APPENDIX F

MINIMUM FLOWS AND MINIMUM WATER LEVELS – ASSESSMENT AND RESULTS

APPENDIX F

MINIMUM FLOWS AND MINIMUM WATER LEVELS – ASSESSMENT AND RESULTS

Introduction

Minimum Flows and Minimum Water Levels (MFLs) were evaluated during the Central Springs/East Coast (CSEC) Regional Water Supply Plan (RWSP) process to determine whether adopted flows and/or levels would be achieved with projected groundwater withdrawals at the 20-year planning horizon (2040) in the CSEC RWSP area. This document reviews the basic methodology used to assess the status of MFLs for the different types of water bodies evaluated within the CSEC RWSP area followed by a summary of the assessment results.

For all types of MFL water bodies, freeboard is commonly used to describe the quantity of additional water available for consumptive uses of water, which would not cause a violation of a water body's adopted MFLs. Freeboard can be expressed in terms of Upper Floridan aquifer (UFA) drawdown (for MFL lakes) or flow (for MFL rivers and springs). A positive freeboard value indicates the availability of additional groundwater or surface water, while a negative value, or deficit, indicates that an MFL is not met or is not projected to be met in a future withdrawal scenario. Each MFL assessment included a current freeboard calculation (most associated with 2015 pumping conditions) and a projected freeboard at 2040 pumping conditions. A deficit at current conditions indicates a water body is in recovery with regard to its MFLs. A positive freeboard at current conditions with a deficit at 2040 projected conditions indicates a water body is in prevention with regard to its MFLs. Finally, a positive freeboard at current conditions and at 2040 projected conditions indicates the MFLs are met throughout the planning horizon.

Lake MFLs Assessment

Within the CSEC RWSP area, there are 42 lakes with adopted MFLs. Twenty-five of these lakes were assessed in the CSEC RWSP. Of the 17 non-assessed MFL lakes, 12 show no significant connection to the UFA and, therefore, are not expected to be influenced by groundwater withdrawals. One of the non-assessed lakes is currently on the St. Johns River Water Management District (SJRWMD) Priority List for reevaluation in 2024. The effectiveness of another non-assessed MFL lake is being evaluated and may be replaced with a more suitable water body if warranted. The three remaining lakes lacked sufficient data for assessment at the time of analysis. See Appendix E for additional details regarding the non-assessed MFL lakes.

Current Status Assessment

For the majority of assessed MFL lakes, a previously estimated freeboard value corresponding to the lake's surface water model year, most ranging from 1995 to 2005, provided the amount of allowable drawdown in the UFA before the most constraining MFL would no longer be achieved. For lakes whose surface water model year corresponded to an existing groundwater flow model simulation, the surface water model year freeboard was brought forward to 2015 by comparing drawdown beneath the lake at the surface water model year and at 2015. For lakes whose surface water model year did not correspond to an existing model simulation, a relationship between groundwater pumping and UFA drawdown was generated using modeled withdrawals within a 10-mile buffer surrounding each lake and modeled drawdown from the available model simulations. It should be noted that the drawdown values were estimated based on pumping within the entire model domain. Pumping within the 10-mile buffer was only used as a proxy to develop the pumping/drawdown relationship. This relationship was used to estimate the drawdown from the surface water model year, allowing for the comparison of drawdown values predicted for the surface water model year and 2015. The difference in drawdown was applied to the surface water model year freeboard value to update freeboard values to 2015.

Future Status Assessment

The groundwater models were then used to derive predicted aquifer drawdown beneath each MFL lake from current pumping conditions to 2040. The differences in drawdown were applied to the current condition freeboard values to determine 2040 MFL status.

Results of the CSEC MFL analysis show that 21 of the 25 assessed lakes are currently meeting their MFLs and will continue to meet their MFLs throughout the planning horizon. Butler, Indian, Scoggin, and Shaw lakes (Volusia County) are in prevention, as they are currently meeting their MFLs, but are not projected to meet their MFLs in 2040. Results are summarized in Table F-1.

Specific deviations from the assessment methodology and any unique circumstances are specified below for each corresponding CSEC RWSP sub-region.

Volusia

For the majority of the Volusia County MFL lakes, the model simulations used to establish the pumping/drawdown relationships utilized historic water use from 1995, 2002, and 2010. The 2015 water use simulation was excluded due to changes in model-wide pumping distributions, which impacted the statistical validity of the relationships.

The pumping/drawdown relationship analysis did not produce statistically valid results for Indian Lake, Coon Pond, or Lake Shaw, likely due to varying pumping distributions within the corresponding buffer regions. For these water bodies, staff created new model simulations (2004 and 2005) to correspond with each lake's surface water model year,

thereby eliminating the need for establishing pumping/drawdown relationships. Freeboard values corresponding to 2004 (for Shaw) and 2005 (for Indian Lake and Coon Pond) were then brought forward to 2015 after comparing drawdown in 2004 or 2005 with 2015. For consistency, the 2005 model simulation was then utilized for Scoggin Lake, whose surface water model year was also 2005. For Indian Lake, the benefit of the Tiger Bay Weir, constructed in 2016, could not be accurately assessed with the Volusia model. Instead, the benefit was extracted from a contractor-developed model (DHI 2015) and added to the 2015 freeboard in order to determine the current MFL status.

For Lake Butler, whose MFLs were recently adopted in 2020, the freeboard value for the most constraining MFL was associated with a five-year average water withdrawal condition, specifically, 2014 to 2018 (Jennewein et. al. 2020). The estimated drawdown under this five-year average condition was compared to the modeled drawdown at 2040 projected pumping. The difference in drawdown was then applied to the 2014–2018 condition freeboard value to determine the MFL status at 2040.

Of the 17 MFL lakes assessed in Volusia County, seven have surface water withdrawals authorized through the SJRWMD consumptive use permitting program. These lakes include Daugharty, Davis, Emporia, Hires, Lower Louise, Shaw, and Upper Louise with withdrawals authorized for mostly nursery and cut foliage irrigation and freeze protection. For each of these lakes, permitted surface water withdrawals were accounted for in the respective surface water models and the original freeboard values. Review of reported 2015 surface water withdrawals from these lakes revealed totals much less than that permitted. As such, the 2015 freeboard values were calculated by simply applying the difference in UFA drawdown beneath each lake from the surface water model year to 2015. It should be noted that the 2015 and projected 2040 freeboard values for these lakes, similar to the surface water model year freeboard values, account for permitted surface withdrawals, which are significantly greater than the reported withdrawals for at least the past four years (2015 through 2018). This decline in surface water use is likely the result of decreased nursery and cut foliage production within northwest Volusia County. Projected growth in surface water use from these smaller lakes, beyond what is currently permitted, is not anticipated within the planning horizon. Future increases in surface water use in Volusia County will most likely occur from the St. Johns River.

Marion/North Lake

Unlike the analysis in Volusia County, model simulations were developed for each of the specific surface water model years for the assessed MFL lakes in Marion and North Lake[1] counties, therefore, a pumping/drawdown relationship for these lakes was not calculated.

[1] Within the CSEC RWSP, North Lake County is defined as that portion of Lake County that is not included in the Central Florida Water Initiative.

Brevard/Indian River/Okeechobee

For Brevard, Indian River, and Okeechobee counties, the MFLs analysis was performed using the East-Central Florida Transient Extended Model Version 1.0 (ECFTX)(CFWI 2020), which was developed collaboratively for the Central Florida Water Initiative (CFWI). The ECFTX model was the only regional groundwater model that spanned the Brevard, Indian River, and Okeechobee counties sub-region. Due to the extensive collaboration employed during ECFTX model development, only the CFWI-approved simulations were utilized for the MFLs analysis in the CSEC RWSP.

The surface water model year for lakes Fox and South, 2000, was not a simulation developed for the ECFTX. An analysis was performed to determine if the existing 2003, 2005, or 2014 simulation could be utilized as a surrogate for 2000 based on similar withdrawal quantities in Brevard County. Results demonstrated that county-wide water use was greater in 2003 (34%) and less in 2005 and 2014 (17% and 8%, respectively) when compared to withdrawals in 2000. However, a comparison of modeled UFA elevations beneath lakes Fox and South in 2003, 2005, and 2014 showed negligible differences. Based on this finding, the surface water model-derived freeboard values from 2000 were brought forward to 2014 as the "current" freeboard.

Spring MFLs Assessment

There are eight springs within the CSEC RWSP area with adopted MFLs, two of which were not assessed in this plan due to property access issues (see Appendix E). Based on the current MFL status assessments, it was determined five of the six assessed springs were achieving their respective MFLs under current pumping conditions (Table F-1). To determine the MFL status for these five springs at 2040, the current freeboard for each spring was compared to the model-predicted decrease in flow resulting from projected 2040 water demand. The results indicate that Alexander, De Leon, Gemini, and Silver Glen springs will continue to meet their MFLs throughout 2040. Silver Springs was classified as being in prevention with regard to its MFLs since it is not projected to achieve its MFLs at the 2040 planning horizon. Finally, although Blue Spring was achieving its previous minimum flow as reported in the first five-year assessment of the 2013 Volusia prevention and recovery strategy (SJRWMD 2019), on April 1, 2019, the minimum flow increased pursuant to the regime identified in chapter 40C-8, *Florida Administrative Code* (*F.A.C.*). The updated MFL status assessment determined that the increased minimum flow would not be met under current pumping conditions, therefore, the status of the Blue Springs MFL shifted to recovery.

Specific deviations from the assessment methodology and any unique circumstances are specified below for each corresponding sub-region.

Volusia

The original MFL status assessments for De Leon and Gemini springs were completed in 2016 based on 2010 water use conditions. Freeboard values for 2010 were brought forward to 2015 using a comparison of predicted spring flow from model simulations corresponding to 2010 and 2015 groundwater withdrawals.

The Blue Spring MFL is unique in that it defines a minimum flow regime that increases in five-year increments with the final minimum flow of 157 cfs becoming effective in 2024 (40C-8, *F.A.C.*) A Blue Spring MFL status evaluation was performed in 2018 to support the first five-year assessment of the 2013 Volusia prevention and recovery strategy (SJRWMD 2019). Results from the analysis showed that the Blue Spring MFL applicable to 2018 (142 cfs) was being achieved under current pumping conditions and the MFL status remained in prevention. In 2019, the Blue Spring minimum flow increased to 148 cfs, pursuant to the adopted MFL. An updated MFL status determination showed that the higher minimum flow was not being met and, therefore, the status of the Blue Spring MFL shifted to recovery. Pursuant to 40C-8.031(13)(a), *F.A.C.*, SJRWMD will perform a causation analysis to evaluate the potential impacts of various stressors on Blue Spring, including whether groundwater pumping is a factor. Based on the results of this analysis, SJRWMD will evaluate existing MFL criteria and may adjust any existing prevention/recovery strategies, if necessary, to ensure the protection of Blue Spring from significant harm due to consumptive uses of water. In addition, SJRWMD staff may request Governing Board authorization to include Blue Spring on the MFL Priority List and Schedule for re-evaluation prior to the next CSEC RWSP.

The existing Blue Spring MFL requires a final minimum flow increase to 157 cfs by 2024. Table A1-5 shows the amount of flow needed to meet the current (148 cfs) and final (157 cfs) Blue Spring MFL at current and projected pumping conditions. Currently, there are sufficient projects and measures identified in the Volusia MFL prevention/recovery strategy (SJRWMD 2013) and five-year assessment (SJRWMD 2019) to ensure achievement of the final Blue Spring MFL at 2040 projected water demand.

Marion/North Lake

Like De Leon and Gemini springs in Volusia County, the original MFL status assessments for Alexander, Silver, and Silver Glen springs were completed in 2016 based on 2010 water use conditions. Freeboard values for 2010 were brought forward to 2015 using a comparison of predicted spring flows from model simulations corresponding to 2010 and 2015 groundwater withdrawals. Due to a county-wide decrease in groundwater withdrawals from 2010 to 2015, the freeboard values for all three springs increased from 2010 to 2015.

Brevard/Indian River/Okeechobee

There are no MFL springs in this sub-region of the CSEC RWSP area.

River MFLs Assessment

There are two rivers (three river reaches) within the CSEC RWSP area with adopted MFLs, one of which was not assessed in this plan due to insufficient data at the time of plan development (see Appendix E). The two assessed river reaches are both located on the St. Johns River; the first at State Road 44 near DeLand in Volusia County and the second 1.5 miles downstream of the Lake Washington weir in Brevard County. Both assessed river reaches are currently meeting their MFLs and are projected to meet their MFLs at 2040.

Volusia

The St. Johns River at State Road (SR) 44 near DeLand in Volusia County is located within the middle St. Johns River. This area is characterized by considerable flow contributions from the UFA from both spring flow and diffuse upward leakage (SJRWMD 2012). In order to assess the current MFL status, a previous analysis of surface water availability (Robison 2004) was compared to permitted upstream river withdrawals and changes in groundwater flow contributions to the river from 2015 to 2040 within the Volusia model domain. In further support of Robison's surface water availability estimate, the SJRWMD Water Supply Impact Study (2012) showed that a similar quantity of withdrawals would result in minor or negligible impacts to the river. Any request for additional surface water withdrawals beyond which are permitted today will be evaluated with the best available analysis tools to ensure continued achievement of MFLs under current and 2040 water demand conditions.

Marion/North Lake

There were no assessed MFL rivers in this sub-region of the CSEC RWSP area.

Brevard/Indian River/Okeechobee

The second assessed MFL river reach is located on the St. Johns River in Brevard County, approximately 1.5 miles downstream of the Lake Washington weir. In this region, the UFA underlies a very thick confining layer, which limits impacts of UFA withdrawals on surface water flows (SJRWMD 2012). As such, a groundwater modeling assessment was not necessary to determine the MFL status for this river reach. Instead, previous analyses of surface water availability (Rao 2008 and Adkins 2008) were compared to upstream permitted withdrawals to estimate a current freeboard and determine current MFL status. Although one availability analysis was associated with a downstream site on the St. Johns River (SR 50), the SJRWMD Water Supply Impact Study (2012) also supports the potential availability of additional withdrawals at Lake Poinsett (located between Lake Washington and SR 50). Any further river withdrawals requested during the planning horizon will be assessed for MFL compatibility using the most current surface water availability determination at the Lake Washington weir prior to withdrawal authorization.

Table F-1: CSEC RWSP MFLs Assessment Summary

Type	Name	County	Current Freeboard/Deficit[1] (ft, mgd, or cfs)[2]	Current MFL Status	MFL Status at 2040 Conditions[3]
Lake	Big	Volusia	1.1	Met	Met
Lake	Bowers	Marion	3.9	Met	Met
Lake	Butler	Volusia	0.2	Met	Prevention
Lake	Colby	Volusia	1.3	Met	Met
Lake	Coon Pond	Volusia	3.5	Met	Met
Lake	Daugharty	Volusia	1.7	Met	Met
Lake	Davis	Volusia	3.1	Met	Met
Lake	Emporia	Volusia	4.4	Met	Met
Lake	Fox	Brevard	0.8	Met	Met
Lake	Halfmoon	Marion	0.7	Met	Met
Lake	Helen	Volusia	1.2	Met	Met
Lake	Hires	Volusia	1.6	Met	Met
Lake	Hopkins Prairie	Marion	1.2	Met	Met
Lake	Indian	Volusia	0.3[4]	Met	Prevention
Lake	Kerr	Marion	0.7	Met	Met
Lake	Lower Louise	Volusia	1.9	Met	Met
Lake	Nicotoon	Marion	2.3	Met	Met
Lake	Scoggin	Volusia	0.4	Met	Prevention
Lake	Shaw	Volusia	0.7	Met	Prevention
Lake	Smith	Marion	1.4	Met	Met
Lake	South	Brevard	0.8	Met	Met
Lake	Three Island	Volusia	1.0	Met	Met
Lake	Upper Louise	Volusia	2.0	Met	Met
Lake	Winnemisett	Volusia	2.1	Met	Met
Lake	Winona	Volusia	2.2	Met	Met
River	St. Johns at SR 44 near DeLand	Volusia	93.9 to 125.9(est[5])	Met	Met
River	St. Johns downstream of Lake Washington	Brevard	11.7 to 73.0(est[5])	Met	Met
Spring	Alexander	Lake	6.6	Met	Met
Spring	Blue	Volusia	-5.9[6]	Recovery	
Spring	De Leon	Volusia	3.0	Met	Met
Spring	Gemini	Volusia	0.7	Met	Met
Spring	Silver	Marion	19.2	Met	Prevention
Spring	Silver Glen	Marion	0.5	Met	Met

[1] Current freeboard/deficit values for the majority of water bodies are associated with 2015 pumping conditions. Exceptions include lakes Fox and South (associated with 2014 pumping conditions), Lake Butler (associated with 2014 – 2018 average pumping), and Blue Spring (associated with 2019 projected pumping).

[2] Freeboard/Deficit is expressed in feet (ft) for MFL lakes, million gallons per day (mgd) for MFL rivers, and cubic feet per second (cfs) for MFL springs.

[3] Represents 2040 MFL status without implementation of projects identified in an MFL prevention/recovery strategy.

[4] Includes benefit of Tiger Bay weir (0.47 ft; DHI 2015), which was constructed in 2016.

[5] Estimate (est) was calculated using a range of starting freeboard values from multiple published reports.

[6] Current freeboard estimated using minimum flow of 148 cfs at 2019 projected pumping.

References

Adkins, M. 2008. *Hydrologic Analysis of Alternative C-1 Rediversion Project*. SJRWMD; Palatka, FL.

Central Florida Water Initiative (CFWI). 2020. *Model Documentation Report East-Central Florida Transient Expanded (ECFTX) Model*. Available from: https://cfwiwater.com/pdfs/ECFTX_Model_Final_Report_Feb_2020.pdf

DHI. 2015. *Tiger Bay Bennett Swamp Model Update and Recalibration; Telescoped Model and Scenario Analysis*. DHI Water and Environment Inc., Lakewood, CO.

Jennewein, S., J. Di, O. Leta, R. Deschler, and A. Sutherland. 2020. *Minimum Levels Determination for Lake Butler, Volusia County, Florida*. SJRWMD Technical Publication SJ2020-1. Available from: www.sjrwmd.com

Rao, D. 2008. *Determination of Potential Water Supply Yield of the Upper St. Johns River at State Road 50, Florida, Using Minimum Flows and Levels Compliance as a Constraint*. SJRWMD Special Publication SJ2009-SP2.

Robison, P. 2004. *Middle St. Johns River Minimum Flows and Levels Hydrologic Methods Report*. SJRWMD Technical Publication SJ2004-2.

SJRWMD. 2012. *Water Supply Impact Study*. SJRWMD Technical Publication SJ2012-1. Available from: www.sjrwmd.com/documents/water-supply/#wsis-final-report

SJRWMD. 2013. *Prevention/Recovery Strategy for Implementation of Minimum Flows and Levels for Volusia Blue Spring and Big, Daugharty, Helen, Hires, Indian, and Three Island Lakes.* SJRWMD, Palatka, FL. Available from: www.sjrwmd.com/static/mfls/gb1311_005.pdf

SJRWMD. 2019. *2018 Five-Year Strategy Assessment for the Implementation of Minimum Flow and Levels for Volusia Blue Spring and Big, Daugharty, Helen, Hires, Indian, and Three Island Lakes*. SJRWMD, Palatka, FL. Available from: www.sjrwmd.com/static/mfls/Volusia_5year_assessment_2019.pdf