UNINTENDED CONSEQUENCES: NUMERIC NUTRIENT CRITERIA WILL CONSTRAIN REUSE OPPORTUNITIES

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Introduction

Florida is comprised of a diversity of landscapes each with its own natural beauty. From the dry Lake Wales ridge to the wet prarie fringing the Kissimmee River floodplain to the deep Shark River Slough to the Vallisneria beds in the Caloosahatchee River to the coral reefs off the Florida Keys, these landscapes often are differentiated based on the quantity and quality of water available to them. Clearly, water is a precious commodity – even in a state like Florida, which receives abundant rainfall. As citizens and stewards, it is our responsibility to safeguard the health of our natural ecosystems.

For more than twenty years, utilities and natural resource managers have understood the value of using reclaimed water to offset demands on our limited freshwater resources and as a means to augment freshwater supplies. However, the promulgation of numeric nutrient criteria by the EPA appears to threaten the future opportunities to beneficially reuse reclaimed water throughout Florida. In particular, it appears that treating reclaimed water to meet numeric nutrient criteria will be excessively costly in terms of cash, energy, and greenhouse gas production. Below, we outline how we got here, we provide quantitative examples of reclaimed water quality from one reclaimed water purveyor located in southeastern Florida, and we provide recommendations regarding EPA's treatment of reclaimed water under their numeric nutrient criteria rule.

Florida's Environmental Stewardship Efforts

The State of Florida has been a leader in water quality control. The Florida Department of Environmental Protection ("DEP") is charged with assessing water quality and developing methods to improve water quality standards. Over the past 20 years the DEP has spent over $20 million collecting and analyzing data on the relationship between chlorophyll *a*, phosphorus, nitrogen, and nitrate-nitrite. Through its total maximum daily load ("TMDL") program, the DEP has identified impaired waters (waters that do not meet applicable water quality standards) and imposed any combination of regulatory, non-regulatory, or incentive-based actions that attain the necessary reduction in pollutant loading.

Additionally, Florida currently uses a narrative nutrient standard for management and protection of its waters. Chapter 62-302.530, Florida Administrative Code (FAC), states that "in no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of flora or fauna." This rule further provides that (for all waters of the state) "the discharge of nutrients shall continue to be limited as needed to prevent violations of other standards contained in this chapter" [Chapter 62-302, FAC]. Such anthropogenic eutrophication is considered degradation within FAC Sections 62-302.300, 62-302.700, and 62-4.242, F.A.C. In essence, the spirit of Florida's narrative rule is to maintain the 'ecological integrity' of Florida's waters (*sensu* Karr 1992).

DEP has relied on this narrative nutrient standard for many years because nutrients are unlike any other "pollutant" regulated by the federal Clean Water Act. Most water quality criteria are based on a toxicity threshold, evidenced by a dose-response relationship, where higher concentrations can be demonstrated to be harmful, and acceptable concentrations can be established at a level below which adverse responses are elicited (usually in laboratory toxicity tests). In contrast, nutrients are not only present naturally in aquatic systems, they are critical for the proper functioning of biological communities, and are often moderated in their expression by many natural factors.

Through the DEP, the Department of Agriculture and Consumer Services ("DACS") and its water management districts, Florida has established robust standards and enacted programs to support water quality. In many ways it leads the nation. And for a number of years, the DEP has been working with a Technical Advisory Committee, comprised of water quality experts from many stakeholder groups, on the establishment of numeric nutrient criteria. The complexity of this science-based, data-driven undertaking is proportional to the diversity of Florida's geology and water resources. It is further complicated because of the lack of understanding of the mechanisms linking eutrophication and imbalances in fish and plant communities. Finally, this process is further confounded by a plethora of other chemical and biological factors that may affect or impair the health of an ecosystem.

DEP staff have spent countless hours researching the different nutrient demands in Florida's thousands of waterways. In 1998 EPA acknowledged the difficulty in establishing numeric standards for nutrients with the publication of the National Strategy for the Development of Regional Nutrient Criteria. Nonetheless, through the diligent efforts of DEP's Technical Advisory Committee, DEP produced a Numeric Nutrient Criteria Plan in September 2007 that outlined its approach for developing numeric nutrient criteria throughout the state. This plan was submitted to and generally agreed upon by the EPA.

Nonetheless, on January 14, 2009, the EPA proffered a determination under Section 303(c)(4)(b) that new or revised water quality standards in the form of numeric nutrient water quality criteria were necessary to meet the requirements of the Clean Water Act in the State of Florida (EPA, 2010). In reaching this determination, the EPA found that Florida's reliance on a case-by-case, site-specific data interpretation of its narrative nutrient criterion was insufficient to ensure protection of applicable designated uses in Florida's waters. Unfortunately, it appears that EPA has discounted the value of Florida's water quality protection program, which is multi-faceted and ensures the protection of water bodies through programs such as TMDL program, a bioassessment program, designation of Outstanding Florida Waters, BMAPs and comprehensive NPDES permit regulations.

Resulting from a 2008 lawsuit brought by the Florida Wildlife Federation seeking to require EPA to promulgate numeric nutrient water quality standards (WQS) for Florida waters, in January 2009, EPA issued a determination letter to the Florida DEP requiring that it meet a strict deadline for adopting such standards (January 2010 for lakes, streams and Class III waters; January 2011 for coastal waters) or else the EPA would step in and establish federal criteria for the state. Because the DEP did not feel it could establish scientifically supported criteria within the time frames proposed by the court, it discontinued its rulemaking effort and the EPA stepped in.

EPA's Numeric Nutrient Criteria for Florida

On January 14, 2010, EPA Administrator Lisa Jackson signed a draft rule proposing numeric nutrient water quality criteria to protect aquatic life in lakes and flowing waters, including canals, within the State of Florida (hereafter referred to as the "Proposed Rule")(EPA, 2009). The Proposed Rule applies to inland surface waters that have been classified as Class I or Class III water bodies pursuant to Rule 62-302.400, F.A.C. that are predominantly fresh waters (i.e., chloride concentration <1,500 mg/L) – wetlands excluded. These waterbodies include the following four water body types: lakes, streams, springs and clear streams, and canals in South Florida. The Proposed Rule specifically defines each of these water body types. Lake means a freshwater body that is not a stream or other watercourse with some open contiguous water free from emergent vegetation. Stream means a free-flowing, predominantly fresh surface water in a defined channel, and includes rivers, creeks, branches, canals (outside south Florida), freshwater sloughs, and other similar water bodies. Spring means the point where underground water emerges onto the Earth's surface, including its spring run. Spring run means a free-flowing water that originates from a spring or spring group whose primary (>50%) source of water is from a spring or spring group. Clear stream means a free-flowing water whose color is less than 40 platinum cobalt units (PCU, which is assessed as true color free from turbidity). Consistent with Rule 62-312.020, F.A.C., "canal" means a trench, the bottom of which is normally covered by water with the upper edges of its two sides normally above water.

<u>Proposed Numeric Nutrient Criteria for Lakes</u>

In the Proposed Rule, the EPA defines lake as a freshwater body that is not a steam or other watercourse with some open contiguous water free from emergent vegetation (EPA, 2010). This definition differs from current DEP definition, which defines lakes as two acres of open water. By failing to include a minimum size for the open contiguous water, the EPA definition does not allow for distinguishing a lake from a wetland, which would result in inappropriately applying lake criteria to wetland systems. Failure to include a minimum size may also result in stormwater or reuse ponds being classified as lake.

Under the Proposed Rule, the numeric nutrient criteria for lakes apply statewide, without regard to differing underlying geology. EPA assessed the regionalization of numeric nutrient criteria for lakes and determined that regionalization was unnecessary and that classification based on color and alkalinity was sufficient. This was based on a qualitative assessment that the relationships between nutrients and chlorophyll were similar among regions. However, like streams and other waters, lakes are influenced by the surrounding geology. It is unclear why the EPA elected to propose state-wide nutrient criteria for lakes rather than region-wide criteria as with streams, especially considering that the EPA identified 47 lake ecoregions in the State of Florida in the 1997 (Griffith et al., 1997).

EPA defined numeric nutrient criteria for Florida's lakes based upon color and alkalinity, because available data showed that lake color and alkalinity appear to affect how total nitrogen (TN) and total phosphorus (TP) concentrations drive chlorophyll *a* concentrations. The Proposed Rule includes two color classifications, clear and colored. Clear lakes are further classified as clear alkaline lakes, which have relatively high alkalinity, and clear acidic lakes, which have relatively low alkalinity values.

Table 1. Numeric nutrient criteria and geochemical classifications for Florida's Class I or III lakes as defined by EPA's Proposed Rule (EPA, 2009).

Long-Term Average Lake Color and Alkalinity	Chlorophyll *a*[1] (µg/L)	Baseline Criteria[2]		Modified Criteria[3] (within these bounds)	
		TP (mg/L)	TN (mg/L)	TP (mg/L)	TN (mg/L)
Colored Lakes > 40 PCU	20	0.050	1.23	0.050-0.157	1.23-2.25
Clear Lakes, Alkaline ≤ 40 PCU and > 50 mg/L $CaCO_3$	20	0.030	1.00	0.030-0.087	1.00-1.81
Clear Lakes, Acidic ≤ 40 PCU and ≤ 50 mg/L $CaCO_3$	6	0.010	0.500	0.010-0.030	0.500-0.900

[1] Throughout EPA (2010) concentration values are based on annual geometric mean values not to be surpassed more than once in a three-year period. In addition, long-term average of annual geometric mean values shall not surpass the listed concentration values. (Duration = annual; Frequency = not to be surpassed more than once in a three-year period or as a long-term average).

[2] Baseline criteria apply unless data are readily available to calculate and apply lake-specific, modified criteria as described by the EPA (EPA, 2009) and the Florida Department of Environmental Protection issues a determination that a lake-specific modified criterion is the applicable criterion for an individual lake. Any such determination must be made consistent with the provisions set forth by the EPA (EPA, 2009). Such determination must also be documented in an easily accessible and publicly available location, such as an official State Web site.

[3] If chlorophyll *a* is below the criterion and there are representative data to calculate ambient-based, lake-specific, modified TN and TP criteria, then FDEP may calculate such criteria within these bounds from ambient measurements to determine lake-specific, modified criteria pursuant to CWA section 303(c).

Proposed Numeric Nutrient Criteria for Rivers and Streams

The Proposed Rule includes both instream protection values and downstream protection values. Although the DEP spent years developing numeric nutrient criteria for Florida's rivers and streams, the EPA rejects the DEP's biological response approach and criteria. For instream values, EPA found that relationships between nutrients and biological response parameters in rivers and streams were affected by many factors that made derivation of a quantitative relationship between chlorophyll *a* levels and nutrients in streams and rivers difficult to establish in the same manner as EPA did for lakes. Thus, EPA used an alternative methodology that evaluated a combination of biological information and data on the distribution of nutrients in a substantial number of healthy stream systems. The EPA determined that reliance on a statistical distribution methodology was a stronger and a more sound approach for deriving TN and TP instream criteria in streams and rivers.

Interestingly, unlike with the lake criteria, the EPA recognized, to a degree, the impacts of underlying geology on the TN and TP levels in rivers and streams across the state. As a result, the Proposed Rule contains instream criteria levels for TN and TP in four geographically distinct watershed regions: Panhandle, North Central, Peninsula, and Bone Valley. The EPA also recognized an additional nutrient watershed region south of Lake Okeechobee, the South Florida Canals region. However, because canals, rather than natural streams and rivers, are present in this region, the nutrient criteria for the South Florida Region is addressed separately in the section entitled South Florida Canals.

Table 2. Instream protection value nutrient criteria for each of the four river and stream nutrient and watershed regions as defined by EPA's Proposed Rule.

Nutrient Watershed Regions	Instream Protection Value (IPV) Criteria	
	TN (mg/L)[1]	TP (mg/L)[1]
Panhandle	0.824	0.043
Bone Valley	1.798	0.739
Peninsula	1.205	0.107
North Central	1.479	0.359

[1] See footnote 1 under Table 1.

Proposed Numeric Nutrient Criteria for Springs and Clear Streams

The TN and TP criteria discussed above for rivers and streams also apply to springs and clear streams. In addition, Class I or Class III springs and clear streams (<40 PCU) must also meet the nitrate (NO3) + nitrite criteria (NO2) contained in the Proposed Rule. The EPA determined nitrate-nitrite concentrations had a significant relationship to nuisance algae and periphyton. As such, the Proposed Rule provides:

> Nitrate (NO3) + Nitrite (NO2) shall not surpass a concentration of 0.35 mg/L as an annual geometric mean more than once in a three-year period, nor surpassed as a long term average of annual geometric mean values.

Proposed Numeric Nutrient Criteria for South Florida Canals

As previously discussed, the Proposed Rule distinguishes South Florida Canals from the four other nutrient watershed regions. Although the canal definition applies to artificial waterways created by man for water supply and flood control purposes, the EPA used a reference site approach along with a statistical distribution approach similar to its approach for rivers and streams. The EPA's reference approach is questionable because it is impossible to determine which canals are "reference" canals because canals are not natural systems. Additionally, although the canal definition could apply to water bodies outside the South Florida region, canal nutrient criteria in the Proposed Rule apply only for "South Florida" which corresponds to the EPA "South Florida Coastal Plan Ecoregion" (Griffith et al, 1994).

Table 3. Numeric nutrient criteria for South Florida canals, classified as Class III waters under Rule 62-302.400 F.A.C., as defined by EPA's Proposed Rule.

	Chlorophyll *a* (µg/L)[1]	Total Phosphorus (TP) (mg/L)[1]	Total Nitrogen (TN) (mg/L)[1]
South Florida Canals	4.0	0.042	1.6

[1] See footnote 1 under Table 1.

The reference approach is based on four canal subregions which the EPA determined best represent the necessary criteria to protect the water bodies. The four subregions are:

- Everglades Agricultural Area (EAA)
- Everglades Protection Area (EvPA)
- East – assumed to include all land east of EAA/EvPA within the South Florida Ecoregion
- West – assumed to include all land west of EAA/EvPA within the South Florida Ecoregion

Importantly, the numeric nutrient criteria in the Proposed Rule would not apply for TP in canals within the Everglades Protection Area (EvPA) since there is an existing TP criterion of 0.010 mg/L that currently applies to the marshes and adjacent canals within the EvPA (Rule 62-302.540, F.A.C.).

Water Quality Standards

Separate from and in addition to proposing numeric nutrient criteria, EPA is also proposing a new water quality standard ("WQS") regulatory tool for Florida, referred to as "restoration WQS" for impaired waters. A restoration WQS would be a WQS that Florida could adopt for an impaired water. This tool will enable Florida to set incremental water quality targets for specific pollutant parameters while at the same time retaining protective criteria for all other parameters to meet the full aquatic life use. Under EPA's proposal, the State would retain the current designated use as the ultimate designated use. However, under the restoration standard approach, the State would adopt interim less stringent designated uses and criteria that would be the basis for enforceable permit requirements and other control strategies during the prescribed timeframes. These interim uses and criteria, as well as the timeframe, are based on a UAA evaluation of what is attainable.

SSACs

EPA included a proposed approach for deriving Federal site-specific alternative criteria (SSAC) based upon state submissions of scientifically defensible recalculations that meet the requirements of CWA section 303(c). Florida's regulations currently do not allow use of Type II procedures for nutrient criteria development because the State currently does not have broadly applicable numeric nutrient criteria for State waters. EPA is proposing a procedure whereby the State could develop a SSAC and submit the SSAC to EPA with supporting documentation for EPA's consideration. The SSAC could be developed either under the State SSAC procedures or the EPA technical processes. In applying for and reviewing a SSAC request, the EPA provides it will be important to examine a stream system on a watershed basis to ensure that a SSAC established for one segment does not result in adverse effects in nearby segments.

What is the State of Reuse in Florida?

While Florida is surrounded by water and receives abundant rainfall, reuse of reclaimed water is a critical means by which Floridians meet their freshwater needs. Water reuse is pervasive throughout the state, being promoted in Florida Statutes and listed as a formal state objective. Reclaimed water receives such attention because it offers an opportunity to both conserve *and* augment our finite freshwater resources. Progressive policy directives and proactive efforts by local governments, regulators, and wastewater utilities have resulted in Florida being the national leader in reuse of reclaimed water. Nearly 500 domestic wastewater treatment facilities provide approximately 667 million gallons per day (mgd) of reclaimed water for beneficial reuse as of 2008 – the most recent annual report available (FDEP 2010). In 2008, 55 % of Florida's reclaimed water was used to irrigate more than 260,456 residences, 477 golf courses, 805 parks, and 285 schools.

Florida's beneficial reuse of reclaimed water is based on a progressive policy that desires to avoid disposal of treated wastewater and increase the efficient and effective reuse of reclaimed water (RCC 2003). The 243 billion gallons of reclaimed water used in 2008 is estimated to have offset the use of over 125 billion gallons of potable water and added 79 billion gallons of water back into available water supplies. Furthermore, efforts are underway to expand reclaimed water supplies in Florida (Stanley et al., 2009). Clearly, reuse of reclaimed water is a valuable and effective tool in the management, conservation, and preservation of Florida's water resources.

Assessing LRD's Effective Reuse Program

The Loxahatchee River District (LRD), located on the southeast coast of Florida in northern Palm Beach and southern Martin Counties, was founded in 1971 as a special district of the state of Florida to preserve and protect the Loxahatchee River. In fulfilling this mission, LRD operates a regional wastewater treatment plant with a permitted capacity of 11 MGD; presently flows are roughly 7 MGD. The wastewater treatment plant employs secondary treatment with advanced filtration and high level disinfection, which results in high quality effluent suitable for public access landscape irrigation. In general, treated wastewater is stored onsite in 50 acres of storage lakes. When necessary, a deep injection well is available as a disposal option; however, since 1983 LRD has operated an efficient reuse program recycling the majority of our treated wastewater for landscape irrigation.

The LRD is proud that our efficient and effective reuse program has resulted in more than 33 billion gallons of reclaimed water being recycled. LRD's reuse program has both offset a significant amount of demand on natural freshwaters in the Loxahatchee River watershed and added meaningful quantities back into the local hydrologic cycle. Consequently, our reuse program has alleviated, to some degree, saltwater intrusion – the largest threat affecting the Northwest Fork of the Loxahatchee River, which was designated as a national wild and scenic river in 1985.

Presently, the LRD has four permitted discharge points for reclaimed water: (1) an 18 MGD underground injection well that is primarily used during wet weather when storage is not available in the reuse system, (2) a 13 MGD emergency discharge outfall to the Southwest Fork of the Loxahatchee River (note this discharge point has never been used in an actual emergency), (3) a stormwater discharge structure providing intermittent discharge of blended groundwater, stormwater, and reclaimed water that ultimately flows to Class III (brackish) waters of the Intra-Coastal Waterway, and (4) a stormwater discharge structure providing intermittent discharge of blended groundwater, stormwater, and reclaimed water that flows to Class I (fresh) waters of the C-18 canal and potentially to the Northwest Fork of the Loxahatchee River.

Previously, Arrington and Dent (2008) demonstrated that LRD's reclaimed water continually meets and exceeds both reclaimed water standards and permitted groundwater compliance limits. Furthermore, analysis of 20 years of groundwater quality revealed no long-term or system-wide negative effects of landscape irrigation with LRD's reclaimed water (Arrington and Dent, 2008). Similarly, the ten years of surface water quality data, shown as annual geometric means, presented below (Figure 1) show reclaimed water quality leaving the treatment facility met our permit conditions but continuously exceeded EPA's proposed numeric nutrient criteria for streams in the Peninsula Region for both nitrogen and phosphorus (1.205 mg/L and 0.107 mg/L, respectively). There is a clear and consistent decline in total nitrogen concentration as you move from wastewater treatment plant effluent to LRD's onsite storage lakes, to the off-site (golf course) storage lakes, and then on to the downstream canal. More surprising, total phosphorus concentrations actually peak at the off-site (golf course) storage lake and then experience an order of magnitude decline as water reaches the downstream canal. All of these data suggest the storage systems have significant assimilative capacity, and that discharge of reclaimed water into the reuse storage lakes and the combined stormwater/reuse storage lakes has not degraded downstream water quality. For example, in the downstream canal the phosphorus criteria were only exceeded during one year while the nitrogen criteria was exceeded 4 out of 10 years.

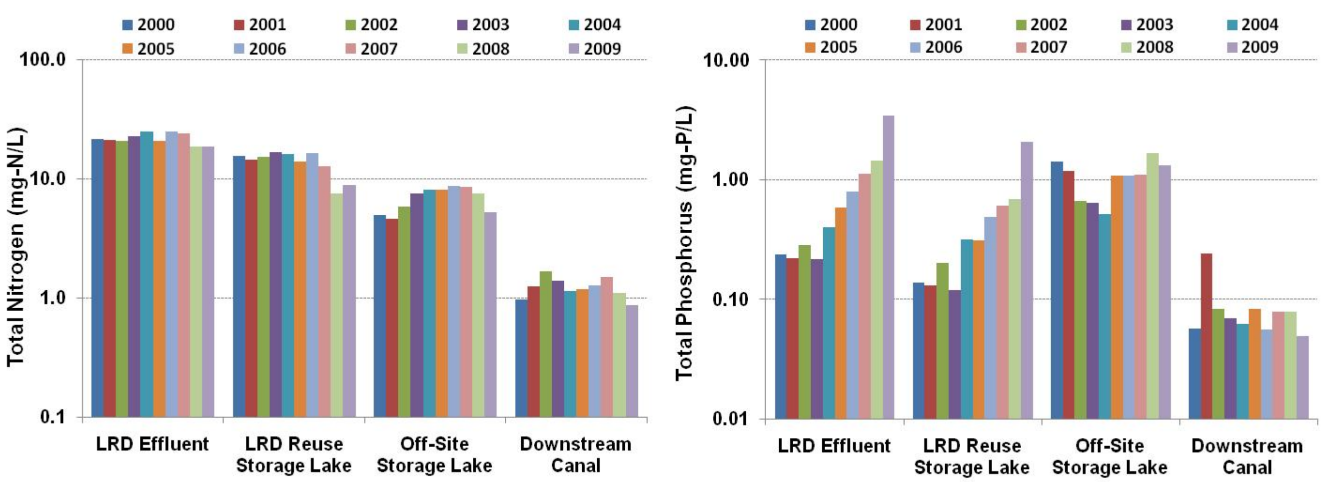

Figure 1. Ten years of water quality data show decreasing concentrations of nitrogen and phosphorus as reclaimed water flows from the wastewater treatment facility, through storage ponds, blends with stormwater, and ultimately to the downstream canal (receiving water). Reclaimed water leaving the treatment facility continuously exceeded numeric nutrient criteria for both nitrogen and phosphorus; however, in the downstream canal the phosphorus criteria was only violated during one year while the nitrogen criteria were violated 4 out of 10 years. Data shown are annual geometric means. The TP increase between 2004-2009 was driven by a shift in treatment process and odor control chemicals; interestingly it was not observed downstream.

The data in Figure 1 support the appropriateness of using reclaimed water to meet landscape irrigation needs, and suggest downstream water quality is not impaired by the beneficial reuse of reclaimed water. Nonetheless, it appears that implementation of EPA's proposed numeric nutrient criteria likely would significantly curtail the potential use of reclaimed water at these sites. In particular, application of EPA's Proposed Rule would seem to imply that, at a minimum, reclaimed water discharged to LRD's two largest users, those that have combined stormwater and reclaimed water storage systems, would have to meet EPA's proposed Peninsula Region stream criteria for TN and TP (1.205 mg/L and 0.107 mg/L, respectively).

Will the Beneficial Reuse of Reclaimed Water Be Constrained?

The EPA did not sufficiently address reclaimed water in their Proposed Rule (EPA, 2010a). In implementing the Proposed Rule, neither the EPA nor DEP have indicated how the beneficial use of reclaimed water will be safeguarded. Depending on the implementation of the Proposed Rule, utilities could be required to treat reuse water to meet the same standards required for instream waters because of potential infiltration, runoff, or discharge of reuse water into Class I or Class III waters regulated under the rule.

If EPA requires reclaimed water to meet numeric nutrient criteria, e.g., maximum concentrations of 1.205 mg-N/L and 0.107 mg-P/L in the Peninsula Region, reclaimed water providers will have to invest substantial amounts of money to design, construct, and operate major nutrient removal facilities. For example, EPA estimated the Loxahatchee River District, with a permitted capacity of 11 MGD, would experience additional capital costs of $28,880,000 and an annual operations and maintenance cost of $3,210,000 in meeting EPA's proposed numeric nutrient criteria (EPA, 2010). This is a significant cost burden to place on the average rate payer. Furthermore, when considering all of the reclaimed water produced by the Loxahatchee River District is used for landscape irrigation, it seems particularly illogical to require nitrogen and phosphorus, valuable nutrients from a turf grass perspective, to be removed from reclaimed water before it can be applied in a landscape irrigation application.

Not only are such nutrient removal efforts costly in terms of dollars paid by rate payers, but the nutrient removal process would unnecessarily consume massive quantities of energy and generate thousands of tons of greenhouse gasses. Clearly, in order to warrant such significant investment in capital, operating costs, energy consumption, and greenhouse gas emissions EPA and the Florida DEP need to demonstrate a direct line of evidence substantiating that landscape irrigation with reclaimed water is degrading Florida's precious water resources.

Regulations necessitating reclaimed water comply with EPA's proposed numeric nutrient criteria will result in reuse programs becoming unsustainable, because economic and environmental costs would far outweigh the benefit of reusing reclaimed water. On a more pragmatic note, purveyors of reclaimed water would have a financial disincentive to produce reclaimed water (e.g., capital and operating costs shown above) and an incentive to simply dispose of treated effluent down existing, permitted deep injection wells. This reduction in reclaimed water available for consumptive uses will also result in an increased demand for ground or surface water supplies. The South Florida Water Management District Regional Upper East Coast Water Supply Plan, which includes the LRD service area, estimates an additional 201 mgd of wastewater will be available for reuse in 2025. However, this valuable water supply may be lost under the Proposed Rule.

More generally, many within Florida are struggling to understand how the State's water quality standards failed to be consistent with the applicable requirements of the Clean Water Act. Florida's water quality protection program is multi-faceted and ensures the protection of water bodies through many programs including the TMDL program, a bioassessment program, designation of Outstanding Florida Waters, BMAPs and comprehensive NPDES permit regulations. While EPA recognizes the existence of these programs, it does not appear to consider the value of these programs and the substantial steps the State of Florida has taken to protect and improve water quality.

Conclusions

We applaud the EPA and Florida's Department of Environmental Protection for their efforts to protect the ecological integrity of Florida's diverse ecosystems and aquatic habitats. Nevertheless, it appears that EPA's proposed numeric nutrient criteria will likely significantly constrain reuse opportunities, which would clearly be an unfortunate unintended consequence. Florida needs to effectively manage our available water resources and aquatic ecosystems – there is a critical balancing act that must take place between environmental protection and meeting future water supply needs.

It appears that EPA's Proposed Rule could significantly curtail the beneficial reuse of reclaimed water – clearly an unintended consequence in a state that values the role of reclaimed water as a means to both offset demands on our limited freshwater and simultaneously augment freshwater supplies. In order to avoid this potential restriction on the availability of and beneficial reuse of reclaimed water, we recommend: (1) EPA (and DEP) exclude reclaimed water from numeric nutrient criteria; (2) landscape irrigation with reclaimed water should be held to suitable agronomic rates to minimize runoff of reclaimed water; (3) when and where possible purveyors of reuse water should avoid mingling reuse water with stormwater, thereby reducing the likelihood of offsite discharge of reuse water; (4) developments (e.g., golf courses, neighborhoods) planning to integrate the use of reuse water should construct separate reuse storage facilities that minimize the likelihood of offsite discharge of reuse water.

References

Arrington, D. A. and R. C. Dent. “Maintenance of Groundwater Quality throughout Twenty Years of Reuse.” Water Practice. pp.1-10. April 2008

[EPA] Environmental Protection Agency. Water Quality Standards for the State of Florida’s Lakes and Flowing Waters. Washington D.C.: Environmental Protection Agency. 2010a.

[EPA] Environmental Protection Agency. Preliminary Estimate of Potential Compliance Costs and Benefits Associated with EPA’s Proposed Numeric Nutrient Criteria for Florida. Washington D.C.: Environmental Protection Agency. 2010b.

Griffith, G. E., D. E. Canfield, Jr., C. A. Horsburgh and J. M. Omernik. Lake Regions of Florida. Washington D.C.: Environmental Protection Agency. 1997.

Griffith, G. E., J.M. Omernik, C.M. Rohm, and S.M. Pierson. 1994. Florida regionalization project. Corvallis, OR: Environmental Protection Agency, Environmental Research Laboratory. 1994.

[FDEP] Florida Department of Environmental Protection. 2008 Reuse Inventory. Tallahassee, Florida: Florida Department of Environmental Protection. 2010.

Karr, J. R. “Ecological integrity. Protecting earth’s life support systems” in Ecosystem Health. ed. by R. Constanza, B.G. Norton and B.D. Haskell. Washington, D.C.: Island Press. 1992.

McKim, T., J. A. Jackson, C. Ferraro, and A. Arrington. “Optimizing Reuse: Lessons from the Roundtable.” Florida Water Resources Journal. pp.16-18. August 2009.

[RCC] Reuse Coordinating Committee and the Water Conservation Initiative Water Reuse Work Group. Water Reuse for Florida: Strategies for Effective Use of Reclaimed Water. Florida Department of Environmental Protection, Tallahassee, Florida. 2003.

Stanley, E., D. A. Arrington, R. C. Dent, D. G. Burden, and R. B. Taylor. “Preserving the environment by increasing reuse supplies: blending nanofiltration concentrate & treated effluent.” Florida Water Resources Journal pp.52-59. August 2009.