LIQUID SOLUTIONS GROUP

TECHNICAL MEMORANDUM

To:	Andrew Sutherland, Ph.D. SJRWMD	**Date:**	October 31, 2018
From:	Roberto Denis, P.E., D.WRE Oscar Vera, Ph.D., P.E., D.WRE	**Reference:**	Wekiva Basin Model Peer Review
Subject:	**Review Comments** **Wekiva Basin MFL Surface Water Models**		

The St. Johns River Water Management District (SJRWMD) has developed draft HSPF and HEC-RAS models to simulate the surface hydrology and hydraulics of the Wekiva Basin. Liquid Solutions Group, on behalf of Orange County Utilities, has reviewed the "Wekiva River Hydrology and Hydraulic Modeling for Minimum Flows and Levels" draft report (Seong and Wester, 2018) which documents the development and testing of these models. Based on this review, we have developed the following comments for consideration by SJRWMD staff and the peer reviewers engaged by the SJRWMD to provide feedback on the draft models for the Wekiva Basin.

1. Verification simulations should be developed and assessed for both the HSPF and HEC-RAS models. The development of a verification simulation to quantify the performance of a surface water model is standard industry practice and routinely utilized by agencies such as the United States Geological Survey to validate the model results. "Its purpose is to ensure that the calibrated model properly assesses all the variables and conditions that can affect model results, and to demonstrate the ability to predict field observations for periods separate from the calibration effort." (Duda, et. al., 2012) As alluded to by Duda, et. al., the most robust type of verification process is an extension of calibration (i.e., not a part of model application) that simulates observed data during one or more discrete periods outside of the calibration period. As such, use of a "long-term" simulation is not an appropriate substitute for this type of verification process.

   Due to the importance of the future use of these models, and the need for accuracy outside of the calibration period, the verification simulations are essential for assessing the suitability of the models.

2. It is recommended that both models (HSPF and HEC-RAS) undergo a sensitivity analysis to determine the relationships between observations, model parameters and model predictions that are most likely to affect the eventual MFL determination task.

Performing sensitivity analyses as part of model calibration efforts is a standard practice and routinely utilized Due to the importance of the future use of these models, and the need for accurate model predictions, sensitivity analyses are essential for assessing the degree of uncertainty and suitability of the models.

3. The period of record selected for calibration of the HEC-RAS model (2008 – 2016), only accounts for a timeframe where water levels had significantly increased. "Based on SJRWMD staff observations, in the last few years (after 2008) the main cause of the changing stage/discharge relationship appears to be the significant increase in vegetation in the Wekiva River." This observation is similar to the findings in other basins. For example, as part of the development of the Silver Springs MFLs, the SJRWMD concluded that for the Silver River "increased channel roughness (most likely resulted from increased SAV biomass/biovolume) is the probable cause of the observed change in stage-flow relationship." (Sutherland, et. al., 2017) Was any effort made to quantify the effect of this issue in the Wekiva Basin using the models?

4. As documented by Sutherland, et. al., 2017, higher levels of vegetation downstream of a spring can cause spring flow suppression. For Silver Springs, the SJRWMD concluded that spring flow suppression due to increased vegetation in the lower Silver River was over 4 times greater than flow suppression due to groundwater pumping. Downstream stage and flow conditions have been shown to have a significant effect on springflows.

   As described, springflows and springflow changes are planned to be modeled or calculated separately. These modeled or calculated values are then proposed to be used as boundary conditions in the Wekiva Basin models. How will the effect of downstream conditions be incorporated into these separate springflow models or calculations?

5. Please provide additional details and the spreadsheet (or other calculations) used to develop the springflows used as input to the HSPF model.

6. Please elaborate on the process for spatial disaggregation of rainfall data across the Wekiva River Watershed sub-basins. Please provide an example illustration for a representative (e.g., average) year.

7. Please provide how many missing rainfall records were filled using NEXRAD data (compared to the total number used).

8. The information on the use of PEST for the calibration of parameters in the HSPF model is very general. In order to better understand the use of PEST, we request the following for each model sub-basin:
   - A tabulation of the HSPF parameters allowed to be adjusted by PEST along with the bounds used;
   - The weights assigned to each parameter or parameter group; and
   - The resulting values for the calibration parameters.

The SJRWMD may already have GIS or spreadsheets such as control files or residual files which can provide this information. Furthermore, we request more information about the specific procedures used to constrain PEST in developing the calibrated parameters. For example, were certain parameters allowed to vary from sub-basin to sub-basin while others were held constant among the sub-basins, but allowed to vary by watershed?

9. We request tabulated water budgets for each HSPF sub-basin. The information should include tabulated inflows and outflows for computed water budget parameters which include, but are not limited to, surface runoff (SURO), surface evapotranspiration (SURET), precipitation (SUPY), upper zone storage (UZS).

10. The impervious percentages associated with the four urban land segments in the HSPF model were: 5, 10, 35 and 50 percent. Please provide information on how these values were derived.

11. Some watershed sub-basins appear more than once in Figure 2 of the report (e.g., sub-basins 17, 25, and 27). Please clarify.

12. Please add rainfall from the Sanford station to Figure 6.

13. Please provide a copy of the report cited in the references section "Mace, J. 2015. Draft report – MFLs for the Wekiva River at State Road 46. SJRWMD, Palatka, FL."

References

Duda, Paul; Hummel, P.; Donigian, Jr, A.; & Imhoff, J. (2012). BASINS/HSPF: Model use, calibration, and validation. Transactions of the ASABE. 55. 1523-1547. 10.13031/2013.42261.

Seong, Choung-Hyun and Wester, A. (2018) Draft Report Wekiva River Hydrology and Hydraulic Modeling for Minimum Flows and Levels. Palatka, FL.

Sutherland, Andrew; Freese, R.; Slater, J.; Gordu, F.; Di, J.; & Hall, G.B. (2017). Minimum Flows Determination For Silver Springs Marion County, Florida. Technical Publication SJ2017-2. Palatka, FL.