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December 11, 2019

Sent via electronic mail to: earl.t.gysan@usace.army.mil

Mr. Tim Gysan
Senior Project Manager
U.S. Army Corps of Engineers, Jacksonville District
Programs and Project Management Division
P.O. Box 4970
Jacksonville, FL 32232-0019

Re: Lake Okeechobee System Operating Manual (LOSOM) Sensitivity Runs and
Performance Metrics

Dear Mr. Gysan:

This letter is in response to your email of November 15, 2019 requesting input from the Project Delivery Team (PDT) on sensitivity runs and performance metrics to be used for the LOSOM analysis. The November 15, 2019 email indicates that to facilitate submittals of comments on the sensitivity runs and performance metrics, the U.S. Army Corps of Engineers, Jacksonville District (USACE), provided comment forms to PDT members. The USACE asked that the comment forms be returned by December 11, 2019.

Martin County appreciates the efforts of the USACE to involve stakeholders, such as Martin County, in the LOSOM process and we are pleased with the opportunity to provide comments. However, due to the lack of generally available information necessary to provide productive comments as requested, Martin County's initial comments are detailed herein along with identification of additional information necessary to provide comprehensive input. Because of the lack of necessary information available at this time, Martin County would then also request that the December 11, 2019 deadline be extended to allow time for the USACE to provide the necessary information, for the County to evaluate the additional information, and then to provide more comprehensive feedback.

SENSITIVITY RUNS

The six sensitivity runs that have been completed by USACE Jacksonville District and presented to the PDT have provided useful information that will assist the formulation process. As mentioned above, however, there are limitations to the available information. Until additional information is made available, Martin County provides the following comments and requests for information necessary to provide a more comprehensive evaluation:

- 1) While the LOOPS model can provide information on alternative regulation schedules, it is not able to include reservoirs or other storage facilities in its current form. It is unclear whether additional sensitivity runs including these reservoirs and/or storage facilities would provide meaningful data. Martin County asks that the upcoming formulation process be laid out in more detail so that the process for developing alternatives and the screening process that will be used to determine which alternatives will be selected can be evaluated;
- 2) Has the USACE considered coupling the LOOPS model with the South Florida Water Management District's RESOPS spreadsheet model as an option for the screening process? If it has not been considered, Martin County requests that the LOOPS model be coupled with the RESOPS model or provide the rationale as to why these models will not be coupled; and
- 3) Please provide the number of alternatives that will be developed and screened and how many alternatives are expected to be modeled and evaluated in detail.

PERFORMANCE MEASURES

At the November 5, 2019 Plan Formulation and Modeling Sub-Team meeting, information on the initial performance measures under consideration by USACE was presented. The performance measures presented include performance measures for meeting LOSOM objectives that include: managing risk to public health and safety, life, and property; continuing to meet authorized purposes for navigation, recreation, and flood control; improving water supply performance, and enhancing ecology in Lake Okeechobee (Lake), Northern Estuaries and across the south Florida ecosystem. After reviewing the LOSOM performance metric materials provided by USACE, the following questions and comments are provided, with the goal of developing scientifically-defensible performance measures that are tailored to the specific water quality and environmental factors important for the management and stewardship of the St. Lucie (SLE) and Indian River Lagoon (IRL) estuaries (collectively, the Estuaries) within Martin County.

Details on Performance Measures

- 1) The information presented at the November 5, 2019 Plan Formulation and Modeling Sub-Team meeting for each proposed performance measure only included information about the source of the performance measure and the deliverables associated with the performance measure. As appropriate to each performance measure, detailed information regarding the desired restoration condition, the justification for the performance measure, the scientific basis for the performance

measure, how the performance measure will be used in evaluation, and the monitoring and assessment approach for obtaining the data needed for evaluation must be made available. We suggest that this information be compiled into a single document to facilitate review by the entire PDT.

Harmful Algal Blooms

Martin County considers the elimination of toxic and otherwise harmful algal blooms (HABs) in the Estuaries that result from Lake discharges one of the most important outcomes from LOSOM. USACE has publicly acknowledged that Lake discharges to the SLE have contained HABs and that HABs are toxic. The development of a HAB performance measure is therefore essential to the success of a new regulatory approach for the Lake. Martin County maintains the position that there should be no discharges to the Estuaries. Recognizing, however, that the current modeling effort considers discharges as a potential outcome, the following are potential performance measures for HABs:

1) The primary goal is the non-occurrence of HABs in the Estuaries and the SLE in particular. This would require, in part, significantly lower volumes of Lake and C&SF discharges entering the SLE at times of the year when HABs are known to occur.

Performance measures that would appear to measure progress towards this goal are:

(a) minimizing discharges from Lake Okeechobee from June – August when HABs are most likely to occur due to increased water temperature and the Lake’s nutrient rich freshwater;

(b) maximizing percentage of time discharges from Lake Okeechobee are within the pulse schedule envelope; and

(c) minimizing percentage of time discharges from Lake are outside of the pulse schedule envelope.

2) Additionally, since HAB formation in the SLE profoundly affects the economy of Martin County, an economic performance measure that evaluates the economic impacts of HABs on Martin County must be developed.

Maximum Lake Water Elevation

A major consideration in developing the LORS 2008 regulation schedule was the concern about the integrity of the Herbert Hoover Dike and the risk associated with high stages in Lake Okeechobee. As a result, a maximum Lake water elevation of 17.25 NGVD was used as a constraint in developing the LORS 2008 regulation schedule. With the anticipated completion of the Herbert Hoover Dike rehabilitation project in 2022, the risk of dike failure will be significantly reduced. While USACE has acknowledged that the risk will be reduced, we have not seen a revised metric for maximum Lake water elevation for LOSOM. Since this metric will have a significant impact on the formulation and evaluation of alternatives, the USACE must develop a risk-based metric as soon as possible.

Water Quality and Nutrient Loading

1) In the consideration of impacts by Lake discharges on the Estuaries and near shore coral reef tract, total nitrogen (TN) and total phosphorus (TP) standards that do not exceed the applicable TMDLs for the receiving water bodies in the Estuaries should be included as PMs to evaluate how discharges through the S-80 and the S-308 effect the achievement of targets set by the TMDL for SLE and IRL.

2) It appears from the information provided that nutrient loads would be calculated from the volume of water released. As nutrient loads to the SLE from watershed runoff and Lake Okeechobee are hydraulically driven (mainly dependent on water volume rather than concentration), this appears to be a reasonable approach, assuming the relationship between flow and nutrient loads can be demonstrated to be consistent, given that the RSM models do not estimate water quality. However, more details are needed in order to provide meaningful input. Specifically, Martin County requests the following information be provided:

(a) From which possible sources will nutrient loads be calculated (i.e. C-44, Lake O, C-23, C-24. Ten Mile Creek, Tidal Basin)?

b) Will empirical nutrient data collected at SFWMD monitoring stations be used to calculate regression relationships between load and discharge at the coastal structures? Any such relationships used in the LOSOM exercise should be documented and provided. Is the load from the C-44 basin based on the difference between the load at S-80 and the load at S-308? Please explain how the effects of the C-44 reservoir and STA on loading will be accounted for.

(c) On what time scale will loads be calculated (weekly, monthly, annually)?

(d) What time scale will be used to compare across alternatives?

(e) Will the comparison across alternatives be relative or will there be comparison to a target load (suggest TMDL)?

f) For which nutrients will loads be calculated (suggest at least Total Nitrogen, Total Phosphorus, and TSS)?

RECOVER Salinity Performance Measure

RECOVER is in the process of revising the Salinity PM for the Northern estuaries, including the SLE. The current 2007 version of the PM has a salinity component and a hydrological component. The salinity component is a salinity envelope at the Roosevelt Bridge of 12 – 20 practical salinity units (psu) and is based on the tolerances of the American Oyster (*Crassostrea virginica*) and shoal grass (*Halodule wrightii*). The hydrologic component is a distribution of total inflow from all sources (including Lake Okeechobee, the SLE watershed and ground water). The written description of the hydrologic component has two thresholds or categories: <350 cubic feet per second (cfs) and >2000 cfs. The graphical model output presented in the 2007 PM document includes additional categories of flow: 350-2000 cfs, 2000 – 3000 cfs and >3000 cfs.

(1) Salinity Component: RECOVER's impending revisions notwithstanding, the following questions are posed. The 12 – 20 psu envelope seems rather narrow, and more representative of an optimal salinity for the two species (oysters, shoal grass) and may not provide sufficient analysis of conditions that may occur. A salinity envelope at the Roosevelt Bridge based on the tolerances of oysters would be more reflective of the anticipated future distribution of both indicator species. Adding additional thresholds to the envelope at the Roosevelt Bridge could provide more information. For example, thresholds for mortality (e.g. 2 psu), stress (e.g. <10 and >30 psu), and upper and lower limits for optima (e.g. 10-30 psu) could be included in the envelope. A similar envelope for shoal grass including thresholds for mortality, stress and optima could also be established further downstream at a location commensurate with the anticipated future distribution of shoal grass. In the final formulation of these envelopes, a duration component should be considered, even if imperfect. If, for example, it is assumed that adult oysters die after 2 weeks of exposure to salinity <2 psu, then this (two weeks <2 psu at the Roosevelt Bridge) could be a measure of a potentially catastrophic event. Potential metrics include: number of days salinity is within each part or area of the envelope (mortality, stress and optimal), number of potentially catastrophic events as defined above and number of times salinity is in each area for 1, 2, 3, or 4 etc. consecutive months.

(2) Hydrologic Component: Again, RECOVER is considering revisions to the current flow distribution. The current thresholds of 350, 2000, and 3000 cfs are being evaluated and refined, with the potential of adding more. The current flow PM includes three different model outputs. One is based on mean monthly flows, another is based on a 14-day moving average flow and a third includes both. Is there a compelling justification for producing results with differing temporal units? If not, this practice should be avoided in the future. Potential metrics include: number of mean monthly flows in each flow category, number of times flows are < 350 cfs, between 2000 and 3000 cfs and > 3000 for 1, 2, 3, 4, 5, etc. consecutive months.

Environmental Performance Measures

Details of the PM set for environmental considerations affected by the LOSOM need to be provided. Specifically:

- 1) The shellfish (American Oyster) habitat suitability index (HSI) has not been defined, but it should not be limited to salinity, temperature, and substrate type. Specifically, substrate type is irrelevant to LOSOM and should not be used in the formulation of environmental PMs. Has any consideration been given to including a total suspended solids (TSS) limit (used as a proxy for DO) in the shellfish HSI? Please explain why or why not.
- 2) At the time of high-volume discharges from S-80, Lake waters reach far into the IRL. Please define the area where the seagrass or submerged aquatic vegetation (SAV) HSI metric will be applied. Will it be throughout all areas of the SLE and IRL? If not, how will the limits be defined? Similar to the shellfish HSI, salinity and TSS are critical to understanding impacts from the Lake and LOSOM.
- 3) Salinity is one of the primary drivers and indicators of estuarine health and is a useful metric when considered in conjunction with the other PMs.
- 4) It is our understanding that the USACE is consulting with experts in coral reef and nearshore marine ecosystems. What recommended PMs have been developed in

consultation with these experts? Metrics including TSS, salinity and nutrient levels
What potential metrics are being considered? Does the suite of metrics include TSS, salinity and nutrient levels?

MODELING APPROACH

It is Martin County's impression that the USACOE will use a hydrologic modeling approach to estimate the rate and volume of freshwater discharges to the SLE. While discharges directly affect the SLE, economic and ecological effects are often due to water quality variables associated with these discharges. Important variables include salinity, TSS, nutrients (especially Total N and Total P), and harmful algae. For example, salinity, TSS, and nutrients affect the health of oysters, seagrasses and offshore reefs, and human health as that was recently publicly acknowledged. Critical uncertainties that Martin County has, as a steward of the receiving water body from Lake discharges, are whether and to what extent that the LOSOM planning process and the LOSOM outcome will account for the water quality effects or other important water quality variables? If so, how?

Similar to the format above, the following are modeling issues and requests for additional information that Martin County would need in order to address the uncertainties and provide comprehensive input.

Three planning tools are under development for the Northern Estuaries: CH3D Hydrodynamic Model, an Oyster Habitat Suitability Index Model, and an SAV Habitat Suitability Model. It is our understanding that the latter will not be available for the St. Lucie Estuary. Are we correct that these models will be used in conjunction with the RSM hydrologic models? Please provide a description of how these models are linked together.

CH3D Hydrodynamic Model

The CH3D is a complex three-dimensional numeric model that can simulate salinity and other attributes like currents in an estuary and is based on several variables including wind, freshwater inflow and tide. The model allows estimation of salinity in the SLE based on the flow data from the RSM Basins Model. We also understand that the CH3D model has a water quality module and could possibly estimate nutrient concentrations.

- 1) The CH3D has been operational for some years now. In the PM matrix, the model is listed as "under development" which leads to the following necessary additional information:
 - (a) Will the full model, including the water quality module, be used or some simplified version and explain why or why not;
 - (b) If a simplified version is to be used, what types of scenarios will be modeled (i.e., what range of flow conditions will be simulated; is the time step hourly, daily, weekly, monthly; what variables drive the model, wind, tide etc.);
 - (c) What is the model accuracy for each output;
 - (d) Will salinity output be used as input to the Habitat Suitability Index Models;
 - (e) What is the spatial resolution (grid size) and spatial extent of the grid; and

(f) Is the spatial resolution sufficient to support the Habitat Suitability Index Models?

2) Overall, the proposed estuarine modeling effort is not well described, other than stating that it will be performed using CH3D. It has generally been indicated that a hydrodynamic model that includes salinity has been developed for the SLE; however, it remains unclear whether the modeling proposed is capable of addressing additional concerns related to water quality (TSS, nutrients, etc.). In order to properly understand the modeling approach and how the model is being used by USACE to evaluate PMs, the following information would need to be provided:

- (a) What are the model grid extents with respect to the Indian River Lagoon, the Intracoastal Waterway and nearshore waters;
- (b) What boundary conditions are used to drive the CH3D model, and at what boundaries are they applied? What is the source of data used to develop the boundary conditions;
- (c) Is TSS being modeled? Dissolved Oxygen (DO)? What data are available to confidently model a discharge plume from the Lake; and
- (d) Are high flow discharges through S-80 being modeled? What data exists to specifically evaluate dispersion/impact area of the plume entering the SLE through the S-80? For the SLE, IRL and offshore regions, the focus should be on the impact of high Lake flow events, rather than “average-annual” conditions.

Oyster Habitat Suitability Index Model

(1) This model is a welcome addition to the toolbox as it links (presumably through the CH3D) the response of an ecological indicator in the estuary to watershed hydrology. The present model is based on salinity, temperature, and substrate. The output of habitat suitability models is generally a score ranging from 1 to say 5, with 1 being poor and 5 being excellent. It would be useful and instructive if scores could be related to conditions that cause mortality, stress or are optimal.

(a) Presumably, salinity output from the CH3D will be used as input to the Index Model. Where will the temperature data come from?

(2) Oysters in the SLE are limited not only by salinity but also by the distribution of appropriate substrate. Because substrate is a factor, there is the possibility that areas currently with appropriate substrate may yield a higher score than areas that do not. Therefore, the results of the model may tend to give a higher score to alternatives that promote the current distribution of oysters rather than those that may still be good for oysters but just in areas that currently have little or no substrate. A sensitivity analysis may be in order to determine the influence of substrate on the HSI score for the different alternatives.

SAV Habitat Suitability Index Model

(1) A model will apparently not be available for the SLE. Shoal grass is one of two RECOVER indicator organisms included in the 2007 Salinity PM.

Published SAV models for the SLE exist and could be considered for use by the USACE including:

Buzzelli, C., P. Gorman, P.H. Doering, Z. Chen, Y. Wan 2015. The application of oyster and

seagrass models to evaluate alternative inflow scenarios related to Everglades restoration. Ecological Modelling 297:154-170.

Buzzelli, C. B., R. Robbins, P. Doering, Z. Chen, D. Sun, Y. Wan, B. Welch and A. Schwarzhild 2012. Monitoring and modeling of *Syringodium filiforme* (Manatee Grass) in Southern Indian River Lagoon. Estuaries and Coasts 35:1401-1415.

It should be noted that variables driving these models include salinity and light.

The following additional information is necessary:

- (a) How does the USACE intend to estimate the effects of alternatives on SAV in the SLE;
- (b) Can a salinity envelope be developed for shoal grass in appropriate location(s), i.e., downstream of the Roosevelt Bridge;
- (c) Can output from the CH3D be used to estimate salinity at this location(s); and
- (d) Once performance measures are finalized, how will they be scored, compared, and weighted to make LOSOM recommendations?

In closing, Martin County appreciates the opportunity to provide input to USACE Jacksonville District on the sensitivity runs and performance metrics. As stated above however, in order to provide comprehensive input needed to ensure protection of the SLE, IRL, and near shore coral reef tract from Lake discharges and to ensure that the SLE BMAP stakeholders meet future TMDL targets, Martin County requests that the USACE provide the information as identified herein. We would also ask that additional time be given for the review of that information. Should you have any questions, please feel free to contact John Maehl at (772) 288-3263 or jmaehl@martin.fl.us.

Sincerely,



Don Donaldson, P.E.

Deputy County Administrator

cc: Marci Jackson, USACE Planning Lead
Jessica Mallet, USACE Modeling Lead
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