicating that this transient, low salinity habitat is important to protect through MFLs development and implementation (Fig 2-10).

Scenario	Upstream gaged inflow (cfs)	Total inflow Q(cfs)	Water age *T* (days) at different distances from the river mouth (Rkm)									
			1	3	5	7	9	11	13	15	17	19
1	7	9	50.0	49.5	49.0	46.8	44.4	39.8	29.1	19.2	13.1	3.1
2	11	18	39.9	39.6	38.8	36.8	34.5	30.2	20.8	12.5	8.6	2.5
3	18	28	32.5	32.3	31.5	29.8	27.5	23.5	14.2	9.6	5.5	1.9
4	21	34	31.3	31.2	30.4	29.2	26.4	22.9	13.6	9.3	5.4	1.8
5	28	41	28.5	28.5	27.9	26.8	23.5	20.5	12.1	7.2	4.5	1.7
6	32	49	27.2	27.1	26.6	25.5	22.3	19.5	11.9	6.3	4.1	1.6
7	35	55	24.4	24.4	23.8	22.8	19.6	17.0	10.1	5.6	3.9	1.5
8	42	62	22.7	22.5	22.0	21.2	17.9	15.6	9.6	5.2	3.3	1.5
9	46	71	21.8	21.5	21.3	20.5	17.1	15.0	9.2	4.7	3.1	1.4
10	53	82	20.9	20.7	20.4	19.8	16.8	14.5	9.0	4.2	3.1	1.3
11	64	96	19.9	19.6	19.4	19.0	16.1	13.9	8.3	3.9	2.6	1.2
12	85	129	15.7	15.5	15.3	14.9	12.4	10.3	4.6	3.4	1.7	1.0
13	124	190	11.1	11.0	10.8	10.6	8.4	6.6	3.7	2.5	1.5	0.8
14	201	305	7.3	7.0	6.9	6.6	5.2	3.4	1.6	1.1	0.6	0.3
15	406	619	3.7	3.3	3.2	2.9	2.1	1.6	1.1	0.7	0.4	0.3
16	710	1078	2.0	1.8	1.6	1.3	1.1	1.0	0.5	0.5	0.3	0.2
17	1780	2707	1.2	1.0	0.7	0.6	0.6	0.4	0.3	0.2	0.2	0.1

* Note that flow values have been converted to cfs.

Fig. 2-9. Residence time associated with various flow conditions by river kilometer (from Huang et al. 2009)

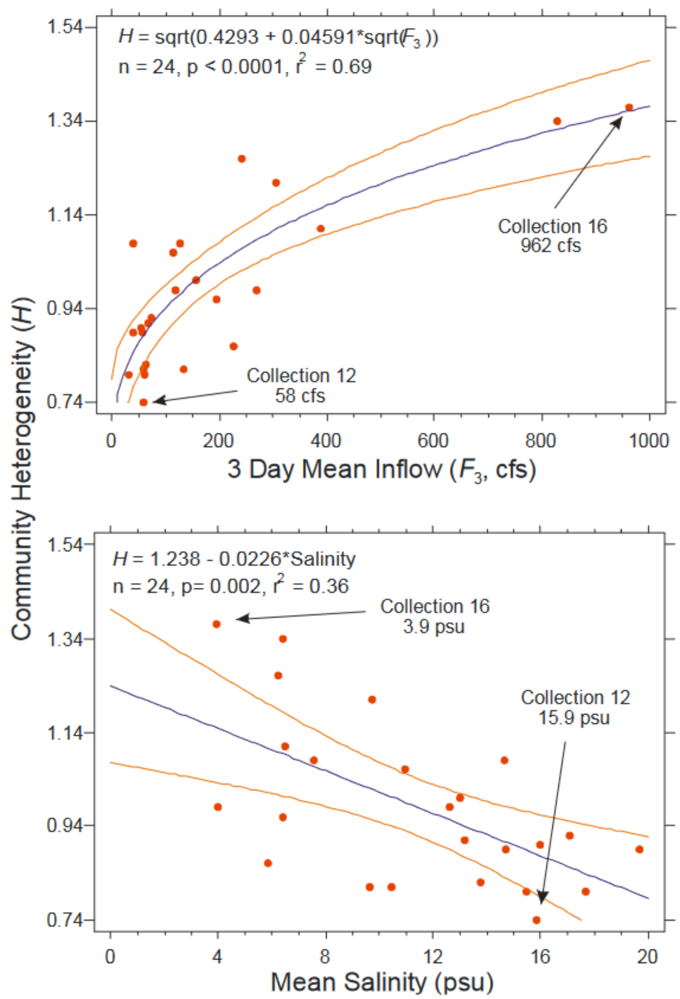

Fig. 2-10. Zooplankton community heterogeneity in Little Manatee River estuary by flow (top panel) and salinity (bottom panel) (from Peebles 2008).

Low Salinity Fish Habitat

The effects of flow reductions on estuarine fish habitat were evaluated using a habitat suitability index for fishes (EFF), based on logistic regression. First, a LOESS model timeseries was used to predict salinity for each date and each 0.1 river kilometer increment from 2015 through 2019. These predicted salinity values were then used as input into the logistic regression model along with the assigned habitat and season categories for each location and date in the timeseries. The report indicated the EFF was a post-hoc modification of the output of logistic regression to compensate for the differences in species prevalence (i.e., how often a species occurs) by adjusting the intercept term by the log odds of the empirical occurrence of the species being modeled. Since the EFF standardizes the outcomes to their average log odds of occurrence, a cut-point value of 0.5 was used to assign “favorable” and “unfavorable” predictions for each species using the LOESS model salinity predictions. Only those t**axa with negative responses to salinity** (they require low salinity) were considered for the MFL analysis. These included Sheepshead (Archosargus probatocephalus), Common Snook, Striped Mojarra (*Eugerres plumieri*), Eastern Mosquitofish (*Gambusia holbrooki*), Naked Goby (*Gobiosoma bosc*), Rainwater Killifish, Clown Goby, Sailfin Molly (*Poecilia latipinna*), Hogchoker, and gobies less than 20 millimeters (small gobies). The effects of flow reductions were quantified as the percent change in area of favorable (low salinity) habitat for these taxa.

For the EFF, flow blocks 1 and 2 were more sensitive to changes in flows than the overall average change across all blocks. For Block 1, Rainwater Killifish, Sailfin Molly, Clown Goby, Naked Goby, and small gobies less than 20 millimeters exhibited a 15% reduction in favorable habitat at a 10% reduction in flows.

At Block 2 flows, Rainwater Killifish, Sailfin Molly, and small gobies exceeded the 15% reduction in favorable habitat threshold at a 20% reduction in flows. The results for Block 3 indicated that none of the species evaluated would see reductions in favorable habitat of 15% or greater until flows were reduced by 30%.

The panel agrees that this was a relevant and rational approach to protect the taxa shown to require low salinity using comprehensive biological data set.

<u>Suggestion</u>: In the conclusions for this topic, it would be useful to summarize how other data considered (e.g., zooplankton) also indicated the need to protect the low salinity habitat, so as to provide as a weight of evidence approach for selection of the 15% EFF habitat reduction. Note that establishing the precise flow blocks for the estuary also needs additional analysis.

2.1.7.2 <u>Review of District Responses</u>

Although an improved EFDC model was used to analyze reduction in various salinity habitats (water volume, bottom area and shoreline length) associated with each 1 PSU salinity isohaline increment from 0 to 30 PSU, application of the Environmental Favorability Function (EFF model) provided more protective results.

The panel agrees that because the EFF model showed the ≤2 PSU habitat was the most sensitive to reductions in flow, that the safeguarding of this low-salinity habitat would inherently protect the higher salinity habitats (*e.g.,* 0 to ~10 PSU, often associated with the nursery zone function of estuaries).

The panel notes that SWFWMD provided additional ecological evidence to support use of the protectiveness associated with the EFF model. This included Janicki Environmental' s (2007) use of PCA of species presence-absence data to identify salinity zones related to macroinvertebrate community structure. In addition, Clewell et al. (2002) found that freshwater plants that tolerate some combination of salinity levels and durations were primarily located upstream of the median location of 2 PSU salinity in the river channels. The panel agrees that the EFF analysis represented the boundaries of salinity zones that are important to either shoreline plant communities, benthic macroinvertebrates, or fish/nekton in the Lower Little Manatee River. The lowest salinity isohaline of <2 PSU that was evaluated is often considered as a critical parameter for the health of the estuary and has been used by SWFWMD as the lower limit in previous estuarine minimum flows evaluations (Herrick et al. 2019a, 2019b, Ghile et al. 2021).

The results of the updated EFF model assessment appeared to be consistent with previous evaluations. Eleven species exhibited a higher probability of occurrence at low- or mid-range salinities than at higher salinities and were considered most useful for assessing potential flow-related habitat favorability changes. The estuarine fish species evaluated included: Sheepshead, Common Snook, Striped Mojarra (*Eugerres plumieri*), Eastern Mosquitofish (*Gambusia holbrooki*), Naked Goby (*Gobiosoma bosc*), Rainwater Killifish (*Lucania parva*), Clown Goby, Sailfin Molly (*Poecilia latipinna*), Red Drum, Hogchoker, and gobies less than 20 mm (small gobies, *Gobiosoma* sp.). The effects of flow reductions were quantified as the percent change in area of favorable habitat (*i.e*., shoreline length) within the domain of the estuarine model segment. This is consistent with the FWC seine sampling method for fish and nekton, which occurs from shoreline habitat. Also note that Table 4-5 has a typo (Gambusia is Eastern mosquitofish, not goby).

The taxa most sensitive to flow reductions were tidal river residents and included Eastern Mosquitofish, Naked Goby, Hogchoker, and small gobies less than 20 mm. More transient, estuarine-dependent species, such as Common Snook, Sheepshead, and Red Drum, were less sensitive to flow reductions though all showed negative responses to flow reductions during the analysis.

The panel agrees that a rational, scientific approach was used to develop these protective MFL criteria for the lower river, and that protection of low salinity fish habitat will also protect salinity sensitive vascular plants, benthic invertebrates, and ichthyoplankton.

In summary, SWFWMD followed relevant statues and rules, properly evaluated applicable environmental values, and used sound scientific approaches to develop MFLs protective of the most sensitive ecological end-points in the upper and lower Little Manatee River.

2.1.8 FLOW BLOCKS (UPPER RIVER)

2.1.8.1 Initial Comment

The District's "building block" approach categorizes the flow record into discrete blocks of low, mid-range, and high flows for the purpose of assessing the potential for significant harm separately for each flow regime. While many previous MFLs defined the blocks based on season with specific days of the year used to differentiate the blocks, the District has recently shifted to a flow-based approach. Blocks used for the proposed Little Manatee River MFLs are defined using flow thresholds that are independent of day-of-year but do generally correspond to typical seasonal periods of low (dry season), mid-range (transition), and high (wet season) flows. The use of flow-based blocks is an improvement over the seasonal block approach, as it properly accounts for times when flows are higher or lower than expected based on historical seasonal variations alone.

Low-Flow Threshold and Block 1 Definition

Several low-flow metrics were evaluated to determine an appropriate division between flow blocks 1 and 2. These include wetted perimeter, fish passage, instream habitat, and navigability. Upper river fish passage was evidently determined to be the controlling factor for selecting the proposed low-flow threshold of 35 cfs. However, the rationale for choosing the Reach 6 cross section for the fish passage requirement is not entirely clear. The critical flow values for Reaches 2 and 4 would result in a more protective MFL for this criterion, although as pointed out in the text it probably wouldn't be appropriate to tie that to flows at the Wimauma flow gage. Perhaps the analysis could be strengthened by estimating the percent of time fish passage would be impeded under the proposed MFL in upstream reaches 2 and 4, compared to current conditions. This would be similar to the method used in the navigation and sediment transport analyses.

Under the proposed MFL, the reduction in frequency of navigable days is projected to exceed 30 per year in river reaches 4 and 6. This seems significant, yet no standard for significant harm resulting from a loss of navigability was presented. The report could benefit from further discussion of this metric and a conclusion regarding the extent of harm caused by the reductions in frequency of navigable days on the upper river. Operations of the existing Canoe Outpost business should be considered.

Uncertainties in the HEC-RAS analysis due to the questionable cross section data, once resolved, may merit a re-evaluation of the proposed low-flow threshold. Essentially all the upper river analyses rely on the HEC-RAS model output directly or indirectly, and a reasonable model representation of channel geometry is essential to these analyses.

Block 3 Lower Threshold

Upper river floodplain inundation was determined to be the controlling factor for selecting two high flow thresholds of 72 cfs and 174 cfs, with 72 cfs being the proposed division between flow blocks 2 and 3. Based on an allowable 15% reduction in wetland area and frequency of inundation, proposed minimum flows are 87% of the flow on the previous day when the previous day's flow was > 72 cfs and < 174 cfs, or 89% of the flow on the previous day when the previous day's flow was > 174 cfs. Table 2-2 relates high flow percentiles to flow values (from Janicki Environmental, Inc., 2016):

Table 2-2. Relationship between High Flow Percentiles and Flow Values

High Flow Percentiles	Flow Values (cfs)
P60	**72**
P65	86
P70	105
P75	133
P80	**174**
P85	241

Figure 2-11 shows the results of an analysis relating HEC-RAS model-predicted stages to spatial extents of floodplain inundation for various flow percentiles.

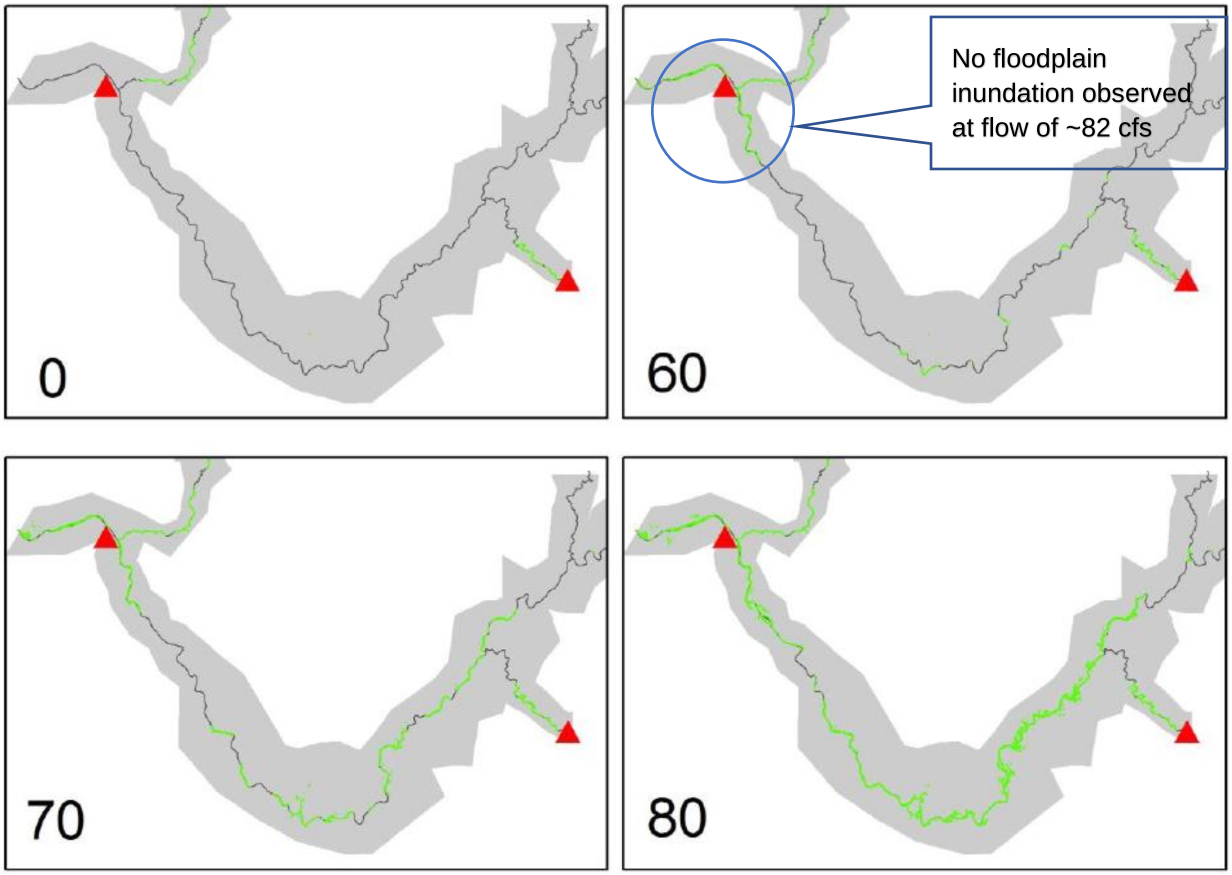

Figure 2-11. Area of Inundated Vegetation (green) as a Function of the Percentile Flow at the USGS Wimauma Gage. USGS flow gages are shown as red triangles. From Janicki Environmental, Inc., 2016.

Janicki Environmental, Inc. (2016) referred to the above figure this way: “This example demonstrates that the floodplain generally does not become inundated until flows are above the 70th percentile (i.e., 110 cfs) though small pockets of wetlands are inundated with flows as low as the 60th percentile (72 cfs).” It is not clear from the supporting documentation if this analysis considered channel bank elevations, or only the elevations within the floodplain. There undoubtedly are low areas within the floodplain that are lower than the adjoining riverbank elevations and are therefore hydraulically isolated river until the stage exceeds its banks.

Furthermore, during field observations conducted on October 15, 2021, flow at the USGS Wimauma gage was about 82 cfs, which would be within proposed block 3. Field observations were conducted at several locations, including the entire area along the main river channel circled in blue in Figure 2-11. No floodplain inundation was observed at any of the visited locations. Flows were fully contained within the banks with significant freeboard suggesting much higher flows would be needed to inundate the floodplain. This raises the question of whether the 60th percentile flow (72 cfs) is properly supported as a high-flow threshold.

Recommendation: Consider riverbank elevations, in addition to floodplain topography, in determining the flow threshold at which floodplain wetlands experience significant inundation due to Little Manatee River flows and stages.

2.1.8.2 Review of District Responses Low-Flow Threshold and Block 1 Definition

Recommendations from Peer Review Report:

1. The report could benefit from further discussion of this metric (navigability) and a conclusion regarding the extent of harm caused by the reductions in frequency of navigable days on the upper river. Operations of the existing Canoe Outpost business should be considered.
2. Uncertainties in the HEC-RAS analysis due to the questionable cross section data, once resolved, may merit a re-evaluation of the proposed low-flow threshold. Essentially all the upper river analyses rely on the HEC-RAS model output directly or indirectly, and a reasonable model representation of channel geometry is essential to these analyses.

District Response: The revised draft report includes an updated low-flow threshold analysis that was conducted using the ZFI HEC-RAS model (ZFI 2010) and updated flow blocks for the upper river. Note that protecting navigation of the upper river (by canoe/kayak) is not a method used to develop minimum flows but an environmental value that must be protected when developing minimum flows. Since the fish passage criterion (0.6 ft) is more protective than that minimum depth needed for canoe/kayak passage (0.5 ft), the low-flow threshold is protective of both fish and canoe/kayak passage.

Review of Response: The revised and updated low-flow threshold analyses and documentation sufficiently addresses this comment. The low-flow analyses and the resulting Block 1 definition are now based on a hydraulic model that has a more realistic representation of riverbed geometry.

Block 3 Lower Threshold

Recommendation from Peer Review Report: Consider riverbank elevations, in addition to floodplain topography, in determining the flow threshold at which floodplain wetlands experience significant inundation due to Little Manatee River flows and stages.

District Response: The revised draft report includes an updated floodplain inundation analysis and updated flow blocks for the upper river.

Review of Response: Section 6.2 of the revised report discusses the updated floodplain inundation analysis. This section mentions difficulties in determining, from available topography, whether inundated floodplain areas are isolated from the main river channel or hydraulically connected at a given stage. Due to these difficulties, District staff conducted a sensitivity analysis to identify flow thresholds that correspond to decreases in inundated wetland floodplain area. "For the analysis, percent-of-flow reductions that would result in a 15 percent decrease in the total inundated wetland areas were assessed for flows at and above the 1st percentile, 2nd percentile, …up to 99th percentile". The analysis found that for flows below the 68th percentile (~96 cfs at US 301), percent-of-flow reduction required to reduce the inundated wetland areas by 15 percent was insensitive to baseline flow percentile, suggesting that "overbank flooding does not start until the flow is above the 68th percentile…". The updated Block 3 lower threshold was therefore set at 96 cfs at the USGS gage at Hwy 301, whereas the previous threshold was set at 72 cfs. The sensitivity analysis is a reasonable approach that sufficiently addresses the peer review comment.

2.1.9 FLOW BLOCKS (LOWER RIVER)

2.1.9.1 Initial Comment

The flow blocks developed for the Upper River were utilized for the Lower River and determinations made on allowable percent reductions to protect salinity habitat within those flow blocks. As part of the salinity habitat volume and area change analyses calculations were made to identify the sensitivity of the change in habitat to different flow ranges and with and without consideration of the low flow cutoff. The calculations basically showed that salinity habitat changes are most sensitive for the lower salinity conditions (<2ppt) and are most sensitive to changes in the low flow ranges. Presently, flow Block 2 extends from the 35 cfs low flow cutoff up to 72 cfs. 72 cfs is not a significantly high flow value and represents the 60th percentile as outlined in the section above. If flow Block 2 were expanded, i.e., such that the high value is increased, the likely impact would be higher allowable reduction calculations based on the volume and area. It is not clear at present what changing the flow block extents would do to the EFF analyses which presently drive the MFL.

Recommendation: Some additional analyses of the sensitivity of the allowable reductions under differing flow blocks should be provided to assess how the MFL may change depending upon the flow block choices for the Lower River.

2.1.9.2 Review of District Responses

Recommendation from Peer Review Report: Some additional analyses of the sensitivity of the allowable reductions under differing flow blocks should be provided to assess how the proposed minimum flows may change depending upon the flow block choices for the lower river.

District Response: The revised draft report includes an updated EFDC hydrodynamic model, updated EFF analyses, and updated flow blocks for the lower river.

Review of Response: The response identifies new information, i.e., a new hydrodynamic model, EFF analyses and modified flow blocks, but does not specifically address the recommendation. The recommendation asked for some evaluation of sensitivity of the MFL numbers to the choice of flow block ranges.

Revised District Response: The revised draft report presents results from sensitivity analyses on a change in the flow blocks utilizing the EFDC hydrodynamic model. While we see some changes, the effects of changing the flow blocks on the proposed minimum flows appears to be relatively small. Details of the analyses have been added to the Hydrodynamic Model Development, Calibration, Verification, and Evaluation of Flow Reduction and Sea Level Rise Scenarios in Aid of Minimum Flows Development for the Lower Little Manatee River appendix (Appendix L).

Review of Response: The revised District Response and addition to Appendix L addresses the comment provided.

2.2 DETAILED COMMENTS

This section presents detailed comments in tabularized form for the MFLs report and (where specific comments were provided) supporting documentation. The tables include the location in the report the comment refers to, the specific comment, whether the comment materially impacts the conclusions supporting development of the proposed MFLs, the proposed corrective actions, the District response to the comment, and the Peer Reviewer determination if the District response was sufficient.

Detailed Comments on Recommended Minimum Flows for the Little Manatee River Draft Report from John Loper, P.E., Anclote Consulting PLLC							
				To be completed by Reviewer(s)			
Comment No.	Peer Reviewer	Figure, Table, or Page and Paragraph Number	Does Comment Directly and Materially Affect Conclusions of Report? (Yes/No)	A. Reviewer's Specific Comments	B. Reviewer's Specific Recommended Corrective Action	District Response	District Response Sufficient? (Yes/No)
1	JL	Page 113, 2nd paragraph	Yes	Review of the HEC-RAS digital model input shows that practically all the river cross sections are represented with idealized flat bottoms. From my field observations, this does not capture the cross-sectional variability in channel depth at many locations (e.g., at channel bends). This raises the question of how many of the source cross sections were surveyed.	Figure 4-1 of the draft minimum flows report shows the locations of 10 vegetation transects with field surveyed cross sections tied into NAVD88. These were apparently not used in the HEC-RAS model. Please provide a comparison of these with the nearest HEC-RAS cross sections. Characterize the level of accuracy of the modeled cross sections and its ramifications on the reliability of the model output for the minimum flows analyses. Suggestion: New field survey of the river channel, to supplement the 10 cross sections mentioned above, should be collected to support future updates to the minimum flows.	The original HEC-RAS model prepared by ZFI included the 10 surveyed cross sections. After substantial discussion in late 2021/early 2022, it was decided that the ZFI model would be used for instream analyses (wetted perimeter, fish passage, and SEFA) and the updated (JEI/SWMM) HEC-RAS model prepared by Janicki Environmental, Inc., would be used for floodplain inundation analyses. This information has been included in the revised draft report.	Yes
2	JL	Table 6-9	No	Minimum flows are to be established at the USGS US Geological Survey (USGS) Little Manatee River at US 301 near Wimauma, FL (No. 02300500) gage. If withdrawals are proposed further upstream, where flows are lower than at	Clarify that upon implementation, future allowable withdrawals would be apportioned based on reach-based flowallocations assumed for this study, relative to flows at the USGS Little Manatee River at US 301 near Wimauma, FL (No. 02300500) gage,or another	Future allowable withdrawals will be apportioned based on the assumed reach-based flow allocations relative to flows at the USGS Little Manatee River at US 301 near Wimauma, FL (No. 02300500) gage.	Yes

Detailed Comments on Recommended Minimum Flows for the Little Manatee River Draft Report from John Loper, P.E., Anclote Consulting PLLC							
Comment No.	Peer Reviewer	Figure, Table, or Page and Paragraph Number	Does Comment Directly and Materially Affect Conclusions of Report? (Yes/No)	To be completed by Reviewer(s)			
				A. Reviewer's Specific Comments	B. Reviewer's Specific Recommended Corrective Action	District Response	District Response Sufficient? (Yes/No)
				Wimauma gage, how will impacts to the affected upper river reaches be evaluated?	proposed method.		
3	JL	Figure 2-4	No	Soils map doesn't appear to show the currentextents of mined lands. Mining and reclamation typically transform the native soils into something quite different.	Suggest revising the soils map to indicate (perhaps using a hatch pattern) areas of mined and reclaimed lands are no longer representative of native undisturbed soils.	Figure 2-4 was revised to include mined areas (black hatch pattern), reclaimed areas (blue hatch pattern), and areas where reclamation work is in progress (red hatch pattern), according to the most recently available (2019) data from the FDEP, Division of Water Resource Management, Support Program and Mining and Mitigation Program. The figure caption and citations listed in the report to incorporate these new data were also revised.	Yes

Detailed Comments on Recommended Minimum Flows for the Little Manatee River Draft Report from John Loper, P.E., Anclote Consulting PLLC							
Comment No.	Peer Reviewer	Figure, Table, or Page and Paragraph Number	Does Comment Directly and Materially Affect Conclusions of Report? (Yes/No)	To be completed by Reviewer(s): A. Reviewer's Specific Comments	B. Reviewer's Specific Recommended Corrective Action	District Response	District Response Sufficient? (Yes/No)
4	JL	Page 26, last paragraph	No	Did the acreage of wetlands really increase between 1974 and 1990, or is this just an artifact of differences in mapping methodology (i.e., different agencies and mapping scales)?	Clarify the reason for the apparentincrease in wetlands.	The acreage of wetlands did not increase between 1974 and 1990. This is a relic of FLUCCS resolution increasing through time. The following sentences was added to the 2nd paragraph of Section 2.2: The FLUCCS information since 1990 is more detailed than the 1974 USGS information due to finer resolution of the mapping units and the application of the hierarchal system of increasing specificity. Some of the changes in land-use/cover between the USGS- and FLUCCS-derived maps are, therefore, likely the result of differences in methodologies rather than actual land-use changes. For example, the apparent two-fold increase in wetlands from 1974 to 1990 is a relic of the coding and mapping procedures used; wetlands did not increase two-fold during this time. Nonetheless, the decadal perspective of land-use changes that the 1974 USGS information allows is useful to consider.	Yes
5	JL	Figures 2-5 through 2-10	No	Mining land use is lumped in with urban landuse. These two categories exhibit radically different	Map the mined lands (excluding those fully reclaimed and re-connected) as a separate	The maps in the report were revised to include mined lands and urban lands as separate land uses. Related tables and	Yes

Detailed Comments on Recommended Minimum Flows for the Little Manatee River Draft Report from John Loper, P.E., Anclote Consulting PLLC							
Comment No.	Peer Reviewer	Figure, Table, or Page and Paragraph Number	Does Comment Directly and Materially Affect Conclusions of Report? (Yes/No)	To be completed by Reviewer(s) A. Reviewer's Specific Comments	B. Reviewer's Specific Recommended Corrective Action	District Response	District Response Sufficient? (Yes/No)
				hydrologic responses to rainfall.	land use category. Table 2-1 has this as a separate category.	figures were also revised, as 2020 data have become available since the draft report was prepared. In addition, a map was added that includes locations of mined areas, reclaimed areas, and areas where reclamation work is in progress, according to the most recently-available (2019) data from the FDEP, Division of Water Resource Management, Support Program and Mining and Mitigation Program.	
6	JL	Section 2.4	No	Section 2.4 provides ample evidence that the UFA in the area is well confined. Based on the District's data and analysis, we can conclude streamflow is unlikely to be significantly affected by groundwater withdrawals from the UFA. Should we be concerned that the phosphate mining activities in the eastern portion of the watershed are changing the degree of confinement to the point where the previous statement will no longer be true? In other words, will	Add discussion to the report, following an evaluation of post-reclamation confining unit thickness and characteristics. Suggestion for future data collection: Install nested monitor wells in reclaimed mined lands for comparison with those nearby with undisturbed geology.	There is little evidence to suggest significant hydraulic communication between the surficial aquifer (SA) and Upper Floridan aquifer (UFA) within the mined areas. Review of District Regional Observation and Monitor-Well Program (ROMP) well reports (Nos. 39, 40, 48, and 49) indicate multiple clay confining units between the SA and UFA. Combined clay thickness of these units ranges from 239 to 373 feet. According to information from the Florida Institute of Phosphate Research: "in the	Yes

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				the removal, via mining, of the upper Hawthorne in mined areas make the SAS and streamflow more vulnerable to withdrawals from the UFA?		areas that are considered economical to mine, the matrix layer, which consists of approximately equal parts phosphate rock, clay, and sand, averages 12 to 15 feet in thickness. The matrix is buried beneath a soil "overburden" that is typically 15-30 feet deep." (https://fipr.floridapoly.edu/about-us/phosphate-primer/floridas-phosphate-deposits.php). This information suggests the upper 50 feet of earth material is typically removed with most of it consisting of the surficial sand aquifer and perhaps 15-20 feet of the bone valley member (phosphate ore) that could be part of the clay confining layer. Considering that Intermediate Confining Unit (ICU) total thickness ranges from 239-373 feet, this information indicates minimal change to the thickness/confining characteristics of the ICU. In addition, nested monitor well data from ROMP Nos. 40, 45.5, and 48 (all within or adjacent	

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						to phosphate mined lands; see map provided below), all show large consistent vertical head differences between the SA and UFA (hydrographs also provided below). This is indicative of tight confinement of the UFA in this area. The hydrographs also show large seasonal variation in UFA water levels (20-30 feet) with little change in SA and upper intermediate aquifer water levels, which also indicates low hydraulic connection between the surface and UFA. Lastly, several generations of calibrated regional groundwater flow models, starting with the Eastern Tampa Bay Regional Flow Model, Southern District model, and now East-Central Florida Transient Expanded Model (ECFTX), have all shown this area to be tightly-confined between the surficial and UFA.	

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						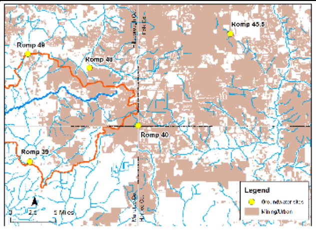 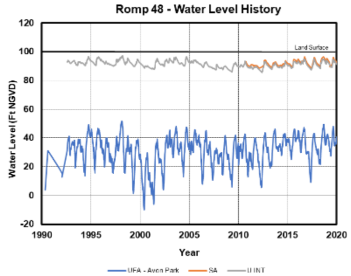 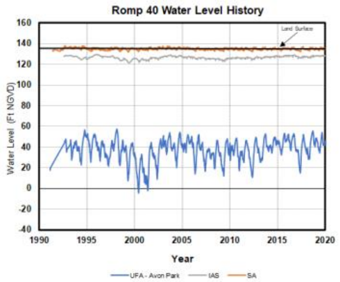	

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						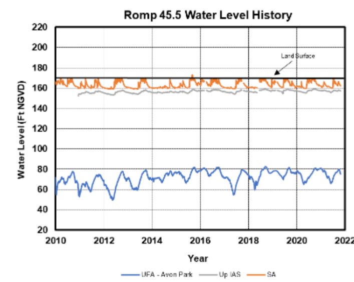 Note that the information presented here in this response was not included in the revised draft report.	

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7	JL	Section 2.5, page 38,first paragraph	No	"…historical excess flows have been trending towards zero since 2000." The paragraph implies this can be attributed to agricultural BMPs. But, to what extent have agricultural excess flows been offset by reduced flows from actively mined lands? Coverage of actively mined lands has increased over the same period, and these lands are essentially severed from the watershed during mining.	Report needs more discussion regarding the impacts of mining on recent streamflow record.	Additional text describing the impacts of mining on the flow record was added to the revised draft report.	Yes
8	JL	Page 42, last paragraph	No	Pumping was reduced by 50 percent in the scenario and then the changes multiplied by two to estimate no-pumping conditions. Why not just turn off pumping in the model to estimate no-pumping conditions? How was agricultural return flow estimated in ECFTX?	Clarify in report text.	Pumping was not "turned off" in the ECFTX model since there was not a "predevelopment calibration" undertaken with the ECFTX model. The calibration and verification periods include the current pumping period from 2003-2014. This period included boundary conditions that represent current stressed conditions and not boundary conditions	Yes

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						representative of predevelopment or zero pumping conditions. In addition, the predevelopment period of "zero" pumping is far outside the range of monthly pumping stresses from the 2003-2014 period. This increases the uncertainty in the model results. The 50 percent reduction scenario was used to help overcome these issues. Results from that scenario were simply doubled to approximate total groundwater withdrawal impacts. Use of the 50 percent pumping reduction scenario has been supported by the Central Florida Water Initiative (CFWI) Hydrologic Assessment Team (HAT) of the Water Resources Assessment Team, which includes consultants representing municipal governments and staff from three different water management districts	

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						(https://cfwiwater.com/hydrologic.html). The derived, total groundwater pumping impact results are consistent with the magnitude and spatial distribution of observed potentiometric surface changes identified using current and predevelopment maps. Agricultural return water was included with rainfall to calculate recharge for the ECFTX groundwater model. This was accomplished through a surface water modeling application that was calibrated to selected flow stations. Section 4.6.1 from 2020 version of the ECFTX model documentation report prepared for the CFWI (full citation provided below) describes the general process as follows: "*The methodology used to develop evapotranspiration*	

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						(ET) and recharge to the SAS uses AFSIRS (Agricultural Field Scale Irrigation Requirement Simulations, Smajstrla 1990) together with the USDA National Resources Conservation Service (NRCS) Curve Number (CN) method for partitioning rainfall and runoff (Restrepo and Giddings 1994, Bandara 2018). A program has been written to call AFSIRS for different land-use polygons to calculate daily ET and recharge requirements, which are translated into model cell values. The model uses time-dependent data, such as rainfall, irrigation return flows, potential evapotranspiration (PET), land use, crop types, and time-independent data, such as drainage basins, soil types, irrigated fractions of the model cell, and irrigation efficiencies." Note, however, that this detailed information was not included in the revised, final	

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						2022 version of the ECFTX model report that is available from the CFWI website at: https://cfwiwater.com/pdfs/ECFTX_2.0_Report_040522_final.pdf. Above Information From: Central Florida Water Initiative (CFWI) Hydrologic Analysis Team (HAT). 2020. Model documentation report East-Central Florida Transient Expanded (ECFTX) Model. South Florida Water Management District, Southwest Florida Water Management District and St. Johns River Water Management District, West Palm Beach, Brooksville, and Palatka, Florida.	
9	JL	Page 113 and Table 5-1	Possibly	How was the flow apportionment ratio by reach determined in the HEC-RAS model? Shouldn't reach # 8, most of which appears to be downstream of the reference USGS streamflow gage, have a flow apportionmentratio of 1.0 instead of 0.92?	Report and/or an appendix needs to include a discussion on how the flow apportionment ratios by reach were estimated.	The reference USGS streamflow gage is located at the most upstream cross section of Reach 8 (not at the last cross section of Reach 8). In the original ZFI HEC-RAS model, it was assumed the flow apportionment ratio for the river segment downstream of the gage was 0.08. In the	Yes, the 2nd Revised Draft Report contains a more robust discussion of this topic, and

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						updated JEI-SWIM HECRAS model, however, it was assumed that there is no additional discharge to the river downstream of the gage. Therefore, 100 percent of flow was maintained at the reference USGS Little Manatee River at US 301 near Wimauma, FL (No. 02300500) streamflow gage.	revised/ corrected flow apportion ment ratios.
10	JL	Page 133	Possibly	"Application of the LWPIP approach to the HEC-RAS model results suggested that most of the wetted perimeter inflection points were near the lowest flows considered…" This may be an artifact of the idealized flat channel bottoms used in the HEC-RAS model.	Recommended action in Comment #1: Please provide a comparison of the 10 surveyed cross sections (Figure 4-1) with the nearest HEC-RAS cross sections. Re-do and compare LWPIP analysis for those surveyed cross sections.	The lowest wetted perimeter inflection point (LWPIP) analysis was updated using the ZFI version of the HEC-RAS model that includes the 10 surveyed cross sections. The updated analysis and results are included in the revised draft report.	Yes

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11	JL	Table 6-9	No	If no surface water withdrawals will be permitted during Block 1, when flows are equal to or less than 35 cfs, why are the Block 1 minimum flows shown to be 90 percent of flows on the previous day? Seems contradictory. Should the Block 1 minimum flows be 100 percent?	Clarify in the table or accompanying text.	As a result of the revised analyses, Block 1 is now defined as when flows are less than or equal to 29 cfs, and the proposed minimum flows are 100 percent of flows on the previous day. Table 6-9 has been updated in the revised draft report.	Yes
12	JL	Section 6.7.8	No	Critical velocity method was used to evaluate sediment transport. Critical shear stress is a more rigorous approach, and shear stress is one of the outputs of the HEC-RAS model. Was this approach considered?	Consider using critical shear stress method in future river and stream minimum flows evaluations.	As a result of the revised analyses, sediment evaluation was conducted using the Engelund-Hansen method, which is based on a stream power approach that uses both critical shear stress and critical velocity. Section 6.7.8 of the revised draft report has been updated to include these new analyses.	Yes
13	JL	Sections 6.7.8 and 6.7.10	No	It is not clear in the report how the flows were modified to simulate the proposed minimum flows at each of the 13 HEC-RAS cross sections. Per Mike Wessel (verbal communication), the flows were apportionedbased on the factors in Table 5-1.	Supplement the report text accordingly.	Sections 6.7.8 and 6.7.10 of the revised draft report have been updated following the revised sediment load evaluation using the Engelund-Hansen method.	Yes

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14	JL	Page 137, fifth paragraph	Yes	"…(the floodplain is not inundated until the 60th percentile of flow, which is 72 cfs). Did this consider channel bank elevations, or only the elevations within the floodplain? Please provide additional details of the predictive model relating flows and floodplain inundation mentioned at the beginning of this subsection. During field observations, flow at the USGS Little Manatee River at US 301 near Wimauma, FL (No. 02300500) gage was about 82 cfs, and no floodplain inundation was observed at any of the visited locations. Flows were fully contained within the banks with significant freeboard suggesting much higher flows would be needed to inundate the floodplain.	Reconsider the 72 cfs threshold forfloodplain inundation.	As a result of the updated floodplain inundation analysis, the threshold for floodplain inundation, as well as the threshold for identifying Block 3 flows, is 96 cfs. Information concerning updates to block-specific flows is provided in Section 5.1 of the revised draft report, and information concerning the floodplain analysis has been updated in Section 6.2.	Yes
15	JL	Page 163, Table 6-13	No	The critical flows presented in this table are based on "first occurrence of out-of-bank flows", according to the text, which should correspond to initial floodplain inundation. However, all the values are multiples of the 72 cfs at the USGS Little Manatee River at	Revise report to reconcile this apparent contradiction.	The critical flows presented in Table 6-13 in the draft report were incorrect. Initial floodplain inundation starts at 96 cfs at the USGS Little Manatee River at US 301 near Wimauma, FL (No. 02300500) gage based on the updated floodplain	Yes

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				US 301 near Wimauma, FL (No. 02300500) gage cited in Section 6.2 as the flow resulting in floodplain inundation. Please explain this apparent contradiction.		inundation analysis described in the revised draft report. Table 6-13 is not included in the revised draft report.	

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16	JL	Section 6.7.8.1	Yes	Under the proposed minimum flows, the reduction in frequency of sediment and detrital transport events relative to baseline is projected to be quite large at certain locations. The report does not include an analysis of the consequences of these reductions. Will significant harm result?	Add a discussion, and a conclusion, regarding the extent of harm caused by the reductions in frequency of sediment and detrital transport events.	A different approach was used for the sediment load evaluation, and Section 6.7.8.1 has been updated accordingly.	Yes
17	JL	Section 6.7.10	Yes	Under the proposed minimum flows, the reduction in frequency of navigable days is projected to exceed 30 per year in river reaches 4 and 6. Seems significant.	Add further discussion and a conclusion regarding the extent of harm caused by the reductions in frequency of navigabledays on the upper river. Consider the operations of the existing Canoe Outpost business.	As a result of the revised analyses using the ZFI HEC-RAS model, Section 6.7.10 has been revised. The 2nd paragraph of that section has been revised as follows: "The critical depth for canoe and kayak navigation in the Upper Little Manatee River is defined as a water depth of 0.5 ft (0.15 m), 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/). As discussed in Section 6.1.2,	Yes

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						29 cfs maintains the fish passage depth of 0.6 feet (0.18 m) at the most restrictive cross section in the upper river. Therefore, the proposed low-flow threshold of 29 cfs at the USGS Little Manatee River at US 301 near Wimauma, FL (No. 02300500) gage is protective of canoe and kayak navigation, since the critical depth needed for canoe and kayak navigation is shallower than that needed for fish passage."	
18	JL	Page 19, third paragraph	No	"Level 1 is the most granular…" Level 1 is the most general (least granular) FLUCCS level.	Minor correction to report text	The text has been revised to indicate that Level 1 is the "most general."	Yes

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1	SP	Page 17, second paragraph	No	Per the discussion in the next paragraph, the tides along the river are a mixture of diurnal and semidiurnal tides.	Update text	The text has been revised to indicate that the tides are a mixture of diurnal and semidiurnal tides.	Yes
2	SP	Page 20, last paragraph	No	Given the nature of mining activities in this area and the impacts of that specific land use on hydrology, it would be beneficial, if possible, to show mining as its own category labeled mining.	Update text	The maps, and related text, tables, and figures were revised to show mining as its own category, and 2020 data that were not available for the preparation of the draft report were added. In addition, a map was added that includes the locations of mined areas, reclaimed areas, and areas where reclamation work is in progress, according to the most recently available (2019) data from the DEP, Division of Water Resource Management, Support Program and Mining and Mitigation Program.	Yes
3	SP	Page 36, last paragraph	No	It would be good at the end of this section to include a discussion of what the information presented in this section means relative to the minimum flows. Basically, identify that surface runoff and interaction with the	Update text	Updated the text in the report to reflect this situation at the end of Section 2.5 to the following: "*The flow changes associated with the Little Manatee River are due to its connection to the surficial aquifer. Surface water runoff from rainfall and increased baseflow due to*	Yes, with question (The comment was provided for a paragraph at the end of

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				surficial aquifer drives the flow in this system and the minimum flows would not need to address losses in flow from the UFA. This is a surface water withdrawal issue.		*agricultural irrigation (water table increases from irrigation and irrigation runoff) directly contribute to flow changes through time. There are no significant groundwater withdrawal impacts that result in reductions to river flow since the system is well-confined from the surficial aquifer to the underlying Upper Floridan aquifer where nearly all groundwater use occurs. Due to this situation, the minimum flow criteria will apply only to any existing or future surface water withdrawals from the river."*	Section 2.4, what was the reasoning to move to the end of Section 2.5) District Response: It made more sense to add this paragraph to the end of Section 2.5/Little Manatee River Flow History instead of Section 2.4/Hydrogeologic System.
5	SP	Page 46, Section 3.1.1	No	Should expand on what special protections the OFW designation provides in terms of regulations, regulatory authority, or allowable impacts.	Update text	The following was added to the paragraph in Section 3.1.1: *"Discharges regulated through a permitting program that are proposed within an OFW must not lower background ambient water quality. Permits for indirect*	Yes

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						discharges that would significantly degrade a nearby waterbody designated as an OFW may not be issued. In addition, activities or discharges within an OFW, or which significantly degrade an OFW, must meet a more stringent public interest test."	

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6	SP	Page 47, Section 3.2, first paragraph	No	There are inconsistencies in ways and detailing how the upper river water quality results are presented compared to the lower river water quality. The flow of the document and the clarity would benefit from consistent presentations of the water quality results summaries in this section.	Modify the sections in water quality write up to present in a consistent manner where appropriate.	The water quality chapter was revised to improve consistency in the description of the upper and lower portions of the river. This included: revising the Methods for Water Quality Analysis section (3.2); the drafting of new sections of text and creating new figures in the Upper River Water Quality section (3.3); and consolidating tables, creating new tables, rewriting text, and recreating figures in the Lower River Water Quality section (3.4).	Yes
7	SP	Page 48, third paragraph	No	There is also an increasing trend in pH which should be mentioned here. That isn't necessarily a positive or negative thing, but it should be discussed.	Update text	The following paragraphs were inserted into the report to discuss the increasing trend in pH: "*An evaluation of long-term monitoring data in the Little Manatee River indicated increasing mineralization of the river, with significant increases in nitrate-nitrite, pH, and turbidity since the 1970s (Flannery et al. 1991). This was attributed to land-use changes in the watershed, particularly from additional groundwater pumping and irrigation runoff. While the trend of increasing forms of nitrogen and pH are still evident in parts of the watershed, irrigation efficiencies*	Yes

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						through the adoption of best management practices have led to a decline in excess flows from agricultural lands since 2000 (JEI 2018a, Appendix C). An increasing trend in river pH in Horse Creek was also postulated to be due to an increase relative groundwater contribution (ATM and JEI, 2021). *Expansive mining and land reclamation activity in the Upper Little Manatee watershed could also impact water quality parameters. During periods of high runoff or discharge, released waters from mining activities can decrease the pH of rivers and increase concentrations of fluoride and phosphate (Kelly et al. 2005b, Toler 1967)."*	
8	SP	Page 48, third paragraph	No	Is there a need to discuss the increasing trend in fluoride? This can be a result of mining activity and is worthy of further discussion on what it means.	Consider and update text if determine it makes sense.	In addition to the paragraphs inserted to address Comment 7, the following sentences were included in the report to discuss the increasing trend in fluoride: *"In the Alafia River, changes to mining practices in the 1970s led to a dramatic reduction in both fluoride and phosphate loadings (Kelly et al. 2005b). The impact of*	Yes

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						extractive activities on fluoride levels in the Upper Little Manatee River are unclear, as neither orthophosphate nor total phosphorus have increased concomitantly as one may expect from evaluations of other mining-impacted systems."	
9	SP	Page 48, fourth paragraph	No	Table 3-2 referenced here in the text does not have the p values as stated which show the relationships with flow. It seems like the table with the regression analyses is missing from this section.	Bring in the right table and reference it.	Table 3-2 was updated with results from Table 7 of Jacobs and Janicki (2020), which is included as an appendix in the revised draft report. The title of the table was updated to reflect the addition of the regression analysis results.	Yes
10	SP	Page 48, fifth paragraph	No	Nitrogen also showed an increasing trend per the table, but this is not discussed here, either for total nitrogen or nitrate-nitrite.	Update text	Total nitrogen increased at both Stations D1 and D3 over time; however, a positive relationship with flow was only observed at Station D3. Nitrate-nitrite increased over time at Station D1, with a negative relationship to flow. The intent of this paragraph was to highlight consistent trends in water quality parameters at both Stations D1 and D3; however, these site-specific nuances were added to the text. The increasing trend in nitrogen in the watershed was addressed in the resolution of Comment 7.	Yes

Detailed Comments on Recommended Minimum Flows for the Little Manatee River Draft Report from Steven J. Peene, PhD., ATM, a Geosyntec Company							
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11	SP	Page 51, Table 3-3	No	The title in this table references the regression analysis results which are not presented in the table.	Update title and bring in correct table per earlier comments.	Table 3-3 was updated with results from Table 8 of Jacobs and Janicki (2020), which is included as an appendix to the revised draft report.	Yes

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12	SP	Page 54, first paragraph	No	Whenever FDEP thresholds are used in the analyses, the text needs to clearly caveat that these analyses do not represent a determination of impairment.	Update text	The referenced text has been updated by inserting the following sentence: *"The DEP threshold is provided for reference only and is not intended to represent a determination of impairment."*	Yes
13	SP	Page 54, first paragraph	No	Need to always state that these are geometric means.	Update text	The text was updated to specify "annual geometric means," rather than "mean" chlorophyll values.	Yes
14	SP	Page 54, second paragraph	No	Same comment as above on caveating the analyses where FDEP thresholds are utilized.	Update text	The referenced text has been updated by inserting the following sentence: *"The DEP threshold, denoted by a dashed line in Figure 3-6, is provided for reference only and is not intended to represent a determination of impairment."*	Yes
15	SP	Page 125, fifth paragraph	No	It is recommended that the Huang and Liu report, which is the only somewhat complete presentation of the development of the EFDC model, be included as an Appendix and referenced as such here.	Include report as an appendix.	Since the EFDC model has been revised, this report is no longer relevant and is not included as an appendix to the revised report. Instead, a new appendix has been added that includes this information.	Yes

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				A. Reviewer's Specific Comments	B. Reviewer's Specific Recommended Corrective Action	District Response	District Response Sufficient? (Yes/No)
16	SP	Page 126	No	Site 02300532 which is the most upstream site did not collect specific conductance and temperature. This is the one station above the braided area in the river which is a critical section of the model for salinity projections especially in the lower salinity ranges, i.e., 0.5 to 5 psu.	No action	No response necessary.	Yes
17	SP	Page 126	No	The Aquaterra report should be included in the appendices and referenced in the document as such.	Include report as an appendix.	This report has been included as an appendix to the revised draft report.	

Detailed Comments on Recommended Minimum Flows for the Little Manatee River Draft Report from Steven J. Peene, PhD., ATM, a Geosyntec Company							
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18	SP	Page 126	No	This document provides a short summary of the data that was used in the development of the model. This is good to give the reader of the main document an idea of how it was developed and calibrated. A key dataset was not described, i.e., the data that was used for the shoreline and depths which went into the model grid. These data are not described in the Huang and Liu report either.	Update text to include discussion of data used for grid shoreline and depths.	As part of the revisions to the EFDC model, a new model grid was developed. The revised draft report includes updated text to describe the data used for the model grid shoreline and depths.	Yes
19	SP	Page 126	Maybe	The representation of the shoreline in the EFDC model is not good in places. This is particularly the case in the lower river but also into some of the upper estuary areas (braided sections). This raises a concern if the representation of the system volume and bottom area (which are key drivers in the minimum flows analyses) are sufficient to accurately predict the net changes under differing flow reduction scenarios.	A recommendation would be to use available data (LIDAR and bathymetry) to calculate the volume and area as a function of river outside of the grid and then using the grid. A comparison will identify if the model reasonably captures the area and volume as a function of river mile.	This comparison was done and discussed. Additional work was conducted to revise the model grid of the EFDC model, and the updated modeling results are included in the revised draft report.	Yes

Detailed Comments on Recommended Minimum Flows for the Little Manatee River Draft Report from Steven J. Peene, PhD., ATM, a Geosyntec Company

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20	SP	Page 126	Maybe	The statistics and plots presented in the reports show very good agreement between the data and the model for water levels, salinity and temperature which may indicate that the overall representation of the system, while not highly accurate horizontally, may be accurate relative to volume and depths longitudinally. This will be identified based on the recommendations in the previous comments.	See recommendation for comment 19.	Additional work was conducted to revise the model grid of the EFDC model, and the updated modeling results are included in the revised draft report.	Yes
21	SP	Page 133	No	This graphic is not highly useful in terms of evaluating the representation of the grid. A better graphic, depicting the grid should be created by overlaying the grid onto aerial photography to provide a better visual of the grid representation. In addition to the graphic of the grid, a graphic showing the depths in the model should be provided.	Develop a better graphic that shows how the grid represents the system, perhaps overlain onto an aerial photo.	An aerial photo that includes the model grid for the updated EFDC model for the Lower Little Manatee River is included in the revised report.	Yes
22	SP	Page 136	No	If only salinities over the dates from 2015 through 2019 are utilized in the analyses, it is important to	Provide an assessment of the hydrologicconditions for this period against the conditions over the full	Salinities from 1996 through 2021 are included in the updated analyses that are described in the	Yes

Detailed Comments on Recommended Minimum Flows for the Little Manatee River Draft Report from Steven J. Peene, PhD., ATM, a Geosyntec Company							
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				discuss how representative of overall hydrologic conditions this period is.	period of record.	revised draft report.	
23	SP	Page 136	No	In the EFDC presentation within the main report, there is discussion on the accuracy of the model in simulating salinities. Some discussion should be provided here on the accuracy of the salinity regression.	Update text	In the updated EFDC model, the salinity boundary conditions are from a hydrodynamic model for Tampa Bay and not the salinity regressions. District Response: Section 5.4.6 of the revised draft report includes text describing the accuracy of the LOESS salinity regression that was used for the EFF analysis.	Yes

Detailed Comments on Recommended Minimum Flows for the Little Manatee River Draft Report from Steven J. Peene, PhD., ATM, a Geosyntec Company							
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				A. Reviewer's Specific Comments	B. Reviewer's Specific Recommended Corrective Action	District Response	District Response Sufficient? (Yes/No)
24	SP	Page 145	Maybe	In the other reports on the EFDC model, the period of data collection was only described for 2004 to 2005. The simulations for the area and volume calculations were outside of the period of available data. The data that was used for the simulation boundary conditions needs to be described. Examination of the data in the EFDC input files appears to indicate it is a combination of generated and measured data. This needs to be discussed here and in other sections of the appendices.	Update text to describe how the data for the boundary condition in the EFDC model was developed over the full period of the simulations.	This problem does not exist in the newly updated EFDC model because the downstream boundary was extended into Tampa Bay, and the boundary conditions were obtained from another hydrodynamic model, which covers the entire Tampa Bay.	Yes
25	SP	Page 145	No	As the 2000 to 2005 period was used for the volume and area calculations, it is important to show or discuss in this section how that period is reflective of the overall hydrology.	Provide an assessment of the hydrologic conditions for this period against the conditions over the full period of record.	This information is included in the text, as well as in the appendix of the revised draft report.	Yes
26	SP	Page 149	No	I think the number in the Block 2 here is not correct. I believe it should be 21 percent and not 31 percent based on the graphs above.	Update text	The block definitions have been revised, and the discussion of the results of the flow reduction evaluation have been revised based on the updated model and revised block definitions.	Yes

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27	SP	Page 151	No	It would be beneficial to present the comparison of the updated model predictions to the measured data as is done in the appendices with some discussion on the accuracy of the regression for projecting salinity. This was done in Section 5 for the EFDC modeling and should be presented in Section 5 for the salinity regressions used in the habitat analyses.	Update text	Additional text was added to the revised draft report to discuss the accuracy of the LOESS model used in the EFF analyses.	Yes
28	SP	Page 154	Maybe	Is there an argument to be made that the minimum flows should reflect the most sensitive species so that Sailfin Molly should be the driver of the minimum flows under this analysis?	Provide reasons for not using the most sensitive species.	The methods to develop the minimum flows for the lower river have been updated (EFDC modeling and EFF analysis). The revised results and revised proposed minimum flows are included in the revised draft report.	
29	SP	Page 155	No	It was good that this type of run was done to show what having the low flow cutoff means to the analyses.	No action	No response necessary.	Yes

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30	SP	Page 156	No	It is important to note that the salinity regressions do not differentiate lateral differences in salinity off the main stem. While they do appear to utilize some data off of the main stem, the end result by river miles provides for a single condition to compare against with no lateral variability. A 3-D model like EFDC, if properly developed and providing good resolution of the system longitudinally and laterally would provide this.	No action	No response necessary.	Yes

Detailed Comments on Hydrodynamic Modeling of the Little Manatee River from Steven J. Peene, PhD., ATM, a Geosyntec Company							
				To be completed by Reviewer(s)			
Comment No.	**Peer Reviewer**	**Figure, Table, or Page and Paragraph Number**	**Does Comment Directly and Materially Affect Conclusions**	**A. Reviewer's Specific Comments**	**B. Reviewer's Specific Recommended Corrective Action**	**District Response**	**District Response Sufficient? (Yes/No)**
1	SP	Page 10, first paragraph	No	The available data for model calibration from April 2004 to June 30, 2005, is sufficient for the purpose of model calibration	No action	No response necessary.	Yes
2	SP	Page 11, Table 3.1, title	No	While it is stated in the text, the table should show the period of record (of good data) for each station.	Update table	This information in included in the appendix prepared by JEI included with the revised draft report.	Yes
3	SP	Page 11, Table 3.1	Maybe	There is no specific conductance data above the braided section of the river so no way to know if the salinity above this area is reasonably calibrated. It is this salinity area, i.e., the less the 2 psu area that drives the minimum flows calculations.	For discussion	It is true that specific conductance data for these braided areas are not available, which are generally low-salinity segments. Station 542 is the most upstream station where specific conductance was measured, representing the best available data we had for the model prediction of salinity in the braided areas. Information related to this issue is included in the appendix that was prepared by JEI that is provided with the revised draft report.	Yes

Detailed Comments on Hydrodynamic Modeling of the Little Manatee River from Steven J. Peene, PhD., ATM, a Geosyntec Company							
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4	SP	Page 11, Figure 3-1	No	It is typically better to show the measurement stations on a map and not on the grid for reference purposed.	Provide a better station map.	This information in included in the appendix prepared by JEI that is provided with the revised draft report.	Yes

Detailed Comments on Hydrodynamic Modeling of the Little Manatee River from Steven J. Peene, PhD., ATM, a Geosyntec Company							
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5	SP	General	Maybe	Review of the model input files provided identified some issues with the downstream boundary conditions utilized in the EFDC model. The first issue is that it appears that the surface and bottom salinity were mistakenly flipped for a portion of the modeling period. This corresponds to the time frame for the boundary conditions outside of the period of the measured data. The second issue is that (based on investigation by District staff) and examination of the input files, the boundary condition for the earlier parts of the simulation 2000 through 2003 were based on "created" water levels, salinities and temperatures versus measured water levels salinities and temperatures. The portions of the simulation where measured data were available utilized measured data. The "created" conditions came from harmonic tides and regressions for salinity. The regressions were developed by HSW at the time. It should be noted that for the minimum flows presented, the HSW regressions were updated.	Recommendations on how to evaluate the impact of the issues raised are provided with the narrative text.	This problem does not exist in the new and improved EFDC model since the open boundary was extended into Tampa Bay for the Lower Little Manatee River estuary.	Yes

Detailed Comments on Hydrodynamic Modeling of the Little Manatee River from Steven J. Peene, PhD., ATM, a Geosyntec Company

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5	SP	Page 16, first paragraph	Maybe	The discussion in this section is an inadequate description of the development of the model grid and the sources of data that went into it. It does not provide any discussion of the source of the shoreline data that the model grid was developed from nor the bathymetric data that was utilized to interpolate onto the grid. It provides no documentation of the accuracy of the physical representation of the depths in the system. The discussion of the grids horizontal representation of the system states that it "adequately approximates the boundaries and the bayous" but examination of the figures provided doesn't support that well. Additionally, there are tributaries and other aspects that are not represented.	Do demonstration outlined in earlier comments on the main document.	Issues associated with this comment have been addressed as an updated EFDC model was developed. The description of the model grid development was updated in the revised draft report, as well as in the related appendix.	Yes
6	SP	Page 16, first paragraph	Maybe	There is no discussion of the impact of flooding and drying in the system and if it plays an important role in the hydrodynamics. Examination of aerial photography in the area would indicate some significant tidal marsh areas which would be expected to flood and dry.	Do demonstration outlined in earlier comments on the main document.	The wetting and drying function of the EFDC model is turned on in the model runs of the updated and improved model.	Yes

Detailed Comments on Hydrodynamic Modeling of the Little Manatee River from Steven J. Peene, PhD., ATM, a Geosyntec Company							
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7	SP	Page 20, Figure 4.2.2	No	Station 554 should not be presented as part of the model calibration as this is the boundary forcing station. It is good to present the comparison to show that the boundary is well represented in the model, but it does not belong in the model calibration discussion.	Adjust text and figures.	Station 554 is a model calibration site in the updated Lower Little Manatee River EFDC model.	Yes, based on boundary condition moved out into bay

Detailed Comments on Recommended Minimum Flows for the Little Manatee River Draft Report from Russ Frydenborg, Frydenborg EcoLogic							
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1	RBF	Chapter 1.1	No	Historical minimum flows approaches and District minimum flows institutional knowledge could be better summarized.	In the future (not associated with current minimum flows, compile a table that summarizes the relationship between previous, successful minimum flows approaches/metrics and protection against significant harm.	The District will consider compiling the described table for use in the development and re-evaluation of minimum flows in the future.	Yes
2	RBF	Chapter 2.2	No	Discussion on land use, land-use changes, and current status of the system could be better quantified.	Please calculate Landscape Development Intensity Index (LDI) on 100 m buffer adjacent to river channel to determine if system is <2, representing minimally disturbed reference conditions.	The LDI was calculated by applying a 100 m buffer around the main channel of the river and its' major tributaries. Land-use and cover data from the buffered area were obtained from 2020 Level III FLUCCS (SWFWMD 2021) and assigned LDI coefficients in accordance with guidance provided in Brown and Vivas (2005) and DEP (2012). The LDI for the main channel of the Little Manatee River was calculated as 1.39. When all major tributaries were included, the calculated LDI was 1.90. Both values indicate a minimally disturbed watershed, consisting primarily of natural lands (Brown and Vivas 2005, DEP 2012). Text describing these calculations	Yes

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				A. Reviewer's Specific Comments	B. Reviewer's Specific Recommended Corrective Action	District Response	District Response Sufficient? (Yes/No)
						was added to the revised draft report in Section 2.2, and the citations were updated to include the mentioned sources.	
3	RBF	Chapter 2	No	The river was not classified in hydrobiogeomorphological terms.	For future riverine minimum flows, please consider use of John Kiefer's Florida- specific approach to classify river by hydrobiogeomorphology.	The District will consider classifying rivers using John Kiefer's Florida-specific approach when developing and re-evaluating minimum flows in the future.	Yes
4	RBF	Figure 3-5, Table 3-8	No	Would occurrences of chlorophyll a >11 ug/L as an annual geometric mean be expected to increase at minimum flows implementation withdrawals in the Little Manatee River estuarine nutrient region?	Please provide analysis with short discussion.	We used the glmer package in R to develop generalized linear mixed models to predict the 50 percent probability of exceeding the 11 ug/L chlorophyll a threshold for estuarine stations. Multiple models were run to include river kilometer, flow, chlorophyll a, season (as quarter of the year beginning in January), and interaction terms between flow and RKm or flow and season. The model with the lowest AIC was selected for analysis. This model incorporated log-transformed flow data, season, river kilometer, and the interaction term for log-transformed flow and river kilometer. The results predict 44.2 percent of samples at station 182 would have a 50 percent or greater probability of exceeding the 11 ug/L chlorophyll threshold under	Yes

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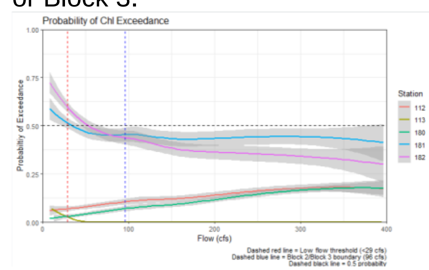
						proposed Block 2 minimum flows, as compared to 32.7 percent under baseline flow conditions. Note this calculation is for individual samples, not for the annual geometric mean, for which the chlorophyll state water quality threshold is based. We do not anticipate this increase in the number of individual samples to exceed the 50 percent probability for threshold exceedance would significantly impact the annual geometric mean. There was no change in other stations under minimum flow conditions in Block 2 or Block 3. 	
5	RBF	Chapter 3.3.1	No	Marine portions of the system should continue to achieve the Chapter 62-303, F.A.C. requirement that the daily average percent DO saturation not	No action needed.	No response necessary.	Yes

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				be below 42 percent saturation in more than 10 percent of the samples.			

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6	RBF	Chapter 4.2.1	No	Based on data provided by the District, the FDEP substrate availability scores were not related to velocity scores.	No action needed.	No response necessary.	Yes
7	RBF	Chapter 4.2.1	No	Average SCI score (55) shows that upper river is healthy at existing water withdrawals.	Please report this finding.	Information regarding the SCI scores for the upper river was added to the revised draft report.	Yes
8	RBF	Appendix G, Table 4-4	No	Are upland occurrences of *Quercus laurifolia* (swamp laurel oak) actually *Quercus hemisphaerica* (sand laurel oak)?	Check species differentiation for future vegetation studies.	Since this study was done by others, the species could not be verified. This will be noted for future vegetation studies of the river corridor.	Yes
9	RBF	Chapter 7.1	No	Sea level rise will contribute to non-attainment of minimum flows.	Monitor and revise as needed.	The District will continue to monitor flows in the Little Manatee River, annually assess the status of minimum flows that are established for the river, and re-evaluate the minimum flows in the future, as necessary.	Yes
10	RBF	Figure 5-3	No	Caption indicates 7 sites for substrate/cover collection, and map shows 8 locations.	Revise as appropriate.	The figure was revised to show the 7 locations.	Yes

Detailed Comments on Recommended Minimum Flows for the Little Manatee River Draft Report from Russ Frydenborg, Frydenborg EcoLogic							
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11	RBF	Section 6.5	Maybe	LOESS model salinity predictions suggested that the inclusion of the 35 cfs low flow water withdrawal threshold would be protective of adverse changes (>15 percent) in favorable habitat for the species requiring the 1-2 psu salinity area. Selection of other precise flow block thresholds for the lower river would benefit from additional analysis.	See comments by Dr. Peene.	The EFDC modeling and EFF analyses used to develop minimum flows for the lower river have been updated. In additions, the flow blocks have been revised. The updated results and resultant proposed minimum flows are described in the revised draft report.	Yes
12	RBF	Chapter 1.1	No	I agree with the 15 percent change metric as a measure to protect against significant harm and expect that the EPA Biological Condition Gradient could help support its use.	In the future (not associated with current proposed minimum flows), please consider how the 15 percent change metric would affect aquatic communities in relation to the EPA Biological Condition Gradient.	The District will consider how the 15 percent change metric would affect aquatic communities in relation to the EPA Biological Condition Gradient during the development and re-evaluation of minimum flows in the future.	Yes

Detailed Comments on Recommended Minimum Flows for the Little Manatee River Draft Report from Russ Frydenborg, Frydenborg EcoLogic							
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13	RBF	Table 3-2, 3-3	No	Organic nitrogen shows an increasing trend at Stations 129 and 140, can this be associated with tannin inputs from the floodplain or agriculture?	Provide short narrative if answer is known.	Text addressing the increasing trend in nitrogen was included in the report, as outlined in the response to Dr. Steve Peene's 7th comment. Briefly, previous evaluations of the Little Manatee River watershed (e.g., Flannery et al. 1991) indicated that increasing nitrogen was likely due to increased groundwater use and subsequent irrigation runoff in the watershed. Since the conclusion of that study, best management practices have improved irrigation efficiencies and reduced excess agricultural flows. However, such runoff may continue to impact water quality of the system.	Yes
14	RBF	Section 6-5	No	While the EFF ultimately was the basis for the proposed minimum flows, it would be useful to summarize how other data considered (e.g., zooplankton, vegetation) also indicated the need to protect the low-salinity habitat.	Please provide short summary describing the weight of evidence indicating the need to protect the low-salinity zone.	The EFDC modeling and EFF analyses used to develop the minimum flows for the lower river have been updated. In addition, supporting information associated with consideration of relevant environmental values that must be considered when establishing minimum flows has been updated. All of this updated information has been included in the revised draft report.	Yes

3.0 REFERENCED LITERATURE

Hood, J., M. Kelly, J. Morales, and T. Hinkle. 2011. Proposed Minimum Flows and Levels for the Little Manatee River – Peer Review Draft. Prepared by the Southwest Florida Water Management District, Brooksville, Florida.

Interflow Engineering, Inc., 2008. Myakka River Watershed Initiative, Historical and Future Conditions Technical Memorandum. Prepared for the Southwest Florida Water Management District, Brooksville, Florida.

Janicki Environmental, Inc., November 2016. Technical Memorandum D-8, Memo on Floodplain Inundation. Prepared for the Southwest Florida Water Management District, Brooksville, Florida.

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