CFWI MFL Status Assessment Methodology for SJRWMD Adopted MFLs (Draft - 02/15/19)

Definitions

- **Freeboard:** For lake or wetland MFLs it is expressed as the allowable drawdown in the UFA, in feet. For spring and river MFLs it is expressed as the allowable reduction in flow rate (in cubic feet per second or cfs).
- **Deficit**: Amount of water required (cubic feet per second or feet) to recover a water body to the MFL condition. Sometimes referred to as negative freeboard.
- **2005 Reference Condition**: A scenario representing 2005 withdrawals, which was established and used to compare to modeled results for various projected future withdrawal conditions for 2015 CFWI RWSP.
- **2014 Reference Condition:** A scenario representing 2014 withdrawals normalized for climatic conditions. The 2014 Reference Condition is used in the 2020 CFWI RSWP to compare modeled results from a number of projected future withdrawal conditions.
- **Surface Water Model Year Condition:** A scenario representing the groundwater pumping in the year an MFL was assessed using a surface water (SW) model.
- **Model Simulation Period**: Groundwater model simulation period from 2003 through 2014

Introduction

In support of the 2020 Central Florida Water Initiative (CFWI) Regional Water Supply Plan (RWSP), the compliance status of MFLs within the CFWI planning area will be reassessed based on the 2014 reference condition and the future status of MFLs within the CFWI planning area will be assessed based on 2030 and 2040 projected water use conditions. Below is a summary of the method used in the 2015 CFWI RWSP and the proposed method to be used to assess compliance and the future status of MFLs for the 2020 CFWI RWSP.

2015 CFWI RWSP Methodology

In support of the 2015 CFWI RWSP process, the compliance status of MFL water bodies in the CFWI planning area was evaluated. As part of this effort, assessments for MFLs within the SJRWMD represented compliance status based on 2005 reference condition. Additionally, adopted and some proposed MFLs were used as the primary criteria for evaluation of regional groundwater availability. The amount of the UFA drawdown or flow reduction that did not cause exceedance of adopted (or proposed) MFLs based on 2005 pumping conditions was referred to as “freeboard”, which was used to establish “reference” MFL thresholds.

Using the East Central Florida Transient (ECFT) groundwater model, the magnitude of Upper Floridan Aquifer (UFA) drawdowns at MFL lakes and flow reductions at MFL springs and rivers were estimated under different groundwater pumping conditions. Initially, the ECFT model was used to simulate the 2005 Reference Condition. Subsequently, four additional ECFT groundwater model simulations, including the 2015, 2025, 2035, and End of Permit (EOP) withdrawal scenarios were performed. The freeboard estimated for 2005 was compared with the projected changes in water levels or flows from

2005 to future groundwater withdrawals. For example, for a given lake, the 2005 freeboard was compared to the water level delta from 2005 to 2035, to determine remaining freeboard at 2035. To evaluate the regional groundwater availability over a twenty-year planning horizon for development of the CFWI RWSP, the 2035 withdrawal scenario was used to assess the status of MFLs relative to the 2005 Reference Condition.

2005 Freeboard/Deficit

The following summarizes the method used to estimate the freeboard/deficit as of 2005 for MFL water bodies located in the SJRWMD portion of the CFWI.

Surface water (SW) models were developed for 6 springs and 13 lakes. If the SW model year was after 2000, the freeboard estimated using the SW model was assumed to be good and was used for the 2005 reference condition (Table 1). If the SW model year was before 2000, double-mass analysis on groundwater levels (for lakes) or flows (for springs) was performed. If double-mass analysis indicated a drawdown or flow reduction due to the additional pumping from the SW model year to 2005, the 2005 freeboard/deficit was calculated by subtracting the amount of drawdown or flow reduction estimated using double-mass analysis from the SW model year freeboard. If not, the freeboard estimated using the SW model was assumed to be a good estimate for 2005 (Table 1).

2035 Freeboard/Deficit

The ECFT model was used to simulate 2005 and 2035 conditions. Since the ECFT model was a transient model, monthly level or flow hydrographs were generated for each system (for lakes, under the centroid of each lake) for 2005 and 2035 pumping conditions. The median of the difference between 2005 and 2035 condition hydrographs was assumed to be equal to the estimated drawdown or flow reduction in 2035 (relative to 2005) and was used to assess the future status of the MFLs. The amount of freeboard or deficit was calculated by subtracting the estimated 2035 drawdown or flow reduction from the 2005 freeboard/deficit shown in Table 1.

Table 1. Summary of MFLs from 2015 CFWI RWSP

Water Body Type	Year Adopted / Proposed Rule Making	Site	County	SW Model Year	2005 Freeboard/Deficit (ft or cfs)*
Lake	2002	Apshawa North	Lake	1998	0.4
Lake	2002 / 2019	Apshawa South	Lake	1998	0.4
Lake / Wetland	2001	Boggy Marsh	Lake	2005	2.1
Lake	2001	Brantley	Seminole	2003	2.2
Lake	2002	Cherry	Lake	2003	1.5
Lake	2003	Emma	Lake	2003	3.0
Lake	2000	Louisa	Lake	2003	2.0
Lake	2003	Lucy	Lake	2003	3.0
Lake	1998	Mills	Seminole	2003	2.3
Lake	2002	Minneola	Lake	2003	2.1
Lake	2001	Pine Island	Lake	2005	1.5

Lake	1998 / 2019	Prevatt	Orange	2002	1.1
Lake	1998 / 2017	Sylvan	Seminole	2002	1.1
River	1992 / 2019	Wekiva River at State Road 46	Orange	1990	8.0
Spring	1992 / 2019	Miami	Seminole	1990	1.0
Spring	1992 / 2019	Palm	Seminole	1990	-1.8
Spring	1992 / 2019	Rock	Orange	1990	2.4
Spring	1992 / 2019	Sanlando	Seminole	1990	4.0
Spring	1992 / 2019	Starbuck	Seminole	1990	0.1
Spring	1992 / 2019	Wekiwa	Orange	1990	2.3

*Positive values indicate "freeboard" and negative values indicate "deficit" in feet (for lakes) and cubic feet per second (for springs and rivers)

2020 CFWI RWSP Proposed Methodology

2014 Freeboard/Deficit

Because of complexity in groundwater hydrology and the interaction between groundwater and surface water features such as lakes and springs, if available, groundwater models are the best available tools to evaluate the impact of groundwater pumping on MFL water bodies. The ECFT model used in 2015 CFWI RWSP has been updated and is now called the East Central Florida Transient Expanded (ECFTX) model. The ECFTX model simulates monthly levels and flows for a period (from 2003 to 2014) that captures both 2005 and 2014 reference conditions. This makes the groundwater model more suitable for current assessment of MFL water bodies within CFWI area.

The proposed methodology is based on the use of the ECFTX groundwater model and assumes that the ECFTX model will produce hydrographs from 2003 to 2014 (model simulation period). 2014 reference condition and MFL SW model year scenarios will be simulated to estimate freeboard/deficit for 2014 reference condition.

2014 Reference Condition Scenario: The year 2014 was selected as the reference year for 2020 CFWI RWSP for evaluation of groundwater availability within CFWI planning region**.** A set of monthly peaking factors from 2003 through 2014 was developed by the CFWI HAT team to normalize the 2014 pumping to account for climatic conditions throughout the simulation period. The monthly peaking factors from 2003 through 2014 will be applied to the 2014 pumping to develop the 2014 reference condition scenario.

MFL SW Model Year Scenarios: The SJRWMD methodology for estimating freeboard for a specific MFL water body is based on long-term simulations of SW models. The freeboard is initially estimated for the pumping condition of the latest year the SW model simulates. The freeboard is later updated, as needed, based on the change in pumping from the SW model year. For example, the freeboard for Lake Apshawa North shown in Table 1 was originally estimated for the SW model year of 1998 and later updated to 2005 as part of 2015 CFWI RWSP, as previously described. The freeboards estimated for both 1998 and 2005 reflect the pumping conditions in 1998 and 2005, respectively, regardless of climatic conditions in those years. For example, the freeboard estimated for 2005 would not change if the pumping remained the same since 2005.

Because of significant challenges with developing spatial distribution of groundwater pumping within the model domain for the years before 2000, the 2005 freeboard shown in Table 1 will be used for an MFL water body if the associated SW model year is before 2000. In addition, the 2003 pumping condition will be used to assess the MFL water bodies with a SW model year of 2002 since 2002 was not included in the ECFTX model simulations. Table 2 summarizes how 2014 freeboard will be calculated for the MFL water bodies with different SW model years shown in Table 1.

Table 2. 2014 Freeboard Calculation

SW Model Year in Table 1	**2014 Freeboard**	**ECFTX Scenarios**
2002	2002 Freeboard +/- Change in UFA level or flows from 2003 pumping condition to 2014 reference condition	2003 SW model year 2014 Reference Condition
2003	2003 Freeboard +/- Change in UFA level or flows from 2003 pumping condition to 2014 reference condition	
2005	2005 Freeboard +/- Change in UFA level or flows from 2005 pumping condition to 2014 reference condition	2005 SW model year 2014 Reference Condition
Pre-2000		

Since the ECFTX is a transient model simulating monthly water levels and flows from 2003 through 2014, MFL SW model year scenarios will be developed by applying a set of monthly peaking factors (MFL peaking factors) to the average pumping in the respective SW model year from 2003 through 2014. The purpose of MFL peaking factors is to capture the seasonal variation in pumping while preserving the average pumping in the respective SW year throughout the simulation period.

For the 2014 reference condition scenario, the pumping in 2014 was adjusted by a set of peaking factors to account for climatic conditions in 2014. For the MFL SW model year scenarios, a separate set of peaking factors were developed because the freeboards shown in Table 1 are based on the pumping condition in the respective years which should be preserved. Therefore, there was no need to make adjustments to account for climatic conditions. The MFL peaking factors were calculated as follows:

$$\text{Peaking Factor in Month } i \text{ of Year } j = \frac{\text{Pumping in Month } i \text{ of Year j}}{\text{Average pumping in Year } j}$$

Where

i : months from January through December

j : years from 2003 through 2014

Freeboard/Deficit Calculations: The first step in the proposed methodology is to run the ECFTX model using the 2014 reference condition. Since the ECFTX model is a transient model, the 2014 reference condition hydrograph (monthly levels or flows) for each MFL system will be generated over the model simulation period (2003 to 2014).

The second step is to run the ECFTX model using SW model year condition for each MFL system. The SW model year condition hydrographs (monthly levels or flows) for each MFL system will be generated over the model simulation period.

The third step is to calculate the difference between the 2014 reference condition hydrograph and the SW model year condition hydrograph representing the simulated drawdown (for lakes, under the

centroid of each lake) or flow reduction under different historical hydrologic condition. The drawdown or flow reduction for each corresponding system will be calculated by averaging the difference between the 2014 reference condition hydrograph and the SW model year condition hydrograph.

The final step is to estimate the 2014 freeboard or deficit by subtracting the drawdown or flow reduction estimated for each corresponding system from the original freeboard/deficit estimated for SW model year shown in Table 1. Table 3 shows step-by-step how the 2014 freeboard/deficit will be estimated.

Table 3 – A step-by-step summary of the proposed methodology

Run ECFTX model using the 2014 reference condition well file.
Generate hydrograph of groundwater levels (below an MFL lake) or flows (at an MFL spring) for each MFL system for the model simulation period (Hydrograph 1 in Figure 1)
Run ECFTX model using the respective SW model year pumping for each system (Tables 1 and 2). Pumping adjusted with MFL peaking factors (SW model year condition) will be applied over the model simulation period
Generate groundwater level or flow hydrographs for each MFL system for the model simulation period (Hydrograph 2 in Figure 1)
Calculate average drawdown or flow reduction by averaging the difference between the 2014 reference condition hydrograph (Hydrograph 1) and the SW model year condition hydrograph (Hydrograph 2) shown in Figure 1 from 2003 to 2014
Subtract the estimated average drawdown or flow reduction from the freeboard/deficit estimated for SW model year shown in Table 1 to calculate the 2014 freeboard or deficit

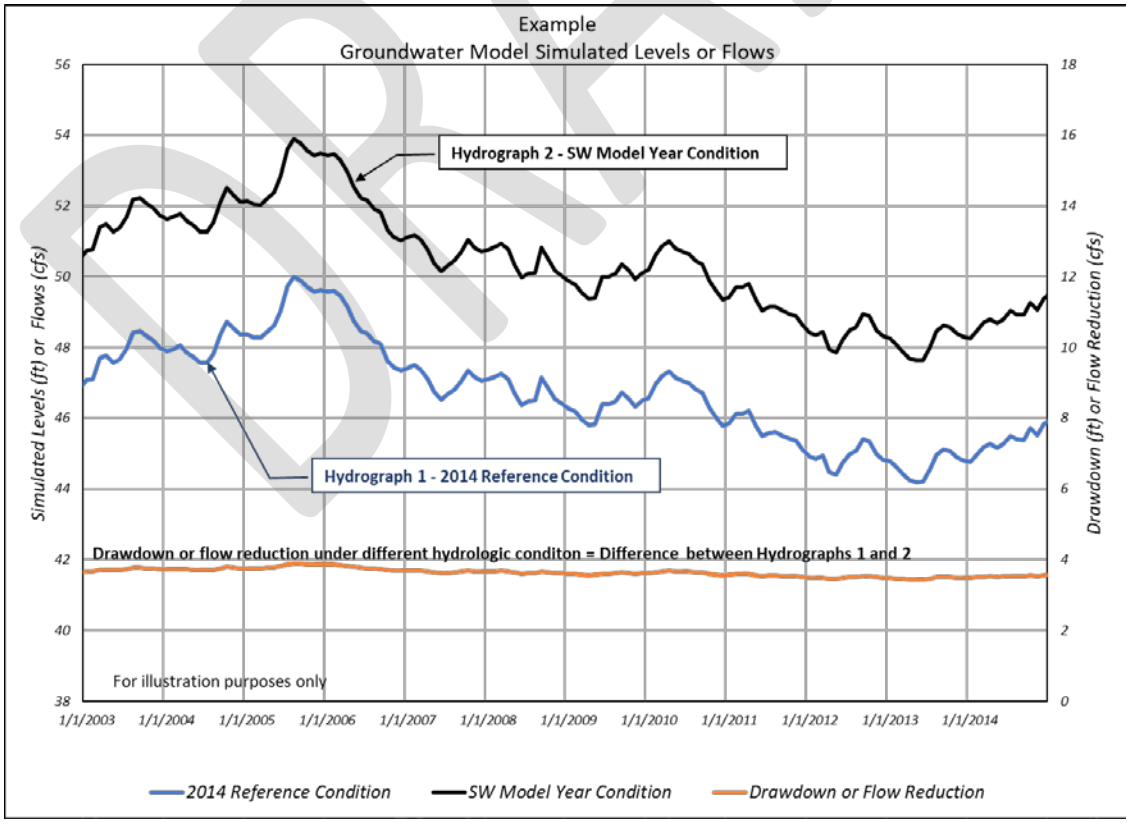

Figure 1. Illustrative graph for estimating freeboard/deficit in 2014 using ECFTX model

2030 and 2040 Freeboard/Deficit

The ECFTX model will be used to simulate 2030 and 2040 conditions. Monthly level or flow hydrographs will be generated for each system for 2030 and 2040 pumping conditions. The average of the difference between 2014 reference condition and 2040 (or 2030) condition hydrographs will be assumed to be equal to the estimated drawdown or flow reduction in 2040 (or 2030) and will be used to assess the future status of the MFLs. The amount of freeboard or deficit will be calculated by subtracting the estimated 2040 (or 2030) drawdown or flow reduction from the 2014 freeboard/deficit.