The Need for Speed: Velocity, Algae, and Florida's Springs

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Florida Bar Environmental and Land Use Law Section Reporter, Vol. XL, No 5, June 2020

Introduction

Florida has more than 1,000 springs, one of the highest concentrations in the world.[2] These springs are a vital ecological, cultural, and economic resource. Recognizing this, in 2016 the Florida Legislature enacted the Florida Spring and Aquifer Protection Act, declaring that springs are a unique part of Florida's scenic beauty and embody immeasurable natural, recreational, economic, and inherent value.[3] The Legislature also recognized that Florida springs offer a window into the status and health of the Floridan Aquifer,[4] which supplies the majority of the State's drinking water.[5]

Unfortunately, Florida springs increasingly face anthropogenic stressors contributing to declining spring discharges and diminished water quality.[6] A 50-year retrospective evaluation of the ecological health of Silver Springs, one of Florida's most iconic springs, showed that fish populations had decreased by 92%, nitrate-nitrogen concentrations had increased by 200%, flows had decreased, water clarity had declined, great masses of filamentous algae now covered the sand and limestone bottom, and overall ecosystem productivity had declined by 27%.[7] Silver Springs in not alone. Springs across the state have experienced declines in flow attributed to decreased rainfall and increased groundwater pumping.[8] Some, such as Kissengen and White Sulfur Springs, have ceased to flow altogether, turning once popular swimming holes into dried-up sinkholes.[9]

For springs ecosystems especially, water quantity and water quality are profoundly linked. Florida's Water Resources Act and implementing regulations recognize this link through the provision requiring establishment of minimum flows and levels, or "MFLs."[10] The statute requires MFLs be established to limit further withdrawals that would be significantly harmful to the water resources or ecology of the area.[11] To implement this mandate uniformly, the Department of Environmental Protection (DEP) adopted a "super rule," the Water Resources Implementation Rule, intended to guide DEP and water management district rulemaking, including the establishment of MFLs.[12] The portion of the rule addressing MFLs sets out a series of water resource values to be protected when setting MFLs.[13] One such value is water quality,[14] explicitly linking water quantity and quality.

A key indicator of water quality in Florida's springs is the prevalence of filamentous algae. While excess nutrients have been shown to lead to excess algae and hence degraded water quality, springs science has also made the link between one key feature of water quantity crucial to algal accumulation—the velocity of the water that flows from the spring. This relationship has been acknowledged by some water management districts in the technical reports accompanying the establishment of certain MFLs, and at least one administrative law judge has found that the evidence supports the relationship, though he declined to require that it be addressed in the MFL at issue. No district has yet used velocity as a basis to establish an MFL.[15] This article describes the state of the science and applicable law regarding the relationship between velocity and algae in Florida's springs. It argues that velocity should be included as an indicator of water quality in the criteria for establishing MFLs in all flowing waters, and that this may best be achieved by incorporating it into the Water Resources Implementation Rule, to be applied uniformly for flowing waters across water management districts.

Algae Accumulation and Water Velocity

One major sign of ecological harm observed in Florida springs is the accumulation of filamentous algae, which can smother habitat occupied by other organisms and native aquatic vegetation.[16] In many of Florida's spring-fed rivers, the abundance of filamentous algae has increased over recent decades, and in some cases replaced the once-dominant aquatic rooted plant communities.[17] These nuisance algae reduce the recreational, aesthetic, and overall water quality of these resources.[18] A 50-year retrospective study of Silver Springs found that the prevalence of filamentous blue and green algae had increased from undetected to half of the overall plant biomass.[19] These changes have not gone unnoticed by long-time visitors to Florida's springs. John Moran, a renowned nature photographer, has documented the algae colonization in Florida's springs over many decades.[20] His photographs illustrate how the once crystal-clear blue waters of many springs have turned murky and clogged with green mats of algae. The growth in algae cover and decline in submerged aquatic vegetation ("SAV")—rooted, underwater plants such as native river grasses—has occurred contemporaneously with observed increases in nitrogen concentration and declines in the discharge of many springs.[21]

The increase in algae abundance in spring-fed rivers has long been attributed to increased levels of nutrients in the water, such as nitrates derived from fertilizers, manure and sewage.[22] However, long-term nitrogen enrichment does not fully explain the relatively recent increases in macroalgal abundance.[23] More recent scientific studies have shown that nitrate reduction alone is unlikely to restore the plant community structure in springs.[24] Rather, these studies have shown that the velocity of water flow[25] in springs is a significant determinant of algae growth and in general is inversely related to algal cover.[26] For example, in several Florida spring systems, filamentous algal abundance increased with lower velocities and lower spring discharge.[27] Higher water velocities act

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as a limiting factor on filamentous algal growth by inhibiting its ability to attach or cling to submerged aquatic vegetation (SAV).[28] Constant high velocities, however, are not required. Episodic high velocity can flush out existing filamentous algae that has already attached to vegetation.[29]

Most recently, modeling and analysis of algal cover, SAV cover, and velocity data sets from several Florida springs have identified critical velocities and shear stresses that predict algal and SAV prevalence.[30] This study also found that decreased velocity due to reduced spring discharge increases the abundance of SAV and algae, and that the consequent friction created by this increased biomass can exacerbate algal proliferation by sustaining lower velocity even as spring discharge recovers.[31] Although scientific debate continues over the exact cause or causes of algal proliferation in springs (and the relationships/feedbacks among causes), there is a growing consensus among springs scientists that when flow velocities are high, algal cover is low.[32] These scientific findings suggest that water quantity indicators, in this case velocity, can be just as relevant to macroalgal proliferation in Florida spring-fed rivers as water quality indicators such as excessive nutrients.[33] In light of these findings, addressing velocity in regulatory determinations would seem to be a necessary consideration in maintaining springs water quality and ecosystem health.

Minimum Flows and Levels (MFLs)

Since velocity is directly linked to, but distinct from, the stage (level) and discharge (flow) of a river, existing Florida law regulating the MFLs is well suited to implement a minimum velocity threshold. The Florida Water Resources Act of 1972 requires the establishment of MFLs by rule, stating in relevant part:

373.042: Minimum flows and minimum water levels–

(1) Within each section, or within the water management district as a whole, the department or the governing board shall establish the following:

(a) Minimum flow for all surface watercourses in the area. 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.

(b) Minimum water level. 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.

The minimum flow and minimum water level shall be calculated by the department and the governing board using the *best information available*. When appropriate, minimum flows and minimum water levels may be calculated to reflect seasonal variations. The department and the governing board *shall consider*, and at their discretion may provide for, *the protection of nonconsumptive uses* in the establishment of minimum flows and minimum water levels.[34]

Section 373.042's requirement to consider non-consumptive uses serves as a source of authority to protect instream uses. Pursuant to Section 373.042(2), Water Management Districts must have established MFLs for all Outstanding Florida Springs by July 1, 2017.[35] And under Section 373.042(3), Districts must adopt a priority list and schedule for adopting MFLs for all other springs with an existing or potential threat to spring flow from consumptive uses. MFLs must be reevaluated periodically and may be revised as needed.[36] If flows or levels of a watercourse fall below the adopted MFL, or are projected to fall below the adopted MFL within 20 years, the water management district must adopt and implement a recovery or prevention strategy for that watercourse.[37] For watercourses in "recovery," districts may still issue consumptive use permits, but "only if they meet applicable District rules, including those implementing the recovery or prevention strategy."[38]

MFLs have primarily focused on ecological resources such as fish passage, aquatic habitat and floodplain inundation.[39] However, given the documented impact of velocity on algae prevalence, MFLs for Florida springs should be adopted that prevent groundwater withdrawals from reducing velocity below the critical threshold that allows algae to thrive. Because velocity inhibits macroalgal proliferation, it can be an effective regulatory metric to protect non-consumptive uses in springs in its own right.

Water Resources Implementation Rule

The Water Resources Implementation Rule (WRIR) in Florida's Administrative Code is a fitting place to add a velocity criterion for water management districts to consider when setting MFLs for Florida springs. The intent of the WRIR is to "provide water resource implementation goals, objectives, and guidance for the development and review of programs, rules, and plans relating to water resources, based on statutory policies and directives."[40] The WRIR states a general policy to "promote of the availability of sufficient water for natural systems, and sufficient and affordable water for all existing and future reasonable-beneficial uses."[41]

The WRIR states that "MFLs should be expressed as multiple flows or levels defining a minimum hydrologic regime, to the extent practical and necessary, to establish the limit beyond which further withdrawals would be *significantly harmful to the water resources or the ecology of the area.*"[42]

In setting MFLs, the WRIR also requires the districts to consider 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."[43]

At least three of these water resource value—(a) Recreation in and on the water, (f) Aesthetic and scenic attributes, and (i) Water quality—are severely compromised by algal proliferation, and perhaps all ten values are impacted.[44] However, Districts

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have been reluctant to apply the relationship between algae proliferation and water velocity to the development of MFLs. For example, in the 2017 Rainbow River MFL report, algae proliferation is only cursorily addressed under the "water quality" resource value and is entirely absent in the discussion under the "recreation" and "aesthetic and scenic attributes" resource values.[45]

Even when addressed in MFL reports, most Districts do not connect algae proliferation to fluctuations in water flow or velocity. For example, in the Rainbow River MFL report, an increase in nitrogen is hypothesized to be the primary source of the imbalance of algae and is implicated as the cause of impairment.[46] In discussing the water quality resource value, the 2017 Silver River MFL report states that "recent research suggests there is little evidence that variations in spring flow rates will demonstrably affect spring water quality."[47] In discussing the aesthetic and scenic attributes resource value, the Silver River MFL report does not address algae proliferation while concluding that reduced flow contributes positively to aesthetic values because water clarity increases with *lower* flows due to less tannic inflow from the floodplain.[48] Outside of the discussion of water resource values, the Silver River MFL report does discuss the velocity/algae link, but concludes that the anticipated reduction in flows under the rule would not appreciably impact in-stream velocities.[49] This conclusion was reached despite data showing that velocity in the Silver River exceeded the 0.25 m/s threshold necessary for limiting algae growth only 20% of the time after year 2000, as compared to 70% of the time prior to 2000.[50] In spite of a growing consensus among scientists who study springs hydrology and hydrodynamics, most springs' MFL reports do not adequately address, if at all, the relationship between velocity and algae.[51] Even assuming more study is appropriate, districts should systematically address this relationship in MFL reports for springs so that MFLs can be promptly revised as further research develops.

In fact, in response to the emergent research demonstrating that velocity plays a significant role in algal cover, the Peer Review of the Recommended Flow for the Rainbow River System concluded that it was, "surprising to see consideration of this algal proliferation issue [velocity-algae relationship] not mentioned. Given that the link with discharge is direct, it warrants explicit mention in the report."[52] The SWFWMD addressed the velocity issue in their Revised Final MFL Draft for the Rainbow River by including the following paragraph:

> Flow strongly influences algae communities in rivers and streams (Biggs 1996, Stevenson 1996). Filamentous algae may be particularly responsive to higher flows because larger algae experience increased drag (Biggs et al. 1998). In several Florida spring systems, filamentous algal abundance increased with lower flow velocities and spring discharge (Hoyer et al. 2004, King 2014). Preliminary work by Cohen et al. (2015) found that flow velocity was inversely related to algal cover in the Rainbow River. The District will continue to evaluate the relationship between hydrology and filamentous algae for the Rainbow River System during the reevaluation period.[53]

Acknowledging that the science on issues related to algae in springs is evolving, the Rainbow River MFL Peer Review Panel recommended employing a precautionary approach as the causal relationships become more certain.[54] In light of the lack of key data on the relationship between nutrient loading and flows, for example, the Panel recommended capping consumptive use withdrawals at current levels due to its perception that the Rainbow River system "is substantially overused to the point that any reduction in flow could impact water quality and should be of concern."[55] Thus, even as research continues to develop the velocity/algae link, a precautionary approach should be employed in the interim given the science that already exists.

Rainbow River MFL Rule Challenge

On May 14, 2019, Rainbow River Conservation, Inc. filed a petition to invalidate the Southwest Florida Water Management District (SWFWMD) Proposed Rainbow River MFL Rule.[56] The petitioners challenged the rule as an "invalid exercise of delegated legislative authority" based on the following:

i. The rule enlarges, modifies, or contravenes the specific provisions of law implemented.

ii. The rule is vague, fails to establish adequate standards for agency decisions, or vests unbridled discretion in the agency.

iii. The rule is arbitrary or capricious. A rule is arbitrary if it is not supported by logic or the necessary facts. A rule is capricious if it is adopted without thought or reason or is irrational.57

Among other claims, Petitioners alleged that the proposed rule's failure to consider the relationship between algae and velocity before setting the MFL was arbitrary and not supported by necessary facts, and that the proposed rule contravened section 373.042 of the *Florida Statutes* which requires the SWFWMD to give significant weight to the Peer Review's concerns about the ecological impact of filamentous algae.[58] After a three-day hearing, the presiding administrative law judge issued a final order granting the petition in part, and denying in part.[59] While the judge's order did not invalidate the Proposed Rule for its failure to consider velocity, the Judge did hold that "a preponderance of the evidence established that a relationship between algal accumulation and flow velocity exists."[60] The judge found that while SWFWMD is required to use the best information available when establishing the MFL, he agreed with SWFWMD that "the existing information regarding the relationship between algal accumulation and water velocity is not sufficient to enable the District to incorporate any such criteria into the development of an MFL."[61]

Another issue addressed in this case was whether SWFWMD failed to adequately address the "water resource" values pursuant to the Water Resource Implementation Rule because it failed to consider the impact of algal accumulation and its relationship to velocity.[62] While

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finding that the SWFWMD's decision to not address the impact of algal accumulation and its relationship to water velocity before adoption of the proposed rule was not arbitrary, the judge noted in a footnote that a rule challenge proceeding is not the proper forum to determine whether a proposed rule is consistent with the Water Resource Implementation Rule, and that such a determination is within the exclusive jurisdiction of DEP.[63] The footnote refers to section 373.114(2) of the Florida Statutes which vests DEP with the exclusive authority to review rules of Water Management Districts to ensure consistency with the WRIR. Any affected person may request a hearing with DEP within 30 days after adoption of a rule to address the consistency of a proposed rule with the WRIR.[64] If the department determines that the rule is inconsistent with the WRIR, it may order the Water Management District to initiate rulemaking proceedings to amend or repeal the rule.[65] While a DEP ruling that an MFL rule is consistent with the WRIR may be subject to judicial review as a final agency action under the Florida Administrative Procedure Act, such a challenge would appear to go to an appellate court.[66] Thus, any challenge to an MFL rule that contained elements both relevant to a consistency challenge under the WRIR and those that would be under the jurisdiction of an administrative law judge would have to be adjudicated in separate venues – despite their interrelationships. This presents a challenge when considering how best to incorporate velocity criteria in MFL rulemaking such that any failure to consider velocity can be adequately and efficiently challenged in a single administrative forum.

Potential for Rulemaking to Incorporate Velocity into the WRIR

Challenges to water management districts' MFL rules based on their failure to adequately protect Florida springs have routinely failed.[67] This may be due more to the deference that courts and administrative tribunals accord to administrative agency decisions rather than to any lack of legitimacy in the rule challengers' claims. For example, in the Rainbow River MFL challenge, the Petitioners challenged the period of historical record of flows and levels applied by SWFWMD when setting the MFL for Rainbow River.[68] The judge found that "while the positions of both parties as to the appropriate period of record have merit, the issue in this proceeding is not whether one position is more meritorious than the other but whether the District's determination of what period would provide the 'best' information was arbitrary and

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capricious."[69] The judge's finding that the SWFWMD's determination was not arbitrary or capricious illustrates judicial reluctance to decide between the merits of opposing experts' scientific claims.

As the judge noted in his final order, water management districts are required to use the best information available when setting MFLs.[70] As discussed in this article, the best information available today suggests a strong link between velocity and algal accumulation. While more research can and should be conducted, this should not delay districts from incorporating velocity criteria into their MFL rules.

One rule that could easily accommodate velocity, and require it to be considered by all Districts, is the Water Resource Implementation Rule.[71] A velocity criterion could be added as a new "water resource value" in subsection (1) of the MFLs section of the rule which would require Water Management Districts to "consider" velocity when establishing MFLs for flowing surface waters.[72] As noted above, however, according to two recent ALJ rulings, an affected party wishing to challenge an MFL rule based on its inconsistency with the WRIR would have to request a hearing with the DEP outside of the normal Chapter 120 rule challenge procedures.

Conclusion – The Need for Speed is Now

As scientific understanding of springs ecology increases, so does the obligation of regulatory authorities to incorporate these advances to best protect these ecosystems. Ongoing research continually refines the inextricable relationship between water quantity and quality issues affecting Florida springs. Probably the most obvious and visible manifestation of ecological harm to springs is filamentous algae. While nitrate pollution has received the most attention, multiple factors likely contribute to algal proliferation in spring. The velocity of water that flows from the spring is now recognized as a significant factor in determining algae establishment, survival, and growth. Despite these advances in our understanding, velocity has yet to be significantly addressed in springs MFLs or in regulation of water withdrawals in general. The determination of flows and levels for MFLs should guarantee that velocity thresholds are periodically met in order to prevent

Endnotes

1 Shannon Boylan is a third-year law student at the University of Florida Levin College of Law and a Student Associate in the College's Conservation Clinic. Daniel Ward is a 2018 graduate of the University of Florida Levin College of Law and was a Student Associate in the Conservation Clinic. Thomas T. Ankersen is a Legal Skills Professor at the University of Florida Levin College of Law and directs the Conservation Clinic.

2 New springs are being discovered all the time. The Florida Geologic Survey maintains the State's official count. See https://ca.dep.state.fl.us/mapdirect/?webmap=07f160c92ea94770ae3a892539e61a83.

3 Fla. Stat. §373.801(1).

4 University of Florida Water Institute, Collaborative Research Initiative on Sustainability and Protection of Springs, CRISPS Final Report 1-2 (2017), https://www.sjrwatermanagement districts.com/static/waterways/springs-science/CRISPS_Final_Report-All_Sections.pdf [hereinafter "CRISPS Final Report"].

5 See generally, U.S. Geological Survey, Floridan Aquifer System Groundwater Availability Study, https://fl.water.usgs.gov/floridan/intro.html.

6 CRISPS Final Report, supra note 4, at 1-2.

7 Robert L. Knight, Silenced Springs xxi (2015).

8 Sean A. King, Hydrodynamic control of filamentous macroalgae in a sub-tropical spring-fed river in Florida, USA, 734 Hydrobiologia 27, 35 (2014).

9 Knight, supra note 7, at 38–41.

10 Fla. Stat. §373.042(1).

11 Id.

12 Fla. Admin. Code R. 62-40.

13 Fla. Admin. Code R. 62-40.473(1)(i).

14 Id.

15 Rainbow River Conservation Inc. v. Sw. Fla. Water Mgmt. Dist., Case No. 19-2517RP 37–38 (DOAH Jan. 31, 2020); see also St. Johns Riverkeeper v. St Johns River Water Mgmt. Dist., Case No. 17-2543RE 34 (DOAH May 24, 2017) (challenge to Silver River MFL Rule where judge found critical velocities related to algae scour were considered).

16 R. Jan Stevenson, et al., Ecological Condition of Algae and Nutrients in Florida Springs: The Synthesis Report 7 (2007).

17 Nathan G. F. Reaver, Linking Landscape Hydrologic Processes to Spring Ecosystem Dynamics 17 (2018) (unpublished Ph.D. dissertation, University of Florida) (on file with the University of Florida George A. Smathers Libraries); King, Hydrodynamic control, supra note 8, at 27.

18 Stevenson, supra note 16, at 8.

19 Knight, supra note 7, at 45.

20 John Moran, John Moran Press Photos, Florida Springs Council, https://www.floridaspringscouncil.org/john-moran-press-photos (depicting the declining quality of several Florida springs).

21 Reaver, Linking Landscape, supra note 17, at 17.

22 Sean A. King, Effects of Flow on Filamentous Algae and Nutrient Limitation in Lotic Systems 13 (2012) (Ph.D. dissertation, University of Florida) (on file with the University of Florida George A Smathers Libraries).

23 King, Hydrodynamic control, supra note 8, at 37 (For example, in Gum Slough Springs, nitrate concentrations reached saturation levels 40 years ago, whereas macroalgal proliferation has only been observed over the past decade).

24 CRISPS Final Report, supra note 4, at ES-4.

25 Water velocity and flow rate are correlated. Higher flows will yield higher velocities, but the two metrics are distinct. Flow measures the volume of water moving per unit time (e.g., cubic feet per second) whereas velocity measures the distance the water moves per unit time (e.g. feet per second). Treating them synonymously may confuse the matter. See, e.g., Southwest Florida Water Management District, Proposed Minimum Flows and Levels for the Gum Slough Spring Run Final Report 16 (2011), https://www.swfwmd.state.fl.us/sites/default/files/documents-and-reports/reports/Original-Gum_MFL_Report_0.pdf (stating that the term "flow" may most legitimately equate to water velocity).

26 See, e.g., CRISPS Final Report, supra note 4; King, Effects of Flow, supra note 22; Nathan G. F. Reaver, et al., Hydrodynamic Controls on Primary Producer Communities in Spring-Fed Rivers, 46 Geophysical Research Letters 4715 (2019).

27 See King, Hydrodynamic control, supra note 8, at 31; Mark Hoyer, et al., Vegetative characteristics of three low-lying Florida coastal rivers in relation to flow, light, salinity and nutrients, 528 Hydrobiologia 31 (2004).

28 Miki Hondzo & Hong Wang, Effects of turbulence on growth and metabolism of periphyton in a laboratory flume, 38 Water Resources Research 1277 (2002) (A laboratory study on filamentous algae growth concluded that the only algae growth-limiting factor was the effect of fluid motion, and other environmental factors, such as light, temperature, and nutrients were not growth-limiting.).

29 CRISPS Final Report, supra note 4, at 7-79 ("higher velocities can limit algal biomass by creating sheer stress on algal communities that scours algal biomass"); King, Hydrodynamic control, supra note 8, at 35 (velocity may have to exceed a certain threshold for a period of weeks to months before drag and shear forces result in a reduction in algal abundance).

30 Several springs ecosystems were found to have an overall mean algae-inhibiting velocity threshold of approximately 0.215 m/s, a value also indicated by earlier studies. See CRISPS Final Report, supra note 4, at 5-3.

31 Id.

32 Generally, springs water quality decline has been chiefly attributed to an increase

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in nitrates, a documented decrease in water transparency, and a concomitant increase in attached algae. Other factors such as light, oxygen, and the prevalence of algae foragers such as snails are also linked to algae abundance. See generally, CRISPS Final Report, supra note 4.

33 See King, Hydrodynamic control, supra note 8, at 35.

34 Fla. Stat. §373.042(1) (emphasis added).

35 Northwest Florida Water Management District has until July 1, 2026.

36 Fla. Stat. §373.0421(5).

37 Fla. Stat. §373.0421(2).

38 Fla. Admin. Code R. 62-40.473(8).

39 See generally Clifford P. Neubauer et al., Minimum Flows and Levels Method of the St. Johns River Water Management District, Florida, USA, 42 Envtl. Mgmt. 1101 (2008).

40 Fla. Admin. Code R. 62-40.110(2).

41 Fla. Admin. Code R. 62-40.310(1)(a).

42 Fla. Admin. Code R. 62-40.473 (emphasis added); see generally Kathryn Slattery, et al., Where's the Harm in This? Defining "Harmful to the Water Resources" in the 2016 Outstanding Florida Springs Legislation, ELULS Reporter, April 2019, at 1.

43 Fla. Admin. Code R. 62-40.473 (emphasis adde).

44 See Petitioners' Proposed Final Order, Rainbow River Conservation, Inc. V. Sw. Fla. Water Mgmt. Dist., DOAH Case No. 19-002517, filed Sep. 18, 2019, at 20, available at https://www.doah.state.fl.us/DocDoc/2019/002517/19002517_237_09182019_16302422_e.pdf (District expert testimony that all water resource values could be affected by algal proliferation).

45 Southwest Florida Water Management District, Recommended Minimum Flow for the Rainbow River System Revised Final Draft 70–73 (2017), https://www.swfwmd.state.fl.us/sites/default/files/documents-and-reports/reports/Rainbow_MFL-Revised_Final_Draft.pdf [hereinafter "Recommended MFL for Rainbow River"].

46 Id. at 64.

47 Andrew B. Sutherland, et al., Bureau of Resource Evaluation and Modeling, St. Johns River Water Management District, Minimum Flows Determination for Silver Springs, Marion County, Florida 109 (2017).

48 Id. at Appendix E 5-50.

49 Id. at 104.

50 Id. at 100.

51 The authors reviewed all published District MFL reports for flowing waterbodies to determine whether the link between algae and velocity was addressed.

52 Matt Cohen, et al., Peer Review of the Recommended Minimum Flow for the Rainbow River System (Nov. 21, 2016), https://www.swfwmd.state.fl.us/sites/default/files/documents-and-reports/reviews/Rainbow_Peer_Rev_Rpt_2016.pdf.districts.state.fl.us/projects/mfl/reports/Rainbow_Peer_Rev_Rpt_2016.pdf.

53 Recommended MFL for Rainbow River, supra note 45, at 64.

54 Cohen, supra note 52, at 3.

55 Id.

56 Petition to Invalidate Proposed Rule 40d-8.041(22) of the Southwest Florida Water Management District, Rainbow River Conservation, Inc. V. Sw. Fla. Water Mgmt. Dist., DOAH Case No. 19-002517, filed May 14, 2019, available at https://www.doah.state.fl.us/DocDoc/2019/002517/19002517PFAH-051419-16261826.pdf.

57 Fla. Stat. §120.52(2), (8).

58 Amended Petition to Invalidate Proposed Rule 40d-8.041(22) of the Southwest Florida Water Management District, Rainbow River Conservation, Inc. V. Sw. Fla. Water Mgmt. Dist., DOAH Case No. 19-002517, filed May 20, 2019, at 10, available at https://www.doah.state.fl.us/DocDoc/2019/002517/19002517_237_05202019_16233940_e.pdf.

59 Rainbow River Conservation Inc. v. Sw. Fla. Water Mgmt. Dist., Case No. 19-2517RP (DOAH Jan. 31, 2020).

60 Id. at 37.

61 Id. at 38; Michael Voss, The Central and Southern Florida Project Comprehensive Review Study: Restoring the Everglades, 27 Ecology L.Q. 751, 766 (2000) (using the "best information available" approach, agencies gather sufficient data about a proposed action to make a decision with a reasonable amount of certainty).

62 Rainbow River Conservation Inc., Case No. 19-2517RP at 35–36.

63 Rainbow River Conservation Inc., Case No. 19-2517RP at 65, fn. 13.

64 Fla. Stat. §373.114(2).

65 Fla. Stat. §373.114(2)(a).

66 See Fla. Stat. §120.68. Where the DEP finds a rule to be inconsistent with the WRIR and orders the repeal or amendment of the rule, a separate procedure exists for water management districts or other parties to appeal the ruling to the Land and Water Adjudicatory Commission. Fla. Stat. §373.114(2)(c).

67 For example, challenges to the MFL Rules for Rainbow River, Silver Springs, and the Sante Fe/Ichetucknee River have all failed.

68 Rainbow River Conservation Inc., Case No. 19-2517RP, at 28.

69 Rainbow River Conservation Inc., Case No. 19-2517RP, at 34.

70 Fla. Stat. §373.042(1).

71 Fla. Admin. Code R. 62-40.473(8).

72 Springs, including Outstanding Florida Springs, are found in 4 out of 5 water management districts, however velocity may be relevant to other flowing waterbodies as well.