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ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 131

[EPA-HQ-OW-2010-0222; FRL-9759-3]

RIN 2040-AF21

Water Quality Standards for the State of Florida's Estuaries, Coastal Waters, and South Florida Inland Flowing Waters

AGENCY: Environmental Protection Agency (EPA).

ACTION: Proposed rule.

SUMMARY: The U.S. Environmental Protection Agency (EPA or Agency) is proposing numeric water quality criteria to protect ecological systems, aquatic life, and human health from nitrogen and phosphorus pollution in estuaries and coastal waters within the State of Florida not covered by EPA-approved State rulemaking, and south Florida inland flowing waters. These proposed criteria apply to Florida waters that are designated as Class I, Class II, or Class III waters and they are intended to protect these designated uses as well as implement for the purposes of the Clean Water Act the State's narrative nutrient provision at Subsection 62-302.530(47)(b), Florida Administrative Code (F.A.C.), which provides that "[i]n no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna."

DATES: Comments must be received on or before **[INSERT DATE 60 DAYS AFTER PUBLICATION IN THE FEDERAL REGISTER**]. Because of EPA's obligation to sign a notice of final rulemaking on or before September 30, 2013 under Consent Decree, the Agency regrets that it will be unable to grant any requests to extend this deadline.

ADDRESSES: Submit your comments, identified by Docket ID No. EPA-HQ-OW-2010-0222, by one of the following methods:

1. www.regulations.gov: Follow the on-line instructions for submitting comments.
2. Email: ow-docket@epa.gov
3. Mail to: Water Docket, U.S. Environmental Protection Agency, Mail code: 2822T, 1200 Pennsylvania Avenue, NW, Washington, DC 20460, Attention: Docket ID No. EPA-HQ-OW-2010-0222.
4. Hand Delivery: EPA Docket Center, EPA West Room 3334, 1301 Constitution Avenue, NW, Washington, DC 20004, Attention Docket ID No. EPA-HQ-OW-2010-0222. Such deliveries are only accepted during the Docket's normal hours of operation, and special arrangements should be made for deliveries of boxed information.

Instructions: Direct your comments to Docket ID No. EPA-HQ-OW-2010-0222. EPA's policy is that all comments received will be included in the public docket without change and may be made available online at www.regulations.gov, including any personal information provided, unless the comment includes information claimed to be Confidential Business Information (CBI) or other information whose disclosure is restricted by statute. Do not submit information that you consider to be CBI or otherwise protected through www.regulations.gov or e-mail. The www.regulations.gov Web site is an "anonymous access" system, which means EPA will not know your identity or contact information unless you provide it in the body of your comment. If you submit an electronic comment, EPA recommends that you include your name and other contact information in the body of your comment and with any disk or CD-ROM you submit. If EPA cannot read your comment due to technical difficulties and cannot contact you for clarification, EPA may not be able to consider your comment. Electronic files should avoid the use of special characters, any form of encryption, and be free of any defects or viruses. For additional information about EPA's public docket visit the EPA Docket Center homepage at http://www.epa.gov/epahome/dockets.htm.

Docket: All documents in the docket are listed in the www.regulations.gov index. Although listed in the index, some information is not publicly available, e.g., CBI or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, will be publicly available only in hard copy. Publicly available docket materials are available either electronically in www.regulations.gov or in hard copy at a docket facility. The Office of Water (OW) Docket Center is open from 8:30 a.m. until 4:30 p.m., Monday through Friday, excluding legal holidays. The OW Docket Center telephone number is (202) 566-2426, and the Docket address is OW Docket, EPA West, Room 3334, 1301 Constitution Avenue, NW, Washington, DC 20004. The Public Reading Room is open from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays. The telephone number for the Public Reading Room is (202) 566-1744.

FOR FURTHER INFORMATION CONTACT: Erica Fleisig, U.S. EPA Headquarters, Office of Water, Mailcode: 4305T, 1200 Pennsylvania Avenue, NW, Washington, DC 20460; telephone number: (202) 566-1057; email address: fleisig.erica@epa.gov.

SUPPLEMENTARY INFORMATION: This supplementary information section is organized as follows:

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H. Executive Order 13211 (Actions That Significantly Affect Energy Supply, Distribution, or Use)

I. National Technology Transfer Advancement Act of 1995

J. Executive Order 12898 (Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations)

I. General Information

A. Executive Summary

1. *Purpose of the Regulatory Action*

The primary purpose of this rule is to propose numeric water quality criteria to protect ecological systems, aquatic life, and human health within the State of Florida from nitrogen and phosphorus pollution. The criteria proposed in this rule apply to certain estuaries and coastal waters within the State of Florida and south Florida inland flowing waters (e.g., rivers, streams, canals)[1], with the exception of waters within the lands of the Miccosukee and Seminole Tribes, the Everglades Agricultural Area (EAA), and the Everglades Protection Area (EvPA).[2]

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[1] EPA has distinguished south Florida inland flowing waters as waters in the South Florida Nutrient Watershed Region (SFNWR). The SFNWR was defined previously in EPA's final rule for lakes and flowing waters as the area south of Lake Okeechobee, the Caloosahatchee River watershed (including Estero Bay) to the west of Lake Okeechobee, and the St. Lucie watershed to the east of Lake Okeechobee.

[2] FL Statute Section 373.4592 (1994) subsection (2) Definitions: (e) "Everglades Agricultural Area" or "EAA" means the Everglades Agricultural Area, which are those lands described in FL Statute Section 373.4592 (1994) subsection (15).

FL Statute Section 373.4592 (1994) subsection (2) Definitions: (h) "Everglades Protection Area" means Water Conservation Areas 1 (which includes the Arthur R. Marshall Loxahatchee National Wildlife Refuge), 2A, 2B, 3A, and 3B, and the Everglades National Park.

The criteria support implementation of pollution control programs authorized under the Clean Water Act (CWA). As part of a comprehensive program to restore and protect the Nation’s waters, Section 303(c) of the CWA directs states to adopt water quality standards for their navigable waters. CWA Section 303(c)(2)(A) and EPA's implementing regulations at 40 CFR 131 require that state water quality standards include the designated use (e.g. public water supply, propagation of fish and wildlife, recreational purposes) and criteria that protect those uses. Criteria may be numeric or narrative in form, but consistent with EPA regulations at 40 CFR 131.11(a)(1), such criteria “must be based on sound scientific rationale and must contain sufficient parameters or constituents to protect the designated use.” EPA regulations at 40 CFR 131.10(b) also provide that “[i]n designating uses of a water body and the appropriate criteria for those uses, the state shall take into consideration the water quality standards of downstream waters and ensure that its water quality standards provide for the attainment and maintenance of the water quality standards of downstream waters.” The CWA requires that any new or revised water quality standards developed by states be submitted to EPA for review and approval or disapproval, and authorizes the EPA Administrator to determine, even in the absence of a state submission, that a new or revised standard is needed to meet CWA requirements.

Florida is known for its abundant and aesthetically beautiful natural resources, particularly its aquatic resources, which are very important to Florida’s economy. Florida’s coastal and estuarine waters play an especially important part in sustaining the environment and the economy in the State. For example, Florida’s saltwater sport fishing industry contributes over $5 billion to the State’s economy and more than 54,000 jobs annually; the State's commercial saltwater fishing industry contributes over $1 billion and more than 10,000 jobs annually.[3] In 2007, nearly 11.3 million residents and 46.3 million visitors participated in recreational saltwater beach activities in Florida. Nearly 3.5 million residents and approximately 1.4 million visitors used saltwater boat ramps, over 4.2 million residents and about 3 million visitors participated in saltwater non-boat fishing, and over 2.6 million residents and almost 1 million visitors participated in canoeing and kayaking.[4]

However, nitrogen and phosphorus pollution has contributed to serious water quality degradation affecting these coastal and estuarine resources in the State of Florida, as well as other Florida waters. In the most recent Florida Department of Environmental Protection (FDEP) water quality assessment report, the *Integrated Water Quality Assessment for Florida: 2012 305(b) Report and 303(d) List Update*, FDEP describes widespread water quality impairment in Florida due to nitrogen and phosphorus pollution. FDEP's 2012 report identifies approximately 754 square miles (482,560 acres) of estuaries (about 14 percent of assessed estuarine area) and 102 square miles (65,280 acres) of coastal waters (about 1.6 percent of assessed coastal waters) as impaired by nutrients. In addition, the same report indicates that 1,108 miles of rivers and streams (about 8 percent of assessed river and stream miles) and 107 square miles (68,480 acres)

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[3] FFWCC. 2011. *The economic impact of saltwater fishing in Florida*. Florida Fish and Wildlife Conservation Commission. <http://myfwc.com/conservation/value/saltwater-fishing>. Accessed December 2011.

[4] FDEP. 2008. Chapter 5 – Outdoor Recreation Demand and Need. In *Outdoor Recreation in Florida, 2008: Florida's Comprehensive Outdoor Recreation Plan, Final Draft*. Florida Department of Environmental Protection, Division of Recreation and Parks, Tallahassee, FL. <http://www.dep.state.fl.us/parks/planning/forms/SCORP5.pdf>. Accessed December 2011.

of lakes (about 5 percent of assessed lake square miles) are impaired due to nutrient pollution. [5]

On January 14, 2009, EPA determined under CWA section 303(c)(4)(B) that new or revised water quality standards (WQS) in the form of numeric nutrient water quality criteria are necessary to protect the designated uses that Florida has set for its Class I, Class II, and Class III waters. Subsequently, EPA entered into a Consent Decree with Florida Wildlife Federation, Sierra Club, Conservancy of Southwest Florida, Environmental Confederation of Southwest Florida, and St. Johns Riverkeeper, effective on December 30, 2009, which established a schedule for EPA to propose and promulgate numeric nutrient criteria for Florida's lakes, flowing waters, estuaries, and coastal waters. The Consent Decree also provided that if Florida submitted and EPA approved numeric nutrient criteria for any relevant waterbodies before the dates outlined in the schedule, EPA would no longer be obligated to propose or promulgate criteria for those waterbodies.

On June 13, 2012, FDEP submitted new and revised WQS for review by the EPA pursuant to section 303(c) of the CWA. These new and revised WQS are set out primarily in Rule 62-302 of the F.A.C. [Surface Water Quality Standards]. FDEP also submitted amendments to Rule 62-303, F.A.C. [Identification of Impaired Surface Waters], which sets out Florida's methodology for assessing whether waters are attaining State WQS. On November 30, 2012, EPA approved the provisions of these rules submitted for review

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[5] FDEP. 2012. *Integrated Water Quality Assessment for Florida: 2012 305(b) Report and 303(d) List Update.* (May 2012). Florida Department of Environmental Protection, Division of Environmental Assessment and Restoration, Tallahassee, FL. <http://www.dep.state.fl.us/water/docs/2012_integrated_report.pdf>. Accessed August 2012.

that constitute new or revised WQS (hereafter referred to as the "newly-approved State WQS").

Among the newly-approved State WQS are numeric criteria for nutrients that apply to a set of estuaries and coastal marine waters in Florida. Specifically, these newly-approved State WQS apply to Clearwater Harbor/St. Joseph Sound, Tampa Bay, Sarasota Bay, Charlotte Harbor/Estero Bay, Clam Bay, Tidal Cocohatchee River/Ten Thousand Islands, Florida Bay, Florida Keys, and Biscayne Bay.[6] Under the Consent Decree, EPA is relieved of its obligation to propose numeric criteria for these waters.

Finally, as described in EPA's November 30, 2012 approval of Florida's new or revised WQS, while EPA believes that the provisions addressing downstream protection will provide for quantitative approaches to ensure the attainment and maintenance of downstream waters consistent with 40 CFR 131.10(b), the provisions themselves do not consist of numeric values. Because EPA is currently subject to a Consent Decree deadline to sign a rule proposing numeric downstream protection values (DPVs) for Florida by November 30, 2012, EPA is proposing numeric DPVs to comply with the Consent Decree. However, EPA has amended its January 2009 determination to specify that numeric criteria for downstream protection are not necessary and that quantitative approaches designed to ensure the attainment and maintenance of downstream water quality standards, such as those established by Florida, are sufficient to meet CWA requirements. As such, EPA will ask the court to modify the Consent Decree consistent with the Agency's amended determination, i.e., to not require EPA to promulgate

[6] Clam Bay, Tidal Cocohatchee River/Ten Thousand Islands, Florida Bay, Florida Keys, and Biscayne Bay are collectively referred to in this proposed rule as "south Florida marine waters," as these are the predominantly marine waters downstream of the South Florida Nutrient Watershed Region.

numeric DPVs for Florida. Accordingly, EPA approved the State's downstream protection provisions subject to the district court modifying the Consent Decree to not require EPA to promulgate numeric DPVs for Florida. If the district court agrees to so modify the Consent Decree, EPA will not promulgate numeric DPVs for Florida. However, if the district court declines to so modify the Consent Decree, EPA would intend to promulgate numeric DPVs for Florida and would also expect to revisit its November 30, 2012 approval of the State Rule's downstream protection provisions to modify or withdraw its approval. Therefore, EPA has also reserved its authority to do so in its approval document.

A full description of all of EPA's recent actions on Florida numeric nutrient criteria and related implications for EPA's own rules can be found at http://water.epa.gov/lawsregs/rulesregs/florida_index.cfm.

EPA is proposing these numeric criteria in accordance with the terms of the January 14, 2009 determination, December 2009 Consent Decree, and subsequent revisions to that Consent Decree that require the EPA Administrator to sign this proposal by November 30, 2012 (discussed in more detail in Section II.D). EPA believes that the proposed criteria in this rule will assure protection of Florida's existing designated uses and are based on sound and substantial scientific data and analyses.

2. *Summary of the Major Provisions of the Regulatory Action*

To develop these proposed numeric nutrient criteria for Florida's estuaries, coastal waters, and south Florida inland flowing waters, the Agency conducted a detailed scientific analysis of the substantial amount of water quality data available from Florida's extensive monitoring data set.

EPA concluded that an approach using relevant biological endpoints and multiple lines of evidence including stressor-response analyses and mechanistic modeling was a strong and scientifically sound approach for deriving numeric nutrient criteria for estuaries, in the form of total nitrogen (TN), total phosphorus (TP) and chlorophyll *a* concentrations. EPA's methodology and the resulting proposed estuarine numeric nutrient criteria are presented in more detail in Section III.B of this notice of proposed rulemaking.

For coastal waters on the Atlantic and Gulf coasts of Florida, EPA is proposing to use a reference condition-based approach. EPA chose to use satellite remote sensing in all coastal areas of Florida except the Big Bend Coastal region. Using this approach, EPA developed chlorophyll *a* criteria from satellite remote sensing imagery and field data to calibrate the satellite remote sensing imagery. In the Big Bend Coastal region of Florida[7], where satellite remote sensing predictions of chlorophyll *a* were not possible due to reflectance that interferes with the remote sensing imagery in that area, EPA used mechanistic and statistical models to determine TN, TP, and chlorophyll *a* criteria for these coastal waters.[8] EPA's methodology and results for its proposed coastal criteria are presented in more detail in Sections III.B and III.C.

EPA is proposing numeric nutrient criteria to ensure the attainment and maintenance of the water quality standards in downstream estuaries and south Florida marine waters pursuant to the provisions of 40 CFR 131.10(b). EPA examined a variety of modeling techniques and data to assess whether waters entering an estuary protect the

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[7] This area includes waters offshore of Apalachicola Bay, Alligator Harbor, Ochlockonee Bay, Big Bend/Apalachee Bay, Suwannee River, and Springs Coast.
[8] EPA derived TN and TP criteria for coastal waters in the Big Bend Coastal region because mechanistic models were used in these areas.

water quality standards within the estuary. Accordingly, EPA is proposing an approach to derive TN and TP criteria expressed as downstream protection values (DPVs) at the points where inland flowing waters flow into estuaries, or marine waters in south Florida (referred to as 'pour points'). These proposed DPVs apply to all flowing waters, including south Florida inland flowing waters (with the exception of waters within the lands of the Miccosukee and Seminole Tribes, EAA, and EvPA), that flow directly into estuaries or south Florida marine waters. EPA's proposed approach for deriving DPVs at the pour points involves an evaluation of water quality in the downstream estuary, water quality conditions at the pour point, and selecting a method to derive the DPV values based on available data. The proposed approaches for deriving DPVs in flowing waters are presented in more detail in Sections III.B and III.D.

Finally, EPA is proposing to extend the approach finalized in 40 CFR 131.43(e)[9] to allow development of Site-Specific Alternative Criteria (SSAC) for estuaries, coastal waters, and south Florida inland flowing waters. EPA's rationale for extending these SSAC provisions is discussed in more detail in Section V.C.

EPA has incorporated sound science, local expertise, and substantial Florida-specific data throughout the development of these proposed numeric TN, TP, and chlorophyll *a* criteria. EPA relied upon peer-reviewed criteria development methodologies,[10] relevant biological endpoints, and a substantial body of scientific

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[9] 40 CFR 131.43(e) authorizes the derivation of Federal Site-Specific Alternative Criteria (SSAC) after EPA review and approval of applicant submissions of scientifically defensible criteria that meet the requirements of CWA section 303(c) and EPA's implementing regulations at 40 CFR 131.

[10] USEPA. 2000a. *Nutrient Criteria Technical Guidance Manual: Lakes and Reservoirs.* EPA-822-B-00-001. U.S. Environmental Protection Agency, Office of Water, Washington, DC.
USEPA. 2000b. *Nutrient Criteria Technical Guidance Manual: Rivers and Streams.* EPA-822-B-00-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC.
USEPA. 2001. *Nutrient Criteria Technical Guidance Manual: Estuarine and Coastal Marine Waters.*

analysis provided to EPA by FDEP, as well as other federal, State, and local partners such as the National Park Service; National Oceanic and Atmospheric Administration (NOAA); U.S. Geological Survey (USGS); Tampa Bay, Indian River Lagoon, Sarasota Bay and Charlotte Harbor National Estuary Programs; St. Johns River and South Florida Water Management Districts; and Florida International University.

EPA sought feedback on the scientific defensibility of the approaches outlined in this proposed rule through a Science Advisory Board (SAB) review.[11] The SAB assembled a group of eighteen expert panelists to review EPA's *Methods and Approaches for Deriving Numeric Criteria for Nitrogen/Phosphorus Pollution in Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters*.[12] The SAB recommendations[13] strengthened the scientific basis of these proposed numeric nutrient criteria. A number of key interest groups presented their comments and views on the underlying science as part of the SAB review process. In addition, EPA met with several groups of stakeholders with local technical expertise to discuss potential approaches for deriving scientifically defensible numeric nutrient criteria.

3. *Costs and Benefits*

EPA-822-B-01-003. U.S. Environmental Protection Agency, Office of Water, Washington, DC.
USEPA. 2010. *Using Stressor-Response Relationships to Derive Numeric Nutrient Criteria.* EPA-820-S-10-001. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

[11] USEPA-SAB. 2011. *Review of EPA's draft Approaches for Deriving Numeric Nutrient Criteria for Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters*. EPA-SAB-11-010. U.S. Environmental Protection Agency, Science Advisory Board, Washington, DC.

[12] USEPA. 2010. *Methods and Approaches for Deriving Numeric Criteria for Nitrogen/Phosphorus Pollution in Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters.* U.S. Environmental Protection Agency, Office of Water, Washington, DC.

[13] USEPA-SAB. 2011. *Review of EPA's draft Approaches for Deriving Numeric Nutrient Criteria for Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters*. EPA-SAB-11-010. U.S. Environmental Protection Agency, Science Advisory Board, Washington, DC.

For the reasons presented in this notice, this is not an economically significant regulatory action under Executive Order 12866. Under the CWA, EPA's promulgation of WQS establishes standards that the State of Florida implements through the National Pollutant Discharge Elimination System (NPDES) permit process for point source dischargers and may also result in new or revised requirements for nitrogen and phosphorus pollution treatment controls on other sources (e.g., agriculture, urban runoff, and septic systems) through the development of Total Maximum Daily Loads (TMDLs) and Basin Management Action Plans (BMAPs). As a result of this action, the State of Florida will need to ensure that permits it issues and Waste Load Allocations (WLAs) issued under TMDLs and BMAPs include any limitations on discharges and other sources necessary to comply with the standards established in the final rule. In doing so, the State will have considerable discretion and a number of choices associated with permit writing (e.g., relating to compliance schedules, variances, etc.) and flexibilities built into the TMDL and BMAP process for WLA assignment. While Florida's implementation of the rule may ultimately result in new or revised permit conditions for some dischargers and WLA requirements for control on other sources, EPA's action, by itself, does not establish any requirements directly applicable to regulated entities or other sources of nitrogen and phosphorus pollution. Additionally, Florida already has an existing narrative water quality criterion[14] which requires that nutrients not be present in estuaries and coastal waters in Florida or in south Florida inland flowing waters in concentrations that cause an imbalance in natural populations of flora and fauna. The

[14] Subsection 62-302.530(47)(b), Florida Administrative Code (F.A.C.), provides that "[i]n no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna."

proposed criteria in this rule are consistent with and serve to implement the State's existing narrative nutrient provision.

Although the proposed rule does not establish any requirements directly applicable to regulated entities or other sources of nutrient pollution, EPA developed an economic analysis to provide information on potential costs and benefits that may be associated with the State implementation requirements that may be necessary to ensure attainment of WQS. EPA conducted an analysis to estimate both the increase in the number of impaired waters that may be identified as a result of the proposed rule and the annual cost of CWA pollution control actions likely to be implemented by the State of Florida to assure attainment of applicable State water quality designated uses for these waters. It is important to note that the costs and benefits of pollution controls needed to attain water quality standards for nutrients for waters already identified as impaired by the State (including waters with TMDLs in place and without TMDLs in place) are not included in EPA estimates of the cost of the rule. EPA believes that these costs and benefits would be incurred in the absence of the current proposed rule and are therefore part of the baseline against which the costs and benefits of this rule are measured. EPA's analysis is fully described in the document entitled *Economic Analysis of Proposed Water Quality Standards for the State of Florida's Estuaries, Coastal Waters, and South Florida Inland Flowing Waters* (hereinafter referred to as the Economic Analysis), which can be found in the docket and record for this proposed rule. The final conclusion of this assessment is that the incremental costs associated with the proposed rule range between $239.0 million and $632.4 million per year (2010 dollars) and total monetized benefits may be in the range from $39.0 to $53.4 million annually. EPA's analysis describes additional benefits that could not be monetized. EPA has provided estimates of the annual costs and benefits; these exceed the $100 million threshold that defines an economically significant rule under section 3(f) of Executive Order 12866. However, EPA cautions that these estimates cannot be used to determine that this rule is economically significant. The direct effect of this rule is to provide Florida with a numeric articulation of its current narrative articulation of nutrients criteria, without affecting the resulting level of protection offered by the criteria. The estimates of costs and benefits here are indirect estimates (costs and benefits associated with controls for waters that would immediately be judged to be impaired due to numeric criteria) of the direct effects of this proposed rule (decreasing the time to implement TMDLs on impaired waters), and the relationship these indirect estimates bear to the true costs and benefits cannot be determined.

B. Which Water Bodies Are Affected By This Rule?

EPA's proposed rule applies to estuaries and coastal marine waters that have been classified by Florida as Class II (Shellfish Propagation or Harvesting) or Class III (Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife), including tidal creeks and marine lakes, but excluding the estuarine and marine waters contained in Florida's newly-approved State WQS. This proposed rule also applies to south Florida inland flowing waters that have been classified by Florida as Class I (Potable Water Supplies) or Class III water bodies pursuant to Section 62-302.400, F.A.C., excluding wetlands (e.g. sloughs in south Florida) and flowing waters within the lands of the Miccosukee and Seminole Tribes, EvPA, or EAA.[15] Pursuant to

[15] In this rule, EPA is interpreting the existing State narrative criterion under Subsection 62-302.530(47)(b), F.A.C. That criterion applies to Florida waters classified as Class I (Potable Water Supplies), Class II

Subsection 62-302.400(4), F.A.C., "Class I, II, and III surface waters share water quality criteria established to protect fish consumption, recreation and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife." [16] Florida currently has a narrative nutrient criterion at Subsection 62-302.530(47)(b), F.A.C.[17] established to protect these three uses and EPA is numerically interpreting Florida's narrative criterion for the purpose of protecting the Class I, II, and III surface waters for the purposes of the CWA in this proposed rulemaking.

EPA is not proposing to change any of Florida's water body classifications with this regulation. The proposed criteria in this regulation would only apply to water bodies that are currently classified by Florida as Class I, II, or III and not to water bodies with other classifications such as Class III limited waters[18] for which use attainability analyses (UAAs) and SSACs for nutrients have been established, or Class IV canals in Florida's agricultural areas.

EPA is defining estuary to be consistent with Florida's definition of estuary in Section 62-303.200, F.A.C., where "estuary" shall mean "predominantly marine regions of interaction between rivers and nearshore ocean waters, where tidal action and river flow mix fresh and salt water." Such areas include bays, mouths of rivers, and lagoons

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(Shellfish Propagation or Harvesting), and Class III Marine and Fresh (Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife). EPA is not aware of any marine waters that Florida has classified as Class I potable water supply. Therefore, for purposes of this rule, EPA is interpreting Subsection 62-302.530(47)(b), F.A.C. to protect fish consumption, recreation, and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife in Florida's Class II and III estuarine and coastal waters.

[16] Class I waters also include an applicable nitrate limit of 10 mg/L and nitrite limit of 1 mg/L for the protection of human health in drinking water supplies. The nitrate limit applies at the entry point to the distribution system (i.e., after any treatment); see Section 62-550, F.A.C., for additional details.

[17] "[i]n no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna"

[18] Class III limited waters include waters that support fish consumption; recreation or limited recreation; and/or propagation and maintenance of a limited population of fish and wildlife; see Chapter 62-302.400(1) F.A.C. for more details.

that have been classified as Class II (Shellfish Propagation or Harvesting) or Class III (Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife) water bodies pursuant to Section 62-302.400, F.A.C., excluding wetlands.

EPA is defining coastal waters based on Florida's definitions of open coastal waters and open ocean waters, taking into account that CWA jurisdiction extends to three nautical miles from shore.[19] EPA's definition of "coastal waters" is all marine waters that have been classified as Class II (Shellfish Propagation or Harvesting) or Class III (Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife) water bodies pursuant to Section 62-302.400, F.A.C., extending to three nautical miles from shore that are not classified as estuaries. EPA's proposed rule defines "marine waters" to mean surface waters in which the chloride concentration at the surface is greater than or equal to 1,500 milligrams per liter (mg/L).

EPA is defining tidal creeks as relatively small coastal tributaries with variable salinity that lie at the transition zone between terrestrial uplands and the open estuary. For another subset of marine waters, marine lakes, EPA is proposing to use the definition of "marine waters" and the definition of lakes included previously in *Water Quality Standards for the State of Florida's Lakes and Flowing Waters* (40 CFR 131.43) to

[19] While CWA jurisdiction, and therefore EPA's proposed criteria, extend only to three nautical miles from shore (CWA section 502(8)), Florida State jurisdiction extends beyond three nautical miles. Florida's seaward boundary in Gulf of Mexico waters is 3 marine leagues (9 nautical miles) and in Atlantic waters is 3 nautical miles (Submerged Lands Act of 1953. <http://www.boem.gov/uploadedFiles/submergedLA.pdf> ; UNITED STATES v. FLORIDA, 363 U.S. 121 (1960)). Florida defines open coastal waters as "all gulf or ocean waters that are not classified as estuaries or open ocean waters." Open ocean waters consist of "all surface waters extending seaward from the most seaward natural 90-foot (15-fathom) isobath" (Subsection 62-303.200, F.A.C.).

define a marine lake as a slow-moving or standing body of marine water that occupies an inland basin that is not a stream, spring, or wetland.

EPA previously defined “flowing waters” in *Water Quality Standards for the State of Florida’s Lakes and Flowing Waters* (40 CFR 131.43). A flowing water is defined as “a free-flowing, predominantly fresh surface water in a defined channel, and includes rivers, creeks, branches, canals, freshwater sloughs, and other similar water bodies.” Consistent with EPA’s definition in 40 CFR 131.43, EPA defines “canal” for this proposed rule to mean a trench, the bottom of which is normally covered by water with the upper edges of its two sides normally above water. Also as defined in 40 CFR 131.43, “predominantly fresh waters” means surface waters in which the chloride concentration at the surface is less than 1,500 mg/L. EPA is not proposing criteria for areas currently managed by the State as wetlands (such as sloughs in south Florida), which are outside the scope of this rulemaking.[20]

C. What Entities May Be Affected By This Rule?

Citizens concerned with water quality in Florida may be interested in this rulemaking. Entities discharging nitrogen or phosphorus to estuaries, coastal waters, and flowing waters in Florida could be indirectly affected by this rulemaking because water quality standards are used in determining National Pollutant Discharge Elimination

[20] FDEP. 2001. Chapter 2: Ecological Description. In: *Everglades Phosphorus Criterion Technical Support Document*. Part III: WCA-3/ENP. Florida Department of Environmental Protection, Everglades Technical Support Section. <http://www.dep.state.fl.us/water/wqssp/everglades/docs/pctsd/IIIChapter2.pdf>. Accessed January, 10, 2011.
Doherty, S.J., C.R. Lane, and M.T. Brown. 2000. Proposed Classification for Biological Assessment of Florida Inland Freshwater Wetlands. Report to the Florida Department of Environmental Protection. Contract No. WM68 (Development of a Biological Approach for Assessing Wetland Function and Integrity). Center for Wetlands, University of Florida, Gainesville, FL.
Ogden, J.C. 2005. Everglades ridge and slough conceptual ecological model. *Wetlands* 25(4):810-820.

System (NPDES) permit limits. Examples of categories and entities that may ultimately be affected are listed in the following table:

Category	Examples of potentially affected entities
Industry	Industries discharging pollutants to estuaries, coastal waters and flowing waters in the State of Florida.
Municipalities	Publicly-owned treatment works discharging pollutants to estuaries, coastal waters and flowing waters in the State of Florida.
Stormwater Management Districts	Entities responsible for managing stormwater runoff in the State of Florida.

This table is not intended to be exhaustive, but rather provides a guide for entities that may be indirectly affected by this action. Other types of entities not listed in the table, such as non-point source contributors to nitrogen and phosphorus pollution in Florida's waters, may be affected through implementation of Florida's water quality standards program (e.g., through Basin Management Action Plans (BMAPs)). Any parties or entities conducting activities within Florida watersheds covered by this proposed rule, or who depend upon or contribute to the water quality of the estuaries, coastal waters, and flowing waters of Florida, may be affected by this rule. To determine whether your facility or activities may be affected by this action, you should examine this proposed rule. If you have questions regarding the applicability of this action to a particular entity, consult the person listed in the preceding **FOR FURTHER INFORMATION CONTACT** section.

D. What Should I Consider as I Prepare My Comments for EPA?

1. *Submitting CBI.* Do not submit confidential business information (CBI) to EPA through http://www.regulations.gov or e-mail. Clearly mark the part or all of the information that you claim to be CBI. For CBI information in a disk or CD-ROM that you mail to EPA, mark the outside of the disk or CD-ROM as CBI and then identify

electronically within the disk or CD-ROM the specific information that is claimed as CBI. In addition to one complete version of the comment that includes information claimed as CBI, a copy of the comment that does not contain the information claimed as CBI must be submitted for inclusion in the public docket. Information so marked will not be disclosed except in accordance with procedures set forth in 40 CFR part 2.

2. *Tips for Preparing Your Comments*. When submitting comments, remember to:

- Identify the rulemaking by docket number and other identifying information (subject heading, **Federal Register** date, and page number).
- Follow directions--The agency may ask you to respond to specific questions or organize comments by referencing a Code of Federal Regulations (CFR) part or section number.
- Explain why you agree or disagree; suggest alternatives and substitute language for your requested changes.
- Describe any assumptions and provide any technical information and/or data that you used.
- If you estimate potential costs or burdens, explain how you arrived at your estimate in sufficient detail to allow for it to be reproduced.
- Provide specific examples to illustrate your concerns, and suggest alternatives.
- Make sure to submit your comments by the comment period deadline identified.

Commenters who submitted public comments or scientific information on the portions of EPA's January 26, 2010 proposed *Water Quality Standards for the State of Florida's Lakes and Flowing Waters* (75 FR 4173) that are addressed in this proposal should reconsider their previous comments in light of the new information presented in this proposal and must re-submit their comments during the public comment period for this rulemaking to receive EPA response.

E. How Can I Get Copies of This Document and Other Related Information?

1. *Docket*. EPA has established an official public docket for this action under Docket Id. No. EPA-HQ-OW-2010-0222. The official public docket consists of the document specifically referenced in this action, any public comments received, and other information related to this action. Although a part of the official docket, the public docket does not include CBI or other information whose disclosure is restricted by statute. The official public docket is the collection of materials that is available for public viewing at the OW Docket, EPA West, Room 3334, 1301 Constitution Ave., NW, Washington, DC 20004. This Docket Facility is open from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays. The Docket telephone number is 202-566-2426. A reasonable fee will be charged for copies.

2. *Electronic Access*. You may access this **Federal Register** document electronically through the EPA Internet under the “Federal Register” listings at http://www.epa.gov/fedrgstr/. An electronic version of the public docket is available through EPA's electronic public docket and comment system, EPA Dockets. You may use EPA Dockets at http://www.regulations.gov to view public comments, access the index listing of the contents of the official public docket, and to access those documents in the public docket that are available electronically. For additional information about EPA's public docket, visit the EPA Docket Center homepage at

http://www.epa.gov/epahome/dockets.htm. Although not all docket materials may be available electronically, you may still access any of the publicly available docket materials through the Docket Facility identified in Section I.E(1).

II. Background

A. Nitrogen and Phosphorus Pollution

1. What is Nitrogen and Phosphorus Pollution?

a. Overview of Nitrogen and Phosphorus Pollution

Excess loading of nitrogen and phosphorus to surface water bodies and groundwater is one of the leading causes of water quality impairments in the United States.[21] The problem extends to both fresh and marine waters,[22] leading to over 15,000 nutrient pollution-related impairments in 49 states across the country—a figure that may substantially understate the problem as many waters have yet to be assessed.[23] Estuaries and coastal waters are especially vulnerable to nitrogen and phosphorus pollution because they are the ultimate receiving waters for most major watersheds transporting nitrogen and phosphorus loadings from multiple upstream sources.[24]

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[21] Dubrovsky, N.M., K.R. Burow, G.M. Clark, J.M. Gronberg, P.A. Hamilton, K.J. Hitt, D.K. Mueller, M.D. Munn, B.T. Nolan, L.J. Puckett, M.G. Rupert, T.M. Short, N.E. Spahr, L.A. Sprague, and W.G. Wilber. 2010. *The Quality of our Nation's waters—Nutrients in the Nation's Streams and Groundwater, 1992–2004.* Circular 1350. U.S. Geological Survey, National Water Quality Assessment Program, Reston, VA. < http://water.usgs.gov/nawqa/nutrients/pubs/circ1350>. Accessed December 2011.

[22] Smith, V.H., S.B. Joye, and R.W. Howarth. 2006. Eutrophication of freshwater and coastal marine ecosystems. *Limnology and Oceanography* 51(1, part 2):351-355.
Schindler, D.W. 2006. Recent advances in the understanding and management of eutrophication. *Limnology and Oceanography* 51(1, part2):356–363.

[23] Nationally, only 27% of rivers and streams and less than 50% of lakes, reservoirs, and ponds have been assessed for impairment (USEPA. 2011. *National Summary of State Information*. U.S. Environmental Protection Agency, Watershed Assessment, Tracking & Environmental Results. <http://iaspub.epa.gov/waters10/attains_nation_cy.control>. Accessed January 2012).

[24] Bricker, S., B. Longstaff, W. Dennison, A. Jones, K. Boicourt, C. Wicks, and J. Woerner. 2007. *Effects of Nutrient Enrichment in the Nation's Estuaries: A Decade of Change*. NOAA Coastal Ocean Program

The problem of nitrogen and phosphorus pollution is not new. Over forty years ago, a 1969 report by the National Academy of Sciences[25] noted that "[m]an's activities, which introduce excess nutrients, along with other pollutants, into lakes, streams, and estuaries, are causing significant changes in aquatic environments. The excess nutrients greatly accelerate the process of eutrophication. The pollution problem is critical because of increased population, industrial growth, intensification of agricultural production, river-basin development, recreational use of waters, and domestic and industrial exploitation of shore properties. Accelerated eutrophication causes changes in plant and animal life – changes that often interfere with use of water, detract from natural beauty, and reduce property values." A 2000 report by the National Research Council[26] concluded that "…scientists, coastal managers, and public decision-makers have come to recognize that coastal ecosystems suffer a number of environmental problems that can, at times, be attributed to the introduction of excess nutrients from upstream watersheds. The problems are caused by a complex chain of events and vary from site to site, but the fundamental driving force is the accumulation of nitrogen and phosphorus in fresh water on its way to the sea."

Florida has long struggled with nutrient pollution impacts to its surface and ground waters. Florida's flat topography makes Florida particularly susceptible to

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Decision Analysis Series No. 26. National Centers for Coastal Ocean Science, Silver Spring, MD. <http://ccma.nos.noaa.gov/publications/eutroupdate/> Accessed January 2012.
National Research Council. 2000. *Clean Coastal Waters: Understanding and Reducing the Effects of Nutrient Pollution*. Report prepared by the Ocean Study Board and Water Science and Technology Board, Commission on Geosciences, Environment and Resources, National Resource Council, Washington, DC.

[25] National Academy of Sciences. 1969. *Eutrophication: Causes, Consequences, Correctives*. National Academy of Sciences, Washington, DC.

[26] National Research Council. 2000. *Clean Coastal Waters: Understanding and Reducing the Effects of Nutrient Pollution*. Report prepared by the Ocean Study Board and Water Science and Technology Board, Commission on Geosciences, Environment and Resources, National Resource Council, Washington, DC.

nitrogen and phosphorus pollution because water moves more slowly over the landscape, allowing time for nitrogen and phosphorus pollution to accumulate in water bodies and cause eutrophication. Florida's high rainfall levels contribute to increased run-off, and higher temperatures and sunlight contribute to eutrophication when excess nutrients are available.[27]

In FDEP's *2012 Integrated Water Quality Assessment for Florida: 2012 305(b) Report and 303(d) List Update*, nutrient pollution is ranked as the fifth major cause of estuary impairments by impaired square miles[28] and the fifth major cause of impairments in coastal waters.[29] FDEP documents nutrient pollution impairments in 754 square miles (482,560 acres) of estuaries (about 14 percent of the estuarine area assessed by Florida) and 102 square miles (65,280 acres) of coastal waters (about 1.6 percent of the assessed coastal waters).[30]

FDEP noted in its *2008 Integrated Water Quality Assessment for Florida: 2008 305(b) Report and 303(d) List Update* that nitrogen and phosphorus pollution poses several challenges in Florida. FDEP stated, "The close connection between surface and groundwater, in combination with the pressures of continued population growth, accompanying development, and extensive agricultural operations, present Florida with a

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[27] Perry, W.B. 2008. Everglades restoration and water quality challenges in south Florida. *Ecotoxicology* 17:569-578.
[28] First, second, third, and fourth major causes of estuary impairments by impaired square miles are mercury in fish, DO, bacteria in shellfish, and fecal coliform, respectively.
[29] FDEP. 2012. *Integrated Water Quality Assessment for Florida: 2012 305(b) Report and 303(d) List Update.* (May 2012). Florida Department of Environmental Protection, Division of Environmental Assessment and Restoration, Tallahassee, FL. <http://www.dep.state.fl.us/water/docs/2012_integrated_report.pdf>. Accessed August 2012.
[30] FDEP. 2012. Integrated Water Quality Assessment for Florida: 2012 305(b) Report and 303(d) List Update. (May 2012). Florida Department of Environmental Protection, Division of Environmental Assessment and Restoration, Tallahassee, FL. <http://www.dep.state.fl.us/water/docs/2012_integrated_report.pdf>. Accessed August 2012.

unique set of challenges for managing both water quality and quantity in the future. After trending downward for 20 years, beginning in 2000 phosphorus levels again began moving upward, likely due to the cumulative impacts of non-point source pollution associated with increased population and development. Increasing pollution from urban stormwater and agricultural activities is having other significant effects."[31]

To better understand the nitrogen and phosphorus pollution problem in Florida, EPA looked at trends in the data Florida uses to create its Integrated Water Quality Reports,[32] and found increasing concentrations of nitrogen and phosphorus compounds in Florida waters over the 12 year period from 1996-2008. Florida's Impaired Waters Rule (IWR) data indicate that levels of total nitrogen have increased approximately 20 percent from a state-wide average of 1.06 mg/L in 1996 to 1.27 mg/L in 2008 and average state-wide total phosphorus levels have increased approximately 40 percent from an average of 0.108 mg/L in 1996 to 0.151 mg/L in 2008.

On a national scale, the primary sources of nitrogen and phosphorus pollution can be grouped into five major categories: (1) urban and suburban stormwater runoff—sources associated with residential and commercial land use and development; (2) municipal and industrial wastewater discharges; (3) row crop agriculture and fertilizer use; (4) livestock production and manure management practices; and (5) atmospheric deposition resulting from nitrogen oxide emissions from fossil fuel combustion and ammonia emissions from row crop agriculture and livestock production. These sources

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[31] FDEP. 2008. *Integrated Water Quality Assessment for Florida: 2008 305(b) Report and 303(d) List Update*. Florida Department of Environmental Protection, Division of Environmental Assessment and Restoration, Tallahassee, FL. <http://www.dep.state.fl.us/water/docs/2008_Integrated_Report.pdf>. Accessed July 2011.
[32] IWR Run 40. Updated through February 2010.

contribute loadings of anthropogenic nitrogen and phosphorus to surface and groundwaters, and may cause harmful impacts to aquatic ecosystems and imbalances in the natural populations of aquatic flora and fauna.[33]

In general, the major sources of nitrogen and phosphorus pollution in Florida estuarine and coastal waters are the same as those found at the national scale: urban and suburban stormwater runoff, wastewater discharges, row crop agriculture, livestock production, and atmospheric deposition. As is the case with much of the southern United States, Florida's population continues to grow, with Florida among the top ten fastest growing states.[34] Florida's population growth is concentrated in major cities and along the coast. As of 2005, Florida's highest population density was along its eastern coast; there has also been significant population expansion along the western coast from Tampa to the south. As populations grow, the increased nitrogen and phosphorus pollution resulting from increased urban stormwater runoff, municipal wastewater discharges, air deposition, and agricultural livestock activities and row-crop runoff can place increased stress on all ecosystems.

In nearly half of the estuaries examined for this rulemaking, urban or stormwater runoff is a major contributor of nitrogen and phosphorus pollution. For example, a report issued in 2010 by the Sarasota Bay Estuary Program indicates that in Sarasota Bay, nutrients are primarily transported to the estuary by stormwater runoff, which is the predominant source in all segments of the estuary (42-60 percent of the total nitrogen

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[33] State-EPA Nutrient Innovations Task Group. 2009. *An Urgent Call to Action: Report of the State-EPA Nutrient Innovations Task Group*. <http://water.epa.gov/scitech/swguidance/standards/criteria/nutrients/upload/2009_08_27_criteria_nutrient_nitgreport.pdf> Accessed May 2012.

[34] U.S. Census Bureau. 2011. *Population Distribution and Change: 2000 to 2010*. <http://www.census.gov/prod/cen2010/briefs/c2010br-01.pdf>. Accessed July 2011.

load).[35] Similarly, according to the Tampa Bay Estuary Program, the largest source of nitrogen to Tampa Bay is also runoff (63 percent of total nitrogen loadings to Tampa Bay from 1999–2003).[36] Impervious land cover is a large driver of stormwater volume. In 2005, one study estimated that 7 percent of Florida's area had total impervious area greater than 20 percent, and of that, a quarter of that land had total impervious area greater than 40 percent. As Florida's population grows, it is likely that the resulting expansion of impervious cover will cause increased harmful impacts on water quality in coastal areas, wetlands, and other aquatic ecosystems.[37]

Wastewater is also a significant contributor of nitrogen and phosphorus pollution. In Florida, there are 443 domestic (not including septic systems) and industrial wastewater dischargers with individual NPDES permits.[38] Of those facilities, 198 are classified as domestic (municipal) wastewater facilities, which treat sanitary wastewater or sewage from homes, businesses, and institutions. The other 245 facilities are classified

[35] SBEP. 2010. *Numeric Nutrient Criteria for Sarasota Bay*. Prepared for the Sarasota Bay Estuary Program by Janicki Environmental, Inc. <http://www.sarasotabay.org/documents/SBEP-NNC-Final-Report.pdf>. Accessed August 2011.

[36] TBEP. No date. *About the Tampa Bay Estuary Program, State of the Bay: Water and Sediment Quality*. Tampa Bay Estuary Program. < http://www.tbep.org/tbep/stateofthebay/waterquality.html>. Accessed January 2012.

[37] Exum, L.R., S.L. Bird, J. Harrison, and C.A. Perkins. 2005. *Estimating and Projecting Impervious Cover in the Southeastern United States*. EPA/600/R-05/061. U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC.

[38] Facilities with NPDES permits either discharge to surface waters or ground waters, using methods that include land application, beneficial reuse of reclaimed water, and deep well injection. USEPA. 2011. Permit Compliance System Database. U.S. Environmental Protection Agency. <http://www.epa.gov/enviro/facts/pcs/customized.html>. Accessed June 2011.
There are also 34,508 dischargers covered under generic or general permits, which FDEP regulates based on categories of wastewater facilities or activities that involve the same or similar types of operations or wastes.

as industrial wastewater facilities. About one third of Florida's population uses on-site sewage treatment and disposal (septic tanks) to treat wastewater.[39]

In Florida, fewer than a quarter of individually permitted domestic and industrial facilities are authorized to discharge to surface waters. The remaining permittees are authorized to discharge solely to groundwater through land-application, beneficial reuse of reclaimed water, or deep well injection. Domestic wastewater treatment facilities permitted by FDEP produce over 1.5 billion gallons of treated effluent and reclaimed water per day, with a total treatment capacity of over 2.5 billion gallons per day. Eighteen percent of domestic wastewater treatment facilities have treatment capacities greater than 500,000 gallons per day, whereas 73 percent of domestic wastewater treatment facilities have capacities less than 100,000 gallons per day.[40]

Wastewater has been cited as contributing to negative impacts on water quality in some areas. On the east coast of Florida, septic systems contribute an estimated 1.5 million pounds of nitrogen per year to Florida's Indian River Lagoon.[41] There have been some successes in reducing the impact of wastewater on marine waters. In Tampa Bay, wastewater treatment plants were one of the major sources of nitrogen prior to the institution of tertiary nitrogen removal. This treatment has contributed to an improvement in Tampa Bay's water quality.[42]

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[39] FDEP. 2011. *General Facts and Statistics about Wastewater in Florida*. Florida Department of Environmental Protection. <http://www.dep.state.fl.us/water/wastewater/facts.htm>. Accessed January 2012.

[40] FDEP. 2011. *Wastewater Program*. Florida Department of Environmental Protection. <http://www.dep.state.fl.us/water/wastewater/index.htm> Accessed January 2012.

[41] USEPA. 2003. *EPA Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems*. EPA-832-B-03-001. U.S. Environmental Protection Agency, Office of Water, Washington, DC. <http://www.epa.gov/owm/septic/pubs/septic_guidelines.pdf>. Accessed August 2011.

[42] Johansson, J.O.R., and H.S. Greening. 2000. Seagrass Restoration in Tampa Bay: A Resource-based

There have been a number of studies examining the sources of nitrogen and phosphorus pollution in waters across Florida. One area of study is Biscayne Bay, located on the southeast coast of Florida, adjacent to Miami. Nutrient pollution in the Bay comes from a number of key sources that vary geographically: stormwater runoff from urban areas, discharges from the Black Point Landfill and Sewage Treatment Plant, agricultural runoff from canals in the South Dade agricultural basin, and contaminated ground water.[43] In the northern section of the Bay, there are inputs from five canals, a landfill, and urban runoff. The southern section of the Bay has a greater contribution from agricultural sources.[44] In one study, researchers found that canals conveying waters from agricultural and urban areas contributed 88 percent and 66 percent of the Bay's total dissolved inorganic nitrogen and total phosphorus loads, respectively.[45]

b. Adverse Impacts of Nitrogen and Phosphorus Pollution on Aquatic Life

Nitrogen and phosphorus pollution in surface and ground waters degrade water quality and negatively impact aquatic life through processes associated with eutrophication.[46] Eutrophication is a predictable, well-understood, and widely-

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Approach to Estuarine Management. Chapter 20 In: *Seagrasses: Monitoring, Ecology, Physiology, and Managemen*t, ed. S.A. Bortone, pp. 279–293. CRC Press, Boca Raton, FL.

[43] Caccia, V.G., and J.N. Boyer. 2007. A nutrient loading budget for Biscayne Bay, Florida. *Marine Pollution Bulletin* 54(7):994–1008.
Caccia, V.G., and J.N. Boyer. 2005. Spatial patterning of water quality in Biscayne Bay, Florida as a function of land use and water management. *Marine Pollution Bulletin* 50(11):1416–1429.

[44] Caccia, V.G., and J.N. Boyer. 2005. Spatial patterning of water quality in Biscayne Bay, Florida as a function of land use and water management. *Marine Pollution Bulletin* 50(11):1416–1429.

[45] Caccia, V.G., and J.N. Boyer. 2007. A nutrient loading budget for Biscayne Bay, Florida. *Marine Pollution Bulletin* 54(7):994–1008.

[46] Eutrophication is the process by which a water body becomes enriched with organic material, which is formed by primary productivity (i.e., photosynthetic activity) and can be stimulated to harmful levels by the anthropogenic introduction of high concentrations of nutrients—particularly nitrogen and phosphorus (National Research Council. 2000. *Clean Coastal Waters: Understanding and Reducing the Effects of Nutrient Pollution*. Report prepared by the Ocean Study Board and Water Science and Technology Board, Commission on Geosciences, Environment and Resources, National Resource Council, Washington, DC. See also Nixon. S.W. 1995. Coastal marine eutrophication: A definition, social causes, and future concerns.

documented biological process by which anthropogenic nitrogen and phosphorus pollution results in increased growth of algae (plankton and periphyton).[47]

Ophelia 41:199-219.)

[47] Cambridge, M.L., J.R. How, P.S. Lavery, and M.A. Vanderklift. 2007. Retrospective analysis of epiphyte assemblages in relation to seagrass loss in a eutrophic coastal embayment. *Marine Ecology Progress Series* 346:97-107.
Frankovich, T.A., and J.W. Fourqurean. 1997. Seagrass epiphyte loads along a nutrient availability gradient, Florida Bay, USA. *Marine Ecology Progress Series* 159:37-50.
Peterson, B.J., T.A. Frankovich, and J.C. Zieman. 2007. Response of seagrass epiphyte loading to field manipulations of fertilization, gastropod grazing and leaf turnover rates. *Journal of Experimental Marine Biology and Ecology* 349(1):61-72.
Howarth, R., D. Anderson, J. Cloern, C. Elfring, C. Hopkinson, B. Lapointe, T. Malone, N. Marcus, K.J. McGlathery, A. Sharpley, and D. Walker. 2000. Nutrient pollution of coastal rivers, bays, and seas. *Issues in Ecology* 7:1-15.
Cloern, J.E. 2001. Our evolving conceptual model of the coastal eutrophication problem. *Marine Ecology Progress Series* 210:223-253.
Elser, J.J., M.E.S. Bracken, E.E. Cleland, D.S. Gruner, W.S. Harpole, H. Hillebrand, J.T. Ngai, E.W. Seabloom, J.B. Shurin, and J.E. Smith. 2007. Global analysis of nitrogen and phosphorus limitation of primary production in freshwater, marine, and terrestrial ecosystems. *Ecology Letters* 10:1135-1142.
Smith, V.H. 2006. Responses of estuarine and coastal marine phytoplankton to nitrogen and phosphorus enrichment. *Limnology and Oceanography* 51(1, part 2): 377–384.
Vitousek, P.M., J.D. Aber, R.W. Howarth, G.E. Likens, P.A. Matson, D.W. Schindler, W.H. Schlesinger, and D.G. Tilman. 1997. Human alteration of the global nitrogen cycle: Sources and consequences. *Ecological Applications* 7(3):737-750.
Bricker, S.B., J.G. Ferreira, and T. Simas. 2003. An integrated methodology for assessment of estuarine trophic status. *Ecological Modelling* 169(1):39-60.
Bricker, S.B., B. Longstaff, W. Dennison, A. Jones, K. Boicourt, C. Wicks, and J. Woerner. 2008. Effects of nutrient enrichment in the nation's estuaries: A decade of change. *Harmful Algae* 8(1):21-32.
Boyer, J.N., C.R. Kelble, P.B. Ortner, and D.T. Rudnick. 2009. Phytoplankton bloom status: Chlorophyll *a* biomass as an indicator of water quality condition in the southern estuaries of Florida, USA. *Ecological Indicators* 9(6, Supplement 1):S56-S67.
Hutchinson, G.E. 1961. The paradox of plankton. *American Naturalist* 95:137-145.
Piehler, M.F., L.J. Twomey, N.S. Hall, and H.W. Paerl. 2004. Impacts of inorganic nutrient enrichment on phytoplankton community structure and function in Pamlico Sound, NC, USA. *Estuarine Coastal and Shelf Science* 61(2):197-209.
Sanders, J.G., S.J. Cibik, C.F. D'Elia, and W.R. Boynton. 1987. Nutrient enrichment studies in a coastal plain estuary: changes in phytoplankton species composition. *Canadian Journal of Fisheries & Aquatic Sciences* 44:83-90.
Parsons, T.R., P.J. Harrison, and R. Waters. 1978. An experimental simulation of changes in diatom and flagellate blooms. *Journal of Experimental Marine Biology and Ecology* 32:285-294.
Paerl, H.W. 1988. Nuisance phytoplankton blooms in coastal, estuarine, and inland waters. *Limnology and Oceanography* 33(4):823-847.
Harding, Jr., L.W. 1994. Long-term trends in the distribution of phytoplankton in Chesapeake Bay: roles of light, nutrients, and streamflow. *Marine Ecology Progress Series* 104:267-291.
Richardson, K. 1997. Harmful or Exceptional Phytoplankton Blooms in the Marine Ecosystem. *Advances in Marine Biology*. 31:301-385.
Hagy, J.D., J.C. Kurtz, and R.M. Greene. 2008. *An Approach for Developing Numeric Nutrient Criteria for a Gulf Coast Estuary*. U.S. Environmental Protection Agency, Office of Research and Development, National Health and Environmental Effects Research Laboratory, Research Triangle Park, NC., EPA 600R-08/004, 44 pp.

Nitrogen and phosphorus pollution increases algal growth that negatively impacts many aspects of ecological communities. As algae growth accelerates in response to nutrient pollution, there may be negative changes in algal species composition and competition among species, leading to harmful, adverse effects, such as the increased growth or dominance of toxic or otherwise harmful algal species.[48] These harmful algal blooms (HABs) can contain undesirable species of diatoms, cyanobacteria, and dinoflagellates, which are known to generate toxins that are a threat to both aquatic life and recreational activities.[49] Many nuisance taxa of algae are also less palatable to aquatic organisms that consume phytoplankton, so prolonged HABs can impact the food supply of the overall aquatic community. More than 100 HAB species have been identified in the United States.[50]

Marine and fresh waters of the United States are increasingly being negatively impacted by HABs.[51] HAB toxins have been linked to illnesses and deaths of marine

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[48] Paerl, H.W. 1988. Nuisance phytoplankton blooms in coastal, estuarine, and inland waters. *Limnology and Oceanography* 33(4):823-847.
Anderson, D.M., P.M. Glibert, and J.M. Burkholder. 2002. Harmful algal blooms and eutrophication: Nutrient sources, composition, and consequences. *Estuaries* 25(4):704-726.
Anderson, D.M., J.M. Burkholder, W.P. Cochlan, P.M. Glibert, C.J. Gobler, C.A. Heil, R.M. Kudela, M.L. Parsons, J.E.J. Rensel, D.W. Townsend, V.L. Trainer, and G.A. Vargo. 2008. Harmful algal blooms and eutrophication: Examining linkages from selected coastal regions of the United States. *Harmful Algae* 8(1):39-53.
[49] Anderson, D.M., P.M. Glibert, and J.M. Burkholder. 2002. Harmful algal blooms and eutrophication: Nutrient sources, composition, and consequences. *Estuaries* 25(4):704-726.
Paerl, H.W. 2002. Connecting atmospheric nitrogen deposition to coastal eutrophication. *Environmental Science & Technology* 36(15):323A-326A.
Anderson, D.M., J.M. Burkholder, W.P. Cochlan, P.M. Glibert, C.J. Gobler, C.A. Heil, R.M. Kudela, M.L. Parsons, J.E.J. Rensel, D.W. Townsend, V.L. Trainer, and G.A. Vargo. 2008. Harmful algal blooms and eutrophication: Examining linkages from selected coastal regions of the United States. *Harmful Algae* 8(1):39-53.
[50] Abbott, G.M., J.H. Landsberg, A.R. Reich, K.A. Steidinger, S. Ketchen, and C. Blackmore. 2009. *Resource Guide for Public Health Response to Harmful Algal Blooms in Florida*. FWRI Technical Report TR-14. Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, St. Petersburg, FL. <http://myfwc.com/research/redtide/task-force/reports-presentations/resource-guide-for-public-health-response-to-harmful-algal-blooms-in-florida/> Accessed June 2011.
[51] Dortch, Q., P. Glibert, E. Jewett, and C. Lopez. 2008. Introduction. Chapter 1 In: *HAB RDDTT 2*

animals, including sea lions, turtles, fish, seabirds, dolphins, and manatees.[52] Diatoms in HABs, such as *Pseudo-nitzschia*, produce domoic acid.[53] Domoic acid has been shown to accumulate in the tissue of mussels, crabs, and fish, causing their predators to become ill or die.[54] Domoic acid poisoning has been reported as the cause of death of humpback whales in the Gulf of Maine in 2003 and sea lions in California's Monterey Bay during May and June of 1998.[55] Other toxin-producing algal species that have been linked to harmful, adverse aquatic life impacts include *Pfisteria piscicida*, which produces several toxins that impact fish and humans[56] and the flagellate *Heterosigma akashiwo* which produces an ichthyotoxin that kills fish.[57]

Secondly, excessive algal growth as a result of nitrogen and phosphorus pollution reduces water clarity, resulting in reduced light availability for macrophytes and

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National Workshop Report, A plan for Reducing HABs and HAB Impacts. eds. Q. Dortch, D.M. Anderson, D.L. Ayres, and P.M. Glibert, pp. 5-12. Woods Hole, MA.

[52] WHOI. 2008. *Marine Mammals*. Woods Hole Oceanographic Institution. <http://www.whoi.edu/redtide/page.do?pid=14215>. Accessed June 2011.
WHOI. 2008. *HAB Impacts on Wildlife*. Woods Hole Oceanographic Institution. <http://www.whoi.edu/redtide/page.do?pid=9682>. Accessed June 2011.
NOAA. 2011. *Overview of Harmful Algal Blooms*. National Oceanic and Atmospheric Administration, Center for Sponsored Coastal Ocean Research. <http://www.cop.noaa.gov/stressors/extremeevents/hab/default.aspx>. Accessed June 2011.

[53] Thessen, A.E., and D.K. Stoecker. 2008. Distribution, abundance and domoic acid analysis of the toxic diatom genus *Pseudo-nitzschia* from the Chesapeake Bay. *Estuaries and Coasts* 31:664-672.

[54] Bushaw-Newton, K.L., and K.G. Sellner. 1999. Harmful Algal Blooms. In: *NOAA's State of the Coast Report*. National Oceanic and Atmospheric Administration, Silver Spring, MD. <http://oceanservice.noaa.gov/websites/retiredsites/sotc_pdf/hab.pdf>. Accessed June 2011.

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[57] Rensel, J.E.J. 2007. *Fish kills from the harmful alga* Heterosigma akashiwo *in Puget Sound: Recent blooms and review*. Prepared for National Oceanic and Atmospheric Administration, Center for Sponsored Coastal Ocean Research, by Rensel Associates Aquatic Sciences, Arlington, Washington, in cooperation with American Gold Seafoods, LLC. <http://www.whoi.edu/fileserver.do?id=39383&pt=2&p=29109>. Accessed January 2012.

seagrasses.[58] Seagrasses cover approximately 2.7 million acres throughout the State and are a central ecological feature of Florida's dynamic, highly productive marine ecosystems.[59] A substantial body of scientific research has linked nitrogen and phosphorus pollution, and subsequent reduced light availability, to seagrass decline. Excessive nutrient inputs increase phytoplankton biomass and thereby increase water column light attenuation, which limits the light available for seagrass photosynthesis. This results in reduced growth and increased mortality of seagrasses. In addition, nitrogen and phosphorus pollution can lead to excess growth of epiphytic algae on seagrasses that blocks the light available to seagrasses and affects seagrass growth.[60] This reduction of seagrass communities, in turn, results in harmful, adverse impacts such as destabilization of sediments, which causes the release of more nutrients into the water column.[61]

The role that nitrogen and phosphorus pollution plays in the decline of seagrass has been studied extensively in Florida.[62] In a report published by USGS in 2001, six of

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Bricker, S.B., B. Longstaff, W. Dennison, A. Jones, K. Boicourt, C. Wicks, and J. Woerner. 2008. Effects of nutrient enrichment in the nation's estuaries: A decade of change. *Harmful Algae* 8(1):21-32.
Boyer, J.N., C.R. Kelble, P.B. Ortner, and D.T. Rudnick. 2009. Phytoplankton bloom status: Chlorophyll *a* biomass as an indicator of water quality condition in the southern estuaries of Florida, USA. *Ecological Indicators* 9(6, Supplement 1):S56-S67.

[59] FFWCC. 2003. *Conserving Florida's Seagrass Resources: Developing a Coordinated Statewide Management Program*. Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, St. Petersburg, FL.

[60] Duarte, C.M. 1991. Seagrass depth limits. *Aquatic Botany* 40(4):363-377.

[61] Boyer, J.N., C.R. Kelble, P.B. Ortner, and D.T. Rudnick. 2009. Phytoplankton bloom status: Chlorophyll a biomass as an indicator of water quality condition in the southern estuaries of Florida, USA. *Ecological Indicators* 9(6, Supplement 1):S56-S67.

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nine Florida estuaries located along the Gulf Coast showed declines in seagrass coverage, the predominant causes of which were nitrogen and phosphorus pollution, dredging, propeller scarring, hydrologic alterations, increased turbidity, and chronic light reduction.[63] Florida Fish & Wildlife Conservation Commission has noted several areas of significant seagrass decline between 1950 and 2000, including 72 percent loss in St. Joseph Sound, 43 percent loss in the northern section of Biscayne Bay near Miami, 40 percent loss in Tampa Bay, 30 percent loss in the Indian River Lagoon, and 29 percent loss in Charlotte Harbor. These losses coincided with population growth in these watersheds, and resulted from human activities such as fertilizer use in residential and agricultural areas and construction projects which contribute high levels of suspended sediments.[64] Several studies have attributed declines in seagrass to excess chlorophyll *a* and phytoplankton in the water column which can increase light attenuation. One study conducted from 1989-1991 found that excess chlorophyll *a* caused light attenuation of 16 to 28 percent across Charlotte Harbor and Tampa Bay. In the same study, the authors noted an overall improvement in seagrass recolonization and areal cover in Hillsborough

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Tomasko, D.A., C.A. Corbett, H.S. Greening, and G.E. Raulerson. 2005. Spatial and temporal variation in seagrass coverage in Southwest Florida: assessing the relative effects of anthropogenic nutrient load reductions and rainfall in four contiguous estuaries. *Marine Pollution Bulletin* 50:797–805.
Orth, R.J., T.J.B. Carruthers, W.C. Dennison, C.M. Duarte, J.W. Fourqurean, K.L. Heck Jr., A.R. Hughes, G.A. Kendrick, W.J. Kenworthy, S. Olyarnik, F.T. Short, M. Waycott, and S.L. Williams. 2006. A global crisis for seagrass ecosystems. *Bioscience* 56:987-996.
Burkholder, J.M., D.A. Tomasko, and B.W. Touchette. 2007. Seagrasses and eutrophication. *Journal of Experimental Marine Biology and Ecology* 350:46-72.
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Bay and other parts of Tampa Bay starting in the late 1980s coinciding with decreased nutrient loading, which resulted in decreased concentrations of chlorophyll *a* and increased water clarity.[65] A later study, which conducted sampling monthly between June 1998 and July 1999, estimated that phytoplankton biomass contributed approximately 29 percent of total water column light attenuation in Lemon Bay, Florida. The authors predicted a continuation in the potential decline of seagrasses with increased urbanization.[66]

Lastly, excessive algal growth also leads to low dissolved oxygen (DO) potentially creating hypoxic and anoxic conditions that cannot support aquatic life and thereby can change the balance of natural populations of aquatic fauna expected to occur.[67] Hypoxia is typically defined as DO < 2 mg/L, and anoxia as DO < 0.1 mg/L.[68] The cause and effect relationship between nitrogen and phosphorus pollution and marine hypoxia is clear and well documented in the scientific literature.[69] Increased nitrogen and phosphorus inputs lead to excessive algal growth and organic matter loading to bottom waters. Bacterial decomposition of the organic matter consumes oxygen and depletes the

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Diaz, R.J. 2001. Overview of hypoxia around the world. *Journal of Environmental Quality* 30(2):275-281.
Diaz, R.J., and R. Rosenberg. 2008. Spreading dead zones and consequences for marine ecosystems. *Science* 321(5891):926-929.

water column of DO.[70] In estuaries and coastal waters, low DO is one of the most widely reported consequences of nitrogen and phosphorus pollution and one of the best predictors of a range of biotic impairments.[71] Low DO causes negative impacts to aquatic life ranging from mortality to chronic impairment of growth and reproduction.[72] When nitrogen and phosphorus pollution creates adverse conditions that result in large hypoxic zones, substantial negative changes in fish, benthic, and plankton communities may occur.[73] This includes avoidance of these areas by fish, mobile benthic invertebrates migrating from the hypoxic area, and fish kills in some systems when fish and other mobile aquatic organisms have nowhere to migrate away from the areas with low DO.[74] This can result in negative changes to the benthic invertebrate community structure of estuaries and coastal areas, with increases of organisms more tolerant of low DO.[75] Even

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[70] Clement, C., S.B. Bricker and D.E. Pirhalla. 2001. Eutrophic Conditions in Estuarine Waters. In: *NOAA's State of the Coast Report*. National Oceanic and Atmospheric Administration, Silver Spring, MD. <http://state-of-coast.noaa.gov/bulletins/html/eut_18/eut.html>. Accessed December 2011.

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Bricker, S.B., C.G. Clement, D.E. Pirhalla, S.P. Orlando, and D.R.G. Farrow. 1999. *National Estuarine Eutrophication Assessment, Effects of Nutrient Enrichment in the Nation's Estuaries*. National Oceanic and Atmospheric Administration, National Ocean Service, Special Projects Office and the National Centers for Coastal Ocean Science. Silver Spring, MD.

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Kidwell, D.M., A.J. Lewitus, S. Brandt, E.B. Jewett, and D.M. Mason. 2009. Ecological impacts of hypoxia on living resources. *Journal of Experimental Marine Biology and Ecology* 381(Supplement 1):S1-S3.

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Baker, S.M., and R. Mann. 1994. Description of metamorphic phases in the oyster *Crassostrea virginica*

intermittent hypoxia can cause shifts in the benthic assemblage to favor resistant or tolerant organisms, which are less desirable food sources, creating unbalanced benthic communities in the hypoxic zone because fish avoid the area.[76] When hypoxia extends into shallow waters, it affects spawning and nursery areas for many important fish species by reducing the habitat available that protects smaller fish and aquatic organisms, especially juveniles, from predation.[77] Hypoxia has been implicated in a recent increase and late-summer dominance of hypoxia-tolerant gelatinous zooplankton (jellyfish and ctenophores) in the Chesapeake Bay and other eastern estuaries.[78] Reduced fishery production in hypoxic zones has been documented in the United States and worldwide.[79]

Hypoxia and anoxia in bottom waters result in anoxia in the surface sediments, which has geochemical consequences including acidification and release of toxic hydrogen sulfide, soluble reactive phosphorus, and ammonia.[80] The sediment of hypoxic

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and effects of hypoxia on metamorphosis. *Marine Ecology Progress Series* 104:91-99.
Baustian, M., and N. Rabalais. 2009. Seasonal composition of benthic macroinfauna exposed to hypoxia in the northern Gulf of Mexico. *Estuaries and Coasts* 32(5):975-983.
Breitburg, D. 2002. Effects of hypoxia, and the balance between hypoxia and enrichment, on coastal fishes and fisheries. *Estuaries* 25(4):767-781.
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[80] Diaz, R.J., and R. Rosenberg. 2008. Spreading dead zones and consequences for marine ecosystems. *Science* 321(5891):926-929.
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zones then becomes a potential source of nutrients that can increase the degree of eutrophication. Systems that have had persistent and chronic hypoxia often fail to recover quickly even after pollution loadings have been reduced.[81] Reduced oxygen also affects a variety of other biogeochemical processes that can negatively impact water quality, such as the chemical form of metals in the water column.[82]

The harmful, adverse impacts of nitrogen and phosphorus pollution on aquatic life have been manifested throughout Florida. The State has been negatively impacted by algal blooms for many years. Red algae, *Laurencia intricata* and *Spyridia filamentosa*; brown algae, *Dictyota sp.* and *Sargassum filipendula*; and green algae, *Enteromorpha sp*., *Codium isthmocladum*, and *Halimeda sp.* grow in the Florida Bay area.[83] At times their increased growth has threatened the commercially important fish, lobster, and shrimp nurseries in the area.[84] Southern Palm Beach and northern Broward counties have been negatively impacted by algal mats made up of *Caulerpa* species since the 1990s. *Caulerpa* species can become overgrown or displace coral, other macroalgae, or sponges. Off Palm Beach County, dive operators and fishermen have reported large amounts of *Caulerpa brachypus* driving fish and lobster away from reefs. Researchers in Florida (e.g., Florida Sea Grant, University of Florida IFAS Extension, University of Central

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waters enhanced by eutrophication. *Nature Geoscience* 4:766–770.

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[84] Anderson, D.M., ed. 1995. *ECOHAB: The Ecology and Oceanography of Harmful Algal Blooms: A National Research Agenda*. Woods Hole Oceanographic Institution, Woods Hole, MA.

Florida, Tampa Bay Estuary Program) and nationally (e.g., National Sea Grant, NOAA) have noted the spread of a related green alga (*Caulerpa taxifolia*) along the California coast, which is illustrative of the potential for future further spread of *C. brachypus* in Florida coastal waters. California is spending millions to eradicate the *C. taxifolia*.[85] *Gambierdiscus toxicus* (a ciguatoxin producer) is found from Palm Beach to the Dry Tortugas and Florida Bay and is suspected to have caused fish kills and disease events.[86] Blooms of *Lyngbya majuscula* were reported in Charlotte Harbor, Cedar Key, Sebastian Inlet, Sarasota Bay, Tampa Bay, Terra Ceia Bay, Palma Sola, Manatee River, and northwest Bradenton in 1999, 2000, and 2002. *Lyngbya majuscula* can form sizeable, floating mats that emit foul odors.[87] In 1991, widespread and persistent blooms of cyanobacteria in Florida Bay coincided with massive sponge die-offs, which negatively impacted the behavior and abundance of populations of juvenile Caribbean spiny lobsters.[88] Two *Pseudo-nitzschia* species found in Florida are *P. calliantha,* which was observed at bloom levels in the northern Indian River Lagoon, and *P. pseudodelicatissima*.[89] *Pseudo-nitzschia* spp. has been observed in Tampa Bay since the

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1960s. *Pseudo-nitzschia* spp. cause amnesic shellfish poisoning in humans and mortality of marine mammals and seabirds.[90]

In addition to being negatively indirectly impacted by algal toxins and decline of seagrass, aquatic life in Florida is directly impacted by hypoxia. In June 2011, a fish kill in Marco Island, Florida was attributed to low dissolved oxygen, resulting from a "mixed" bloom of non-toxic algae and diatoms.[91] In 2010, there were reports of algal blooms and fish kills in the St. Johns River.[92] Spring releases of water from Lake Okeechobee into the St. Lucie Canal resulted in floating mats of toxic cyanobacteria, *Microcystis aeruginosa,* prompting Martin and St. Lucie county health departments to issue public health warnings.[93] A large *Microcystis* bloom was documented in the Lower St. Johns River in 2005, covering a 100 mi (160 km) stretch from Jacksonville to Crescent City.[94] Toxic cyanobacteria *Anabaena circinalis* and *Cylindrospermopsis*

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variability in the distribution of harmful algae species in the Indian River Lagoon, Florida, USA. *Harmful Algae* 10:277-290.
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raciborskii have been implicated in fish kills in the Lower St. Johns River basin.[95] In addition, in June 2009, a large algal bloom stretching more than 14 mi (23 km) was documented in Tampa Bay. This was linked to surface water runoff of nutrients and pollutants (e.g., fertilizers, yard waste, animal feces) that were washed into the bay from recent heavy rains.[96]

Numerous algal blooms, some capable of producing toxins, foul odors, and fish kills, occurred in Florida coastal areas, estuaries, and canals in 2011. Green algae, known as June Grass, were found washing onto local beaches on Okaloosa Island. The algae adhere to swimmers, cover beaches and hinder fishing.[97]

In the Caloosahatchee River and estuary, high algae and salinity levels caused the Olga water treatment plant in Lee County to close in May 2011. Customers complained about unusual tastes and odors in their drinking water. The blue-green algae bloom significantly affected areas from the W.P. Franklin Lock and Dam, upstream through Alva and LaBelle, Florida. The bloom caused fish, bird and shellfish mortalities, and triggered the Lee County Health Department to issue warnings and advisories on water and fish consumption as well as swimming. Toxic blue-green algae species were identified in the bloom, including *Anabaena*, *Oscillatoria* and *Aphanizomenon* sp.[98]

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The Indian River Lagoon also experienced large and prolonged algae blooms. High levels of green algae *Resultor* sp. were found from Titusville to Melbourne and covering the entire Banana River. The algae were thought to be responsible for killing hundreds of fish and inhibiting seagrass growth.[99] A large rust-colored bloom of *Pyrodinium bahamense* formed in Old Tampa Bay in August 2011; the bloom stretched from Safety Harbor to the Howard Frankland Bridge and was thought to be caused by a combination of heat, rain, and fertilizer runoff.[100]

c. Adverse Impacts of Nitrogen and Phosphorus Pollution on Human Health

As noted previously in section II.A.1.b, nitrogen and phosphorus pollution have been explicitly linked to changes in natural algal species composition including increased growth or dominance of toxic or otherwise harmful algal species.[101] Toxins produced by

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[99] Florida Today. 2011, July 18. *Green algae killing fish, seagrass in northern Indian River Lagoon*. 10 News WTSP – Tampa Bay.< http://www.wtsp.com/rss/article/201465/19/Green-algae-killing-fish-seagrass-in-northern-Indian-River-Lagoon>. Accessed December 2011.
[100] Reyes, R. 2011, August 31. *Algae bloom continues to grow in Old Tampa Bay*. Tampa Bay Online. <http://www2.tbo.com/news/breaking-news/2011/aug/31/1/algae-bloom-continues-to-grow-in-old-tampa-bay-ar-254281/>. Accessed December 2011.
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[101] Paerl, H.W. 1988. Nuisance phytoplankton blooms in coastal, estuarine, and inland waters. *Limnology and Oceanography* 33(4):823-847.
Anderson, D.M., P.M. Glibert, and J.M. Burkholder. 2002. Harmful algal blooms and eutrophication: Nutrient sources, composition, and consequences. *Estuaries* 25(4):704-726.

HABs have been linked, through recreational exposure, to adverse human health impacts through ingestion of contaminated seafood, dermal reactions, and respiratory problems.[102] Ingestion of seafood that is contaminated with toxins can cause gastrointestinal, neurological, cardiovascular, and hepatological illnesses. In some severe cases, ingestion of even a small amount of contaminated seafood can result in coma or death.[103]

Nitrogen and phosphorus pollution has been linked to human health impacts in Florida, primarily through illnesses associated with HABs. Although marine HABs occur naturally, increased nutrient loadings and pollution have been linked to increased occurrence of some types of HABs.[104] Significant HAB-caused toxins that have been

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Anderson, D.M., J.M. Burkholder, W.P. Cochlan, P.M. Glibert, C.J. Gobler, C.A. Heil, R.M. Kudela, M.L. Parsons, J.E.J. Rensel, D.W. Townsend, V.L. Trainer, and G.A. Vargo. 2008. Harmful algal blooms and eutrophication: Examining linkages from selected coastal regions of the United States. *Harmful Algae* 8(1):39-53.

[102] WHOI. 2006. *Harmful Algae and Red Tides Primer*. Woods Hole Oceanographic Institution, Woods Hole, MA.
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[103] Bushaw-Newton, K.L., and K.G. Sellner. 1999. Harmful Algal Blooms. In: *NOAA's State of the Coast Report*. National Oceanic and Atmospheric Administration, Silver Spring, MD. <http://oceanservice.noaa.gov/websites/retiredsites/sotc_pdf/hab.pdf>. Accessed June 2011.

[104] Lopez, C.B., Q. Dortch, E.B. Jewett, and D. Garrison. 2008. *Scientific Assessment of Marine Harmful Algal Blooms*. Interagency Working Group on Harmful Algal Blooms, Hypoxia, and Human Health of the Joint Subcommittee on Ocean Science and Technology, Washington, DC.

found in Florida's marine waters include saxitoxins, brevetoxins, ciguatoxins, cyanotoxins, domoic acid, and okadaic acid.[105]

Ciguatoxins lead to Ciguatera fish poisoning (CFP), one of the most commonly reported food borne illnesses caused by a marine biotoxin in the United States,[106] with 176 cases reported to U.S. poison centers in 2009 (22 percent of the total reported cases of food poisoning from seafood toxins).[107] Ciguatoxins are bioaccumulative, causing gastrointestinal, neurological, or cardiovascular symptoms that vary in intensity.[108] In Florida, CFP poses a significant risk to public health.[109] One estimate indicates that approximately 1,300 cases of CFP (reported and unreported cases) occur annually in Florida.[110] The Florida Department of Health (FDOH) reported 8 cases of CFP in 2005, 44 cases in 2006, 34 cases in 2007, and 51 cases in 2008.[111]

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105 Abbott, G.M., J.H. Landsberg, A.R. Reich, K.A. Steidinger, S. Ketchen, and C. Blackmore. 2009. *Resource Guide for Public Health Response to Harmful Algal Blooms in Florida*. FWRI Technical Report TR-14. Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, St. Petersburg, FL. <http://myfwc.com/research/redtide/task- force/reports-presentations/resource-guide-for-public-health-response-to-harmful-algal-blooms-in-florida/>. Accessed June 2011.
106 Dickey, R.W., and S.M. Plakas. 2010. Ciguatera: A public health perspective. *Toxicon* 56:123-136.
107 Bronstein, A.C., D.A. Spyker, L.R. Cantilena, Jr., J.L. Green, B.H. Rumack, and S.L. Giffin. 2009. 2008 Annual Report of the American Association of Poison Control Centers' National Poison Data System (NPDS): 26th Annual Report. *Clinical Toxicology* 48:979–1178.
108 McKee D.B., L.E. Fleming, R. Tamer, R. Weisman, and D. Blythe. 2001. Physician diagnosis and reporting of ciguatera fish poisoning in an endemic area. In: *Harmful Algal Blooms* 2000: Proceedings *of the Ninth International Conference on Harmful Algal Blooms, Hobart, Australia, 7-11 February 2000,*,eds. G.M. Hallegraeff, S.I. Blackburn, C.J. Bolch, and R.J. Lewis, pp. 451-453. Intergovernmental Oceanographic Commission of UNESCO, Paris, France.
109 Abbott,G. M., J. H. Landsberg, A.R. Reich, K.A. Steidinger, S. Ketchen, and C. Blackmore. 2009. *Resource Guide for Public Health Response to Harmful Algal Blooms in Florida.* FWRI Technical Report TR-14. Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, St. Petersburg, FL. <http://myfwc.com/research/redtide/task- force/reports-presentations/resource-guide-for-public-health-response-to-harmful-algal-blooms-in-florida/>. Accessed June 2011.
110 Abbott,G. M., J. H. Landsberg, A.R. Reich, K.A. Steidinger, S. Ketchen, and C. Blackmore. 2009. *Resource Guide for Public Health Response to Harmful Algal Blooms in Florida.* FWRI Technical Report TR-14. Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, St. Petersburg, FL. <http://myfwc.com/research/redtide/task- force/reports-presentations/resource-guide-for-public-health-response-to-harmful-algal-blooms-in-florida/>. Accessed June 2011.
111 Abbott,G. M., J.H. Landsberg, A.R. Reich, K.A. Steidinger, S. Ketchen, and C. Blackmore. 2009. *Resource Guide for Public Health Response to Harmful Algal Blooms in Florida*. FWRI Technical Report TR-14. Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, St.

Saxitoxins lead to paralytic shellfish poisoning (PSP), which occurs when humans eat shellfish contaminated with saxitoxins. These toxins affect the nervous system and in severe cases cause respiratory paralysis.[112] Between January 2002 and May 2004, 28 cases of saxitoxin poisoning associated with puffer fish caught in Florida's Indian River Lagoon (IRL) were reported. In 2002, the Florida Fish and Wildlife Conservation Commission banned the commercial and recreational harvest of puffer fish in several water bodies in Florida and made that ban permanent in 2004.[113] Domoic acid, also produced by HABs, can also cause food poisoning, producing symptoms ranging from mild gastrointestinal discomfort to permanent brain damage and, in rare cases, death.[114]

In addition, elevated levels of nitrate, a byproduct of nitrogen pollution in surface waters, can cause public health concerns if the water is a drinking water source, where [115] nitrate is converted to harmful nitrite after ingestion.[116] The primary human health concern with nitrates and nitrites in drinking water is methemoglobinemia, although

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Petersburg, FL. <http://myfwc.com/research/redtide/task- force/reports-presentations/resource-guide-for-public-health-response-to-harmful-algal-blooms-in-florida/>. Accessed June 2011.

[112] Landsberg, J., F. Van Dolah, and G. Doucette. 2005. Marine and estuarine harmful algal blooms: Impacts on human and animal health. Chapter 8 In: *Oceans and Health: Pathogens in the Marine Environment*. eds. S. Belkin and R.R. Colwell, pp. 165-215. Springer, New York.

[113] Abbott, G.M., J.H. Landsberg, A.R. Reich, K.A. Steidinger, S. Ketchen, and C. Blackmore. 2009. *Resource Guide for Public Health Response to Harmful Algal Blooms in Florida*. FWRI Technical Report TR-14. Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, St. Petersburg, FL. <http://myfwc.com/research/redtide/task- force/reports-presentations/resource-guide-for-public-health-response-to-harmful-algal-blooms-in-florida/>. Accessed June 2011.
Landsberg, J.H., S. Hall, J.N. Johannessen, K.D. White, S.M. Conrad, J.P. Abbott, L.J. Flewelling, R.W. Richardson, R.W. Dickey, E.L.E. Jester, S. M. Etheridge, J.R. Deeds, F.M. Van Dolah, T.A. Leighfield, Y. Zou, C.G. Beaudry, R.A. Benner, P.L. Rogers, P.S. Scott, K. Kawabata, J.L. Wolny, and K.A. Steidinger. 2006. Saxitoxin Puffer Fish Poisoning in the United States, with the First Report of *Pyrodinium bahamense* as the Putative Toxin Source. *Environmental Health Perspectives* 114(10):1502-1507.

[114] NOAA. 2009. *Marine Biotoxins*. National Oceanic and Atmospheric Administration, Northwest Fisheries Science Center. <http://www.nwfsc.noaa.gov/hab/habs_toxins/marine_biotoxins/index.html>. Accessed December 2011.

[115] FDEP. 1998. *Ground-water Quality and Agricultural Land Use in the Polk County Very Intense Study Area (VISA)*. AMR 1998-2. Florida Department of Environmental Protection, Division of Water Facilities. <http://www.dep.state.fl.us/water/ monitoring/docs/facts/fs9802.pdf>. Accessed September 2010.

[116] Gulis. G., M. Czompolyova, and J.R. Cerhan. 2002. An Ecologic Study of Nitrate in Municipal Drinking Water and Cancer Incidence in Trnava District, Slovakia. *Environmental Research* 88:182–187.

adverse thyroid effects have been associated with elevated nitrates as well.[117] Methemoglobinemia, or “blue baby syndrome,” as the name implies, most often affects infants less than six months old (although adults can also be affected) when the ingested nitrate is converted to nitrite in the body that prevents hemoglobin in the blood from delivering oxygen effectively throughout the body. Methemoglobinemia is an acute disease and symptoms can develop rapidly in infants, usually over a period of days. Symptoms include shortness of breath and blueness of the skin, and even death in severe cases. [118]

EPA developed a Maximum Contaminant Level (MCL) of 10 mg/L for nitrate in drinking water and an MCL of 1 mg/L for nitrite.[119] Nitrates are found in groundwater and wells in Florida, ranging from the detection limit of 0.02 mg/L to over 20 mg/L. Elevated nitrate concentrations in groundwater are more common in rural agricultural areas which are often served by private wells. When nitrate occurs at concentrations greater than 1 mg/L, it is considered to be the result of human activities such as application of agricultural fertilizers, disposal of animal wastes, and use of septic tanks.[120] Monitoring of Florida Public Water Supplies from 2004-2011 indicates that

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[117].Fan, A.M., and V.E. Steinberg. 1996. Health implications of nitrate and nitrite in drinking water: an update on methemoglobinemia occurrence and reproductive and development toxicity. *Regulatory Toxicology and Pharmacology* 23(1 Pt 1):35–43.

[118] Manassaram, D.M., L.C. Backer, and D.M. Moll. 2006. A Review of Nitrates in Drinking Water: Maternal Exposure and Adverse Reproductive and Developmental Outcomes. *Environmental Health Perspectives* 114(3):320–327.

FDEP. 2011. *Drinking Water: Inorganic Contaminants*. Florida Department of Environmental Protection. <http://www.dep.state.fl.us/water/drinkingwater/inorg_con.htm>. Accessed November 2011.

[119] USEPA. 2007. *Nitrates and Nitrites: TEACH Chemical Summary*. U.S. Environmental Protection Agency. <http://www.epa.gov/teach/chem_summ/Nitrates_summary.pdf>. Accessed May 2012.

[120] DeSimone, L.A., P.A. Hamilton, and R.J. Gilliom. 2009. *Quality of Water from Domestic Wells in Principal Aquifers of the United States, 1991-2004: Overview of Major Findings*. Circular 1332.U.S. Geological Survey, National Water Quality Assessment Program, Reston, VA. <http://water.usgs.gov/nawqa/studies/domestic_wells/WaterWellJournalArticle_DeSimoneetal2009.pdf>. Accessed November 2011.

exceedances of the nitrate MCL reported by drinking water plants in Florida ranged from 19-34 annually.[121] A study in the late 1980s conducted by Florida Department of Agriculture and Consumer Services (FDACS) and FDEP, analyzed 3,949 shallow drinking water wells for nitrate.[122] Nitrate was detected in 2,483 wells (63%), with 584 wells (15%) above the MCL of 10 mg/L.

d. Adverse Impacts of Nitrogen and Phosphorus Pollution on the Economy

Excessive algal blooms result in a range of economic losses, including lost revenue from impacts to commercial fisheries, recreational fishing and boating trips, and tourism, as well as increased drinking water costs and reduced waterfront property values.[123] More information concerning the costs and benefits of the numeric nutrient criteria proposed in this rule can be found in Section VI.

The economic value of Florida's marine recreational fisheries is higher than any other state in the country. Recreational fishing contributed over $5 billion to Florida's economy in 2006. In the 2008-2009 fiscal year, over 1 million individuals bought a

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Spechler, R.M. 2010. *Hydrogeology and Groundwater Quality of Highlands County, Florida*. Scientific Investigations Report 2010–5097. U.S. Geological Survey, Reston, VA
Dubrovsky, N.M., K.R. Burow, G.M. Clark, J.M. Gronberg, P.A. Hamilton, K.J. Hitt, D.K. Mueller, M.D. Munn, B.T. Nolan, L.J. Puckett, M.G. Rupert, T.M. Short, N.E. Spahr, L.A. Sprague, and W.G. Wilber. 2010. *The Quality of our Nation's Waters—Nutrients in the Nation's Streams and Groundwater, 1992–2004.* Circular 1350. U.S. Geological Survey, National Water Quality Assessment Program, Reston, VA. <http://water.usgs.gov/nawqa/nutrients/pubs/circ1350>. Accessed May 2012.
[121] FDEP. 2012. *Chemical Data for 2004, 2005, 2006, 2007, 2008, 2009, 2010, and 2011*. Florida Department of Environmental Protection. <http://www.dep.state.fl.us/water/drinkingwater/chemdata.htm>. Accessed May 2012.
[122] Southern Regional Water Program. 2010. *Drinking Water and Human Health in Florida*. <http://srwqis.tamu.edu/florida/program-information/florida-target-themes/drinking-water-and-human-health.aspx>. Accessed May 2012.
Obreza, T.A., and K.T. Morgan. 2008. *Nutrition of Florida Citrus Trees*. 2nd ed. SL 253. University of Florida, IFAS Extension. <http://edis.ifas.ufl.edu/pdffiles/SS/SS47800.pdf>. Accessed May 2012.
[123] Dodds, W.K., W.W. Bouska, J.L. Eitzmann, T.J. Pilger, K.L. Pitts, A.J. Riley, J.T. Schloesser, and D.J. Thornbrugh. 2009. Eutrophication of U.S. Freshwaters: Analysis of Potential Economic Damages. *Environmental Science and Technology* 43(1):12-19.

marine recreational fishing license, generating over $29 million in revenue.[124] Similarly, Florida has one of the nation's top producing commercial fisheries. In 2009, Florida's harvest of the top five commercial species of fish and shellfish was worth more than $55 million combined. In total, commercial fishing contributed more than $1 billion to the economy of Florida. Outdoor recreation in Florida (including wildlife-viewing, fishing, and water sports) generates $10.1 billion annually.[125] In 2006, over 3 million Florida residents and 746,000 visitors participated in wildlife-viewing activities, for total retail sales of an estimated $3.1 billion.[126]

At the county level, Monroe County's commercial tourism and fishing industries rely on finfish and shellfish from Florida Bay. Measurable economic losses associated with the changing environmental conditions of the Bay have occurred, primarily from the substantial decline in pink shrimp harvests due to loss of submerged aquatic vegetation (habitat), which was linked to nitrogen and phosphorus pollution as a contributing factor. From 1986 through the early 1990s, employment in commercial fishing declined by about 10 percent, while income of individuals in the industry declined by $16 million. These losses coincided with massive seagrass die-offs in the Bay and blue-green algae blooms.[127]

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[124] FFWCC. No Date. *The Economic Impact of Saltwater Fishing in Florida*. Florida Fish and Wildlife Conservation Commission. <http://myfwc.com/conservation/value/saltwater-fishing>. Accessed December 2011.

[125] FFWCC. No Date. *Economic Impact of Outdoor Recreation*. Florida Fish and Wildlife Conservation Commission.
<http://myfwc.com/conservation/value/outdoor-recreation>. Accessed July 2011.

[126] USFWS. 2008. *2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation: Florida*. FHW/06-FL. U.S. Fish and Wildlife Service. <http://www.census.gov/prod/2008pubs/fhw06-fl.pdf>. Accessed July 2011.

[127] Gorte, R.W. 1994. *The Florida Bay economy and changing environmental conditions*. 94-435 ENR, CRS Report for Congress, Congressional Research Service, The Library of Congress.

HAB toxins can make seafood unsafe for human consumption, leading to an overall reduction in the amount of fish purchased due to the real or perceived threats of contamination.[128] Potential economic impacts from nitrogen and phosphorus pollution in Florida include monetary losses due to depressed fisheries, tourism and property values, and elevated costs to address nutrient impacts (e.g., beach cleanup costs, HAB monitoring).

Seagrass habitats are valuable components of Florida's estuarine and coastal waters. FDEP has estimated that each acre of seagrass is worth $20,255 per year, which would translate to a benefit of $44.6 billion statewide.[129] The nearly 2.2 million acres of seagrass beds in Florida's nearshore waters support fish and shellfish that are economically vital to commercial and recreational businesses in Florida.[130] Some estuary

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[128] Anderson, D.M.. 2008. *Hearing on "Harmful Algal Blooms: The Challenges on the Nation's Coastlines".* Woods Hole Oceanographic Institution. <http://www.whoi.edu/page.do?pid=8916&tid=282&cid=46007>. Accessed December 2011.

[129] USGS. 2001. *Seagrass Habitat In the Northern Gulf of Mexico: Degradation, Conservation, and Restoration of a Valuable Resource*. U.S. Geological Survey, Gulf of Mexico Habitat Program Team, 855-R-04-001. <http://gulfsci.usgs.gov/gom_ims/pdf/pubs_gom.pdf>. Accessed July 2011.
Burkholder, J.M., D.A. Tomasko, and B.W. Touchette. 2007. Seagrasses and eutrophication. *Journal of Experimental Marine Biology and Ecology* 350:46-72.
Waycott, M., C.M. Duarte, T.J.B. Carruthers, R.J. Orth, W.C. Dennison, S. Olyarnik, A. Calladine, J.W. Fourqurean, K.L. Heck, Jr., A.R. Hughes, G.A. Kendrick, W.J. Kenworthy, F.T. Short, and S.L. Williams. 2009. Accelerating loss of seagrasses across the globe threatens coastal ecosystems. *Proceedings of the National Academy of Sciences of the United States of America* 106(30):12377-12381.
Short, F.T., B. Polidoro, S.R. Livingstone, K.E. Carpenter, S. Bandeira, J.S. Bujang, H.P. Calumpong, T.J.B. Carruthers, R.G. Coles, W.C. Dennison, P.L.A. Erftemeijer, M.D. Fortes, A.S. Freeman, T.G. Jagtap, A.H.M. Kamal, G.A. Kendrick, W.J. Kenworthy, Y.A. La Nafie, I.M. Nasution, R.J. Orth, A. Prathep, J.C. Sanciangco, B. van Tussenbroek, S.G. Vergara, M. Waycott, and J.C. Zieman. 2011. Extinction risk assessment of the world's seagrass species. *Biological Conservation*144:1963-1971.
Watson R.A., R.G. Coles, and W.J. Lee Long. 1993. Simulation estimates of annual yield and landed value for commercial penaeid prawns from a tropical seagrass habitat, Northern Queensland, Australia. *Australian Journal of Marine and Freshwater Research* 44:211–219.
Carlson, P., and L. Yarbro. 2008. Seagrass Mapping and Monitoring: Big Bend and Beyond. Presented at Florida Water Resources Monitoring Council Meeting, St. Petersburg, FL, September 24-25, 2008.
Costanza, R., R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R.V. Neill, J. Paruelo, R.G. Raskin, P. Sutton, and M. van den Belt. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387:253–260.

[130] FDEP. 2011. *Celebrate Seagrass Awareness Month*. Florida Department of Environmental Protection. <http://www.dep.state.fl.us/coastal/news/articles/2011/1103_Seagrass.htm>. Accessed June 2011.

experts have attempted to quantify the overall value of individual estuaries in Florida. For example, the Indian River Lagoon National Estuary Program estimated the total value of the Indian River Lagoon at $3.7 billion (2009 dollars). In the study, recreational and non-use values of the lagoon were estimated to increase by nearly $80 million per year (2009 dollars) if there were a significant increase in the amount and diversity of wildlife in the lagoon, as well as increased water quality throughout the system from restoration and water quality improvement projects.[131]

According to a study on the impacts of HABs on beachfront tourism-dependent businesses in the Ft. Walton Beach and Destin areas of Florida, HABs reduced restaurant and lodging revenues by $2.8 million and $3.7 million per month, respectively, representing a 29 percent to 35 percent decline in average monthly revenues.[132]

A study by Mather Economics estimated the effects of water quality on real estate value in the South Florida Water Management District. The aggregate owner-occupied residential real estate value in the 16-county South Florida Water Management District is approximately $976 billion. If water quality (measured by dissolved oxygen levels) can be returned to 1970 levels as a result of restoring the Everglades (a potential 23.4 percent

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Scott, R. 2011. *Seagrass Awareness Month*. Proclamation by Governor Rick Scott of the State of Florida. Florida Department of Environmental Protection. <http://www.dep.state.fl.us/coastal/habitats/seagrass/awareness/Proclamation_2011.pdf>. Accessed June 2011.

[131] USEPA. 2009. *Determining an Estuary's Economic Value*. EPA-842F09001. U.S. Environmental Protection Agency, National Estuary Program, Washington, DC. <http://water.epa.gov/type/oceb/nep/upload/2009_05_28_estuaries_inaction_Efficient_IndianRiver.pdf>. Accessed July 2011.

[132] Larkin, S.L., and C.M. Adams. 2007. Harmful algal blooms and coastal business: economic consequences in Florida. *Society & Natural Resources* 20(9):849-859.

improvement in water quality), the study found that real estate values would increase by $16 billion.[133]

In addition to negatively impacting Florida businesses, nitrogen and phosphorus pollution increases costs for beach cleanup, HAB monitoring, and wastewater treatment. For example, approximately $63,000 was spent annually from 1995-1997 to dispose of red seaweed and fish killed by HAB events that littered 17.5 miles of beach in Sarasota County.[134]

In addition, there are increased costs due to the need to treat polluted sources of drinking water. As an example of increased costs for drinking water treatment, in 1991, Des Moines (Iowa) Water Works constructed a $4 million ion exchange facility to remove nitrate from its drinking water supply. This facility was designed to be used an average of 35–40 days per year to remove excess nitrate levels at a cost of nearly $3,000 per day.[135] In another example, Fremont, Ohio (a city of approximately 20,000) has experienced high levels of nitrate from its drinking water source, the Sandusky River, resulting in numerous drinking water use advisories. An estimated $15 million is needed to build a reservoir (and associated piping) that will allow for selective withdrawal from the river to avoid elevated levels of nitrate and provide storage.[136] By regulating allowable levels of chlorophyll *a* in Oklahoma drinking water reservoirs, the Oklahoma

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[133] McCormick, B., R. Clement, D. Fischer, M. Lindsay, R. Watson. 2010. *Measuring the Economic Benefits of America's Everglades Restoration: An Economic Evaluation of Ecosystem Services Affiliated with the World's Largest Ecosystem Restoration Project*. Prepared for the Everglades Foundation, Palmetto Bay, FL, by Mather Economics, Roswell, GA.

[134] Hoagland, P., D.M. Anderson, Y. Kaoru, and A.W. White. 2002. The economic effects of harmful algal blooms in the United States: estimates, assessment issues, and information needs. *Estuaries* 25:819-837.

[135] Jones, C.S., D. Hill, and G. Brand. 2007. Use a multifaceted approach to manage high sourcewater nitrate. *Opflow* June:20–22.

[136] Taft, Jim, Association of State Drinking Water Administrators (ASDWA). 2009. Personal Communication.

Water Resources Board estimated that the long-term cost savings in averted drinking water treatment for 86 systems would range between $106 million and $615 million if such regulations were implemented.[137] These statistics are illustrative of what treatment to address nitrates and nitrites can cost. Any impacts in Florida would be site-specific and might or might not be comparable to these numbers.

B. Statutory and Regulatory Background

Section 303(c) of the CWA (33 U.S.C. 1313(c)) directs states to adopt WQS for their navigable waters. CWA Section 303(c)(2)(A) and EPA's implementing regulations at 40 CFR 131 require, among other things, that state WQS include the designated use and criteria that protect those uses. EPA regulations at 40 CFR 131.11(a)(1) provide that states shall "adopt those water quality criteria that protect the designated use" and that such criteria "must be based on sound scientific rationale and must contain sufficient parameters or constituents to protect the designated use." In addition, 40 CFR 131.10(b) provides that "[i]n designating uses of a water body and the appropriate criteria for those uses, the state shall take into consideration the water quality standards of downstream waters and ensure that its water quality standards provide for the attainment and maintenance of the water quality standards of downstream waters."

States are also required to review their water quality standards at least once every three years and, if appropriate, revise or adopt new standards (CWA section 303(c)(1)). Any new or revised water quality standards must be submitted to EPA for review and approval or disapproval (CWA section 303(c)(2)(A) and (c)(3)). In addition, CWA

[137] Moershel, Philip, Oklahoma Water Resources Board (OWRB) and Mark Derischweiler, Oklahoma Department of Environmental Quality (ODEQ). 2009. Personal Communication.

section 303(c)(4)(B) authorizes the Administrator to determine, even in the absence of a state submission, that a new or revised standard is needed to meet CWA requirements. The EPA approved the State of Florida's rules (which include criteria for certain estuaries and coastal marine waters) on November 30, 2012. The criteria proposed in this rulemaking protect the uses designated by the State of Florida and implement Florida's narrative nutrient provision at Subsection 62-302.530(47)(b), F.A.C. for the purposes of the CWA. These criteria include numeric values that apply to Florida's estuaries and coastal waters not covered by the newly-approved State WQS, south Florida inland flowing waters, and DPVs to ensure the attainment and maintenance of the water quality standards of downstream estuaries.[138] As explained more fully in Section I.A, EPA does not intend to finalize these DPVs if the district court modifies the Consent Decree consistent with EPA's amended determination that numeric DPVs are not necessary to meet CWA requirements in Florida.

C. Water Quality Criteria

Water quality criteria include three components. The first component is "magnitude," the concentration of a pollutant that can be maintained over time in the ambient receiving water without adversely affecting the designated use that the criteria is intended to support. The second component is "duration," or the time period over which exposure is averaged (i.e., the averaging period) to limit the time of exposure to elevated concentrations. This accounts for the variability in the quality of the ambient water due to

[138] The criteria proposed in this rulemaking do not address or implement Florida's narrative nutrient provision at Subsection 62-302.530(47)(a), F.A.C. Subsection 62-302.530(47)(a), F.A.C. remains in place as an applicable water quality standard for CWA purposes.

variations of constituent inputs, flow, and other factors. The third component is "frequency," or how often the magnitude/duration condition may be exceeded and still protect the designated use. Combining the criterion-magnitude with the duration and frequency prevents harmful effects from infrequent exceedances of the criterion-magnitude by ensuring compensating periods of time during which the concentration is below the criterion-magnitude. When criterion-magnitudes are exceeded for short periods of time or infrequently, aquatic life can typically recover; that is, the designated uses of the water body are typically protected. Designated uses are typically not protected when criterion-magnitudes are exceeded for longer periods of time (i.e., for longer than the specified duration) or more frequently (i.e., more often than the allowed frequency).[139] Use of this magnitude-duration-frequency format allows for some exceedances of the criterion-magnitude concentrations while still protecting applicable designated uses, which is important for pollutants such as nitrogen and phosphorus because their concentrations can vary naturally in the environment.

Under CWA section 304(a), EPA periodically publishes criteria recommendations for use by states in setting water quality criteria for particular parameters to protect recreational and aquatic life uses of waters. Where EPA has published recommended criteria, states have the option of adopting water quality criteria based on EPA's CWA section 304(a) criteria guidance, section 304(a) criteria guidance

[139] USEPA. 1994. *Water Quality Standards Handbook: Second Edition, Chapter 3 – Water Quality Criteria*. EPA-823-B-94-005a. U.S. Environmental Protection Agency, Office of Water, Washington, DC. USEPA 1991. *Technical Support Document for Water Quality-based Toxics Control. Appendix D – Duration and Frequency*. EPA/505/2-90-001. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

modified to reflect site-specific conditions, or other scientifically defensible methods (40 CFR 131.11(b)(1)).

For nitrogen and phosphorus pollution, EPA has published under CWA section 304(a) a series of peer-reviewed, national technical approaches and methods for the development of numeric nutrient criteria for lakes and reservoirs,[140] rivers and streams,[141] and estuarine and coastal marine waters.[142] EPA based the methodologies used to develop numeric nutrient criteria for Florida in this proposed regulation on these published guidance documents, which identify three scientifically defensible approaches for deriving nutrient criteria: (1) the reference condition approach derives criteria from observations collected in reference water bodies or during reference time periods; (2) the mechanistic modeling approach represents contaminant loadings, hydrodynamics, and impacts in aquatic systems using equations that represent physical and ecological processes, calibrated using site-specific data; and (3) the stressor-response approach estimates the relationship between nutrient concentrations and response measures related to a designated use of the water body. These three analytical approaches have been independently peer-reviewed and are appropriate for deriving scientifically defensible numeric nutrient criteria, taking into consideration the method-specific data needs and available data. In addition to these approaches, consideration of established (e.g.,

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[140] USEPA. 2000a. *Nutrient Criteria Technical Guidance Manual: Lakes and Reservoirs.* EPA-822-B-00-001. U.S. Environmental Protection Agency, Office of Water, Washington, DC.
[141] USEPA. 2000b. *Nutrient Criteria Technical Guidance Manual: Rivers and Streams.* EPA-822-B-00-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC.
[142] USEPA. 2001. *Nutrient Criteria Technical Manual: Estuarine and Coastal Marine Waters*. EPA-822-B-01-003. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

published and peer-reviewed) nutrient response thresholds is also an acceptable approach for deriving criteria.[143]

The criteria proposed in this rulemaking implement Florida's narrative nutrient provision at Subsection 62-302.530(47)(b), F.A.C., for the purposes of the CWA as numeric values that apply to, and protect, Class I, II, and III estuaries and coastal waters in Florida and south Florida inland flowing waters. In Florida, water quality criteria established for Class I, II, and III surface waters must protect "fish consumption, recreation and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife."[144] Florida's existing narrative nutrient provision serves to protect Class I, II, and III waters from nitrogen and phosphorus pollution by requiring that "[i]n no case shall nutrient concentration of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna."

After an extensive review of the latest scientific knowledge relating to the impacts of nutrient pollution on aquatic systems, EPA is proposing the use of three biological endpoints – maintenance of seagrasses, maintenance of balanced algal populations, and maintenance of aquatic life (fauna) – as the most sensitive to effectively derive numeric nutrient criteria that will protect Class I, II, and III designated uses from the harmful, adverse effects of nutrient pollution. The endpoint measures that EPA is proposing to use to determine the nutrient concentrations to protect these biological endpoints are light levels to maintain historic depth of seagrass colonization, chlorophyll *a* concentrations associated with balanced phytoplankton biomass, and sufficient DO to maintain aquatic

[143] USEPA. 2000a. *Nutrient Criteria Technical Guidance Manual: Lakes and Reservoirs.* EPA-822-B-00-001. U.S. Environmental Protection Agency, Office of Water, Washington, DC.
[144] Pursuant to Subsection 62-302.400(4), F.A.C.

life. Fish consumption relies on the presence of fish and aquatic life as well as the habitat that supports them, which in turn relies on seagrasses and limited occurrence of nuisance algal blooms. The protection of recreation (both fishing and swimming related uses) relies on the presence of fish and aquatic life as well as limited occurrence of nuisance algal blooms. Lastly, the protection of propagation and maintenance of a healthy, well-balanced population of fish and wildlife relies on the presence of fish and aquatic life as well as the habitat that supports them.

EPA's January 14, 2009 determination addressed Florida's narrative nutrient provision at Subsection 62-302.530(47)(b), F.A.C. As discussed earlier, EPA has proposed and promulgated criteria, in this and other proposals, to implement that provision, which provides that "[i]n no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna. The criteria proposed in this rulemaking do not address or implement Florida's narrative nutrient provision at Subsection 62-302.530(47)(a), F.A.C. which provides that "[t]he discharge of nutrients shall continue to be limited as needed to prevent violations of other standards contained in this chapter. Human-induced nutrient enrichment (total nitrogen or total phosphorus) shall be considered degradation in relation to the provisions of Sections 62-302.300, 62-302.700, and 62-4.242, F.A.C." Subsection 62-302.530(47)(a), F.A.C. remains in place as an applicable WQS for CWA purposes and could result in more stringent nitrogen and phosphorus limits than those proposed in this rule, where necessary to protect other applicable water quality standards in Florida.

D. EPA Determination Regarding Florida and Consent Decree

On January 14, 2009, EPA determined under CWA section 303(c)(4)(B) that new or revised water quality standards in the form of numeric water quality criteria for nitrogen and phosphorus pollution are necessary to meet the requirements of the CWA in the State of Florida. EPA's determination is available at the following website: http://water.epa.gov/lawsregs/rulesregs/florida_consent.cfm.

Subsequently, EPA entered into a Consent Decree with Florida Wildlife Federation, Sierra Club, Conservancy of Southwest Florida, Environmental Confederation of Southwest Florida, and St. Johns Riverkeeper, effective on December 30, 2009, which established a schedule for EPA to propose and promulgate numeric nutrient criteria for Florida's lakes, springs, flowing waters, estuaries, and coastal waters, as well as downstream protection values (DPVs) to protect downstream lakes and estuaries. The Consent Decree provided that if Florida submitted and EPA approved numeric nutrient criteria for the relevant water bodies before the dates outlined in the schedule, EPA would no longer be obligated to propose or promulgate criteria for those water bodies.

E. EPA's Rulemaking and Subsequent Litigation

On December 6, 2010, EPA published a rule finalizing numeric nutrient criteria for Florida's lakes, springs, and flowing waters outside of the South Florida Nutrient Watershed Region (40 CFR 131.43). The 2010 "inland waters rule" was previously scheduled to take effect on March 6, 2012, with the exception of one provision that allowed entities to submit Site-Specific Alternative Criteria (SSAC) effective February 4, 2011. The March 6, 2012 effective date was subsequently extended on two occasions (77

FR 13497 and 77 FR 39949) such that the current effective date of the rule is January 6, 2013. Concurrently with this proposal, EPA is issuing a separate proposed rule to stay the inland waters rule until November 15, 2013. For more information on the proposed stay rule, see http://water.epa.gov/lawsregs/rulesregs/florida_inland.cfm.

Following the publication of the inland waters rule, 12 cases were filed in the U.S. District Court for the Northern District of Florida challenging the rule. The cases, consolidated before Judge Robert Hinkle in the Tallahassee Division of the Northern District, were filed by environmental groups, Florida's State Department of Agriculture, the South Florida Water Management District, and various industry/discharger groups. The challenges alleged that EPA's determination and final inland waters rule were arbitrary, capricious, an abuse of discretion, and not in accordance with the law for a variety of reasons. Oral argument in the case was held on January 9, 2012 before Judge Hinkle.

On February 18, 2012, the Court upheld EPA's January 2009 determination and the final numeric nutrient criteria for Florida's lakes and springs, as well as the site-specific alternative criteria (SSAC) provisions and the provisions for calculating DPVs using either modeling or a default option for an impaired lake that is not attaining its numeric nutrient criteria.[145] With regard to EPA's numeric nutrient criteria for flowing waters (i.e., streams) and the default option to calculate DPVs for unimpaired lakes based on ambient stream nutrient concentrations at the point of entry to the lake, the Court found that EPA had not provided sufficient information in its final rule explaining why or how the criteria or DPV protect against harmful increases, as opposed to any increase, in

[145] Case 4:08-cv-00324-RH-WCS, February 18, 2012.

nutrients. The Court observed that EPA's scientific approach to deriving stream criteria (i.e., the reference condition approach), including the criteria's duration and frequency components, "are matters of scientific judgment on which the rule would survive arbitrary-or-capricious review." The Court also found, however, that EPA had not explained in sufficient detail how the stream criteria would prevent a "harmful increase in a nutrient level". In addition, the Court found that EPA had not explained in sufficient detail how exceedances of the default DPV for unimpaired lakes would lead to "harmful effects" in the downstream lake. Thus, the Court invalidated these two aspects of EPA's final rule and remanded them to the Agency for further action. Concurrently with this proposal, EPA is issuing a separate proposed rule for Florida's streams and DPVs for unimpaired lakes (*Water Quality Standards for the State of Florida's Streams and Downstream Protection Values for Lakes: Remanded Provisions*). For more information on the proposed rule for the remanded provisions, see http://water.epa.gov/lawsregs/rulesregs/florida_inland.cfm.

On several occasions, the court granted EPA's request to modify the deadlines in the December 2009 Consent Decree.[146] Under the revised Consent Decree, EPA is required to propose criteria for Florida's estuaries, coastal waters, and south Florida inland flowing waters by November 30, 2012 and to finalize such criteria by September 30, 2013.

In accordance with the January 14, 2009 determination, the December 30, 2009 Consent Decree, and the subsequent modifications to the deadlines in the December 30, 2009 Consent Decree, EPA is proposing in this notice numeric nutrient criteria for

[146] http://water.epa.gov/lawsregs/rulesregs/florida_consent.cfm

estuaries and coastal waters in the State of Florida, and south Florida inland flowing waters. This proposed rule satisfies EPA's requirement to propose criteria for these three categories of Florida waters by November 30, 2012.

F. Florida Adoption of Numeric Nutrient Criteria and EPA Approval

On June 13, 2012, FDEP submitted new and revised WQS for review by the EPA pursuant to section 303(c) of the CWA. These new and revised WQS are set out primarily in Rule 62-302 of the F.A.C. [Surface Water Quality Standards]. FDEP also submitted amendments to Rule 62-303, F.A.C. [Identification of Impaired Surface Waters], which sets out Florida's methodology for assessing whether waters are attaining State WQS. On November 30, 2012, EPA approved the provisions of these rules submitted for review that constitute new or revised WQS (referred to in this preamble as the "newly-approved State WQS").

Among the newly-approved State WQS are numeric criteria for nutrients that apply to a set of estuaries and coastal marine waters in Florida. Specifically, these newly-approved State WQS apply to Clearwater Harbor/St. Joseph Sound, Tampa Bay, Sarasota Bay, Charlotte Harbor/Estero Bay, Clam Bay, Tidal Cocohatchee River/Ten Thousand Islands, Florida Bay, Florida Keys, and Biscayne Bay. Under the Consent Decree, EPA is relieved of its obligation to propose numeric criteria for these waters.

III. Proposed Numeric Criteria for Florida's Estuaries, Coastal Waters, and South Florida Inland Flowing Waters

In this notice of proposed rulemaking, EPA is proposing numeric nutrient criteria to protect against harmful increases in nutrients, and therefore, protect the designated uses of the State of Florida's Class I, II, and III waters, specifically Florida's estuaries and coastal waters (excluding those contained in Florida's newly-approved State WQS), and south Florida inland flowing waters. This proposed rule also includes downstream protection values (DPVs) to ensure the attainment and maintenance of WQS in downstream estuarine and south Florida marine waters. The proposed criteria and related provisions in this rule reflect a detailed consideration of the best available scientific research, data, and analyses related to the specific circumstances for deriving numeric nutrient criteria in the State of Florida. EPA's actions are consistent with and support existing Florida WQS regulations.

EPA proposes developing numeric nutrient criteria to restore and maintain the balance of natural populations of aquatic flora and fauna in Florida waters. The analytical process that EPA used to derive the proposed criteria consisted of several steps that included (1) classification of the water body systems, (2) subdividing water body systems into smaller segments that have similar chemical, physical, and biological features, (3) review and analysis of biological endpoints, and (4) application of one or more analytical methodologies.

After accounting for the spatial coverage of Florida's newly-approved State WQS, EPA grouped Florida's remaining estuarine and coastal waters according to the natural geographic features of estuarine basins and their associated watersheds (classification). This resulted in 19 estuarine systems and three coastal systems. Next, EPA divided each resulting estuary and coastal system into segments on the basis of similar biological, chemical, and physical attributes (segmentation). Segmentation resulted in 89 estuarine segments among the 19 estuarine systems and 71 coastal segments among the three coastal systems. In the Big Bend region (Ochlockonee Bay to Springs Coast) EPA combined coastal waters with estuarine waters for analysis. The classification serves as an organizing framework for analyses, and the segmentation delineates areas in each estuary or coastal system where the numeric nutrient criteria apply.

EPA is proposing to develop numeric nutrient criteria for Florida's estuarine and coastal waters based on three biological endpoints that are sensitive to changes in nitrogen and phosphorus concentrations. These biological endpoints reflect the water quality conditions necessary to ensure protection of balanced populations of aquatic flora and fauna: (1) maintenance of seagrasses (as measured by water clarity sufficient to maintain historic depth of seagrass colonization), (2) maintenance of balanced algal populations (as measured by chlorophyll *a* concentrations associated with balanced phytoplankton biomass), and (3) maintenance of aquatic life (as measured by levels of dissolved oxygen sufficient to maintain aquatic life). For each water body, EPA derived numeric nutrient criteria based on the most nutrient sensitive of the three endpoints and the sufficiency of data available in each segment.

For each estuary and coastal system, one of three analytical approaches was used to derive numeric nutrient criteria—reference condition, stressor-response (statistical modeling), and mechanistic modeling. In some cases, a secondary approach provided corroborating evidence for the results of the primary analytical methodology. EPA evaluated multiple lines of evidence to determine the analytical approach that was best suited for derivation of numeric nutrient criteria in each estuarine or coastal system. In general, and as discussed in more detail in later Sections of this proposed rule, the reference condition approach was applied when there were sufficient data available to characterize conditions that were representative of and protective of designated uses, the stressor-response approach was applied when there were sufficient data available to statistically quantify relationships between nutrient concentrations and the biological endpoints, and lastly, the mechanistic modeling approach was applied when there were sufficient data and information available to quantify the relationships between nutrient loads and the biological endpoints.

For calculating DPVs for estuaries and south Florida marine waters, EPA is proposing four approaches for setting nitrogen and phosphorus protective levels in a hierarchy that reflects the data and scientific information available, including (1) water quality simulation modeling, (2) reference condition approach, (3) dilution models, and (4) the numeric nutrient criteria in the estuarine segment to which a freshwater stream or canal discharges.

For south Florida EPA is proposing the use of downstream protection values (DPVs) to manage nitrogen and phosphorus pollution in the inland flowing waters and protect the water quality of estuaries and coastal waters downstream. As in estuarine and coastal systems, EPA followed a series of steps to derive criteria in south Florida inland flowing waters, including classification of water bodies, segmentation, review and analysis of biological endpoints, application of analytical methodologies, and development of DPVs. EPA defined south Florida inland flowing waters as inland predominantly fresh surface waters that have been classified as Class I or Class III, which encompasses the waters south of Lake Okeechobee, the Caloosahatchee River (including Estero Bay) watershed, and the St. Lucie watershed. EPA segmented south Florida waters by identifying 22 canal pour points that drain freshwater to each marine segment. To manage nitrogen and phosphorus pollution in the inland flowing waters and protect the water quality of estuaries and coastal waters downstream EPA then screened water quality data at each pour point to prevent the use of upstream water quality data that coincided with a documented downstream impact. EPA then calculated DPVs using the reference condition approach.

In deriving scientifically sound numeric nutrient criteria for this proposed rulemaking, EPA relied on the local technical expertise of various scientific experts in Florida. EPA met and consulted with FDEP's scientific and technical experts during the development of these numeric nutrient criteria as part of an ongoing collaborative process to analyze, evaluate, and interpret a substantial amount of Florida-specific data. EPA carefully evaluated the technical approaches and scientific analyses that FDEP presented as part of their draft approaches to develop numeric nutrient criteria for estuaries within the State. Finally, EPA also carefully considered substantial stakeholder input from twelve public hearings conducted by FDEP during 2010, in addition to working with scientists from several Florida National Estuary Programs (NEPs), Water Management Districts, universities, and other government agencies in Florida.

To further ensure the best use of available data and scientific analyses for deriving criteria, the Agency submitted its potential methods and approaches for an independent, scientific peer review by EPA's Science Advisory Board (SAB) in November 2010. The SAB reviewed the document entitled, *Methods and Approaches for Numeric Nutrient Criteria for Nitrogen/Phosphorus Pollution in Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters*, and submitted their final recommendations to EPA in July 2011.[147] The SAB agreed that a dual nutrient strategy to derive criteria for both nitrogen and phosphorus is warranted. The SAB also found that all of the approaches that EPA proposed for use in this rulemaking (i.e., reference condition, stressor-response, and mechanistic modeling) have utility and recommended that a combination of approaches be used where data and models are available. The SAB provided numerous recommendations to strengthen the application of the approaches to develop numeric nutrient criteria for Florida waters that EPA has used to refine the methods and approaches for deriving the criteria proposed in this rulemaking.[148]

Section III.A provides an overview of the technical elements used to support derivation of the numeric nutrient criteria proposed in this rulemaking for estuaries and coastal waters.[149] The remainder of Section III specifically describes EPA's proposed

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[147] USEPA-SAB. 2011. *Review of EPA's Draft Approaches for Deriving Numeric Nutrient Criteria for Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters*. EPA-SAB-11-010. U.S. Environmental Protection Agency, Science Advisory Board, Washington, DC.
USEPA. 2010. *Methods and Approaches for Deriving Numeric Criteria for Nitrogen/Phosphorus Pollution in Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters.* U.S. Environmental Protection Agency, Office of Water, Washington, DC.
[148]EPA response letter to SAB. <http://yosemite.epa.gov/sab/sabproduct.nsf/fedrgstr_activites/DCC3488B67473BDA852578D20058F3C9/$File/EPA-SAB-11-010_Response_10-26-2011.pdf>. Accessed May 2012.
[149] Additional details are provided in a separate document, the *Technical Support Document for U.S. EPA's Proposed Rule for Numeric Nutrient Criteria for Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters (TSD)*; located at www.regulations.gov, Docket ID No. EPA-HQ-OW-2010-0222.

numeric nutrient criteria for estuaries (Section III.B), coastal waters (Section III.C), and south Florida inland flowing waters (Section III.D). Also included are proposed DPVs for estuaries (Section III.B) and south Florida marine waters (Section III.D).

A. General Information and Approaches

For each group of waters addressed in Section III, EPA is proposing to use system-specific approaches based on the classification and segmentation results for each system (described in detail in Sections III.B, III.C, and III.D) for the derivation of numeric nutrient criteria to ensure that the diversity of unique ecosystems found in each type of water body is taken into consideration. This system-specific approach allows the Agency to consider the physical, chemical, and biological characteristics of a particular water body and to select a scientifically defensible approach, considering the data and information available for each system. This section describes the technical approaches EPA employed to derive the proposed criteria and DPVs, including (1) data and segmentation, (2) biological endpoints, and (3) analytical methodologies.

1. Data Sources and Segmentation

a) Estuaries

Florida's estuarine areas encompass approximately 1,950 square miles. EPA used the IWR Run 40 database[150] to identify available data from a range of sampling sites in Florida's estuaries. To compute relationships between nutrient concentrations and chlorophyll *a*, EPA relied on measurements of Total Kjeldahl Nitrogen (TKN), TN, Nitrate-Nitrite (NO_3-NO_2), TP, and chlorophyll *a* from the IWR Run 40 database. The

[150] Florida's IWR data are the chemical, physical and biological water quality data that FDEP uses to create its integrated reports. IWR Run 40. Updated through February 2010. FL IWR and STORET can be found at: <http://www.dep.state.fl.us/WATER/STORET/INDEX.HTM>

resulting dataset included 180,814 water quality samples, collected at 13,648 sites. The Agency also analyzed additional data submitted by local experts and organizations.

The water quality and biological communities of an estuary are affected by multiple factors related to the shape and size of the estuary, its connections to the ocean, geology, climate, and watershed characteristics (e.g., watershed area and land use). Because each of these factors can vary from one system to another, causing the water quality and aquatic populations of flora and fauna in each estuary to be distinct, EPA proposes to classify 19 individual estuarine systems based on the natural geographic features of estuarine basins and their associated watersheds. This approach has been utilized previously in development of the NOAA Coastal Assessment Framework.[151] This approach is also consistent with a watershed approach to water quality management, which EPA encourages as a way to integrate and coordinate efforts within a watershed in order to most effectively and efficiently assess conditions and implement controls.[152]

EPA is proposing to sub-divide each estuarine system into segments based on physical factors and long-term average salinity gradients. Estuaries are complex and dynamic systems that reflect the mixing of fresh and marine water, and different ecological zones correspond to differences in salinity within each estuary. The estuary segments are expected to have unique physical, chemical, and biological characteristics that may respond differently to nutrient inputs than other segments within the same

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[151] NOAA. 2007. *NOAA's Coastal Geospatial Data Project, Coastal Assessment Framework (CAF).* NOAA/NOS Special Projects Office - Coastal Geospatial Data Project. Silver Spring, MD. <http://coastalgeospatial.noaa.gov/>. Accessed May 2012.

[152] USEPA. 2008. *Handbook for Developing Watershed Plans to Restore and Protect Our Waters.* EPA 841-B-08-002. U.S. Environmental Protection Agency, Office of Water, Washington DC.

estuary.[153] EPA is proposing numeric nutrient criteria for 89 individual segments in 19 estuaries. A detailed description and detailed maps of EPA's proposed within-estuary segments are provided in the TSD (Volume 1: Estuaries, Section 1.3 and for each estuarine system in Section 2).

b) Coastal Waters

There are substantial data available from satellite remote sensing that can be used in a scientifically defensible and reliable way in conjunction with available field monitoring data to derive numeric chlorophyll *a* criteria for coastal waters. Satellite remote sensing technologies have been widely used[154] to measure chlorophyll *a* in approximately 3,865 square miles of coastal waters in Florida. These technologies allow consistent and reliable monitoring of expansive areas of Florida's coastline.

The data EPA used to derive numeric chlorophyll *a* criteria for Florida's coastal waters encompass a twelve year period of record (1998-2009). The length of this data record captures the long-term variability that has been observed in water quality within Florida's coastal waters and allows EPA to take advantage of the available remote sensing data. To obtain chlorophyll *a* measurements from satellite remote sensing (chl_{RS}-*a*), EPA processed data from over 1,000 8-day composites of remotely sensed images from satellite ocean color data. The eight-day binning period is a standard approach based on the satellite orbit repeat period of 16 days for the Sea-viewing Wide Field-of-view

[153] Telesh, I.V., and V.V. Khlebovich. 2010. Principal processes within the estuarine salinity gradient: A review. *Marine Pollution Bulletin* 61(4-6):149-155.
[154] Gregg, W.W., and N.W. Casey. 2004. Global and regional evaluation of the SeaWiFS chlorophyll data set. *Remote Sensing of Environment* 93(4):463-479.

Sensor (SeaWiFS) satellite.[155] EPA also obtained field monitoring TN, TP, and chlorophyll *a* data from FDEP IWR Run 40, the Northeastern Gulf of Mexico Chemical Oceanography and Hydrography Study (NEGOM), the Ecology and Oceanography of Harmful Algal Blooms Research Program (ECOHAB), the Florida Fish and Wildlife Conservation Commission Fish and Wildlife Research Institute (FWRI), NOAA Oceanographic Data Center (NODC), Mote Marine Laboratory, and the SeaWiFS Bio-optical Archive and Storage System (SeaBASS). Field monitoring data included over 5,500 chlorophyll *a* measurements, which were reduced to 1,947 measurements after screening for data quality, as described later in this proposed rule.

EPA is not proposing to derive TN and TP criteria for Florida's coastal waters due to lack of sufficient field monitoring data for TN and TP. Although it would be a more reliable indicator to include TN and TP in combination with chlorophyll *a*, EPA believes that the chlorophyll *a* criteria should protect these Florida waters because chlorophyll *a* can be a sensitive biological parameter that would serve as a signal to the State that nutrient pollution is creating an imbalance in the natural populations of aquatic flora and fauna in Florida's coastal waters. Where EPA has not derived criteria for certain parameters in this proposed rule, due to insufficient scientific evidence to support a protective threshold for numeric nutrient criteria (e.g., TN and TP for the majority of Florida's coastal waters), EPA or the State may consider deriving criteria in the future for those parameters.

[155] Campbell, J.W., J.M. Blaisdell, and M. Darzi. 1995. Volume 32, Level-3 SeaWiFS Data Products: Spatial and Temporal Binning Algorithms. In: *SeaWiFS Technical Report Series*. eds. Hooker, S.B., E.R. Firestone, and J.G. Acker. NASA Technical Memorandum 104566, Vol. 32. National Aeronautics and Space Administration. Greenbelt, MD.

To ensure data quality, EPA screened available field monitoring data to find samples with, at a minimum, metadata for date, time, latitude, longitude, and chlorophyll *a* or light attenuation information. Where multiple samples of chlorophyll *a* at different depths existed, EPA selected the sample closest to the surface in order to provide a better comparison to the remotely sensed data. The monitoring sampling times were also compared to the satellite overpass times. EPA used samples falling within a plus or minus three hour time window to minimize variability between the sample time and satellite overpass time. EPA then compared the satellite chl_{RS}-*a* data to the field monitored chlorophyll *a* data. From this assessment EPA determined that chl_{RS}-*a* accurately represents chlorophyll *a* in coastal waters.

For the purposes of deriving criteria for coastal waters using remote sensing data, EPA is proposing to exclude chl_{RS}-*a* measurements taken during known bloom events of *Karenia brevis* from the statistical distribution of coastal data. *K. brevis* is a dinoflagellate responsible for red tide. Satellites can detect *K. brevis* blooms when cell counts are above 50,000 cells/L. EPA flagged coastal segments with cell counts greater than 50,000 cells/L during an 8-day composite and did not include them in the chl_{RS}-*a* distributions used in criteria derivation.[156] In addition, the same segment was flagged one week prior to and after a bloom detection to provide a temporal buffer as blooms are transported along the coast. This proposed approach is consistent with recommendations from the Agency's Science Advisory Board, which recommended EPA screen out these data points, as they are likely not representative of reference conditions.[157] Analyses of

[156] Heil, C.A., and K.A. Steidinger. 2009. Monitoring, management, and mitigation of *Karenia* blooms in the Eastern Gulf of Mexico. *Harmful Algae* 8:611-617.
[157] USEPA-SAB. 2011. *Review of EPA's draft Approaches for Deriving Numeric Nutrient Criteria for*

cumulative distributions of chl_{RS}-*a* show they are minimally affected by inclusion or removal of observations affected by *K. brevis*.

EPA classified Florida's coastal waters into three main areas: the Florida Panhandle, West Florida Shelf, and Atlantic Coast. These three coastal areas were subdivided into a total of 71 segments based on FDEP's Water Body Identification System (WBIDs), physical factors, the optical properties of the coastal areas, water quality characteristics, and the jurisdictional limits of the Clean Water Act (i.e., three nautical mile seaward limit). A detailed description of EPA's data screening process and a map of the coastal waters are provided in the TSD (Volume 2: Coastal Waters, Section 1.3).

c) Request for Comment on Data and Segmentation

EPA believes the proposed data and segmentation approaches provide a strong foundation for the derivation of numeric nutrient criteria that will protect the designated uses in Florida's estuaries and coastal waters. EPA requests comment on all aspects of these approaches. Additionally, the Agency is soliciting additional relevant data and information to assist in the derivation of numeric nutrient criteria. Relevant data and information includes, but is not limited to: monitoring data for DO, chlorophyll *a*, TN, TP, TKN, dissolved organic nitrogen, dissolved organic phosphorus, dissolved inorganic nitrogen, dissolved inorganic phosphorus, and NO_3-NO_2. EPA also invites comment on the timeframe of the data used to derive criteria for each of the water body types. In addition, EPA requests comment on excluding chl_{RS}-*a* measurements taken during known

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Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters. EPA-SAB-11-010. U.S. Environmental Protection Agency, Science Advisory Board, Washington, DC.

bloom events of *K. brevis* from the statistical distribution of coastal data. EPA also solicits additional available scientific data and information that could be used in the derivation of numeric criteria for nitrogen and phosphorus in coastal waters.

Even though waters were assigned to segments to ensure homogeneity of water quality across different locations within a segment, EPA recognizes that limited variability may still exist across locations within a given segment. EPA also solicits comment on and requests any additional available information regarding the ability of the proposed segmentation approaches to account for the unique water quality conditions that can be found in estuarine and coastal waters throughout the State. Finally, EPA is proposing to derive numeric nutrient criteria using a system-specific approach. EPA requests comment on the spatial scale of the proposed criteria and whether a broader spatial approach would be more appropriate.

2. Biological Endpoints

When deriving numeric nutrient criteria, it is important to identify nutrient-sensitive biological endpoints relevant to particular estuarine and coastal systems. These biological endpoints serve as sensitive measures to identify protective concentrations of TN, TP, and chlorophyll *a* that, in turn, will support balanced natural populations of aquatic flora and fauna and protect the State's designated uses. EPA conducted an extensive evaluation of available scientific literature to select appropriate biological endpoints, reviewing over 800 documents. From this review of the latest scientific knowledge, EPA has determined that maintenance of seagrasses, maintenance of balanced algal populations, and maintenance of aquatic life are three sensitive biological endpoints, which can be measured by water clarity (as it relates to light levels sufficient to maintain historic depth of seagrass colonization), chlorophyll *a*, and DO, respectively, and appropriately used in derivation of numeric nutrient criteria that protect the State's designated uses from harmful increases in nitrogen and phosphorus concentrations. The selection of these biological endpoints was based upon their scientific defensibility; sensitivity to harmful, adverse effects caused by the pollutants nitrogen and phosphorus; and the sufficiency of data available for each.

EPA derived TN, TP, and chlorophyll *a* criteria to: (1) maintain water clarity to achieve seagrass depth of colonization targets, (2) reduce the risk of phytoplankton blooms, and (3) maintain dissolved oxygen concentrations sufficient for balanced, natural aquatic life in Florida's estuaries and coastal waters. As set out more fully in the following discussion, these three biological endpoints provide a scientifically defensible basis upon which to derive numeric nutrient criteria that protect balanced natural populations of aquatic flora and fauna over the full range of estuarine and coastal conditions across Florida; waters that achieve these endpoints support designated uses.

a) Maintenance of Seagrasses

EPA selected the maintenance of seagrasses, as measured by water clarity to maintain historic depth of seagrass colonization, as one biological endpoint and corresponding endpoint measure to derive numeric nutrient criteria for estuaries. Healthy populations of seagrasses serve as widely recognized indicators of biological integrity in estuarine systems and, in turn, of balanced natural populations of aquatic flora and fauna.[158]

[158] Ferdie, M., and J.W. Fourqurean. 2004. Responses of seagrass communities to fertilization along a

Because of the unique conditions that are created within seagrass communities, populations of other aquatic floral and faunal species benefit from the presence and abundance of seagrasses.[159] For example, seagrasses act as nurseries for many species by providing refuge from predators. Seagrasses also improve water quality by trapping suspended sediments, preventing sediment resuspension, and retaining nutrients. Florida's NEPs and FDEP have also used endpoints based on seagrasses to derive their recommended estuarine criteria because of seagrass sensitivity to nutrient pollution.

Seagrass communities depend on a variety of physical, chemical, and biological conditions to thrive. Among these, adequate underwater light availability (as measured by water clarity) is one critical factor for seagrass health. The relationship between water clarity and the depth to which seagrasses grow, known as the depth of colonization, has been well-documented.[160] When seagrasses receive sufficient sunlight, seagrass biomass

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gradient of relative availability of nitrogen and phosphorus in a carbonate environment. *Limnology and Oceanography* 49(6):2082-2094.
Orth, R.J., T.J.B. Carruthers, W.C. Dennison, C.M. Duarte, J.W. Fourqurean, K.L. Heck, A.R. Hughes, G.A. Kendrick, W.J. Kenworthy, S. Olyarnik, F.T. Short, M. Waycott, and S.L. Williams. 2006. A global crisis for seagrass ecosystems. *BioScience* 56(12):987-996.
Doren, R.F., J.C. Trexler, A.D. Gottlieb, and M.C. Harwell. 2009. Ecological indicators for system-wide assessment of the greater everglades ecosystem restoration program. *Ecological Indicators* 9:S2-S16.
Gibson, G.R., M.L. Bowman, J. Gerritsen, and B.D. Snyder. 2000. *Estuarine and Coastal Marine Waters: Bioassessment and Biocriteria Technical Guidance*. EPA 822-B-00-024. U.S. Environmental Protection Agency, Office of Water, Washington, DC.
http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/biocriteria/upload/2009_04_22_biocriteria_States_estuaries_estuaries.pdf. . Accessed November 2011.

[159] Orth, R.J., T.J.B. Carruthers, W.C. Dennison, C.M. Duarte, J.W. Fourqurean, K.L. Heck Jr., A.R. Hughes, G.A. Kendrick, W.J. Kenworthy, S. Olyarnik, F.T. Short, M. Waycott, and S.L. Williams. 2006. A global crisis for seagrass ecosystems. *Bioscience* 56(12):987-996.

[160] Dennison, W.C. 1987. Effects of light on seagrass photosynthesis, growth, and depth distribution. *Aquatic Botany* 27:15-26.
Dennison, W.C., R.J. Orth, K.A. Moore, J.C. Stevenson, V. Carter, S. Kollar, P.W. Bergstrom, and R.A. Batiuk. 1993. Assessing water quality with submersed aquatic vegetation. *BioScience* 43(2):86-94.
Duarte, C.M. 1991. Seagrass depth limits. *Aquatic Botany* 40(4):363-377.
Gallegos, C.L. 1994. Refining habitat requirements of submersed aquatic vegetation: Role of optical models. *Estuaries* 17(1):187-199.
Gallegos, C.L., and W.J. Kenworthy. 1996. Seagrass depth limits in the Indian River Lagoon (Florida, USA): Application of an optical water quality model. *Estuarine, Coastal and Shelf Science* 42(3):267-288.

remains constant or increases over time. Conversely, when incoming light is blocked by substances in the water column, such as phytoplankton, suspended solids, or color, seagrass growth slows or stops. Studies on seagrasses have documented the relationship of nutrient pollution-related accelerated algal growth to declines in available light and subsequent declines in seagrass communities.[161] Since the area within an estuary available for seagrass growth is partially a function of the total area with enough sunlight at sufficient depths to sustain growth, as water clarity decreases and reduces the amount of sunlight that can reach the seagrasses, the available area for seagrass growth also decreases. Hence, the greater the water clarity (and associated available light), the deeper the water that can support seagrass communities and, therefore, the greater the extent of seagrass coverage.

EPA reviewed studies that empirically assessed the relationship between seagrass growth and available light[162] and is proposing that, for Florida, when an average value of 20 percent of the sunlight that strikes the water's surface (incident light) reaches the bottom of the water column (to the depth of seagrass colonization), sufficient light is

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Gallegos, C.L. 2005. Optical water quality of a blackwater river estuary: the Lower St. Johns River, Florida, USA. *Estuarine, Coastal and Shelf Science* 63(1-2):57-72.
Steward, J.S., R.W. Virnstein, L.J. Morris, and E.F. Lowe. 2005. Setting seagrass depth, coverage, and light targets for the Indian River Lagoon system, Florida. *Estuaries and Coasts* 28(6):923-935.

[161] Ferdie, M., and J.W. Fourqurean. 2004. Responses of seagrass communities to fertilization along a gradient of relative availability of nitrogen and phosphorus in a carbonate environment. *Limnology and Oceanography* 49(6):2082-2094.
Orth, R.J., T.J.B. Carruthers, W.C. Dennison, C.M. Duarte, J.W. Fourqurean, K.L. Heck, A.R. Hughes, G.A. Kendrick, W.J. Kenworthy, S. Olyarnik, F.T. Short, M. Waycott, and S.L. Williams. 2006. A global crisis for seagrass ecosystems. *BioScience* 56(12):987-996.

[162] Dennison, W.C., R.J. Orth, K.A. Moore, J.C. Stevenson, V. Carter, S. Kollar, P.W. Bergstrom, and R.A. Batiuk. 1993. Assessing water quality with submersed aquatic vegetation. *BioScience* 43(2):86-94.
Duarte, C.M. 1991. Seagrass depth limits. *Aquatic Botany* 40(4):363-377.
Gallegos, C.L. 1994. Refining habitat requirements of submersed aquatic vegetation: Role of optical models. *Estuaries* 17(1):187-199.
Steward, J.S., R.W. Virnstein, L.J. Morris, and E.F. Lowe. 2005. Setting seagrass depth, coverage, and light targets for the Indian River Lagoon system, Florida. *Estuaries and Coasts* 28(6):923-935.

available to maintain seagrasses. A similar value has been used in previous nutrient management efforts in Florida.[163]

EPA is also proposing that protecting and maintaining water clarity sufficient to support an appropriate depth of colonization provides the greatest protection of balanced natural populations of aquatic flora and fauna since maintenance of seagrass habitat is critical to ecosystem conditions. EPA used available historical seagrass coverage data (including the earliest available, generally 1940-1960, or more recent, 1992) to compute the historical maximum depth of seagrass colonization as a reference. In all cases the most recent (2000-2010) seagrass coverage was also evaluated to determine existing depth of colonization, and to relate this value to existing water quality. To compute seagrass depth of colonization, EPA overlaid seagrass coverage data and bathymetric data compiled by NOAA using a Geographic Information System.[164] EPA then used the data on seagrass coverage to determine the maximum depths that seagrasses have been able to grow in each estuary, where applicable (this approach was not used in some estuaries in Florida that do not have historical evidence of seagrass colonization), in order to identify a reference point for a healthy level of seagrass colonization. Because seagrass habitats support a rich array of biological uses,[165] EPA is proposing to derive numeric nutrient criteria to maintain a comparable depth of seagrass colonization to the reference level (i.e. seagrasses growing at the deepest observed depth of colonization) to ensure

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[163] Janicki, A.J., and D.L. Wade. 1996. *Estimating critical external nitrogen loads for the Tampa Bay estuary: an empirically based approach to setting management targets.* Technical Publication 06-96. Prepared for Tampa Bay National Estuary Program, St. Petersburg, FL, by Coastal Environmental, Inc., St. Petersburg, FL.

[165] Hughes, A.R., S.L. Williams, C.M. Duarte, K.L. Heck, Jr., and M. Waycott. 2009. Associations of concern: declining seagrasses and threatened dependent species. *Frontiers in Ecology and the Environment* 7(5):242-246.

protection of balanced natural populations of aquatic flora and fauna. EPA chose to use the historical maximum observed depth, and resulting areal coverage, because increasing nutrients beyond the point that is protective of maximum coverage of seagrass is likely to cause a decline in seagrass coverage. Because a wide variety of organisms rely on healthy seagrass communities, a decrease in seagrass coverage to levels below the maximum observed depth will result in a decline in overall system health and biodiversity.[166] EPA calculated a water clarity target that would ensure 20% percent of incident light at the surface would be able to reach the reference depth of colonization. Finally, EPA used this water clarity target to derive numeric criteria for TN, TP, and chlorophyll *a* to support balanced natural populations of aquatic flora and fauna. (More detail on the importance of seagrass can be found in the TSD, Volume 1: Estuaries, Section 1.2.1).

b) Maintenance of Balanced Algal Populations

Based upon EPA's extensive review of current scientific literature, EPA selected maintenance of balanced algal populations, as measured by the chlorophyll *a* concentrations associated with balanced phytoplankton biomass, as the second biological endpoint and corresponding endpoint measure to derive numeric nutrient criteria for estuaries and coastal waters. The maintenance of balanced algal populations is an important sensitive biological endpoint because of its responsiveness to nutrient enrichment, integral role in aquatic food webs, well-established use as an integrative

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[166] Hughes, A.R., S.L. Williams, C.M. Duarte, K.L. Heck, Jr., and M. Waycott. 2009. Associations of concern: declining seagrasses and threatened dependent species. *Frontiers in Ecology and the Environment* 7(5):242-246.
Orth, R.J., T.J.B. Carruthers, W.C. Dennison, C.M. Duarte, J.W. Fourqurean, K.L. Heck, A.R. Hughes, G.A. Kendrick, W.J. Kenworthy, S. Olyarnik, F.T. Short, M. Waycott, and S.L. Williams. 2006. A global crisis for seagrass ecosystems. *BioScience* 56(12):987-996.
FFWCC. 2003. *Conserving Florida's Seagrass Resources: Developing a Coordinated Statewide Management Program*. Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute. St. Petersburg, FL.

measure of aquatic ecosystem condition, and correlation with changes in floral composition and subsequent faunal response.[167] Chlorophyll *a* is the endpoint measure of balanced algal populations, and has a long history of use in aquatic ecology as a measure of phytoplankton biomass and production.[168] Elevated chlorophyll *a* concentrations resulting from nutrient pollution-enhanced algal growth and accumulation are a well-documented symptom of eutrophication and the harmful, adverse impacts of nitrogen and phosphorus pollution across the nation, and specifically in Florida (refer to Section II.A for additional information).[169] In most of Florida's coastal and estuarine waters, healthy biological communities depend on balanced natural populations of algae because algae are integral components of aquatic food webs and aquatic nutrient cycling.[170]

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[167] Boyer, J.N., C.R. Kelble, P.B. Ortner, and D.T. Rudnick. 2009. Phytoplankton bloom status: Chlorophyll a biomass as an indicator of water quality condition in the southern estuaries of Florida, USA. *Ecological Indicators* 9s:S56-S67.
Hagy, J.D., J.C. Kurtz, and R.M. Greene. 2008. *An approach for developing numeric nutrient criteria for a Gulf coast estuary.* EPA 600R-08/004. U.S. Environmental Protection Agency, Office of Research and Development, National Health and Environmental Effects Research Laboratory, Gulf Breeze, FL.
Bricker, S.B., C.G. Clement, D.E. Pirhalla, S.P. Orlando, and D.R.G. Farrow. 1999. *National Estuarine Eutrophication Assessment. Effects of Nutrient Enrichment in the Nation's Estuaries*. National Oceanic and Atmospheric Administration, National Ocean Service, Special Projects Office and the National Centers for Coastal Ocean Science, Silver Spring, MD.
See Section B.3 in Appendix B of USEPA. 2010. *Methods and Approaches for Deriving Numeric Criteria for Nitrogen/Phosphorus Pollution in Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters*. U.S. Environmental Protection Agency, Office of Water, Washington, DC.
[168] Wetzel, R.G. 2001. *Limnology: Lakes and River Ecosystems.* 3rd ed. Academic Press, San Diego, CA.
Kalff, J. 2002. *Limnology: Inland Water Ecosystems*. Prentice-Hall, Inc., Upper Saddle River, New Jersey.
[169] Elser, J.J., M.E.S. Bracken, E.E. Cleland, D.S. Gruner, W.S. Harpole, H. Hillebrand, J.T. Ngai, E.W. Seabloom, J.B. Shurin, and J.E. Smith. 2007. Global analysis of nitrogen and phosphorus limitation of primary production in freshwater, marine, and terrestrial ecosystems. *Ecology Letters* 10:1135-1142.
Smith, V.H. 2006. Responses of estuarine and coastal marine phytoplankton to nitrogen and phosphorus enrichment. *Limnology and Oceanography* 51(1 part 2):377–384
[170] Hauxwell, J., C. Jacoby, T. Frazer, and J. Stevely. 2001. *Nutrients and Florida's Coastal Waters: The Links Between People, Increased Nutrients and Changes to Coastal Aquatic Systems*. Florida Sea Grant Report No. SGEB-55. Florida Sea Grant College Program, University of Florida, Gainesville, FL. <http://edis.ifas.ufl.edu/pdffiles/SG/SG06100.pdf>. Accessed June 2011.
NOAA. 2011. *Overview of Harmful Algal Blooms*. National Oceanic and Atmospheric Administration, Center for Sponsored Coastal Research.
<http://www.cop.noaa.gov/stressors/extremeevents/hab/default.aspx>. Accessed June 2011.

Elevated chlorophyll *a* concentrations resulting from nitrogen and phosphorus pollution alter the trophic state of estuarine and coastal waters and increase the frequency and magnitude of algal blooms. EPA evaluated the available scientific literature to determine chlorophyll *a* concentrations indicative of phytoplankton blooms associated with imbalance in natural populations of aquatic flora and fauna. Published reports on chlorophyll *a* concentrations in estuarine waters across the nation, including Florida estuaries, reflect the range of natural trophic states and enrichment. These studies suggest that low algal bloom conditions are defined as maximum chlorophyll *a* concentrations less than or equal to 5 μg/L, medium bloom conditions are defined as maximum chlorophyll *a* concentrations from greater than 5 to 20 μg/L, high bloom conditions are defined as maximum chlorophyll *a* concentrations from greater than 20 to 60 μg/L, and hypereutrophic conditions are defined by maximum bloom concentrations above 60 μg/L.[171] Two Florida estuaries, Florida Bay and Pensacola Bay, were analyzed as a part of a larger NOAA national survey of estuaries. The authors reported the average chlorophyll *a* concentrations were 20 μg/L or less for seven of ten large estuaries nationally, and were especially low for Florida Bay (8 μg/L) and Pensacola Bay (10 μg/L).[172] Other literature regarding phytoplankton blooms indicated similar results.[173]

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[171] Bricker, S.B., J.G. Ferreira, and T. Simas. 2003. An integrated methodology for assessment of estuarine trophic status. *Ecological Modelling* 169(1):39-60.
[172] Glibert, P.M., C.J. Madden, W. Boynton, D. Flemer, C. Heil, and J. Sharp, eds. 2010. *Nutrients in Estuaries: A Summary Report of the National Estuarine Experts Workgroup, 2005–2007*. Report to U.S. Environmental Protection Agency, Office of Water, Washington DC.
[173] OECD. 1982. *Eutrophication of Waters: Monitoring, Assessment and Control*. Organisation for Economic Cooperation and Development, Paris, France.
Painting, S.J., M.J. Devlin, S.J. Malcolm, E.R. Parker, D.K. Mills, C. Mills, P. Tett, A. Wither, J. Burt, R. Jones, and K. Winpenny. 2007. Assessing the impact of nutrient enrichment in estuaries: susceptibility to eutrophication. *Marine Pollution Bulletin* 55:74–90.
Painting, S.J., M.J. Devlin, S.I. Rogers, D.K. Mills, E.R. Parker, and H.L. Rees. 2005. Assessing the suitability of OSPAR EcoQOs for eutrophication vs. ICES criteria for England and Wales. *Marine Pollution Bulletin* 50:1569–1584.

Chlorophyll *a* concentrations associated with hypereutrophic conditions (>60 µg/L) reflect a trophic state that is unnatural for Florida estuaries. While some estuaries in the State are more productive than others, high chlorophyll *a* concentrations (20 to 60 µg/L) also do not appear to reflect balanced conditions in Florida, especially given observed ranges in Florida. Concentrations of chlorophyll *a* in this high range are associated more frequently with loss of seagrass and a shift of algal populations to monoculture or, in other words, a loss in the balance of diverse populations of aquatic flora.[174] Moreover, this concentration range was also associated with conditions where other uses, including recreation, are adversely affected. Based on the range of chlorophyll *a* concentrations indicative of natural algal bloom conditions characteristic of Florida estuaries, as well as the literature on concentrations associated with harmful, adverse conditions for estuarine biota and other use support, EPA is proposing a chlorophyll *a* concentration of 20 µg/L as the water quality target to define a nuisance algal bloom. Thus, estuarine waters with chlorophyll *a* concentrations that exceed this water quality target threshold are indicative of imbalanced populations of aquatic flora and fauna (More detail regarding EPA's analysis can be found in the TSD, Volume 1: Estuaries, Section 1.2.2).

EPA also considered the available scientific research described in this section to establish an allowable frequency of occurrence of phytoplankton blooms, represented by chlorophyll *a* levels greater than 20 µg/L, to further define this endpoint measure. EPA is

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Tett, P., R. Gowen, D. Mills, T. Fernandes, L. Gilpin, M. Huxham, K. Kennington, P. Read, M. Service, M. Wilkinson, and S. Malcolm. 2007. Defining and detecting undesirable disturbance in the context of marine eutrophication. *Marine Pollution Bulletin* 55:282–297.

[174] Bricker, S.B., J.G. Ferreira, and T. Simas. 2003. An integrated methodology for assessment of estuarine trophic status. *Ecological Modelling* 169(1):39-60.

proposing a value of 10% as an allowable frequency of occurrence of phytoplankton blooms, that is, chlorophyll *a* measurements may not exceed 20 µg/L more than 10% of the time. This frequency is also consistent with current nutrient management practices in Florida, such as those utilized in approved Florida TMDLs.

c) Maintenance of Aquatic Life

EPA selected maintenance of aquatic life, as measured by the sufficiency of dissolved oxygen (DO) to maintain aquatic life, as a third biological endpoint and corresponding endpoint measure to derive numeric nutrient criteria for estuaries. DO concentrations are a well-known indicator of the health of estuarine and coastal biological communities. Aquatic animals including fish, benthic macroinvertebrates, and zooplankton depend on adequate levels of DO to survive and grow. These levels may differ depending on the species and life stage of the organism (e.g., larval, juvenile, and adult).[175]

To derive the DO endpoint, EPA conducted an analysis of the dissolved oxygen requirements of sensitive species in Florida using the Virginian Province dissolved oxygen evaluation procedure.[176] This analysis derives DO levels that protect both larval recruitment and growth for aquatic organisms. EPA used the results of this analysis to determine the dissolved oxygen water quality targets considered for numeric nutrient criteria development that would protect sensitive aquatic species in Florida estuaries.

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[175] Diaz, R.J. 2001. Overview of hypoxia around the world. *Journal of Environmental Quality* 30(2):275-281.
Diaz, R.J., and R. Rosenberg. 2008. Spreading dead zones and consequences for marine ecosystems. *Science* 321(5891):926-929.
[176] Vincent, A.M., J. Flippin, E. Leppo, and J.D. Hagy III. Dissolved oxygen requirements of Florida-resident saltwater species applied to water quality criteria development. *In review*.
USEPA. 2000. *Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras*. EPA-822-R-00-012. U.S. Environmental Protection Agency, Office of Water, Washington DC.

EPA is proposing that satisfying three different DO requirements in Florida's estuarine waters would meet the needs of resident sensitive aquatic species, and thus support the maintenance of aquatic life. These requirements are an instantaneous DO concentration of 4.0 mg/L, a daily average DO concentration of 5.0 mg/L, and a bottom water average DO concentration of 1.5 mg/L. Both the instantaneous minimum of 4.0 mg/L and the daily average of 5.0 mg/L are spatial averages over the water column for each estuarine segment. These values and interpretations are consistent with existing Florida DO criteria (Subsection 62-302.530(30), F.A.C.) and FDEP's assessment procedures (Subsection 62-303.320(5), F.A.C.). (More detail on both the existing Florida DO criteria and EPA's analysis can be found in the TSD, Volume 1: Estuaries, Sections 1.2.3 and 1.4.1).

d) Other Endpoints Considered by EPA

EPA considered, but is not proposing to use, the following nutrient-sensitive biological endpoints: (1) harmful algal blooms (HABs), (2) coral, (3) epiphytes, (4) macroinvertebrate and fish indices, (5) macroalgae, (6) *Spartina* marshes (salt-marshes), and (7) the Eastern oyster (*Crassostrea virginica*). EPA did not select these biological endpoints because there was an absence of sufficient data to quantify the link between measurements of these endpoints and nitrogen and phosphorus concentrations. Additional details on these alternative endpoints are provided in Appendix B in the *Methods and Approaches for Deriving Numeric Criteria for Nitrogen/Phosphorus Pollution in Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters*.[177]

e) Request for Comment on Endpoints

[177] USEPA. 2010. *Methods and Approaches for Deriving Numeric Criteria for Nitrogen/Phosphorus Pollution in Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters.* U.S. Environmental Protection Agency, Office of Water, Washington, DC.

EPA believes that maintenance of seagrasses, maintenance of balanced algal populations, and maintenance of aquatic life are the three most appropriate nutrient-sensitive biological endpoints to use to derive numeric nutrient criteria to ensure that nutrient concentrations in a body of water protect balanced natural populations of aquatic flora and fauna, and in turn support designated uses. EPA requests comment regarding the biological endpoints and endpoint measures selected. EPA also solicits additional scientific information on other appropriate endpoints that can be used to protect fish consumption, recreation, and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife in Florida's Class II and III estuarine and coastal waters.

3. Analytical Methodologies

EPA used three analytical approaches to derive TN, TP, and chlorophyll *a* numeric nutrient criteria for different types of waters in Florida. In most of Florida coastal waters, EPA is proposing to use a reference condition approach that utilizes data from waters that support balanced natural populations of aquatic flora and fauna to derive numeric nutrient criteria. In Florida estuaries (including some coastal waters in the Big Bend Coastal region), EPA is proposing to use statistical and mechanistic models to determine protective concentrations of TN, TP, and chlorophyll *a* linked to biological endpoints. Where sufficient data were not available to apply statistical models (i.e., stressor-response approach) in all segments in an estuary, EPA used mechanistic model predictions to derive criteria. In these instances, EPA analyzed the available stressor-response analysis as a second line of evidence, in segments where the data were available.

a) Reference Condition Approach

EPA is proposing to use the reference condition approach to derive numeric nutrient criteria in coastal waters that support balanced natural populations of aquatic flora and fauna. EPA is proposing this approach to derive numeric chlorophyll *a* criteria for Florida's coastal waters because the scientific data and information available were insufficient to establish accurate quantifiable relationships between TN and TP concentrations and harmful, adverse effects due to the limited TN and TP data available. Therefore, EPA is proposing to rely upon the reference condition approach to identify numeric chlorophyll *a* criteria concentrations that protect the designated uses, and avoid any adverse change in natural populations of aquatic flora or fauna in Florida's coastal waters.

The reference condition approach, which has been well documented, peer reviewed, and developed in a number of different contexts,[178] is used to derive numeric nutrient criteria that are protective of applicable designated uses by identifying numeric

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[178] USEPA. 2000a. *Nutrient Criteria Technical Guidance Manual: Lakes and Reservoirs.* EPA-822-B-00-001. U.S. Environmental Protection Agency, Office of Water, Washington, DC.
USEPA. 2000b. *Nutrient Criteria Technical Guidance Manual: Rivers and Streams.* EPA-822-B-00-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC.
Stoddard, J.L., D.P. Larsen, C.P. Hawkins, R.K. Johnson, and R.H. Norris. 2006. Setting expectations for the ecological condition of streams: the concept of reference condition. *Ecological Applications* 16:1267–1276.
Herlihy, A.T., S.G. Paulsen, J. Van Sickle, J.L. Stoddard, C.P. Hawkins, L.L. Yuan. 2008. Striving for consistency in a national assessment: the challenges of applying a reference-condition approach at a continental scale. *Journal of the North American Benthological Society* 27:860–877.
USEPA. 2001. *Nutrient Criteria Technical Manual: Estuarine and Coastal Marine Waters*. EPA-822-B-01-003. U.S. Environmental Protection Agency, Office of Water, Washington, DC.
USEPA-SAB. 2011. *Review of EPA's draft Approaches for Deriving Numeric Nutrient Criteria for Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters*. EPA-SAB-11-010. U.S. Environmental Protection Agency, Science Advisory Board, Washington, DC.

nutrient criteria concentrations occurring in least-disturbed, healthy coastal waters that are supporting designated uses.

To derive the proposed numeric nutrient criteria using the reference condition approach, EPA first selected reference conditions in Florida's coastal waters where the Agency was confident that designated uses are protected. EPA reviewed available monitoring information, peer-reviewed literature, and technical reports to ensure that, where applicable, seagrass beds are healthy, DO is adequate for sensitive species, phytoplankton biomass is balanced, and that any other information relating to the ecosystem indicates that the waters are supporting balanced natural populations of aquatic flora and fauna. EPA also removed data during periods of temporary known human disturbances (e.g., bridge and roadway construction) where natural populations were temporarily affected. Finally, EPA reviewed CWA section 303(d) listings, and removed data associated with impairment listings for chlorophyll *a*, dissolved oxygen, and nutrients, as well as data from coastal segments adjacent to CWA section 303(d) impaired estuary waters, such that the resulting data would reflect unimpaired conditions. EPA only removed data from the period of impairment. The result of this rigorous analysis was a set of reference waters that, although not pristine, reflected healthy conditions that were supporting designated uses, and thus free from harmful, adverse effects on natural populations of aquatic flora and fauna due to nutrient pollution. EPA has confidence that these reference waters are supporting designated uses and balanced natural populations of flora and fauna, and has confidence that if the criteria are attained or maintained at the concentrations that are among the highest observed in these waters, then designated uses and natural populations of aquatic flora and fauna will be protected in coastal waters. Further details regarding data screening can be found in the TSD (Volume 2: Coastal Waters, Section 1.4).

After selecting the reference waters, EPA calculated the annual geometric mean concentrations of chlorophyll *a* for each year of the data record and for each segment.[179] EPA then calculated a normal distribution based on the annual geometric mean chlorophyll *a* concentrations. From this distribution, which represents the population of water quality observations in each segment, EPA selected the 90th percentile as the applicable criteria for each segment. EPA selected the 90th percentile as an appropriate concentration to specify the criterion-magnitude because the Agency is confident that the distribution reflects minimally-impacted, biologically healthy reference conditions, which support the State's Class II and III designated uses. The use of the 90th percentile of chlorophyll *a* is also supported by several eutrophication assessment frameworks in Europe and the U.S, such as the Oslo-Paris Commission "Common Procedure"(OSPAR), Water Framework Directive of the EU, Assessment of Estuarine Trophic Status in the US, and the Marine Strategy Framework Directive used by the European Commission, which identify the 90th percentile as representative of a chlorophyll *a* concentration above which eutrophication is considered ecologically problematic or where an undesirable disturbance to aquatic life and water quality from eutrophication are highly likely to appear.[180] For further information on the use of the reference approach see the TSD (Volume 2, Coastal Waters, Section 1.5.1).

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[179] Geometric means were used for averages in the reference condition, statistical modeling, and mechanistic modeling approaches because concentrations were log-normally distributed.

[180] OSPAR Commission. 2005. *Common Procedure for the Identification of the Eutrophication Status of the OSPAR Maritime Area (Reference Number: 2005-3)*. OSPAR Commission, London.
Ferreira, J.G., J.H. Andersen, A. Borja, S.B. Bricker, J. Camp, M.C. da Silva, E. Garcés, A-S. Heiskanen,

EPA chose not to select the extreme upper end of the distribution (95th or 100th percentile). This is because these highest observed annual average concentrations (i.e., 95th or 100th percentile) have rarely been observed at any reference site and are most likely to be heavily influenced by extreme event factors (e.g., hurricanes, droughts). Thus these highest observed concentrations could be outliers that are not representative of conditions that would typically support designated uses and natural populations of aquatic flora and fauna. Therefore, EPA has less confidence that such highest observed concentrations would continue to be supportive of designated uses and natural populations of aquatic flora and fauna if maintained in all coastal waters at all times.

Alternatively, the selection of a much lower percentile, such as a representation of the central tendency of the distribution (i.e., 50th percentile), would not be appropriate because it would imply that half of the conditions observed at reference sites would not support designated uses and natural populations of aquatic flora and fauna, when EPA's analysis indicates that they do. By setting the criteria at the 90th percentile of the reference condition distribution, EPA believes the designated uses, i.e., natural populations of aquatic flora and fauna, will be protected when these concentrations are attained for the majority of coastal water segments. For those coastal water segments that are shown to accommodate or require higher or lower concentrations, the SSAC provision is provided in EPA's proposed rule as discussed in Section V.C.

C. Humborg, L. Ignatiades, C. Lancelot, A. Menesguen, P. Tett, N. Hoepffner, and U. Claussen. 2011. Overview of eutrophication indicators to assess environmental status within the European Marine Strategy Framework Directive. *Estuarine, Coastal and Shelf Science* 93(2):117-131.
Bricker, S.B., J.G. Ferreira, and T. Simas. 2003. An integrated methodology for assessment of estuarine trophic status. *Ecological Modelling* 169:39–60.
European Commission. 2003. *Common Implementation Strategy for the Water Framework Directive (2000/60/EC): Guidance Document No. 5, Transitional and Coastal Waters-Typology, Reference Conditions and Classification Systems*. European Commission, Working Group 2.4—COAST, Office for Official Publications of the European Communities, Luxembourg.

b) Statistical Modeling

EPA evaluated the data available for each estuary segment in terms of temporal and spatial representativeness to establish whether there were sufficient data to use a statistical model. Where enough monitoring data in estuaries were available, EPA developed statistical models (i.e., stressor-response relationships[181]) that quantified relationships between TN, TP, chlorophyll *a*, and the selected endpoint measures (i.e., water clarity to maintain maximum depth of seagrass colonization and chlorophyll *a* concentrations associated with balanced phytoplankton biomass). There were not enough temporally-resolved DO monitoring data, particularly in pre-dawn hours when dissolved oxygen concentrations are typically lower than during that day[182], in any of the estuaries to permit the use of statistical models to derive criterion values associated with sufficient DO to support aquatic life. Where the available endpoints were shown to be sufficiently sensitive, EPA used these relationships to calculate TN, TP, and chlorophyll *a* concentrations that achieved the selected water quality targets for these endpoints, which serve as measures of balanced natural populations of aquatic flora and fauna.

To determine chlorophyll *a* concentrations supportive of the water clarity depth target to achieve the healthy seagrass endpoint in a segment, EPA estimated the relationship between annual geometric mean chlorophyll *a* concentrations and annual geometric mean water clarity for each segment. Then, EPA computed the chlorophyll *a* criterion as the chlorophyll *a* concentration that was associated with the water clarity

[181] USEPA. 2010. *Using stressor-response relationships to derive numeric nutrient criteria*. EPA-820-S-10-001.U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology, Washington, DC.

[182] D'Avanzo, C., and J.N. Kremer. 1994. Diel Oxygen Dynamics and Anoxic Events in an Eutrophic Estuary of Waquoit Bay, Massachusetts. *Estuaries and Coasts* 17(1B):131-139.

target. In other words, the chlorophyll *a* criterion was determined such that the water quality target for water clarity was achieved on an annual average basis.[183] In some segments, increased annual geometric mean chlorophyll *a* concentrations were not associated with decreased annual geometric mean water clarity, possibly because other factors, such as suspended sediment or colored dissolved organic material, more strongly affected water clarity.[184] In these segments, EPA determined that the water clarity endpoint was not sufficiently sensitive to increased chlorophyll *a*, and therefore, this endpoint was not used to derive a chlorophyll *a* criterion, and associated TN and TP criteria in that segment.

EPA also used stressor-response relationships to derive chlorophyll *a* criteria to maintain balanced algal populations. To this end, EPA used logistic regression to estimate the relationship between annual geometric mean chlorophyll *a* concentrations and the probability of any single chlorophyll *a* measurement exceeding EPA's proposed water quality target of 20 μg/L during the year. Then, EPA derived a chlorophyll *a* criterion from this relationship by selecting the annual geometric mean chlorophyll *a* concentration that ensured that any single chlorophyll *a* measurement would not exceed 20 μg/L more than 10% of the time.

After calculating chlorophyll *a* candidate criteria values necessary to meet the water quality targets for the two biological endpoints for which data were available (maintenance of seagrasses and maintenance of balanced algal populations), in each water body segment, EPA selected the more stringent of the two as the proposed criterion

[183] Dennison, W.C. 1987. Effects of light on seagrass photosynthesis, growth, and depth distribution. *Aquatic Botany* 27:15-26.
[184] Gallegos, C.L. 2005. Optical water quality of a blackwater river estuary: the Lower St. Johns River, Florida, USA. *Estuarine, Coastal and Shelf Science* 63(1-2):57-72.

for that segment to ensure that the proposed chlorophyll *a* criterion would protect both endpoints.

To calculate TN and TP criteria associated with the chlorophyll *a* criterion, EPA estimated the relationship between annual geometric mean TN and TP concentrations and annual geometric mean chlorophyll *a* concentrations for each segment. EPA then used these relationships to compute the TN and TP concentrations that were required to maintain average chlorophyll *a* concentrations at the chlorophyll *a* criterion. In some estuary segments, increased TN or TP concentrations were not associated with increased chlorophyll *a* concentrations, possibly because of differences in the proportion of TP or TN that was composed of biologically unavailable forms of phosphorus or nitrogen, or because of unique physical or hydrological characteristics of the estuary segment.[185] In these segments, EPA determined that chlorophyll *a* concentrations were not sufficiently sensitive to increases in TN or TP concentrations, and therefore, this approach was not used to derive criteria for these segments.

In instances where one of the endpoints was not sufficiently sensitive to increases in TN or TP concentrations the relationship of the other endpoint to TN or TP was examined. If both endpoints were insensitive to TN or TP, then the statistical models were not used to derive candidate criteria for the particular nutrient.

In a limited number of estuary segments, EPA found that the TN, TP, or chlorophyll *a* concentrations that were associated with achieving the water quality targets for the biological endpoints were outside (greater than or less than) the range of TN, TP, or chlorophyll *a* concentrations observed in the available data for the estuary. In other

[185] USEPA. 2001. *Nutrient Criteria Technical Manual: Estuarine and Coastal Marine Waters*. EPA-822-B-01-003. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

words, in these situations, using statistical models to derive numeric nutrient criteria would require EPA to extrapolate the TN, TP, and chlorophyll *a* relationships beyond the range of available data. Because of the uncertainty inherent in conducting such extrapolations, EPA is proposing instead to set numeric nutrient criteria derived from these statistically modeled relationships at the 90^{th} percentile or 10^{th} percentile limit of the distribution of available data instead of deriving criteria outside the range of data observations.[186] For example, if the statistically modeled value for TP associated with achieving all water quality targets to meet the biological endpoints in an estuary segment was less than the 10^{th} percentile of annual average values of TP observed in that segment, EPA is proposing to set the criterion value at the 10^{th} percentile of annual average values of TP. This approach defines criterion values that maintain balanced natural populations of aquatic flora and fauna within the limits of available data and is consistent with EPA's reasoning for the selection of the 90^{th} percentile when using the reference condition approach. EPA requests comment on whether to extrapolate stressor-response relationships beyond the range of available data. For further information on the use of statistical modeling approach, see the TSD (Volume 1: Estuaries, Section 1.4.2 and Appendix B).

c) Mechanistic Modeling

EPA also quantified relationships between nitrogen and phosphorus loads and the three biological endpoints using a coupled system of watershed models and estuarine hydrodynamic and water quality models. These models simulated the physical, chemical, and biological processes in a watershed-estuarine system. EPA first used the watershed

[186] USEPA. 2010. *Using Stressor-response Relationships to Derive Numeric Nutrient Criteria*. EPA-820-S-10-001. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

models to develop estimates of TN, TP, and freshwater inputs to the estuary. Next, EPA used the estuarine hydrodynamic and water quality models to simulate estuarine water quality responses to the watershed inputs, including changes in estuarine TN, TP, and chlorophyll *a* concentrations, water clarity, and DO. Then, EPA utilized these models to determine concentrations of TN and TP that would protect the most nutrient-sensitive biological endpoint to derive the numeric nutrient criteria.

To select the appropriate models, EPA developed an inventory of watershed and estuary models that have been applied previously to estuaries in Florida, including models developed by FDEP.[187] Based on the results of the review, EPA selected the Loading Simulation Program in C++ (LSPC)[188] to simulate freshwater flows and nutrient loading from watersheds, the Environmental Fluid Dynamics Code (EFDC)[189] to simulate estuarine hydrodynamics, and the Water Quality Analysis Simulation Program (WASP)[190] to simulate estuarine water quality.[191]

LSPC can continuously simulate the hydrologic and water quality processes on pervious and impervious land surfaces, in streams, and in well-mixed impoundments throughout the watershed and can provide daily estimates of stream flow, TN, and TP concentrations entering the estuary. In addition, LSPC is publicly available and has been

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[187] Wolfe, S.H. 2007. *An Inventory of Hydrodynamic, Water Quality, and Ecosystem Models of Florida Coastal and Ocean Waters*. Florida Department of Environmental Protection, Tallahassee, Florida.
[188] USEPA. 2011. *Loading Simulation Program in C++ (LSPC)*. http://www.epa.gov/athens/wwqtsc/html/lspc.html. Accessed December 2011.
[189] USEPA. 2011. *Environmental Fluid Dynamics Code (EFDC)*. http://www.epa.gov/athens/wwqtsc/html/efdc.html. Accessed December 2011.
[190] USEPA. 2011. *Water Quality Analysis Simulation Program (WASP)*. http://www.epa.gov/athens/wwqtsc/html/wasp.html. Accessed December 2011.
[191] USEPA. 2010. *Methods and Approaches for Deriving Numeric Criteria for Nitrogen/Phosphorus Pollution in Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters.* U.S. Environmental Protection Agency, Office of Water, Washington, DC.

peer reviewed.[192] LSPC has been successfully applied for water quality management purposes to many watersheds throughout the southeastern United States and Florida. Therefore, EPA is proposing to apply the LSPC model to the watersheds in Florida outside of the South Florida Nutrient Watershed Region.

EFDC and WASP have been applied in conjunction to simulate hydrodynamics and water quality (respectively) for many water quality management projects throughout the southeastern United States and Florida. EFDC and WASP are also publicly available and have undergone peer review.[193] Based on the extensive use of these models for similar applications and their acceptance in the scientific community, EPA is proposing to use the EFDC and WASP models to derive numeric nutrient criteria for Florida's estuaries.

For estuaries where monitoring data were insufficient to calculate criteria using the statistical models, EPA mechanistically modeled the conditions in each system and corresponding watershed that occurred from 2002-2009 using all available, screened data. EPA evaluated data over the historic period of record and is proposing to use 2002 through 2009 as a representative modeling period because complete, continuous flow and water quality data were available. This period also reflects the range of hydrology and meteorology observed over the historic period of record across the Florida estuaries.

EPA then used relationships between TN, TP, and biological endpoints quantified by the mechanistic models to derive numeric nutrient criteria. That is, EPA

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[192] USEPA-SAB. 2011. *Review of EPA's draft Approaches for Deriving Numeric Nutrient Criteria for Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters*. EPA-SAB-11-010. U.S. Environmental Protection Agency, Science Advisory Board, Washington, DC.
[193] USEPA-SAB. 2011. *Review of EPA's draft Approaches for Deriving Numeric Nutrient Criteria for Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters*. EPA-SAB-11-010. U.S. Environmental Protection Agency, Science Advisory Board, Washington, DC.

determined the concentrations of TN and TP that were associated with meeting all biological endpoints in each segment.

Because estuaries differ in their physical, chemical, and hydrological characteristics, EPA expected that differences would exist in the degree to which different biological endpoints respond to changes in nutrient concentration. For example, in certain estuaries, high concentrations of colored dissolved organic material (CDOM) occur naturally and reduce water clarity. Because of the influence of CDOM in these estuarine systems, changes in TN, TP, and chlorophyll *a* are not strongly associated with changes in water clarity. In these systems, the water clarity endpoint does not appear to be sensitive to changes in nutrients, and therefore, the water clarity endpoint does not provide useful information for the purposes of deriving numeric nutrient criteria in these systems. In each estuarine system, EPA used output from mechanistic models and available monitoring data to evaluate the sensitivity of each endpoint measure to changes in nutrients. This analysis was used to determine which endpoints were most critical to determine protective nutrient concentrations. Endpoints that were found to be insensitive to changes in nutrient concentrations in a particular estuarine system were not considered further in deriving numeric nutrient criteria for a system. Numeric nutrient criteria for each system were based on the modeled scenario in which the remaining endpoint measures were met during the modeled period, calculated as annual geometric means for each year during the modeled period. Criteria were calculated using the 90th percentile of the annual geometric means from the modeled years for the model scenario meeting all appropriate endpoints. EPA selected the 90th percentile to account for natural variability in the data to represent the upper bound of conditions supporting designated uses. The selection of the 90th percentile is appropriate for the same reasons as when using the reference condition approach. For further information on the use of the mechanistic modeling approach, see the TSD (Volume 1: Estuaries, Section 1.4.1).

d) Request for Comment on Analytical Methodologies

EPA believes that the three proposed analytical methodologies used in combination result in numeric nutrient criteria that are supportive of balanced natural populations of aquatic flora and fauna, and thus protect Class II and III estuarine and coastal waters in the State of Florida from nutrient pollution. These analytical methodologies utilized the latest scientific knowledge, nutrient sensitive endpoints, and the best available data. The Agency requests comment on the application of the proposed methodologies and whether these methodologies are appropriate to derive criteria protective of designated uses in Florida's estuaries and coastal waters. Specifically, EPA is soliciting comment and any scientific information on the use of these approaches in areas where there may be other factors present in addition to nutrients that may also affect the three biological endpoints by attenuating light in similar ways as chlorophyll *a* (e.g., colored dissolved organic matter (CDOM) or suspended sediments). EPA is also requesting comment on the procedures used to screen data to identify reference conditions that are supporting balanced natural populations of aquatic flora and fauna.

B. Proposed Numeric Criteria for Estuaries

1. Introduction

EPA is proposing to use a system-specific approach to derive numeric nutrient criteria for estuaries to ensure that the unique physical, chemical, and biological characteristics of each estuarine ecosystem are taken into consideration.[194]

2. Proposed Numeric Criteria (Estuaries)

EPA is proposing numeric TN, TP, and chlorophyll *a* criteria for 89 discrete segments within 19 estuarine systems in Florida (Table III.B-1). These include Class II and III waters under Florida law (Section 62-302.400, F.A.C.); EPA did not find any Class I estuarine waters in Florida. The 19 estuaries include seven systems in the Florida Panhandle region, four systems in the Big Bend region, and eight systems along the Atlantic coast. Maps showing the locations of these estuarine systems and EPA's proposed within-estuary segments are provided in the TSD (Volume 1: Estuaries, Section 1.3 and Section 2).

In some areas a gap may exist between maps used by Florida and EPA to show where criteria apply. In areas where a gap exists between EPA's proposed criteria and Florida's numeric criteria, EPA proposes that Florida's numeric criteria from the adjacent estuary or marine segment apply (see Section 62-302.532, F.A.C. for values). EPA proposes that Florida's criteria from the northernmost segment of Clearwater Harbor/St Joseph Sound (Subsection 62-302.532(a)1., F.A.C.) apply to the waters between that segment and the southernmost segment of EPA's Springs Coast estuary system. EPA proposes that Florida's numeric criteria from the northernmost segment of Biscayne Bay

[194] USEPA. 2001. *Nutrient Criteria Technical Manual: Estuarine and Coastal Marine Waters*. EPA-822-B-01-003. U.S. Environmental Protection Agency, Office of Water, Washington, DC.
Glibert, P.M. ,C.J. Madden, W. Boynton, D. Flemer, C. Heil, and J. Sharp, eds. 2010. *Nutrients in Estuaries: A Summary Report of the National Estuarine Experts Workgroup, 2005–2007*. Report to U.S. Environmental Protection Agency, Office of Water, Washington DC.

(Subsection 62-302.532(h)5., F.A.C.) apply to the waters of the intercoastal waterway between that segment and the southernmost segment of EPA's Lake Worth Lagoon estuary system.

In other areas a gap may exist within estuaries covered by Florida's numeric criteria. In these areas, EPA proposes that Florida's criteria from the adjacent estuary or marine segment to the south apply to that gap. EPA proposes that Florida's criteria from (1) the upper Lemon Bay segment (Subsection 62-302.532(d)2., F.A.C.) apply to the segment between the upper Lemon Bay segment and the Dona/Roberts Bay segment (Subsection 62-302.532(d)1., F.A.C.), (2) the Tidal Cocohatchee River segment (Subsection 62-302.532(e)1., F.A.C.) apply to the waters between the Tidal Cocohatchee River segment and the Estero Bay segment (Subsection 62-302.532(d)9., F.A.C.), (3) the Clam Bay segment (Subsection 62-302.532(j)., F.A.C.) apply between the Clam Bay segment and the Tidal Cocohatchee River segment (Subsection 62-302.532(e)1., F.A.C.), and (4) the Naples Bay segment (Subsection 62-302.532(e)4., F.A.C.) apply to the segment between the Naples Bay segment and the Clam Bay Segment (Subsection 62-302.532(j)., F.A.C.). For further information regarding the derivation and protectiveness of Florida's criteria, see http://water.epa.gov/lawsregs/rulesregs/florida_index.cfm.

Table III.B-1. EPA's Proposed Numeric Criteria for Florida's Estuaries (in geographic order from northwest to northeast)

			Proposed Criteria		
Perdido Bay	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-*a**[1] (µg/L)
	Upper Perdido Bay	0101	0.59	0.042	5.2
	Big Lagoon	0102	0.26	0.019	4.9
	Central Perdido Bay	0103	0.47	0.031	5.8

	Lower Perdido Bay	0104	0.34	0.023	5.8
Pensacola Bay	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Blackwater Bay	0201	0.53	0.022	3.9
	Upper Escambia Bay	0202	0.43	0.025	3.7
	East Bay	0203	0.50	0.021	4.2
	Santa Rosa Sound	0204	0.34	0.018	4.1
	Lower Escambia Bay	0205	0.44	0.023	4.0
	Upper Pensacola Bay	0206	0.40	0.021	3.9
	Lower Pensacola Bay	0207	0.34	0.020	3.6
	Santa Rosa Sound	0208	0.33	0.020	3.9
	Santa Rosa Sound	0209	0.36	0.020	4.9
Choctawhatchee Bay	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Eastern Choctawhatchee Bay	0301	0.47	0.025	8.1
	Central Choctawhatchee Bay	0302	0.36	0.019	3.8
	Western Choctawhatchee Bay	0303	0.21	0.012	2.4
St. Andrews Bay	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	East Bay	0401	0.31	0.014	4.6
	St. Andrews Sound	0402	0.14	0.009	2.3
	Eastern St. Andrews Bay	0403	0.24	0.021	3.9
	Western St. Andrews Bay	0404	0.19	0.016	3.1
	Southern St. Andrews Bay	0405	0.15	0.013	2.6
	North Bay 1	0406	0.22	0.012	3.7
	North Bay 2	0407	0.22	0.014	3.7
	North Bay 3	0408	0.21	0.016	3.4
	West Bay	0409	0.23	0.022	3.8
St. Joseph Bay	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	St. Joseph Bay	0501	0.25	0.018	3.8

	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
Apalachicola Bay	St. George Sound	0601	0.53	0.019	3.6
	Apalachicola Bay	0602	0.51	0.019	2.7
	East Bay	0603	0.76	0.034	1.7
	St. Vincent Sound	0605	0.52	0.016	11.9
	Apalachicola Offshore	0606	0.30	0.008	2.3
Alligator Harbor	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Alligator Harbor	0701	0.36	0.011	2.8
	Alligator Offshore	0702	0.33	0.009	3.1
	Alligator Offshore	0703	0.33	0.009	2.9
Ochlockonee Bay[+]	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Ochlockonee-St. Marks Offshore	0825	0.79	0.033	2.7
	Ochlockonee Offshore	0829	0.47	0.019	1.9
	Ochlockonee Bay	0830	0.66	0.037	1.8
	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	St. Marks River Offshore	0827	0.51	0.022	1.7
	St. Marks River	0828	0.55	0.030	1.2
Big Bend/ Apalachee Bay[+]	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Econfina Offshore	0824	0.59	0.028	4.6
	Econfina	0832	0.55	0.032	4.4
	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Fenholloway	0822	1.15	0.444	1.9
	Fenholloway Offshore	0823	0.48	0.034	10.3
	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Steinhatchee-Fenholloway Offshore	0821	0.40	0.023	4.1
	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Steinhatchee River	0819	0.67	0.077	1.0
	Steinhatchee	0820	0.34	0.018	3.5

	Offshore				
	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Steinhatchee Offshore	0818	0.39	0.032	4.8
Suwannee River+	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Suwannee Offshore	0817	0.78	0.049	5.2
Springs Coast+	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Waccasassa River Offshore	0814	0.38	0.019	3.9
	Cedar Keys	0815	0.32	0.019	4.1
	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Crystal River	0812	0.35	0.013	1.3
	Crystal-Homosassa Offshore	0813	0.36	0.013	2.1
	Homosassa River	0833	0.47	0.032	1.9
	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (ug/L)
	Chassahowitzka River	0810	0.32	0.010	0.7
	Chassahowitzka River Offshore	0811	0.29	0.009	1.7
	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Weeki Wachee River	0808	0.32	0.010	1.6
	Weeki Wachee Offshore	0809	0.30	0.009	2.1
	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Pithlachascotee River	0806	0.50	0.022	2.4
	Pithlachascotee Offshore	0807	0.32	0.011	2.5
	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Anclote River	0804	0.48	0.037	4.7
	Anclote Offshore	0805	0.31	0.011	3.2

	Anclote Offshore South	0803	0.29	0.008	2.6
Clearwater Harbor/ St. Joseph Sound	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	See Section 62-302.532(1)(a) F.A.C.				
Tampa Bay	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	See Section 62-302.532(1)(b) F.A.C.				
Sarasota Bay	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	See Section 62-302.532(1)(c) F.A.C.				
Charlotte Harbor/Lemon Bay	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	See Section 62-302.532(1)(d) F.A.C.				
Lake Worth Lagoon/ Loxahatchee	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	North Lake Worth Lagoon	1201	0.55	0.067	4.7
	Central Lake Worth Lagoon	1202	0.57	0.089	5.3
	South Lake Worth Lagoon	1203	0.48	0.034	3.6
	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Lower Loxahatchee	1301	0.68	0.028	2.7
	Middle Loxahatchee	1302	0.98	0.044	3.9
	Upper Loxahatchee	1303	1.25	0.072	3.6
St. Lucie	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Lower St. Lucie	1401	0.58	0.045	5.3

	Middle St. Lucie	1402	0.90	0.120	8.4
	Upper St. Lucie	1403	1.22	0.197	8.9
Indian River Lagoon	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Mosquito Lagoon	1501	1.18	0.078	7.5
	Banana River	1502	1.17	0.036	5.7
	Upper Indian River Lagoon	1503	1.63	0.074	9.2
	Upper Central Indian River Lagoon	1504	1.33	0.076	9.2
	Lower Central Indian River Lagoon	1505	1.12	0.117	8.7
	Lower Indian River Lagoon	1506	0.49	0.037	4.0
Halifax River	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Upper Halifax River	1601	0.75	0.243	9.4
	Lower Halifax River	1602	0.63	0.167	9.6
Guana, Tolomato, Matanzas, Pellicer	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Upper GTMP	1701	0.77	0.144	9.5
	Lower GTMP	1702	0.53	0.108	6.1
Lower St. Johns River	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Lower St. Johns River	1801	0.75	0.095	2.5
	Trout River	1802	1.09	0.108	3.6
	Trout River	1803	1.15	0.074	7.7
Nassau River	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Lower Nassau	1901	0.33	0.113	3.2
	Middle Nassau	1902	0.40	0.120	2.4
	Upper Nassau	1903	0.75	0.125	3.4
St. Marys River	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Lower St. Marys River	2002	0.27	0.045	3.0
	Middle St. Marys River	2003	0.44	0.036	2.7

[1] Chlorophyll *a* is defined as corrected chlorophyll, or the concentration of chlorophyll *a* remaining after the chlorophyll degradation product, phaeophytin *a*, has been subtracted from the uncorrected chlorophyll *a* measurement.
* For a given water body, the annual geometric mean of TN, TP, or chlorophyll *a*, concentrations shall not exceed the applicable criterion concentration more than once in a three-year period.
[+] In these four areas (collectively referred to as the "Big Bend region"), coastal and estuarine waters are combined. Criteria for the Big Bend region apply to the coastal and estuarine waters in that region.

a) Summary of Approaches (Estuaries)

1) Proposed Approach (Estuaries)

In estuaries where sufficient monitoring data were available to statistically quantify relationships between TN, TP, chlorophyll *a*, and biological endpoints, and the endpoints available to derive criteria were shown to be sufficiently sensitive (i.e., Choctawhatchee Bay; St. Joseph Bay; Suwannee River; Indian River Lagoon; Halifax River; and the Guana, Tolomato, Matanzas, and Pellicer (GTMP) estuarine system), statistical models were used to derive the proposed numeric nutrient criteria. In three of the estuaries, Choctawhatchee Bay, St. Joseph Bay, and Indian River Lagoon, there were sufficient available data for water clarity associated with historic depth of seagrasses, and chlorophyll *a* concentrations associated with balanced phytoplankton biomass targets, and these biological endpoints were sensitive to changes in nutrients in most segments, so proposed criteria were derived that were protective of these endpoints. In the Suwannee River, the water clarity endpoint was not sensitive to changes in nutrients, so proposed criteria were derived that were protective of the chlorophyll *a* target associated with balanced phytoplankton biomass. In the Halifax River and GTMP, seagrass has not been historically present, so the proposed criteria were derived that are protective of the chlorophyll *a* target associated with balanced phytoplankton biomass.

In all other estuaries mechanistic models were used to quantify the relationship between nutrient loads and biological endpoints. EPA then used the models to derive proposed numeric nutrient criteria that protect the endpoints. For each estuary, the endpoints that were shown to be sufficiently sensitive to nutrient changes above non-anthropogenic nutrient levels were used, as described in Section III.A.3.c. The endpoints for each of the estuaries where mechanistic models were used to derive criteria are noted in the following discussion.

In Perdido Bay, Apalachicola Bay, three segments in Lake Worth Lagoon/Loxahatchee (Lake Worth Lagoon, segments 1201, 1202, and 1203), and St. Lucie, all three biological endpoints were found to be sensitive to changes to nutrients, and so proposed criteria were derived that were protective of historic depth of seagrasses (water clarity), chlorophyll *a* concentrations associated with balanced phytoplankton biomass, and dissolved oxygen concentrations sufficient to maintain aquatic life.

In St. Andrews Bay, 2 segments in the Springs Coast (Anclote River/Anclote Offshore, segments 0804 and 0805) and 3 segments in Lake Worth Lagoon/Loxahatchee (Lower, Middle, and Upper Loxahatchee, segments 1301, 1302, and 1303), dissolved oxygen concentrations were found to be insensitive to changes in nutrients. Proposed criteria were derived that were protective of historic depth of seagrasses (water clarity) and chlorophyll *a* concentrations associated with balanced phytoplankton biomass.

In Pensacola Bay, 3 segments in Ochlockonee Bay (Ochlockonee-St. Marks Offshore/Ochlockonee Offshore/Ochlockonee Bay, segments 0825, 0829, and 0830), and 4 segments in Big Bend/Apalachee Bay (Econfina/Econfina Offshore, segments 0824, 0832; Steinhatchee-Fenholloway Offshore, segment 0821; Steinhatchee Offshore, segment 0818), and 1 segment in Springs Coast (Anclote Offshore South, segment 0803), water clarity was found to be insensitive to changes in nutrients. In Alligator Harbor and

2 segments in Springs Coast (Waccasassa River Offshore/Cedar Keys, segments 0814, 0815), there was not enough available information to derive seagrass depth targets. As a result, the proposed criteria were derived to be protective of water quality targets for chlorophyll *a* concentrations associated with balanced phytoplankton biomass and dissolved oxygen concentrations sufficient to maintain aquatic life.

In 2 segments in Ochlockonee Bay (St. Marks Offshore/St. Marks River, segments 0827, 0828), 2 segments in Big Bend/Apalachee Bay (Steinhatchee River/Steinhatchee Offshore, segments 0819, 0820), and 2 segments in Springs Coast (Pithlachascotee River/Pithlachascotee Offshore, segments 0806, 0807), dissolved oxygen and water clarity were both found to be insensitive to changes in nutrients. In 2 segments in Big Bend/Apalachee Bay (Fenholloway/Fenholloway Offshore, segments 0822, 0823) and 7 segments in Springs Coast (Crystal River/Crystal-Homosassa Offshore/Homosassa River, segments 0812, 0813, 0833; Chassahowitzka River/Chassahowitzka Offshore, segments 0810, 0811; and Weeki Wachee/Weeki Wachee Offshore, segments 0808, 0809), dissolved oxygen was found to be insensitive to changes in nutrients and there was not enough available information to derive seagrass depth targets. In Nassau River and St. Marys River, dissolved oxygen was found to be insensitive to changes in nutrients and seagrass has not been historically present. For all of these estuaries, proposed criteria were derived that were protective of chlorophyll *a* concentrations associated with balanced phytoplankton biomass.

In the Lower St. Johns River, seagrass has not been historically present, so proposed criteria were derived that were protective of chlorophyll *a* associated with balanced phytoplankton biomass and dissolved oxygen concentrations sufficient to maintain aquatic life. For this system, EPA used the dissolved oxygen from the Site-Specific Alternative Criteria, developed by FDEP and adopted for the marine portion of the Lower St. Johns River, as an additional DO endpoint with which to derive the proposed criteria to support dissolved oxygen concentrations sufficient to maintain aquatic life.[195] This DO criterion, adopted as a water quality standard specific to this system, was used as an alternative target to the daily water column average DO concentration of 5.0 mg/L.

EPA considered several alternative approaches for deriving estuarine numeric nutrient criteria, including approaches proposed by the St. Johns River Water Management District for estuaries within their jurisdiction (Lower St. Johns River, Mosquito Lagoon, Tolomato-Matanzas estuary, Halifax River estuary, Indian River Lagoon, and Banana River). While some of these approaches segmented Florida's estuaries differently than the segmentation approach EPA is proposing, all the alternative approaches used multiple biological endpoints and analytical methods to determine the health of each system and derive criteria. EPA solicits comments on the alternative approaches described in more detail in the following sections. Additional details on these approaches are provided in the TSD (Volume 1: Estuaries, Section 2).

2) Alternative for St. Johns River Water Management District Waters

The St. Johns River Water Management District (SJRWMD) submitted proposed approaches to EPA for several estuaries within their jurisdiction. These included the St. Johns River, Mosquito Lagoon, Tolomato-Matanzas estuary, Halifax River estuary,

[195] FDEP. 2006. Site Specific Alternative Dissolved Oxygen Criterion to Protect Aquatic Life in the Marine Portions of the Lower St. Johns River Technical Support Document. Appendix L In: FDEP. 2008. *TMDL Report: Total Maximum Daily Load for Nutrients for the Lower St. Johns River*. Florida Department of Environmental Protection, Tallahassee, FL.

Indian River Lagoon, and Banana River. In general, SJRWMD proposed a weight of evidence approach employing several analytical techniques to derive numeric nutrient criteria for each of the systems. The following paragraphs outline the methods proposed for each of these systems.

The SJRWMD has proposed the use of the values for TN, TP, and chlorophyll *a* for the Lower St. Johns River (LSJR) that have already been developed as part of an existing TMDL to support designated uses in the river. The LSJR is defined as the main stem segments of the river between the juncture with the Ocklawaha River and the river mouth at Mayport, with the marine portion occurring between Julington Creek and the mouth. A SSAC was developed for DO in the marine portion of the river. It was approved by EPA in 2006 and is in effect as a WQS. The TMDL contains TN and TP protective loads in the freshwater portion of the LSJR and a TN protective load in the saline portion of the LSJR. These loads are set at a level necessary to achieve the marine DO SSAC and protect the statewide standard for DO in the freshwater section. The TMDL also contains a water quality target for chlorophyll *a* that is intended to implement the State's narrative nutrient criterion.

Similar to the modeling approach proposed by EPA for Florida estuaries, TN, TP, and chlorophyll *a* criteria were derived for the LSJR using linked watershed, hydrodynamic, and water quality models. Non-point nutrient inputs from the watershed to the river were determined for each sub-basin in the LSJR using the Pollutant Load Screening Model (PLSM), estimates of atmospheric deposition, and estimates of loading from tributaries and upstream. Within the river, hydrodynamics were modeled using the Environmental Fluid Dynamics Code (EFDC) model and water quality processes were modeled using the U.S. Army Corps of Engineers Quality Integrated Compartment Model (CE-QUAL-ICM), Version 2. The models were calibrated for the period from January 1, 1995 to November 30, 1998. TMDL model scenarios were assessed on an annual basis to determine if chlorophyll *a* levels exceeded the chlorophyll *a* threshold of 40 µg/L less than 10% of the time that was set as the water quality target to prevent undesirable shifts in algal community composition.

For Mosquito Lagoon, a suite of five approaches are considered to develop a weight of evidence by which numeric nutrient criteria can be developed. These approaches are based upon one of three relationships: 1) the link between nutrients, phytoplankton growth (as shown by chlorophyll *a*), and the trophic state of a system; 2) the link between nutrients, phytoplankton growth (as shown by chlorophyll *a*), the effects of phytoplankton on light attenuation in the water column, and the light requirements of seagrasses; or 3) the connection between TP and harmful algal bloom (HAB) occurrence. The first and primary approach uses a reference period from 2004-2008 to calculate annual median and maximum wet season medians of chlorophyll *a*, TN, and TP. The reference time period was selected because the TN, TP, and chlorophyll *a* observed during that period were low, the rainfall amounts during that period were representative of typical rainfall over time, and the Trophic State Index value for that time period was greater than 50, which is considered to be "good" (mesotrophy to oligo-mesotrophy).

The second approach draws upon an optical model linking chlorophyll *a* to previously established light attenuation targets as a way to predict annual median chlorophyll *a* in southern Mosquito Lagoon that would be protective of seagrass and serve as a basis for criteria derivation. A third approach derives a TP level that corresponds to minimum "bloom" levels of the dinoflagellate *Pyrodinium bahamense*, the common HAB species seen primarily in the southern Lagoon. A fourth line of evidence applied to the Mosquito Lagoon is multivariate geometric mean function regression models relating TN and TP to chlorophyll *a* on an annual basis and during the wet season. The final method is based on two general nutrient models.[196] Targets for chlorophyll *a* are set based on the reference period mentioned earlier for the north and central segments and the optical model for the southern segments. The reference method is used to derive the TN, TP, and chlorophyll *a* criteria for the Mosquito Lagoon with the other four methods providing supporting evidence. Two criteria magnitudes for TN, TP, and chlorophyll *a* are presented; one an annual median value and the other a wet season (July-September) median value.

The approaches used for the Indian River Lagoon (IRL) and Banana River Lagoon (BRL) are similar to those used for Mosquito Lagoon. The approaches are based upon a weight of evidence relying on two general ecological relationships: 1) the link between nutrients, phytoplankton growth (as shown by chlorophyll *a*), and the trophic state of a system; and 2) the link between nutrients, phytoplankton growth (as shown by chlorophyll *a*), the effects of phytoplankton on light attenuation in the water column, the light requirements of seagrasses, and the previously established depth limit for seagrasses. The influence of TP on HAB events is also discussed as an ancillary line of evidence. As a first line of evidence loading limits are derived based on analyses done for TMDLs in 2009. The loading limits were established using regression models that regress

[196] Steward, J.S., and E.F. Lowe. 2010. General empirical models for estimating nutrient load limits for Florida's estuaries and inland waters. *Limnology and Oceanography* 55(1):433-445.
Dettmann, E.H. 2001. Effect of water residence time on annual export and denitrification of nitrogen in estuaries: A model analysis. *Estuaries* 24(4):481-490.

seagrass depth limit targets against loading of TN and TP.[197] The second method used annual medians of data from reference segments that meet desired depth thresholds established by the TMDL analyses. The third approach relies upon an optical model similar to the one described earlier for the Mosquito Lagoon using data from 1996-2007. A model was built for each of the sub-lagoons: the BRL, North IRL, and Central IRL (divided into Sebastian and South Central reaches). An optical model is in development for the North Central reach. The fourth approach also applies two general models to data specific to the IRL and BRL.[198] Where the Dettmann (2001) model could not be used to predict TN concentrations, a TN:TP ratio for the given sublagoon was applied to the TP limit to calculate TN limits. The fifth approach relies upon the relationship between HAB occurrence and TP concentrations. Targets for chlorophyll *a* are presented as a range of values established using the optical model approach and the reference segment approach. Proposed TN and TP loading criteria are based on the loading limits established using the TMDL analyses. Primary proposed TN and TP criteria concentrations are calculated based on the reference segment method. Alternate criteria are proposed using a convergence of the concentrations calculated by the reference segment method and general models. Two criteria magnitudes are proposed, one for an annual median and the other for a wet season (June-October) monthly maximum.

The SJRWMD proposed criteria for the Tolomato and Matanzas Estuary (TME) using a weight of evidence approach and methods similar to those used in the other

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[197] Steward J.S., R.V. Virnstein, L.J. Morris, and E.F. Lowe. 2005. Setting Seagrass Depth, Coverage, and Light targets for the Indian River Lagoon system, Florida. *Estuaries* 6:923-935.
[198] Steward, J.S., and E.F. Lowe. 2010. General empirical models for estimating nutrient load limits for Florida's estuaries and inland waters. *Limnology and Oceanography* 55(1):433-445.
Dettmann, E. H. 2001. Effect of water residence time on annual export and denitrification of nitrogen in estuaries: A model analysis. *Estuaries* 24:481-490.

estuaries. TN and TP concentrations and chlorophyll *a* target concentrations are based on an approach that analyzes water quality and estimated current loading during a reference period from 2000-2009. The period of reference was selected based on a desirable TSI score (<50), rainfall amounts typical of average conditions, and completeness of the data record. Criteria magnitudes are proposed as an annual median or mean and a maximum wet season (June-September) median or mean. The reference period approach of criteria derivation for the TME is supported by an additional line of evidence using regression analyses of chlorophyll *a* versus TN and TP. Target chlorophyll *a* values are based on the reference period analyses. The general nutrient models of Steward and Lowe (2010) and Dettmann (2001) are also used as an additional method by which to estimate loading limits and concentrations associated with those limits.

The SJRWMD also derived proposed criteria for the Halifax River Estuary. SJRWMD derived criteria using three methods. The first is a reference condition based on the period from 2000-2008. This period is selected because of the low TN levels compared to the previous decade, the low chlorophyll *a* concentrations which are consistent with chlorophyll *a* targets established for other estuaries throughout the State, and the "good" trophic status shown by TSI values less than 50. Concentrations are calculated using annual median concentrations and maximum wet-season median concentrations (as the highest monthly values from July-September) of TN, TP, and chlorophyll *a*. Simple linear regressions are used as a second line of evidence to calculate TN and TP criteria based on chlorophyll *a* targets established by the reference period calculations. The general nutrient models of Steward and Lowe (2010) and Dettmann (2001) are used as a final method by which to estimate loading limits and concentrations associated with those limits. Proposed loading and concentration criteria for the North Halifax River Estuary are based on the loading and concentration estimates of the general nutrient models, with estimates of loadings from wastewater treatment facilities in the estuary removed to represent reference conditions. The current estimated concentrations (ca. 2004) of TN and TP based on the reference approach are proposed as criteria for the South Halifax River Estuary. Target chlorophyll *a* values for both segments are calculated using the reference period approach.

EPA is also considering the use of approaches outlined in Steward et al. (2005) to derive criteria in Indian River Lagoon. In particular EPA is considering using the depth of colonization within reference segments as “upper restoration depths” and the highest value observed for a specific segment as a minimum target for that segment. For more information regarding the derivation of these criteria, please see the TSD (Volume 1: Estuaries, Sections 2.18.9 (Indian River Lagoon), 2.19.9 (Halifax River), 2.20.9 (GTMP), and 2.21.9 (St Johns River)).

3) Request for Comment on Proposed and Alternative Approaches

EPA believes that the proposed approach for each estuarine system is appropriate, scientifically defensible, and results in numeric nutrient criteria that protect the State’s designated uses to ensure that nutrient concentrations of a body of water support balanced natural populations of aquatic flora and fauna. EPA requests comment on this system-specific approach and the resulting numeric nutrient criteria. EPA also solicits additional available scientific information that can be used to derive numeric nutrient criteria to provide protection of fish consumption, recreation, and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife and protect Florida's Class II and III estuarine waters from nitrogen and phosphorus pollution.

In addition, EPA requests comment on the alternative approaches developed by the St. Johns River Water Management District for waters under their jurisdiction. Specifically, EPA requests comment on the scientific defensibility of these approaches, as well as whether application of these approaches will result in numeric nutrient criteria that will protect Class II and III estuarine waters in the State of Florida. EPA also requests comment on promulgating the alternative criteria in lieu of EPA's proposed criteria.

b) Proposed Criteria Duration and Frequency (Estuaries)

Aquatic life water quality criteria include magnitude, duration, and frequency components. For EPA's proposed TN, TP, and chlorophyll *a* criteria for estuarine waters, the criterion-magnitude values (expressed as concentrations) are provided in Table III.B-1, the criterion-duration (or averaging period) is specified as annual, and the criterion-frequency is specified as a no-more-than-once-in–three-years excursion frequency of the annual geometric mean. EPA is proposing a criteria-duration of one year, in which sampled nutrient concentrations are summarized as annual geometric means to be consistent with the data set used to derive these criteria, which relied on either annual average nutrient concentrations or annual nutrient loading to the water body. EPA's proposed excursion frequency of no-more-than-once-every-three-years is intended to minimize negative effects on designated uses as it will allow water bodies enough time to recover from occasionally elevated levels of nitrogen and phosphorus concentrations.[199]

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[199] Boynton, W.R., J.D. Hagy, L. Murray, C. Stokes, and W.M. Kemp. 1996. A comparative analysis of

These duration and frequency components of the criteria are identical to those finalized in EPA's rule for Florida's lakes and flowing waters (40 CFR section 131.43), which will add consistency to the implementation of these criteria with those established in the previous rulemaking for upstream waters. Finally, the 3-year evaluation period provides a sufficient representation of average water body characteristics in the majority of cases, because it balances both short-term and long-term variation, while not imposing undue monitoring expectations. EPA requests comment on the frequency and duration components of these criteria and whether the three components of the criteria (magnitude, duration, and frequency) taken in combination will ensure protection of the designated uses of these waters.

c) Proposed DPVs (Estuaries)

EPA is proposing a procedure to establish numeric TN and TP criteria for streams in Florida to protect the downstream estuarine water bodies that ultimately receive nitrogen and phosphorus pollution from these streams. These numeric nutrient criteria, which EPA refers to as Downstream Protection Values, or DPVs, would apply at each stream's point of entry into the downstream water, referred to as the pour point. However, as explained more fully in Section I.A, EPA does not intend to finalize these DPVs if the district court modifies the Consent Decree consistent with EPA's amended determination that numeric DPVs are not necessary to meet CWA requirements in Florida. EPA selected the pour point as the location to apply DPVs because the downstream waters respond to the nutrient inputs from the pour point, and all contributions from the network of flowing waters above this point affect the water quality

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eutrophication patterns in a temperate coastal lagoon. *Estuaries* 19(2B):408-421.

at the pour point. If the DPV is not attained at the point of entry into the estuary, then the collective set of streams in the upstream watershed does not attain the DPV, for purposes of CWA section 303(d).

The Agency is proposing a hierarchical procedure that includes four approaches for setting TN and TP DPVs. EPA's intention in proposing the four approaches is to provide a range of methods for the State to derive TN and TP DPVs that reflect the data and scientific information available. Water quality modeling is the most rigorous and most data-demanding method, and will generally result in the most refined DPVs. Water quality modeling is EPA's preferred method for establishing DPVs and is listed first in the hierarchy. It is followed by less rigorous methods that are also less data-demanding. Using a procedure from a lower tier of the hierarchy requires less data, but also generally results in more stringent DPVs to account for the uncertainties associated with these less refined procedures. The methods available to derive DPVs should be considered in the following order:

1. Water quality simulation models to derive TN and TP values,
2. Reference condition approach based on TN and TP concentrations at the stream pour point, coincident in time with the data record from which the downstream receiving estuary segment TN and TP criteria were developed using the same data quality screens and reference condition approach,
3. Dilution models based on the relationship between salinity and nutrient concentration in the receiving segment, and

4. The TN and TP criteria from the receiving estuary segment to which the freshwater stream discharges, in cases where data are too limited to apply the first three approaches.

All four approaches are briefly described in the following discussion. A more detailed description of the approaches, as well as the TN and TP DPVs that result from using each of the approaches, is provided in the technical support document (Volume 1: Estuaries, Section 1.6).

EPA believes that the first approach, the use of water quality simulation models, is the most refined method to define a DPV at the stream's pour point that will support balanced natural populations of aquatic flora and fauna in the downstream estuary. This approach may be appropriate when water quality simulation models are available, such as in the estuarine systems where mechanistic models were used to derive criteria. The modeled nutrient loads entering the estuaries that result in attainment of the biological endpoints within the estuaries can be used to derive DPVs by computing the annual geometric mean TN and TP concentrations that correspond with the modeled loads at the pour point of each stream for each of the years 2002 through 2009. Because EPA used coupled watershed and estuarine models to establish the estuary criteria (in some locations), EPA is confident that the watershed modeling provides concentrations that are protective of corresponding estuarine biological endpoints. Therefore EPA selected the 90th percentile from the distribution of annual geometric means of modeled loads as the DPV to be consistent with the use of the 90th percentile used to derive the criteria protective of the estuary using the mechanistic models (Volume 1: Estuaries, Section 1.6).

EPA is proposing the second DPV approach, a reference condition approach, for estuarine systems where water quality simulation models are not available, and where a reference condition approach is used to derive estuary TN, TP, and chlorophyll *a* criteria. Since the downstream estuary is supporting balanced natural populations of aquatic flora and fauna during the reference condition period, the nutrient loads passing through the pour points into the estuary during that same period should be protective of the estuary. Therefore, EPA believes it would be appropriate in these cases to derive reference condition-based DPVs using water quality data at the pour point of the freshwater streams, coincident in time with the data record from which EPA derived the downstream estuary segment TN and TP criteria. EPA proposes that the same data screens and reference condition approach be applied to the pour point data as were applied to the estuary data when deriving DPVs using this approach. This will prevent deriving a DPV using upstream water quality data that coincided with a documented downstream impact (e.g., CWA section 303(d) listing for nutrients in the estuary segment) and ensure mathematical consistency between the DPVs and estuarine criteria.

EPA is proposing the third DPV approach for estuarine systems where water quality simulation models are not available. For example, this approach may be appropriate in the Indian River Lagoon, the Halifax River, and the GTMP estuarine systems where EPA used statistical models to derive the criteria protective of the estuary. In these areas, EPA believes it would be appropriate to derive DPVs using dilution models based on the relationship between salinity and nutrient concentration. The concept is that the tidal mixing or dilution can be estimated from the estuarine salinity. By plotting observed estuarine TN or TP versus the estuarine salinity and fitting a linear regression, the TN or TP at various levels of salinity can be determined. This regression model can then be used to determine the TN or TP concentration at the pour point that will ensure attainment and maintenance of the estuarine numeric nutrient criteria concentration. The TN and TP DPV for the inflowing canal or stream can be determined from the point on the regression line having the same salinity as the pour point, which is by definition 2.7 psu.

EPA's fourth proposed approach for establishing DPVs is to apply the downstream receiving estuary segment TN and TP criteria as shown in Table III.B-1 to the pour point as the DPVs. This is the simplest approach and may be appropriate where data are too limited to apply the first three approaches. As noted in Table III.B-1, Florida derived numeric nutrient criteria for Clearwater Harbor, Tampa Bay, Sarasota Bay, and Charlotte Harbor estuaries that can be found in Section 62-302.532(a)-(d), F.A.C. Therefore, the applicable DPVs for those four estuaries would be Florida's estuary criteria in Section 62-302.532(a)-(d), F.A.C. if using this fourth proposed approach for establishing DPVs.

EPA believes the proposed approaches for deriving DPVs establish a decision-making framework that is binding, clear, predictable, and transparent. Therefore, EPA is proposing that DPVs derived using these approaches do not require EPA approval under Clean Water Act section 303(c) to take effect.[200] A DPV calculated under options 2, 3, and 4 may be more stringent than a DPV calculated using a water quality model. These alternative options are intended to ensure that water quality standards are not only restored when found to be impaired, but are maintained when found to be attained,

[200] 65 FR 24641, 24648 (April 27, 2000).

consistent with the CWA. Higher levels of TN and/or TP may be allowed in watersheds where it is demonstrated that such higher levels will fully protect the estuary's WQS. To the extent that it is determined that the alternative option DPVs for a given estuary are over-protective, applying a water quality model as set out in EPA's option 1 would result in a more refined definition of the DPV for that estuary.

EPA believes that these proposed approaches to establish DPVs are appropriate, scientifically defensible, and result in numeric values that will ensure the attainment and maintenance of the downstream estuarine criteria. EPA requests comment on these approaches. EPA also requests comment on the alternative approach of finalizing the numeric TN and TP DPVs that EPA calculated using these approaches (as provided in Volume 1: Estuaries, Section 1.6 of the technical support document) in place of the proposed approaches. Finally, EPA solicits additional available scientific information that can be used to ensure attainment and maintenance of the downstream estuarine criteria. Commenters who submitted comments or scientific information related to DPVs for estuaries during the public comment period for EPA's proposed inland waters rule (75 FR 4173) should reconsider their previous comments in light of the new information presented in this proposal and must re-submit their comments during the public comment period for this rulemaking to receive EPA response.

d) Proposed Approach and Criteria for Tidal Creeks

Tidal creeks are relatively small coastal tributaries that lie at the transition zone between terrestrial uplands and the open estuary. They are small sub-estuaries that exhibit a wide range of salinities typical of larger estuaries, but on a smaller scale. Tidal creeks are important spawning and nursery areas for aquatic life in adjacent estuary and coastal systems. They typically receive freshwater flow from streams and groundwater, similar to estuaries, but have less developed drainage systems. Alternatively, some tidal creeks are dominated by mangroves and other wetland vegetation with no freshwater stream inputs, and serve as conduits for tidal water to enter and leave wetland areas. Water quality and biological conditions are different in tidal creeks compared to estuarine systems due to relatively small drainage areas, narrow stream channels, shallow depths, and the influence of adjacent marsh and mangrove habitats.

EPA reviewed the available scientific information and has determined that there are insufficient data and research at this time to develop separate numeric nutrient criteria specifically for tidal creeks. EPA, therefore, proposes to apply the TN and TP criteria developed for either the adjacent freshwater or estuarine segments to each tidal creek in Florida, depending on the tidal creek's salinity levels. If the mean chloride concentration of the tidal creek is < 1,500 mg/L, EPA proposes to apply the TN and TP criteria from the adjacent freshwater segment (as defined in 40 CFR 131.43).[201] If the mean chloride concentration of the tidal creek is > 1,500 mg/L, EPA proposes to apply the chlorophyll *a*, TN, and TP criteria from the adjacent estuary segment (as defined in Section III.B of this proposed rulemaking). Alternatively, EPA requests comment on applying the more stringent of the two sets of criteria, freshwater or estuarine, to tidal creeks with varying salinity levels. For more information please see the TSD (Volume 1: Estuaries, Section 3.1).

[201] EPA did not establish chlorophyll *a* criteria for freshwater streams due to lack of available approaches to interpret existing data to infer scientifically supported thresholds for these nutrient-specific response variables in Florida streams.

As a second alternative option, EPA could use the mean salinities for each tidal creek to interpolate TN and TP concentrations between freshwater and estuarine criteria from adjacent freshwater and estuarine segments. TN and TP vary predictably along a salinity gradient, allowing for this interpolation where salinity data are available. The calculation EPA could use for this interpolation is provided in the TSD (Volume 1: Estuaries, Section 3.1).

EPA believes that the proposed approach for tidal creeks is appropriate, scientifically defensible, and results in numeric nutrient criteria that protect the State's designated uses and ensure that nutrient concentrations of a body of water support balanced natural populations of aquatic flora and fauna. EPA requests comment on the proposed option and the alternative. EPA also requests additional available scientific information that can be used to provide protection for fish consumption, recreation, and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife to protect Florida's tidal creeks from nitrogen and phosphorus pollution.

e) Proposed Approach and Criteria for Marine Lakes

Marine lakes are coastal lakes and ponds with groundwater or intermittent surface water connections to marine water. They do not have a permanent surface connection to tidal waters. They are small and shallow, and generally round or elliptical in shape, as they were formed from depressions that became isolated from marine waters by sand and dune formation. Some marine lakes are stratified by a salinity gradient where a freshwater layer at the surface is separated from a denser saline layer below. Similar to inland lakes, marine lakes in Florida are generally oligotrophic under undisturbed conditions with low nitrogen and phosphorus concentrations and low productivity. Their oligotrophic nature and stratification make them susceptible to the adverse effects of nitrogen and phosphorus pollution. EPA analyzed the data from over 50 marine lakes in Florida and found that chlorophyll *a* responded to TN and TP in a similar fashion, based on color and alkalinity, as freshwater inland lakes. Details and supporting documentation are provided in the TSD (Volume 1: Estuaries, Section 3.2).

EPA is proposing to apply the criteria developed for freshwater inland lakes in EPA's December 6, 2010 rulemaking for Florida's lakes and flowing waters (40 CFR 131.43) to protect the designated uses in marine lakes since marine lakes have a similar trophic condition expectation and chlorophyll *a* response to nutrient concentrations. The criteria EPA proposes to apply to marine lakes are those found in 40 CFR 131.43 and replicated in Table III.B-2.

Table III.B-2. EPA's Proposed Numeric Criteria for Florida's Marine Lakes

Long Term Average Lake Color[a] and Alkalinity	EPA Final Chl-a[b,*] μg/L	EPA Final TN and TP Criteria [Range]	
		TN mg/L	TP mg/L
Colored lakes[c]	20	1.27 [1.27-2.23]	0.05 [0.05-0.16]
Clear lakes, high alkalinity[d]	20	1.05 [1.05-1.91]	0.03 [0.03-0.09]
Clear lakes, low alkalinity[e]	6	0.51 [0.51-0.93]	0.01 [0.01-0.03]

[a] Platinum-cobalt units (PCU) assessed as true color free from turbidity
[b] Chl-a is defined as corrected chlorophyll, or the concentration of chl-a remaining after the chlorophyll degradation product, phaeophytin a, has been subtracted from the uncorrected chl-a measurement.
[c] Long-term color > 40 PCU and alkalinity > 20 mg/L $CaCO_3$
[d] Long-term color ≤ 40 PCU and alkalinity > 20 mg/L $CaCO_3$
[e] Long-term color ≤ 40 PCU and alkalinity ≤ 20 mg/L $CaCO_3$
* For a water body, the annual geometric mean of chl-a, TN or TP concentrations shall not exceed the applicable criterion concentration more than once in a three-year period.

EPA believes that the proposed approach for marine lakes is appropriate, scientifically defensible, and results in numeric nutrient criteria that protect the State's designated uses and ensure that nutrient concentrations of a body of water support balanced natural populations of aquatic flora and fauna. EPA requests comment on the proposed approach. EPA also solicits additional available scientific information that can be used to provide protection for fish consumption, recreation, and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife to protect Florida's marine lakes from nitrogen and phosphorus pollution.

C. Proposed Numeric Criteria for Coastal Waters

1. Introduction

EPA is defining coastal waters in this proposed rulemaking as marine waters that start at the land margin and extend up to three nautical miles from shore, with chloride concentrations greater than 1,500 mg/L, excluding estuaries. Unlike estuaries, which are typically highly influenced by freshwater flows and can be organized within boundaries, coastal waters are less confined, with open connections to ocean waters, and have localized influences from freshwater sources near the estuary/coastal boundary (i.e., estuary pass).

EPA is proposing to derive chlorophyll *a* criteria for coastal waters using satellite remote sensing, where possible. This approach is possible for all coastal waters except those in the Big Bend Coastal region. In the Big Bend Coastal region (waters offshore of Apalachicola Bay, Alligator Harbor, Ochlockonee Bay, Big Bend/Apalachee Bay, Suwannee River, and Springs Coast), seagrass beds and CDOM export from rivers confound interpretation of satellite data and derivation of chl$_{RS}$-*a*. EPA's proposed approach and criteria for the Big Bend Coastal region is discussed in Section III.B.

2. Proposed Numeric Criteria (Coastal Waters)

EPA is proposing numeric chlorophyll *a* criteria, as measured by remotely sensed numeric chlorophyll *a* (chl$_{RS}$-*a*), for 71 segments in three coastal regions of Florida classified as Class III waters under Florida law (Section 62-302.400, F.A.C.). A map showing the locations of the coastal segments can be found in the TSD (Volume 2: Coastal Waters, Section 1.3). EPA's proposed coastal criteria are listed in Table III.C-1.

Table III.C-1. EPA's Proposed Numeric Criteria for Florida's Coastal Waters

Coastal Region	Coastal Segment^{+}	Approximate Location	Chlorophyll$_{RS}$-a^{1}* (mg/m^3)
Panhandle	1	Alabama border	2.41
	2	Pensacola Bay Pass	2.57
	3		1.44
	4		1.16
	5		1.06
	6		1.04
	7		1.14
	8	Choctawhatchee Bay Pass	1.23
	9		1.08
	10		1.09
	11		1.11
	12		1.18
	13		1.45
	14	St. Andrews Bay Pass	1.74
	15	St. Joseph Bay Pass	2.75
	16		2.39
	17	Southeast St. Joseph Bay	3.47
West Florida Shelf	18		3.96
	19	Tampa Bay Pass	4.45
	20		3.37
	21		3.25
	22		2.95
	23		2.79
	24		2.98
	25		3.24
	26	Charlotte Harbor	4.55

	27		4.22
	28		3.67
	29		4.16
	30		5.70
	31		4.54
	32		4.03
	33	Fort Myers	4.61
Atlantic Coast	34	Biscayne Bay	0.92
	35		0.26
	36		0.26
	37		0.24
	38		0.21
	39		0.21
	40		0.20
	41		0.20
	42		0.21
	43		0.25
	44		0.57
	45	St. Lucie Inlet	1.08
	46		1.42
	47		1.77
	48		1.55
	49		1.44
	50		1.53
	51		1.31
	52		1.40
	53		1.80
	54	Canaveral Bight	2.73
	55		2.33
	56		2.28
	57		2.06
	58		1.92
	59		1.76
	60		1.72
	61		2.04
	62		1.92
	63		1.86
	64		1.95
	65		2.41
	66		2.76
	67		2.80
	68		3.45
	69	Nassau Sound	3.69
	70		3.78
	71	Georgia border	4.22

[1] Chlorophyll$_{RS}$-*a* is remotely sensed calculation of chlorophyll *a* concentrations.
* For a given water body, the annual geometric mean of the chlorophyll *a* concentration shall not exceed the applicable criterion concentration more than once in a three-year period.
[+] Please see TSD for location of Coastal Segments (Volume 2: Coastal Waters, Section 1.3).

As discussed in Section III.A.1.b, EPA is not proposing TN and TP criteria for Florida's coastal waters.

a) Summary of Approaches

1) Proposed Approach (Coastal Waters)

EPA conducted a comprehensive review of water body-specific water quality and impairment information as detailed in Section III.A.3.a. EPA determined through this review that at most times, Florida coastal waters appear to be supporting balanced natural populations of aquatic flora and fauna. EPA removed data from criteria computations in the limited instances where the Agency found that coastal waters were listed on the State's CWA section 303(d) list to ensure the resulting dataset was representative of times and locations that these waters were supporting balanced natural populations of aquatic flora and fauna. Therefore, EPA is proposing to use a reference condition approach using data collected from satellite remote sensing of chlorophyll *a*.

To derive proposed criteria for coastal areas, EPA chose to use chl_{RS}-*a* measurements from the SeaWiFS satellite because it had the longest and earliest historical record.[202] From the satellite measurements, screened to reflect conditions supportive of balanced natural populations of flora and fauna, EPA calculated criteria as the 90th percentile of the annual geometric means of chl_{RS}-*a* values over the 1998-2009 period in each coastal segment (For a discussion of EPA's selection of the 90th percentile to derive the proposed coastal criteria, see Section III.A.3.a and the TSD (Volume 2: Coastal Waters)).

[202] NOTE: SeaWiFS was replaced by MODIS and MERIS satellite generated data. EPA has developed an approach that can utilize any new satellite data sources for ongoing assessment purposes.

b) Request for Comment on Proposed Approach

EPA believes that the proposed approach for coastal waters is appropriate, scientifically defensible, and results in numeric nutrient criteria that protect the State's designated uses and ensure that nutrient concentrations of a body of water support balanced natural populations of aquatic flora and fauna. EPA requests comment on this approach and the resulting numeric nutrient criteria. EPA also solicits additional available scientific information that can be used to provide protection of fish consumption, recreation and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife and protect Florida's Class III coastal waters from nitrogen and phosphorus pollution.

c) Proposed Criteria Duration and Frequency (Coastal Waters)

For EPA's proposed chlorophyll *a* criteria for coastal waters, the criterion-magnitude values (expressed as concentrations) are provided in Table III.C-1, the criterion-duration (or averaging period) is specified as annual, and the criterion-frequency is specified as no-more-than-once-every-three-years. EPA is proposing a criteria-duration of one year, in which sampled chlorophyll *a* concentrations are summarized as annual geometric means, to be consistent with the data set used to derive these criteria, which relied on annual average concentrations. EPA's proposed excursion frequency of no-more-than-once-every-three-years is intended to minimize negative effects on designated uses as it will allow water bodies enough time to recover from occasionally elevated chlorophyll *a* concentrations.[203] These duration and frequency components of the criteria

[203] Boynton, W.R., J.D. Hagy, L. Murray, C. Stokes, and W.M. Kemp. 1996. A comparative analysis of

are identical to those finalized in EPA's rule for Florida's lakes and flowing waters (40 CFR 131.43), which will add consistency to the implementation of these criteria with those established in the previous rulemaking. Finally, the 3-year evaluation period provides a sufficient representation of average water body characteristics in the majority of cases, because it balances both short-term and long-term variation, while not imposing undue monitoring expectations. EPA requests comment on the frequency and duration components of these criteria and whether the three components of the criteria (magnitude, duration and frequency) taken in combination will ensure protection of the designated uses of these waters.

D. Proposed Numeric Criteria for South Florida Inland Flowing Waters

1. Proposed Numeric Criteria (South Florida Inland Flowing Waters)

For purposes of this proposal, EPA is defining "south Florida inland flowing waters" as inland predominantly fresh surface waters that have been classified as Class I or Class III in the South Florida Nutrient Watershed Region, which encompasses the waters south of Lake Okeechobee, the Caloosahatchee River (including Estero Bay) watershed, and the St. Lucie watershed. This area contains more than 1,700 miles (2,736 km) of canals, dikes, and levees that control the movement of freshwater in south Florida. Some of the significant land management units within south Florida include the Everglades Agricultural Area, the Loxahatchee National Wildlife Refuge (Water Conservation Area 1), Water Conservation Areas 2 and 3, Big Cypress National Preserve, Everglades National Park, Biscayne Bay National Park, and the Florida Keys National

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eutrophication patterns in a temperate coastal lagoon. *Estuaries* 19(2B):408- 421.

Marine Sanctuary. A map showing this region is provided in the TSD (Volume 3: South Florida Inland Flowing Waters, Section 3).

EPA is proposing that TN and TP DPVs be derived using the approaches outlined in Section III.D.2 for 22 pour points in south Florida, outside of the Everglades Protection Area (EvPA) and Everglades Agricultural Area (EAA), where inland flowing waters discharge into south Florida marine waters (Biscayne Bay, Florida Bay, and marine waters on the southeast and southwest coasts). For south Florida, EPA is proposing the use of DPVs to manage nitrogen and phosphorus pollution in the inland flowing waters and protect the water quality of estuaries and coastal waters downstream. Therefore, the applicable numeric nutrient criteria for south Florida inland flowing waters, outside the lands of the Miccosukee and Seminole Tribes, EvPA, and the EAA, would consist solely of the south Florida marine water DPVs. The calculated DPVs using the approaches in Section III.D.2 for the 22 pour points are presented in the TSD (Volume 3: South Florida Inland Flowing Waters, Section 2).

The proposed approaches to derive DPVs that EPA is proposing for south Florida inland flowing waters do not apply to flowing waters (canals) within the EvPA or the EAA. There is an existing TP criterion of 0.010 mg/L (10 ppb) that currently applies to the marshes and adjacent canals within the EvPA (Section 61-302.540, F.A.C.). EPA approved that TP criterion in 2005 as protective of the waters in the EvPA. EPA's approval was upheld by the U.S. District Court in *Miccosukee Tribe of Indians of Florida, et al. v. U.S. EPA*.[204] For this proposal, EPA has determined that the existing TP criterion continues to be protective of the designated uses of the flowing waters in the

[204] Miccosukee Tribe of Indians of Fla., et al. v. U.S. EPA, No. 1:04-cv-21448 ASG, 2008 WL 2967654 (S.D. Fla. July 29, 2008).

EvPA and that no additional numeric nutrient criteria are necessary at this time for the EvPA. While the existing TP criterion does not apply directly to the flowing waters of the EAA, EPA has also determined that the TP criterion will serve to be protective of the designated uses of the flowing waters in the EAA. Most of the water flowing from the EAA currently passes through stormwater treatment areas (STAs) that have been specifically constructed to remove phosphorus from the water before it enters the EvPA. The waters discharging from the STAs are subject to CWA discharge permits that must include limits as stringent as necessary to meet the 10 ppb TP criterion in the EvPA. Efforts to reduce phosphorus upstream of the STAs (i.e., in the EAA) are currently underway to ensure the water discharged from the STAs will meet the TP criterion in the EvPA. Based on the combination of the actions that will be necessary to ensure that waters from the EAA do not cause an impairment of the downstream waters in the EvPA, EPA has determined that the existing TP criterion is the only numeric nutrient criterion that is necessary to protect the flowing waters of the EAA as well as the EvPA. Development of water quality standards for the EvPA and restoration actions within the EAA to attain the TP criterion have been and remain subject to the oversight of two federal district courts. EPA believes its decision not to propose additional numeric nutrient criteria for these areas is appropriate given the ongoing restoration efforts in the Everglades. For further information about ongoing EPA and FDEP actions related to Everglades restoration see: (1) http://www.epa.gov/aboutepa/states/fl.html, and (2) http://depnewsroom.wordpress.com/hot-topics/everglades/.

2. *Proposed DPVs (South Florida)*

EPA is proposing a procedure to establish numeric TN and TP criteria for south Florida inland flowing waters to protect the downstream marine waters that ultimately receive nitrogen and phosphorus pollution from upstream sources. However, as explained more fully in Section I.A, EPA does not intend to finalize these DPVs if the district court modifies the Consent Decree consistent with EPA's amended determination that numeric DPVs are not necessary to meet CWA requirements in Florida. Like the DPVs that EPA is proposing to protect estuaries in Florida, EPA is proposing the DPVs for south Florida inland flowing waters that will apply at each stream or canal's point of entry into the downstream south Florida marine water. If the DPV is not attained at the pour point into the applicable marine water segment, then the collective set of flowing waters, including canals, in the upstream watershed does not attain the DPV, for purposes of CWA section 303(d).

The Agency is proposing a hierarchical procedure that includes four approaches for setting TN and TP DPVs. These are the same approaches EPA is proposing for the State to derive DPVs for Florida estuaries to reflect the data and scientific information available. The methods available to derive DPVs should be considered in the following order:

1. Water quality simulation models to derive TN and TP values,
2. Reference condition approach based on TN and TP concentrations at the stream pour point, coincident in time with the data record from which the downstream receiving marine water segment TN and TP criteria were developed using the same data quality screens and reference condition approach,

3. Dilution models based on the relationship between salinity and nutrient concentration in the receiving segment, and
4. The TN and TP criteria from the receiving marine water segment to which the freshwater stream discharges, in cases where data are too limited to apply the first three approaches.

EPA's intention in proposing the four approaches is to provide a range of methods for deriving TN and TP DPVs that reflect the degree of data and scientific information available. Water quality modeling is the most rigorous and most data-demanding method, and will generally result in the most refined DPVs. Water quality modeling is EPA's preferred method for establishing DPVs and is listed first in the hierarchy. Due to the highly modified and managed canal systems in south Florida, EPA did not develop mechanistic models for the region, however, EPA is including the option for use if mechanistic models are developed for south Florida in the future. EPA's lead approach for calculating DPVs in south Florida is the reference condition approach. This approach is followed by less rigorous methods that are also less data-demanding. Using a procedure from a lower tier of the hierarchy requires less data, but also generally results in more stringent DPVs to account for the uncertainties associated with these less refined procedures.

All four approaches are briefly described in the following discussion. A more detailed description of the approaches, as well as the TN and TP DPVs that result from using the lead approach, the reference condition approach, is provided in the technical support document (Volume 3: South Florida Inland Flowing Waters, Section 2).

EPA believes that the first approach, the use of water quality simulation models, is the most refined method to define a DPV at the stream's pour point that will support balanced natural populations of aquatic flora and fauna in the downstream marine water. This approach may be appropriate when water quality simulation models are available, such as in the estuarine systems where mechanistic models were used to derive the criteria protective of the estuary.

EPA is proposing the second DPV approach, the reference condition approach, where a reference condition approach is used to derive TN, TP, and chlorophyll *a* criteria in the downstream marine water, as the lead approach for calculating DPVs in south Florida. Florida derived numeric nutrient criteria for TN, TP, and chlorophyll *a* in south Florida marine waters using a "Maintain Healthy Conditions Approach," which derives criteria reflective of ambient water quality conditions (Section 62-302.532, F.A.C.). This approach is akin to EPA's reference condition approach, which is designed to develop numeric nutrient criteria that are protective of applicable designated uses by identifying numeric nutrient criteria concentrations occurring in least-disturbed waters that are supporting designated uses. Since the downstream marine water is supporting balanced natural populations of aquatic flora and fauna during the reference condition period, the nutrient loads passing through the pour points into the marine water during the same period should be protective of the marine water. Therefore, EPA believes it would be appropriate in these cases to derive reference condition-based DPVs using water quality data at the pour point of the freshwater streams, coincident in time with the data record from which the downstream marine water segment TN and TP criteria were derived. EPA proposes that water quality data used to calculate DPVs at each pour point be screened to prevent the use of upstream water quality data that coincided with a documented downstream impact. This will prevent deriving a DPV using upstream water quality data that coincided with a documented downstream impact (e.g., CWA section 303(d) listing for nutrients in the marine water segment) and ensure mathematical consistency between the DPVs and marine water criteria.

The third DPV approach is also available for south Florida marine systems where water quality simulation models are not available. In these areas, EPA believes it would be appropriate to derive DPVs using dilution models based on the relationship between salinity and nutrient concentration. The concept is that the tidal mixing or dilution can be estimated from the marine water salinity. By plotting observed marine water TN or TP versus the marine water salinity and fitting a linear regression, the TN or TP at various levels of salinity can be determined. This regression model can then be used to determine the TN or TP concentration at the pour point associated with the average marine water salinity that will ensure the attainment and maintenance of the marine water numeric nutrient criteria concentration.

EPA's fourth approach for establishing DPVs is to apply the downstream receiving marine water segment TN and TP criteria to the pour point as the DPVs. This is the simplest approach and may be appropriate where data are too limited to apply the first three approaches. Florida derived numeric nutrient criteria for south Florida marine waters that can be found in Section 62-302.532(e)-(h), F.A.C. Therefore, the applicable DPVs for those south Florida marine waters would be Florida's criteria in Section 62-302.532(e)-(h), F.A.C. if using this fourth proposed approach for establishing DPVs.

EPA believes the proposed approaches for deriving DPVs establish a decision-making framework that is binding, clear, predictable, and transparent. Therefore, EPA is proposing that DPVs derived using these approaches do not require EPA approval under Clean Water Act section 303(c) to take effect.[205] A DPV calculated under options 2, 3, and 4 may be more stringent than a DPV calculated using a water quality model. These alternative options are intended to ensure that water quality standards are not only restored when found to be impaired, but are maintained when found to be attained, consistent with the CWA. Higher levels of TN and/or TP may be allowed in watersheds where it is demonstrated that such higher levels will fully protect the marine water's WQS. To the extent that it is determined that the alternative option DPVs for a given marine water are over-protective, applying a water quality model as set out in EPA's option 1 would result in a more refined definition of the DPV for that marine water.

EPA believes that these proposed approaches to establish DPVs are appropriate, scientifically defensible, and result in numeric values that will ensure the attainment and maintenance of the downstream south Florida marine water criteria. EPA requests comment on these approaches. EPA also requests comment on the alternative approach of finalizing the numeric TN and TP DPVs that EPA calculated using these approaches (as provided in Volume 3: South Florida Inland Flowing Waters, Section 2 of the technical support document) in place of the proposed approaches. Finally, EPA solicits additional available scientific information that can be used to ensure attainment and maintenance of the downstream south Florida marine water criteria. Commenters who submitted comments or scientific information related to DPVs for estuaries during the public

[205] 65 FR 24641, 24647 (April 27, 2000).

comment period for EPA's proposed inland waters rule (75 FR 4173) should reconsider their previous comments in light of the new information presented in this proposal and must re-submit their comments during the public comment period for this rulemaking to receive EPA response.

a) Alternative Approach (South Florida Inland Flowing Waters)

As an alternative to EPA's proposed DPV-only approach for south Florida inland flowing waters, EPA developed protective instream TN and TP criteria for Class I and III flowing waters (including canals and streams) in three inland subregions in south Florida (Biscayne, Palm Beach, and West) that are outside the lands of the Miccosukee and Seminole Tribes, EAA, and EvPA. EPA's alternative criteria for south Florida inland flowing waters are listed in Table III.D-1.

Table III.D-1. EPA's Alternative Numeric Criteria for South Florida's Inland Flowing Waters

Subregion	TN (mg/L)	TP (mg/L)
Biscayne	2	0.052
Palm Beach	2	0.052
West	2	0.052

EPA defined the boundaries of these three subregions based on patterns in geology/soils, hydrology, and vegetation. EPA compiled data for these subregions from IWR Run 40 and the South Florida Water Management District's DBHydro database. EPA screened the data to include freshwater locations and Class III waters, resulting in 4,758 daily averages with matched chl-a, TN, and TP data.

Next, EPA chose to evaluate algal biomass, as indicated by chlorophyll *a* concentrations, as a sensitive endpoint for numeric nutrient criteria development. Nutrient pollution can increase biomass of primary producers, especially algae, and have subsequent negative impacts on recreation and aquatic life. The application of algal biomass as an endpoint for criteria derivation in south Florida inland flowing waters, including canals, might be appropriate given the following observations: (1) flow in these water bodies is frequently reduced, leading to long residence times; (2) canopy cover is reduced both naturally and through manipulation, reducing light limitation; and (3) nutrient concentrations are elevated. Because both average chlorophyll *a* concentrations and instantaneous chlorophyll *a* concentrations (e.g. bloom conditions) can impact recreation and aquatic life, EPA chose to derive TN and TP criteria to reduce the likelihood of increased nuisance algal blooms by relating maximum chlorophyll *a* to average annual chlorophyll concentrations. EPA defined nuisance algal bloom conditions as concentrations above 30 µg/L using trophic state boundaries, user perception studies, and observed impacts. EPA evaluated existing scientific literature on the frequency of occurrence of chlorophyll *a* levels, and selected a 10 percent occurrence of nuisance algal blooms as the maximum allowable frequency to prevent impairment of recreation and aquatic life in the three south Florida inland subregions.[206]

EPA then used statistical models to derive TN and TP criteria to limit the frequency of occurrence of nuisance algal blooms in these waters, defined by chlorophyll *a* concentrations above 30 µg/L. The resulting TN and TP criteria represent the annual geometric mean of TN and TP concentrations from flowing waters in each of the three

[206] Havens, K.E. and W.W. Walker. 2002. Development of a total phosphorus concentration goal in the TMDL process for Lake Okeechobee, Florida (USA). *Lake and Reservoir Management* 18(3):227-238.

subregions that are associated with a 10 percent or lower frequency of nuisance algal bloom occurrence. If EPA were to finalize this alternative approach instead of EPA's lead approach, these TN and TP criteria would apply throughout the flowing waters in each of the three subregions, not just at the pour points. If criteria are calculated using this alternative approach, DPVs for protecting downstream south Florida marine waters will still be calculated using the hierarchical approach in Section III.D.2, unless, as described more in Section I.A, the district court modifies the Consent Decree consistent with EPA's amended determination that numeric DPVs are not necessary to meet CWA requirements in Florida. Additional details on this alternative approach are provided in the TSD (Volume 3: South Florida Inland Flowing Waters, Section 3).

b*) Request for Comment on Proposed and Alternative Approaches*

EPA believes that the proposed approach for south Florida inland flowing waters is appropriate, scientifically defensible, and results in the protection of south Florida inland flowing waters. EPA requests comment on this approach. EPA also solicits additional available scientific information that can be used to provide protection of fish consumption, recreation and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife in south Florida's Class I and III inland flowing waters from nitrogen and phosphorus pollution.

In addition, EPA requests comment on the alternative approach of deriving instream criteria for south Florida inland flowing waters outside of the lands of the Miccosukee and Seminole Tribes, EvPA, and EAA. Specifically, EPA requests comment on the scientific defensibility of this alternative approach as well as whether application of this approach will result in numeric nutrient criteria that protect the State's designated uses and ensure that nutrient concentrations of a body of water support balanced natural populations of aquatic flora and fauna.

Commenters who submitted comments or scientific information related to numeric nutrient criteria for south Florida inland flowing waters during the public comment period for EPA's proposed inland waters rule (75 FR 4173) should reconsider their previous comments in light of the new information presented in this proposal and must re-submit their comments during the public comment period for this rulemaking to receive EPA response.

F. Applicability of Criteria When Final

EPA proposes that the numeric nutrient criteria for Florida's estuaries, coastal waters, and south Florida inland flowing waters described in this rule be effective for CWA purposes 60 days after EPA publishes final criteria, and apply in addition to any other criteria for Class I, II, or Class III waters already adopted by the State and submitted to EPA (and for those adopted after May 30, 2000, approved by EPA). EPA requests comment on this proposed effective date.

Additionally, EPA also requests comment on the alternative of a delayed effective date, such as the 15-month delayed effective date that EPA promulgated in the final inland waters rule. EPA subsequently further extended the effective date of the 2010 rule to allow time for FDEP to finalize and EPA to review Florida's own numeric nutrient criteria rulemaking and reduce any administrative confusion and inefficiency that should occur if Federal criteria took effect while FDEP was finalizing or EPA was reviewing the State rulemaking. Florida's newly-approved State WQS include a schedule for future

State rulemaking whereby they will develop numeric nutrient criteria for additional estuaries by June 30, 2013 and again by June 30, 2015. If Florida is on schedule toward adoption of protective and approvable standards for their additional waters, EPA may consider delaying the effective date of its final rule to after June 30, 2015 to allow time for Florida to finalize and EPA to review the State's numeric nutrient criteria.

For water bodies that Florida has designated as Class I, II, and III, any final EPA numeric nutrient criteria will be applicable CWA water quality criteria for purposes of implementing CWA programs including permitting under the NPDES program, as well as monitoring and assessment, and establishment of TMDLs. The proposed criteria in this rule, when finalized, would be subject to Florida's general rules of applicability to the same extent as are other State-adopted and/or federally-promulgated criteria for Florida waters. Furthermore, states have discretion to adopt general policies that affect the application and implementation of WQS (40 CFR 131.13). There are many applications of criteria in Florida's water quality programs. Therefore, EPA believes that it is not necessary for purposes of this proposed rule to enumerate each of them, nor is it necessary to restate any otherwise generally applicable requirements.

It is important to note that no existing TMDL for waters in Florida will be rescinded or invalidated as a result of finalizing this proposed rule, nor will this proposed rule when finalized have the effect of withdrawing any prior EPA approval of a TMDL in Florida. Neither the CWA nor EPA regulations require TMDLs to be completed or revised within any specific time period after a change in water quality standards occurs. TMDLs are typically reviewed as part of states' ongoing water quality assessment programs. Florida may review TMDLs at its discretion based on the State's priorities, resources, and most recent assessments. NPDES permits are subject to five-year permit cycles, and in certain circumstances are administratively continued beyond five years. In practice, States often prioritize their administrative workload in permits. This prioritization could be coordinated with TMDL review. Because current nutrient TMDLs were established to protect Florida's waters from the effects of nitrogen and phosphorus pollution, the same goal as EPA's numeric nutrient criteria, the Agency believes that, absent specific new information to the contrary, it is reasonable to presume that basing NPDES permit limits on those TMDLs will result in effluent limitations as stringent as necessary to meet the federal numeric nutrient criteria.

IV. Under What Conditions Will EPA Either Not Finalize or Withdraw These Federal Standards?

Under the CWA, Congress gave states primary responsibility for developing and adopting water quality standards for their navigable waters (CWA section 303(a)-(c)). On June 13, 2012, FDEP submitted new and revised WQS for review by the EPA pursuant to section 303(c) of the CWA. On November 30, 2012, EPA approved the provisions of these rules submitted for review that constitute new or revised WQS (see Section II.F for additional information). Florida continues to have the option to adopt and submit to EPA numeric nutrient criteria for any of the State’s Class I, Class II, and Class III waters that are not covered in their June 13, 2012 submission to EPA, consistent with CWA section 303(c) and implementing regulations at 40 CFR 131. Although EPA is proposing numeric nutrient criteria for Florida estuaries, coastal waters, and south Florida inland flowing waters, if EPA approves criteria that are legally effective under Florida law for any other waters covered in this proposed rule as fully satisfying the CWA before publication of the final rulemaking, EPA will not proceed with the final rulemaking for those waters. Also, EPA will not proceed with final rulemaking for numeric DPVs, provided that the district court modifies the Consent Decree consistent with EPA's amended determination that numeric DPVs are not necessary to meet CWA requirements in Florida (see Section I.A for more information).

Pursuant to 40 CFR 131.21(c), if EPA finalizes this proposed rule, EPA's promulgated WQS become applicable WQS for purposes of the CWA on their effective date unless or until EPA withdraws those federally-promulgated WQS. Withdrawing the Federal standards for the State of Florida would require rulemaking by EPA pursuant to the requirements of the Administrative Procedure Act (5 U.S.C.551 *et seq*.). EPA would undertake such a rulemaking to withdraw the Federal criteria if and when Florida adopts and EPA approves numeric nutrient criteria that fully meet the requirements of section 303(c) of the CWA and EPA's implementing regulations at 40 CFR 131. If Florida adopts and EPA approves nutrient criteria that meet these requirements for a subset of waters, EPA would withdraw the Federal standards for that subset of waters.

V. Alternative Regulatory Approaches and Implementation Mechanisms

A. Designating Uses

Under CWA section 303(c)(2)(A), states shall adopt designated uses after taking "into consideration the use and value of water for public water supplies, protection and propagation of fish, shellfish, and wildlife, recreation in and on the water, agricultural, industrial and other purposes including navigation." Designated uses "shall be such as to protect the public health or welfare, enhance the quality of water and serve the purposes of [the CWA].” (CWA section 303(c)(2)(A)). EPA’s regulation at 40 CFR 131.3(f) defines “designated uses” as “those uses specified in water quality standards for each water body or segment whether or not they are being attained.” A “use” is a particular function of, or activity in, waters of the United States that requires a specific level of water quality to support it. In other words, designated uses are a state’s concise statements of its management objectives and expectations for individual surface waters.

In the context of designating uses, states often work with stakeholders to identify a collective goal for their waters that the state intends to strive for as it manages water quality. States may evaluate the attainability of these goals and expectations to ensure they have designated appropriate uses (40 CFR 131.10(g)). EPA’s regulations at 40 CFR 131 interpret and implement CWA sections 101(a)(2) and 303(c)(2)(A) to require that states adopt designated uses that provide water quality for the protection and propagation of fish, shellfish, and wildlife and for recreation in and on the water (referred to as uses specified in section 101(a)(2) of the Act), wherever attainable (40 CFR 131.2; 131.5(a)(4); 131.6(a),(f); 131.10(g),(j)). Where states do not designate uses specified in 101(a)(2) of the Act, or remove such uses, they must demonstrate that the uses are not attainable consistent with the use attainability analysis (UAA) provisions of 40 CFR 131.10, specifically 131.10(g). A state may remove protection for a use specified in CWA section 101(a)(2) if it can show, based on a UAA consistent with 131.10, that the use is not attainable. States may include waters located in the same watershed in a single UAA, provided that there is site-specific information to show how each individual water fits into the group in the context of any single UAA and how each individual water meets the applicable requirements of 40 CFR 131.10(g) for removing or modifying a use.

EPA's proposed numeric nutrient criteria for estuaries, coastal waters, and south Florida inland flowing waters will apply to those waters designated by Florida as Class I (Potable Water Supplies), Class II (Shellfish Propagation or Harvesting), and Class III (Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife). If Florida removes the Class I, Class II, and/or Class III designated use for any particular water body ultimately affected by this rule such that it is no longer designated as either Class I, II, or III, and EPA approves such a removal because it is consistent with CWA section 303(c) and regulations at 40 CFR 131, then the federally-promulgated numeric nutrient criteria would not apply to that water body. Only the water quality criteria associated with the revised designated use would apply to that water body.

B. Variances

A variance may be described as a time-limited designated use and criteria that target a specific pollutant(s), source(s), water body(ies) and/or water body segment(s). Variances constitute new or revised water quality standards subject to the procedural and substantive requirements applicable to removing a designated use.[207] Thus, EPA may only approve a variance if it is based on the same factors, set out at 40 CFR 131.10(g), that are required to revise a use specified in CWA section 101(a)(2) through a UAA.

Typically, variances are time-limited, but may be renewed. Temporarily modifying the designated use for a particular water body through a variance process allows a state to identify an interim designated use and associated criteria to serve as the basis for NPDES permit limits and certifications under CWA section 401 during the term

[207] *In re Bethlehem Steel Corporation*, General Counsel Opinion No. 58. March 29, 1977 (1977 WL 28245 (E.P.A. G.C.)). USEPA. 1994. *Water Quality Standards Handbook: Second Edition.* EPA-823-B-94-005a. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

of the variance while maintaining the designated use and associated criteria as the ultimate goal. A state should seek a variance instead of removing or revising the designated use where the state believes the designated use and associated criteria can be attained at some point in the future. By maintaining the designated use, and associated criteria, and by specifying a point in the future when the designated use will be fully applicable in all respects, the state ensures that further progress will be made in improving water quality and attaining the ultimate goal.

A variance may be written to address a specific geographic area, a specific pollutant or pollutants, and/or a specific discharger. All other applicable water quality standards not specifically modified by the variance, including any other criteria adopted to protect the designated use, remain applicable. State variance procedures, as part of state water quality standards, must be consistent with the substantive requirements of 40 CFR 131. Each variance must be submitted to EPA as a revised water quality standard for review and approval or disapproval pursuant to CWA section 303(c).

For purposes of this proposal, EPA is proposing criteria that apply to use designations that Florida has already established. EPA believes that the State continues to have sufficient authority under 131.10 to grant variances under its variance procedures to Class I, Class II or Class III uses and associated criteria. For this reason, EPA is not proposing a Federal variance procedure.

C. Site-Specific Alternative Criteria

Site-specific alternative criteria (SSAC) are alternative values to otherwise applicable water quality criteria that would be applied on a watershed, area-wide, or water body-specific basis that meet the regulatory test of protecting the water's designated use, having a basis in sound science, and ensuring the protection and maintenance of downstream water quality standards. SSAC may be more or less stringent than the otherwise applicable criteria. In either case, because the SSAC must protect the same designated use and must be based on sound science according to the requirements of 40 CFR 131.11(a), there is no need to modify the designated use or conduct a UAA. A SSAC may be appropriate when additional scientific data and analyses can bring increased precision or accuracy to expressing the concentration of a water quality parameter that is protective of the designated use.

In EPA's 2010 rulemaking for Florida's lakes and flowing waters outside of the South Florida Nutrient Watershed Region, EPA promulgated a procedure whereby EPA's Region 4 Regional Administrator may establish a SSAC after making available the proposed SSAC and supporting documentation for public comment (40 CFR 131.43(e)). This procedure became effective for CWA purposes on February 4, 2011. Under this provision, any entity, including the State, can submit a proposed Federal SSAC directly to EPA for the Agency's review and assessment as to whether an adjustment to the applicable Federal numeric nutrient criteria is warranted. The Federal SSAC process is separate and distinct from the State's SSAC processes in its water quality standards.

The current Federal SSAC procedure allows EPA to determine that a revised site-specific chlorophyll *a*, TN, TP, or nitrate+nitrite numeric criterion should apply in lieu of the generally applicable criteria promulgated in the final rule for Florida's lakes and flowing waters where that SSAC is demonstrated to be protective of the applicable designated use(s). The promulgated procedure provides that EPA will solicit public comment on its determination. Because EPA's rule established this procedure, implementation of this procedure does not require withdrawal of the associated federally-promulgated criteria for the Federal SSAC to be effective for purposes of the CWA. EPA has promulgated similar procedures for EPA's granting of variances and SSACs in other federally-promulgated water quality standards.[208]

As outlined in 40 CFR 131.43(e) and in the draft "Technical Assistance for Developing Nutrient Site-Specific Alternative Criteria in Florida" (June 2011), the process for obtaining a Federal SSAC includes the following steps. First, an entity seeking a SSAC compiles the supporting data, conducts the analyses, develops the expression of the criterion, and prepares the supporting documentation demonstrating that alternative numeric nutrient criteria are protective of the applicable designated use. The "entity" may be the State, a city or county, a municipal or industrial discharger, a permittee, a consulting firm acting on the behalf of a client, or any other individual or organization. The entity requesting the SSAC bears the burden of demonstrating that any proposed SSAC meets the requirements of the CWA and EPA's implementing regulations, specifically 40 CFR 131.11. Second, if the entity is not the State, the entity must provide notice of the proposed SSAC to the State, including all supporting documentation so that the State may provide comments on the proposal to EPA. Third, EPA's Region 4 Regional Administrator will evaluate the technical basis and protectiveness of the proposed SSAC and decide whether to publish a public notice and take comment on the proposed SSAC. The Regional Administrator may decide not to publish a public notice and instead return the proposal to the entity submitting the proposal, with an explanation as to why the proposed SSAC application did not provide

[208] See 40 CFR 131.33(a)(3), 40 CFR 131.34(c), 40 CFR 131.36(c)(3)(iii), 40 CFR 131.38(c)(2)(v), 40 CFR 131.40(c).

sufficient information for EPA to determine whether it meets CWA requirements or not. If EPA solicits public comment on a proposed SSAC, upon review of comments, the Regional Administrator may determine that the Federal SSAC is or is not appropriate to account for site-specific conditions and make that determination publicly available together with an explanation of the basis for the decision.

Since the SSAC provision in EPA's 2010 rule became effective, numerous entities have contacted EPA regarding a possible interest in obtaining a federal SSAC. However, following discussions with EPA, it became clear that a different water quality standards mechanism, such as a designated use change or variance, would be more appropriate in their particular situation. On March 9, 2011, EPA received a SSAC request from a pulp and paper mill that discharges to the Fenholloway River. Since the SSAC was derived from data in a nearby reference stream, the Econfina River, the TN and TP SSAC were requested to apply to both the Econfina and Fenholloway Rivers. Additional information was submitted by the requestor during 2011 and 2012 to address questions posed by EPA. At this time, EPA does not have sufficient information to move forward with proposing or establishing the TP or TN SSAC for the Fenholloway and Econfina Rivers.

EPA believes that there is benefit in extending this procedure for EPA adoption of Federal SSAC that will adjust the numeric nutrient criteria proposed in this rule. EPA is therefore proposing that a similar procedure promulgated in 40 CFR 131.43(e) apply to estuaries, coastal waters, and south Florida inland flowing waters. EPA requests comment on the following proposed application of the SSAC procedure.

To successfully develop a Federal SSAC for a given estuary, coastal water, or south Florida inland flowing water, a thorough analysis is necessary that indicates how the alternative concentration of TN, TP, or chlorophyll *a* supports both the designated use(s) of the water body itself, and provides for the attainment and maintenance of the WQS of downstream water bodies, where applicable. This analysis should have supporting documentation that consists of examining indicators of longer-term response to multiple stressors, such as seagrass health, as well as indicators of shorter-term response specific to nitrogen and phosphorus pollution, such as chlorophyll *a* concentrations associated with balanced phytoplankton biomass or sufficient dissolved oxygen to maintain aquatic life.

EPA is proposing seven approaches for developing SSAC for estuaries, coastal waters, and south Florida inland flowing waters that are similar to the four approaches EPA finalized in the 2010 rule for Florida's lakes and flowing waters. The first five proposed approaches are replicating the approaches EPA used to develop estuary, tidal creek, marine lake, coastal, and south Florida inland flowing water criteria, respectively, and applying these methods to a smaller subset of waters or water body segments. To understand the necessary steps in this analysis, interested parties should refer to the complete documentation of these approaches in the Technical Support Document for this proposed rule.

The sixth proposed approach for developing SSAC is to conduct a biological, chemical, and physical assessment of water body conditions. A detailed description of the supporting rationale must be included in the documentation submitted to EPA. The components of this approach could include, but are not limited to, evaluation of: seagrass health, presence or absence of native flora and fauna, chlorophyll *a* concentrations or phytoplankton density, average daily dissolved oxygen fluctuation, organic versus inorganic components of total nitrogen, habitat assessment, and hydrologic disturbance. This approach could apply to any water body type, with specific components of the analysis tailored for the situation.

The proposed seventh approach for developing SSAC is a general provision for using another scientifically defensible approach that is protective of the designated use. This provision allows applicants to make a complete demonstration to EPA using methods not otherwise described in the rule or its statement of basis, consistent with 40 CFR 131.11(b)(1)(iii). This approach could potentially include use of mechanistic models or other data and information.

D. Compliance Schedules

A compliance schedule, or schedule of compliance, refers to "a schedule of remedial measures included in a 'permit,' including an enforceable sequence of interim requirements … leading to compliance with the CWA and regulations." (40 CFR 122.2, CWA section 502(17)). In an NPDES permit, Water Quality-Based Effluent Limitations (WQBELs) are effluent limits based on applicable water quality standards for a given pollutant in a specific receiving water (NPDES Permit Writers Manual, EPA-833-B-96-003, December, 1996). EPA regulations provide that schedules of compliance may only be included in permits if they are determined to be "appropriate" given the circumstances of the discharge and are to require compliance "as soon as possible" (40 CFR 122.47).[209]

[209] Hanlon, Jim. USEPA Office of Wastewater Management. 2007, May 10. Memorandum to Alexis Stauss, Director of Water Division EPA Region 9, on "Compliance Schedules for Water Quality-Based

Florida has adopted a regulation authorizing compliance schedules. That regulation, Subsection 62-620.620(6), F.A.C., is not affected by this proposed rule. The complete text of the Florida rules concerning compliance schedules is available at https://www.flrules.org/gateway/RuleNo.asp?ID=62-620.620. Florida is, therefore, authorized to grant compliance schedules, as appropriate, under its rule for WQBELs based on EPA's federally-promulgated numeric nutrient criteria.

VI. Economic Analysis

The CWA provides a comprehensive framework for the protection and restoration of the health of the Nation's waters. EPA determined in 2009 that addressing the significant number of Florida waters impaired by nitrogen and phosphorus required the establishment of numeric nutrient criteria as part of Florida water quality standards adopted under the CWA. State implementation of numeric nutrient criteria in the proposed rule may result in an incremental level of controls needed for compliance with CWA programs, or require them sooner than would occur under current CWA programs. These controls include new or revised National Pollutant Discharge Elimination System (NPDES) permit conditions for point source dischargers and controls on other sources of nitrogen and phosphorus (e.g., agriculture, urban runoff, and septic systems) through the development of Total Maximum Daily Loads (TMDLs) and Basin Management Action Plans (BMAPs).

EPA conducted an analysis to estimate both the increase in the number of impaired waters that may be identified as a result of the proposed rule, and the potential annual cost of CWA pollution control actions likely to be implemented by the State of

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Effluent Limitations on NPDES Permits."

Florida and private parties to assure attainment of applicable State water quality designated uses. It is important to note that the costs of pollution controls needed to attain water quality standards for nutrients for waters already identified as impaired by the State (including waters with and without TMDLs in place) are not included in EPA estimates of the cost of the rule. EPA's analysis is fully described in the document entitled *Economic Analysis of Proposed Water Quality Standards for the State of Florida's Estuaries, Coastal Waters, and South Florida Inland Flowing Waters* (hereinafter referred to as the Economic Analysis), which can be found in the docket and record for this proposed rule. This analysis shows that the incremental costs associated with the proposed rule range between $239.0 million and $632.4 million per year (2010 dollars) and monetized benefits may be in the range from $39.0 to $53.4 million annually.

1. NRC Review of Phase 1 Cost Estimates

On December 6, 2010 EPA published a final rule to set numeric nutrient criteria for lakes and streams in Florida designed to protect those waters for their State-designated uses, such as swimming, fishing, or as drinking water sources (Phase 1 rule). EPA developed an economic analysis to provide the public with information on potential costs and benefits that may be associated with Florida's implementation of EPA's rule. EPA's estimate of the annual costs of that rule ranged from $135.5 to $206.1 million; stakeholder estimates of the same cost categories ranged from $8 to $13 billion annually. While these costs are not directly related to today's proposed rule, EPA determined that an independent peer review of its economic analysis for the Phase 1 rule would provide important information on the disparity between EPA's cost estimates and those of some stakeholders, and would be helpful to inform and improve its analysis of today's proposed rule. Accordingly, EPA requested the National Research Council (NRC) of the National Academies to review EPA's economic analysis for the Phase 1 rule. The NRC Committee completed its "Review of the EPA's Economic Analysis of Final Water Quality Standards for Nutrients for Lakes and Flowing Waters in Florida" in June. The Committee was charged with reviewing and commenting on three specific areas:

1) EPA's assumption that only newly impaired waters should be analyzed,
2) EPA's decision to estimate costs associated only with sources affecting newly impaired waters, by sector, and
3) EPA's assumptions about levels of control by point and nonpoint sources, including the use of variances and other flexibilities for more cost-effective approaches and whether to implement reverse osmosis and other stringent control technologies.

NRC answered the first charge, agreeing with EPA's assumption that only newly impaired waters should be analyzed. NRC also addressed the second charge, but took exception with EPA's approach to not estimating costs for unassessed waters or for septic systems affecting impaired springsheds. NRC also suggested that EPA underestimated the affected acres in agriculture. The Committee did not offer specific suggestions for how to compute the increased acreage that should be analyzed. However, on the cost side, they suggest including costs associated with installation of regional treatment systems on agricultural lands.

As for the third charge, the Committee largely addressed this by examining the details of EPA's unit costs, including comments suggesting ways in which EPA underestimated or overestimated costs. The Committee did not directly address EPA's assumptions regarding the use of SSACs, variances and use designations, except to propose an alternative cost estimating framework based on predicting the future time path of waters progressing through the stages of listing as impaired, TMDL development, and BMAP implementation, with and without the rule. The Committee generally concluded that EPA's cost estimates were likely too low, while the stakeholder estimates were too high.

In response to the NRC review, EPA has attempted to incorporate many of the recommendations and suggestions made throughout the NRC report including: using the HUC-12 watershed unit of analysis; analyzing potential costs for unassessed waters that could be incrementally impaired; analyzing costs for each industrial plant rather than extrapolating the results from a small sample; reviewing actual experience from existing TMDLs to identify BMPs sufficient to meet numeric targets; considering permeable reactive barriers for septic systems and their installation costs; and considering uncertainty in government expenditures. EPA has addressed these recommendations and suggestions in this analysis of costs for the coastal and estuary criteria.

The NRC Committee also described an approach for EPA to consider in analyzing the impacts of its numeric nutrients criteria rules by tracing out two time-paths of costs and benefits: one time-path for the baseline and one reflecting the proposed rule. The costs and benefits of the proposed rule could then be analyzed as the present value of the difference in the two time-paths of costs and benefits, respectively. To execute this approach, EPA would need to model not just its projection of the eventual controls that would be implemented under the proposed rule, but its predictions of the prioritization of watersheds that Florida would adopt to determine the timing of controls. NRC suggested that EPA could engage external stakeholders in a collaborative process to determine a collective set of assumptions to use as part of this analytical approach (or at least to "isolate and possibly reconcile" areas of disagreement). EPA acknowledges the merit of this approach, and notes that it is consistent with EPA's intent that its numeric nutrients criteria simply interpret Florida's current narrative nutrient criterion, by providing the often time-consuming first step of the science-based modeling necessary for developing a TMDL. The ultimate effect of the EPA's proposal would be to improve the efficiency and effectiveness of Florida's WQS program with regard to nutrients. However, given the exigencies of the consent decree and the timing of the NRC review, EPA determined that it was not possible to adopt the NRC's alternative approach for this proposal. The NRC's alternative approach was presented as a finding, rather than a recommendation, because the NRC acknowledged that time and budget constraints might render this approach unworkable for the current rule.

Considering the exigencies, EPA took the approach of estimating costs and benefits for a representative future year, using current water quality data as a basis for projecting what incremental water quality controls would need to be implemented during this future year to meet the new criteria. An approach that compares two complete future time-paths (with and without the proposed rule) requires taking the difference between those two time-paths, discounting over time, and summing in order to express the impacts in present value terms. In contrast, EPA's approach identifies waters that would be newly identified as impaired and the controls that would be needed to meet the new criteria. EPA then annualizes the costs of these controls over an appropriate time horizon. As such, the two approaches are not directly comparable. Nonetheless, EPA believes its approach sheds light on the costs and benefits associated with its numeric nutrients criteria rules and complies with the Executive Order requirements for conducting economic analysis of regulations. As noted above, EPA has made significant changes to its approach to address the NRC recommendations that are applicable to it.

2. *Baseline for Cost Analysis*

EPA is promulgating numeric nutrient criteria to supplement the State of Florida's current narrative nutrient criteria. The incremental impacts of the proposed rule are the potential costs and benefits associated with implementation of the proposed numeric criteria, including DPVs, for estuaries, coastal waters, and south Florida inland flowing waters, above and beyond the costs associated with State implementation of its current narrative nutrient criterion. The baseline incorporates requirements associated with restoration of already identified impaired waters, including waters for which TMDLs are approved and waters for which TMDLs are not yet developed. Because the numeric nutrients criteria proposed here interpret Florida's existing narrative criterion, which is also the basis for existing TMDLs, the analysis assumes that these TMDLs would be adopted as site-specific criteria. Thus, there would be no additional costs or benefits associated with the proposed rule for these waters. The baseline for this analysis also includes EPA's previously promulgated numeric nutrient criteria for Florida's lakes and flowing waters.

For waters that the State of Florida has already identified as impaired but for which it has not yet developed TMDLs, EPA expects that the effect of this proposed rule will be to shorten the time and reduce the resources necessary for the State of Florida to develop TMDLs and BMAPs. For waters that the State of Florida has developed

TMDLs, EPA has looked at the proposed criteria to compare these to the target loadings in the TMDLs and has not found a consistent pattern of existing TMDLs being either more or less stringent than would be required to meet the criteria proposed in this rule. For already impaired waters and waters already under a TMDL, EPA assumed that no additional controls on nonpoint sources to these waters would be needed as a consequence of this rule. However, there may be an incremental impact of the proposed rule for any point source dischargers to these waters that have or may receive waste load allocations for just one nutrient pollutant if those waters are not attaining criteria for the other as a result of this proposed rule. These costs are included in this economic analysis.

For waters not currently impaired under the baseline, EPA uses current water quality measurements to predict which waters would be deemed unimpaired as a result of the proposed rule (and therefore need not be analyzed for nonpoint source control costs). EPA acknowledges that these conditions could change in the future. To the extent that the experience in implementation of the proposed rule deviates from these specific assumptions about the baseline, EPA's estimates of the costs and benefits may be under- or overestimated. See Section 2 of the Economic Analysis for a full description of the baseline. EPA requests comment on its assumptions regarding the baseline.

3. Incremental Costs

The likely effect of this proposed rule will be the assessment and identification of additional waters that are impaired and not meeting the numeric water quality criteria in the proposed rule. The incremental impact of the proposed rule includes the costs for controls on point and nonpoint sources, developing and implementing TMDLs to attain the proposed criteria, and the monetary value (benefits) of the resulting potential increase in water quality. The economic analysis describes these potential incremental impacts of the proposed rule. It is important to note that EPA took care not to include costs for the estuarine and coastal marine waters contained in Florida's newly-approved State WQS.

To develop these estimates, EPA first assessed State control requirements associated with current water quality, existing impaired waters, and existing TMDLs, as well as existing regulations specific to estuaries, coastal waters and south Florida inland flowing waters (the baseline). EPA then identified the costs and benefits associated with additional pollution controls to meet EPA's proposed numeric criteria, beyond pollution controls currently needed or in place. To estimate incremental costs to municipal and industrial dischargers, EPA gathered publicly available facility information and data on potential control technologies, and used Florida Department of Environmental Protection (FDEP) point source implementation procedures to estimate the change in WQBELs and treatment controls that could result from the proposed rule. EPA assessed potential non-point source control costs by using publicly available information and data to determine land uses near waters that would likely be identified as impaired under the proposed rule. EPA used current FDEP data on stormwater controls and Florida Department of Agricultural and Consumer Services (FDACS) manuals to estimate costs of implementing stormwater and agricultural best management practices (BMPs) to attain the proposed numeric criteria. EPA also estimated the potential costs associated with upgrades of homeowner septic systems and potential government costs of developing additional TMDLs for water identified as impaired under this rule. Finally, EPA qualitatively and quantitatively described and estimated some of the potential benefits of complying with the new water quality standards. Although it is difficult to predict with certainty how the State of Florida will implement these new water quality standards, the result of this analysis represent EPA's best estimates of costs and benefits of the State of Florida's likely actions to implement this proposed rule.

A. Incrementally Impaired Waters

Compared to current conditions, potentially incrementally impaired waters are those waters that exceed EPA's proposed criteria for which FDEP has not already developed a TMDL or listed as impaired for nutrients. To estimate incremental costs associated with attainment of criteria, EPA first removed any waters for which the State of Florida has already determined to be impaired or established a TMDL and/or BMAP, because it considers these waters part of the baseline for this analysis. BMAPs are iterative and are updated on a continual basis until the TMDL targets are met. EPA assumes that controls will be implemented through these mechanisms until the TMDLs are met. Although additional costs to address baseline impairments may be needed in the future (after this rule is promulgated), EPA does not believe that these costs should be attributed to this proposed rule, but are instead part of the baseline. As discussed above, the State of Florida is not required to revise any existing TMDL as a result of this rule, and WQBELs in NPDES permits that are consistent with an existing EPA approved TMDL meet the requirements of the CWA. TMDL nutrient criteria have been shown to be both more stringent and less stringent when compared to criteria under this proposed rule and EPA has provided SSACs as a mechanism to approve the standards in existing TMDLs and BMAPs. Thus, EPA does not anticipate that this rule will result in increased nonpoint source controls costs for watersheds that already have an EPA-approved TMDL.

After excluding waters already identified as impaired under Florida's existing narrative criteria, EPA next identified estuarine and coastal segments that do not meet the numeric criteria of this proposed rule. EPA then assumed identified waterbodies (WBIDs[210]) that overlap those segments may be identified as incrementally impaired. EPA then identified the watersheds that contain or surround, in the case of coastal waters, those incrementally impaired WBIDs.

EPA analyzed FDEP's database of ambient water quality monitoring data and compared monitoring data for each segment with EPA's proposed criteria for TN and TP to identify incrementally impaired waters. EPA compiled the most recent five years of monitoring data and determined if there was sufficient data available to calculate more than one annual geometric mean in a consecutive three year period. With sufficient data, EPA calculated the annual geometric mean for each segment identified by EPA segment boundaries, and identified waters as incrementally impaired if they exceeded the applicable criteria in this proposed rule. The results of this analysis are shown in Table VI(A).

Table VI(A)(1): Number of WBIDs Summary of Data Analysis for Proposed Criteria[1]

Criteria Type	Baseline Impaired[2]	Not Currently Impaired Under the Baseline		Total
		Data Available[3]	Data Not Available	
Coastal	0	5	68	73
Estuaries	42	121	95	258
Total	42	126	163	331

Source: FDEP IWR run 44.
1. Represents number of WBIDs, based on 10% of WBID area overlapping segments for which EPA is proposing numeric nutrient criteria.
2. On 303(d) list as impaired for nutrients or covered under a nutrient-related TMDL. EPA did not assess these waters further for attainment of the proposed criteria.
3. WBIDs in segments for which at least two geometric means in a consecutive three year period can be calculated based on having at least four samples in a given year, with one sample in winter and summer.

[210] WBID is a waterbody identification number assigned by Florida, in order to delineate the boundaries of Florida's waters.

Controls may also be needed to meet the proposed criteria in a portion of the 163 WBIDs for which EPA does not have data if subsequent data would indicate impairment. These 163 WBIDs are variously located in the same watersheds as WBIDs that are baseline impaired or incrementally impaired by this proposed rule, or in watersheds either with no known impaired WBIDs or for which none of the WBIDs have sufficient data to determine impairment status. Without additional information about these waters, EPA determined the number of impaired-though-unassessed waters as a range. As a low estimate, it is possible that none of the unassessed waters would be impaired. Given the targeting scheme for Florida's IWR data, these unassessed waters likely have a lower probability of impairment than assessed waters, and zero represents the lower bound. For the high end of the range, EPA considered a proportional impairment rate of assessed waters. The impairment rate of unassessed waters may be anywhere in between.

While helpful in establishing the number of waterbodies that may be incrementally impaired, the assumption of proportional impairment does not produce information on location needed to estimate associated costs. The majority of unassessed waters lie along the coast and in close proximity to baseline impaired and impaired assessed waters. Hence, for this analysis, EPA assumed that impairment in unassessed waters would most likely be near baseline impairments and impaired assessed waters, since the loads causing impairment in these assessed waters could also affect the downstream unassessed waters. For coastal waters and south Florida waters, EPA used GIS to locate waters within or adjacent to the same watersheds associated with baseline impairments and impaired assessed waters. For estuaries, the number of unassessed waters estimated to be impaired (based on the assumption of proportional impairment) would not fit within the same watersheds associated with baseline impairments and impaired assessed waters. Therefore, EPA used GIS analysis to identify a buffer around the watersheds associated with baseline impairments and impaired assessed waters that would just include the estimated number of impaired unassessed waters. EPA found that a buffer size of 0.7 miles encompassed the estimated number of impaired unassessed waters. A smaller buffer (e.g., 0.5 mile) would not include enough unassessed waters. A larger buffer (e.g., 1 mile) would include too many unassessed waters. EPA then used this 0.7 mile buffer to identify the associated incremental watersheds that may need nonpoint source controls. EPA has estimated the acres of various land uses within these watersheds and reported as the upper bound in the Additional Unassessed Water column of Table VI(A)(2).

Table VI(A)(2): Summary of Land Use in Incrementally Impaired Watersheds for the Analysis of Costs under the Proposed Rule (acres)

Land Use Type	Assessed Waters[1]	Additional Unassessed Water[2]	Total
Agriculture	15,312	0 - 22,828	15,312 - 38,140
Communications and Utilities	3,337	0 - 3,315	3,337 - 6,652
Forest	199,432	0 - 256,137	199,432 - 455,569
Industrial	2,025	0 - 6,703	2,025 - 8,729
Other	9,276	0 - 11,306	9,276 - 20,582
Transportation Corridors	9,177	0 - 3,636	9,177 - 12,813
Urban	128,787	0 - 86,508	128,787 - 215,295
Water	220,728	0 - 102,615	220,728 - 323,343
Wetlands	196,545	0 - 322,355	196,545 - 518,899
Total	784,619	0 - 815,403	784,619 - 1,600,022

1. Total acreage of 12-digit HUC watersheds surrounding the incrementally impaired WBIDs based on sufficient data, excluding watersheds for which EPA has already estimated a need for controls.
2. Acreage surrounding potential incrementally impaired unassessed waters not associated with baseline impairment or incremental impairment under the proposed rule based on sufficient data.

The costs associated with the additional controls that would be necessary in the watersheds not already included in the cost analysis because of known incremental impaired waters will be included in the remainder of this section.

B. Point Source Costs

Point sources of wastewater must have a National Pollution Discharge Elimination System (NPDES) permit to discharge into surface waters. EPA identified point sources potentially discharging nitrogen and phosphorus to estuaries, coastal waters, and south Florida inland flowing waters by evaluating the Integrated Compliance Information System-National Pollutant Discharge Elimination System (ICIS-NPDES) database. EPA identified all facilities with any permitted discharge to estuarine, coastal, and south Florida inland flowing waters with an existing effluent limit or monitoring requirement for nitrogen or phosphorus, as well as those with the same industry code as any point source with an identified nutrient monitoring requirement. This analysis identified 121 point sources as having the potential to discharge nitrogen and/or phosphorus. Table VI(B) summarizes the number of point sources with the potential to discharge nitrogen and/or phosphorus.

Table VI(B). NPDES-Permitted Wastewater Dischargers Potentially Affected by Proposed Rule

Discharger Category	Major Dischargers [a]	Minor Dischargers [b]	Total
Municipal Wastewater	53	31	84
Industrial Wastewater	19	18	37
Total	72	49	121

[a] Facilities discharging greater than one million gallons per day or likely to discharge toxic pollutants in toxic amounts.
[b] Facilities discharging less than one million gallons per day and not likely to discharge toxic pollutants in toxic amounts.

1. Municipal Waste Water Treatment Plant (WWTP) Costs

EPA considered the costs of known nitrogen and phosphorus treatment options for municipal WWTPs. Nitrogen and phosphorus removal technologies that are available can reliably attain annual average total nitrogen (TN) concentration of approximately 3.0 mg/L or less and annual average total phosphorus (TP) concentration of approximately 0.1 mg/L or less.[211] EPA considered wastewater treatment to these concentrations to be the target levels for the purpose of this analysis. The NRC suggested that there is uncertainty associated with this assumption because dischargers to impaired waters typically receiving WQBELs equal to the numeric water quality criteria (NRC, 2012; p. 48). However, procedures for determining appropriate WQBELs include an evaluation of effluent quality and assimilative capacity of the receiving water. Specifically for nutrients, EPA found no implementation evidence in Florida to support the assumption that the criteria would be adopted as end-of-pipe limits. Instead, based on the State of Florida protocol[212] and the examples from existing nutrient TMDLs, EPA assumed for this analysis that state implementation of the proposed rule will not result in criteria end-of-pipe effluent limitations for municipal WWTPs.

The NPDES permitting authority determines the need for WQBELs for point sources on the basis of determining their reasonable potential to exceed water quality criteria. To determine reasonable potential on a facility-specific basis, data such as instream nutrient concentrations and low flow conditions would be necessary. However,

[211] U.S. EPA, 2008, "Municipal Nutrient Removal Technologies Reference Document. Volume 1 – Technical Report," EPA 832-R-08-006.

[212] Florida Department of Environmental Protection (FDEP). 2006a. TMDL Protocol. Version 6.0. Task Assignment 003.03/05-003.

because most WWTPs are likely to discharge nutrients at concentrations above applicable TN and/or TP criteria, EPA assumed that all WWTPs have reasonable potential to exceed the numeric criteria. The NRC supported this assumption.

For municipal wastewater, EPA estimated costs to reduce effluent concentrations to 3 mg/L or less for TN and 0.1 mg/L or less for TP using advanced biological nutrient removal (BNR). Although reverse osmosis and other treatment technologies may have the potential to reduce nitrogen and phosphorus concentrations even further, EPA believes that implementation of reverse osmosis applied on such a large scale has not been demonstrated.[213] The NRC supported this assumption (NRC, 2012; p. 46) but said that in some instances, treatment to levels beyond the controls of advanced BNR would be required (NRC, 2012; p. 48). Such levels have not been required for WWTPs by the State of Florida in the past, including for those WWTPs under TMDLs with nutrient targets comparable to the criteria in this proposed rule. EPA believes that should state-of-the-art BNR technology, together with other readily available and effective physical and chemical treatment (including chemical precipitation and filtration), fall short of compliance with permit limits associated with meeting the new numeric nutrient criteria, then it is reasonable to assume that entities would first seek out alternative compliance mechanisms such as reuse, site-specific alternative criteria, variances, and designated use modifications. In addition, under a TMDL, FDEP could allocate greater load reductions to nonpoint sources based on baseline contributions and existing controls, thus resulting in fewer reductions required from point source dischargers. EPA acknowledges that if its

[213] Treatment using reverse osmosis also requires substantial amounts of energy and creates disposal issues as a result of the large volume of concentrate generated.

assumptions about the availability of reuse, SSACs, variances and designated use changes are incorrect, then the costs presented here are underestimates.

To estimate compliance costs for WWTPs, EPA identified current WWTP treatment capabilities using FDEP's Wastewater Facility Regulation (WAFR) database, and information obtained from NPDES permits and/or water quality monitoring reports. Table VI(B)(1) summarizes EPA's best estimate of the number of potentially affected municipal WWTPs that may require additional treatment for nitrogen and/or phosphorus to meet the numeric criteria supporting State designated uses.

Table VI(B)(1). Summary of Potential for Additional Nutrient Controls for Municipal Wastewater Treatment Plants [a]

Discharge Type	Number of Dischargers				
	Additional Reduction in TN and TP [a]	Additional Reduction in TN Only [b]	Additional Reduction in TP Only [c]	No incremental controls needed [d]	Total
Major	7	0	22	22	51
Minor	17	0	1	10	28
Total	24	0	23	32	79

Source: Based on treatment train descriptions in FDEP's Wastewater Facility Regulation database[214] and permits, WLAs in TMDLs and existing regulations, assuming dischargers would have to install advanced BNR for compliance under the rule.
a. Includes dischargers without treatment processes capable of achieving the target levels or existing WLA for TN and TP, or for which the treatment train description is missing or unclear.
b. Includes dischargers with chemical precipitation only.
c. Includes dischargers with Modified Ludzack-Ettinge (MLE), four-stage Bardenpho, and BNR specified to achieve less than 3 mg/L, or those with WLA under a TMDL for TN only.
d. Includes dischargers with anaerobic-anoxic oxidation (A^2/O), modified Bardenpho, modified University of Cape Town (UCT), oxidation ditches, or other BNR coupled with chemical precipitation, those with WLAs under a TMDL for both TN and TP, those discharging to waters on the 303(d) list for nutrients or DO, and those ocean dischargers covered under the Grizzle-Figg Act that will cease discharge completely by 2025.

An EPA study provides unit cost estimates for BNR for various TN and TP performance levels[215]. To estimate costs for WWTPs, EPA used the average capital and

[214] Florida Department of Environmental Protection (FDEP). 2009. Wastewater Facility Information: Wastewater Facility Regulation (WAFR) database. http://www.dep.state.fl.us/water/wastewater/facinfo.htm. Accessed June 2009.
[215] USEPA. 2008. *Municipal Nutrient Removal Technologies Reference Document. Volume 1 – Technical*

average operation and maintenance (O&M) unit costs for technologies that achieve an annual average of 3 mg/L or less for TN and/or 0.1 mg/L or less for TP. NRC noted that these unit costs were significantly lower than those estimated by the Florida Water Environment Association Utility Council (FWEAUC) and suggested to verify the unit costs against FWEAUC's unit costs. Multiplying these unit costs by facility flow reported in EPA's PCS database, EPA estimated that total costs could be approximately $44.1 million per year (2010 dollars).[216]

EPA also conducted a sensitivity analysis to address the potential for dischargers under TMDLs that establish WLAs for TN or TP (and not both pollutants), such that incremental costs could be required under the proposed rule to control the other pollutant. The results of this analysis suggest a range of additional costs from $3.6 million to $5.6 million annually (see section 5.3 of the Economic Analysis). Thus, estimated total cost could range from approximately $47.7 million to $49.7 million per year.

2. Industrial Point Source Costs

Incremental costs for industrial dischargers are likely to be facility-specific and depend on process operations, existing treatment trains, and composition of waste streams. EPA identified 36 industrial dischargers potentially affected by the proposed rule. Of those, 4 are subject to an existing nutrient TMDL, and 4 discharge to waters currently listed as impaired. As with WWTPs, EPA assumed that costs to industrial dischargers under an existing nutrient TMDL with WLAs for both nitrogen and phosphorus and costs at facilities discharging to currently impaired waters are not

Report. EPA 832-R-08-006. U.S. Environmental Protection Agency, Office of Wastewater Management, Municipal Support Division.

[216] Estimated capital costs annualized at 7% over 20 years, plus estimated annual O&M.

attributable to this proposed rule because those costs would be incurred absent the rule (under the baseline).

To estimate potential costs to the remaining 28 potentially affected industrial facilities (Table VI(B)(2)), EPA used effluent data for flows, TN, and TP from Discharge Monitoring Reports in EPA's ICIS-NPDES database and other information in NPDES permits to determine whether or not they have reasonable potential to cause or contribute to an exceedance of the proposed criteria in this proposed rule. Because the numeric nutrient criteria are annual geometric means, EPA assumed that any discharger with an average TN or TP concentration greater than the proposed criterion would have reasonable potential. For those facilities with reasonable potential, EPA further analyzed their effluent data and estimated potential revised water quality based effluent limits (WQBELs) for TN and TP. If the data indicated that the facility would not be in compliance with the revised WQBEL, EPA estimated the additional nutrient controls those facilities would likely implement to allow receiving waters to meet designated uses and the costs of those controls. Although reverse osmosis and other treatment technologies have the potential to reduce nitrogen and phosphorus concentrations even further, EPA believes that implementation of reverse osmosis applied on such a large scale has not been demonstrated as likely or necessary.[217] If BNR or other more conventional cost-effective treatment technologies would not meet the revised WQBELs, EPA believes it is reasonable to assume that entities would first seek out other available compliance mechanisms such as reuse, site-specific alternative criteria, variances, and designated use modifications. In addition, under a TMDL FDEP could allocate greater

[217] Treatment using reverse osmosis also requires substantial amounts of energy and creates disposal issues as a result of the large volume of concentrate that is generated.

load reductions to nonpoint sources based on baseline contributions resulting in fewer reductions from point source dischargers.

Using this method, EPA estimated that the potential costs for industrial dischargers could be approximately $15.2 million annually (2010 dollars). Note that a number of the dischargers would not incur incremental costs, while others would incur costs of implementing controls such as chemical precipitation, filtration, and/or BNR. NRC said that the use of similar unit costs for industrial flows as EPA had used for municipal waste water treatment facilities did not capture the higher costs associated with lower flows and therefore industrial costs are underestimated. The source EPA used to find unit costs included plant costs with low flows that EPA was able to compare to plant costs with high flows, as NRC suggested. EPA found no pattern for higher or lower costs and therefore did not change its unit costs. The NRC also suggested EPA should include costs for flow equalization atsome industrial facilities. EPA does not have enough flow data to estimate flow equalization costs, but did use the 90th percentile flows as the basis for costs for dischargers with variable flows (see Cost Calculations for Industrial Dischargers). EPA considers the use of the 90th percentile flow together with an allowance for contingencies to provide sufficient costs allowance to cover the cost of equalization should that be necessary at individual facilities.

Table VI(B)(2): Potential Incremental Costs for Industrial Dischargers [a]			
Industrial Category	Total Number of Facilities	Number of Facilities with costs [b]	Total Annual Costs (million 2010$/yr)

Chemicals and Allied Products	1	0	$0.0
Electric Services	8	2	$0.5
Food	2	1	$0.2
Mining	0	0	$0.0
Other	14	1	$0.0
Pulp and Paper	3	3	$14.5
Total	28	7	$15.2
a May not add due to rounding b In most cases, only a few facilities are projected to incur costs; others do not.			

C. Non-point Source Costs

To estimate the potential incremental costs associated with controlling nitrogen and phosphorus pollution from non-point sources, EPA identified land areas near incrementally impaired waters using GIS analysis. EPA identified the 12-digit hydrologic units (HUC-12s) in Florida that contain, or in the case of coastal waters, surround an incrementally impaired WBID (WBIDs are GIS polygons for water assessment), and excluded those HUC-12s that are included in the baseline or cost analysis for in the Inland Rule. EPA then identified all the 12-digit HUCs that drain to any remaining unassessed WBIDs that may become incrementally impaired should they be assessed in the future. EPA then identified land uses in these HUCs using GIS analysis of data obtained from the State of Florida. By using the HUC-12 delineation, EPA has addressed the NRC recommendation that EPA use the more refined HUC-12 delineation instead of the larger HUC-10 delineation.

1. Costs for Urban Runoff

EPA's GIS analysis indicates that urban land (excluding land for industrial uses covered under point sources) accounts for approximately 128,800 acres to 215,300 acres of the land near incrementally impaired waters. EPA's analysis indicates that urban runoff is already regulated on a portion of this land under EPA's stormwater program requiring municipal separate storm sewer system (MS4) NPDES permits. Florida has a total of 27 large (Phase I) permitted MS4s serving greater than 100,000 people and 132 small (Phase II) permitted MS4s serving fewer than 100,000 people. MS4 permits generally do not have numeric nutrient limits, but instead rely on implementation of BMPs to control pollutants in stormwater to the maximum extent practicable. Even those MS4s in Florida discharging to impaired waters or under a TMDL currently do not have numeric limits for any pollutant.

In addition to EPA's stormwater program, several existing State rules are intended to reduce pollution from urban runoff and were included in the baseline for EPA's proposed rule. For example, Florida's Urban Turf Fertilizer rule (administered by FDACS) requires a reduction in the amount of nitrogen and phosphorus that can be applied to lawns and recreational areas. Florida's 1982 stormwater rule (Chapter 403 of Florida statues) requires stormwater from new development and redevelopment to be treated prior to discharge through the implementation of BMPs. The rule also requires that older systems be managed as needed to restore or maintain the beneficial uses of waters, and that water management districts establish and implement other stormwater pollutant load reduction goals. In addition, the "Water Resource Implementation Rule" (Chapter 62-40, F.A.C.) establishes that stormwater design criteria adopted by FDEP and the water management districts shall achieve at least 80% reduction of the average annual load of pollutants that cause or contribute to violations of water quality standards (95% reduction for outstanding natural resource waters). This rule sets design criteria for new development that is not based on impairment status of downstream waters. For NPDES permits, reasonable potential exists for any effluent concentrations above the criteria even if the water is attaining standards. Therefore, EPA assumed that post-1982 developed land already has controls to meet 80% reductions and only older developed land would need an incremental level of control. The rule also states that the pollutant loadings from older stormwater management systems shall be reduced as necessary to restore or maintain the designated uses of waters. As the proposed numeric nutrients criteria interpret the existing narrative criterion, EPA assumes any such reductions requiring costs are not a consequence of the proposed criteria. The NRC suggested that existing State rules are not being fully complied with and EPA should not consider them to be part of the baseline. EPA's assumption of compliance with the 1982 Stormwater Rule is based on FDEP's economic analysis indicating that post-1982 development would not need additional controls. Given the State's cyclical monitoring schedule, existing ambient monitoring data may not yet fully reflect nutrient reductions because the rule has only been in effect since July 2009. Other controls that target the quantity of stormwater runoff from low-density residential land may not be as cost effective as the Urban Turf Fertilizer Rule. Thus, EPA did not estimate an incremental level of control to be needed for low-density residential land.

Identifying water as impaired under the proposed rule could result in changes to MS4 NPDES permit requirements for urban runoff, so that Florida waters meet the proposed criteria. However, the combination of additional pollution controls required will likely depend on the specific nutrient reduction targets, the controls already in place, and the relative amounts of nitrogen and phosphorus pollution contained in urban runoff at each particular location. Because stormwater programs are usually implemented using an iterative approach – with the installation of controls followed by monitoring and re-evaluation – estimating the complete set of pollution controls required to meet a particular water quality target would require detailed site-specific analysis.

Although it is difficult to predict the complete set of potential additional stormwater controls that may be required to meet the numeric criteria that supports State designated uses in incrementally impaired waters, EPA estimated potential costs for additional treatment by assessing the amount of urban land that may require additional stormwater controls. FDEP has previously assumed that all urban land developed after adoption of Florida's 1982 stormwater rule would be in compliance with the Phase 1 rule and EPA believes it is reasonable to make a similar assumption for this proposed rule.[218] Using this assumption, EPA used GIS analysis of land use data obtained from the State of Florida[219] to identify the amount of remaining urban land located near incrementally impaired waters. For Phase I MS4s, EPA used a range of acres with 46,700 acres as the upper bound and zero acres as the lower bound, because Phase I MS4 urban areas already must implement controls to the "maximum extent practicable." As such, these municipalities may not need to achieve additional reductions if existing requirements are already fully implemented. EPA similarly estimated ranges of acreage needing stormwater controls for Phase II MS4 areas, and non-MS4 urban areas. GIS analysis of land use data indicates that land in Phase II MS4 and non-MS4 urban areas are low

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218 FDEP. 2010. *FDEP Review of EPA's "Preliminary Estimate of Potential Compliance Costs and Benefits Associated with EPA's Proposed Numeric Nutrient Criteria for Florida": Prepared January 2010 by the Environmental Protection Agency.* Florida Department of Environmental Protection, Division of Environmental Assessment and Restoration.

219 Florida Geographic Data Library, 2009.

density residential. For the urban land that is not low density residential, some additional structural BMPs may be necessary to comply with EPA's numeric nutrient criteria. Because nutrient reductions from low density residential land under the existing Urban Turf Fertilizer Rule are likely sufficient, and the State of Florida asserts that urban land developed after 1982 (77.9% of urban land) would not need additional controls for compliance with EPA's numeric nutrient criteria, EPA estimated that approximately 27,700 to 43,100 acres of Phase II MS4 urban land and 19,600 to 28,900 acres of urban land outside of MS4 areas may require additional stormwater controls to meet EPA's numeric nutrient criteria. The actual acreage may be somewhere within the range. Using this procedure, EPA estimated that 47,300 to 118,700 acres may require additional stormwater controls.

The cost of stormwater pollution controls can vary widely. FDEP tracks the cost of stormwater retrofit projects throughout the State that it has provided grant funding for.[220] EPA estimated control costs based on the average unit costs, $19,300, across all projects from FDEP (2012c) to account for the mix of project types likely to be installed based on their current prevalence in grant funding throughout the state. The NRC suggested that higher pollutant removals may be obtained by more advanced stormwater control measures such as bioretention or other vegetated infiltration, which may be more costly than the current set of FDEP-funded projects. NRC (2009) indicates annual per-

[220] FDEP. 2010. "Appendix 3: Cost Analysis for Municipal Discharge using 30 Year Annualization and Florida MS4 Numeric Nutrient Criteria Cost Estimation," In: *FDEP Review of EPA's "Preliminary Estimate of Potential Compliance Costs and Benefits Associated with EPA's Proposed Numeric Nutrient Criteria for Florida": Prepared January 2010 by the Environmental Protection Agency*. Florida Department of Environmental Protection, Division of Environmental Assessment and Restoration.

acre costs could range from $300 per acre to $3,500 per acre.[221] EPA does not have the necessary information to exactly compare this source with EPA's average unit costs of $19,300, but believes EPA's unit costs are captured within the higher end of the range. Given that the costs may be comparable to the NRC suggested projects and the retrofit data is specific to projects that Florida has already implemented therefore making them more likely to be implemented for future projects, EPA continues to use costs from the Florida specific retrofit project data.

EPA multiplied the average capital costs per acre ($19,300) of the FDEP projects by the number of acres potentially requiring controls to estimate the potential incremental stormwater capital costs associated with the proposed rule. EPA then used FDEP's estimate of operation and maintenance (O&M) costs (at 5% of capital costs), and annualized capital costs using FDEP's discount rate of 7% over 20 years. This analysis indicates that urban runoff control costs could range from approximately $131.9 million to $330.9 million. Table VI(C)(2) summarizes these estimates.

Table VI(C)(1): Estimated Incremental Urban Stormwater Costs

Urban Land Type	Estimated Acres Potentially Needing Controls[1]	Capital Costs (million $)[2]	O&M Costs (million $/yr)[3]	Annual Costs (million $/yr)[4]
MS4 Phase I Urban	0 - 46,700	$0 - $901.4	$0 - $45.1	$0.0 - $130.2
MS4 Phase II Urban	27,700 - 43,100	$534.0 - $832.8	$26.7 - $41.6	$77.1 - $120.3
Non-MS4 Urban	19,600 - 28,900	$379.2 - $557.5	$19.0 - $27.9	$54.8 - $80.5
Total	47,300 - 118,700	$913.2 - $2,291.7	$45.7 - $114.6	$131.9 - $330.9

1. Phase I MS4s range represents implementation of BMPs to the MEP resulting in compliance with EPA's rule or controls needed on all pre-1982 developed land that is not low density residential; Phase II MS4s and urban land outside of MS4s represent controls needed on all pre-1982 developed land that is not low density residential. Assumes that up to 46% of land associated with unassessed waters would require controls.
2. Represents acres needing controls multiplied by median unit costs of stormwater retrofit costs from FDEP (2010b).
3. Represents 5% of capital costs.
4. Capital costs annualized at 7% over 20 years plus annual O&M costs.

221 NRC (2009) does not provide the discount rate, useful life, or annual O&M costs it uses to estimate annual costs.

2. Agricultural Costs

EPA's GIS analysis of land use indicates that agriculture accounts for about 15,312 to 38,140 acres of land near incrementally impaired waters. This differs substantially from the Inland Rule where over 800,000 acres of agricultural land use were identified in watersheds draining to potentially incrementally impaired WBIDs, because agriculture is a much more prevalent land use inland than near the coast. Agricultural runoff can be a source of nitrogen and phosphorus to estuaries, coastal waters and south Florida inland flowing waters through the application of fertilizer to crops and pastures and from animal wastes. For waters impaired by nitrogen and phosphorus pollution, the 1999 Florida Watershed Restoration Act established that agricultural BMPs should be the primary instrument to implement TMDLs. Thus, additional waters identified by the State as impaired under the proposed rule may result in State requirements or provisions to reduce the discharge of nitrogen and/or phosphorus to incrementally impaired waters through the implementation of BMPs. The NRC suggested that for Phase I, the incremental agricultural land area identified was likely underestimated. EPA addressed this finding by including land area associated with potentially impaired unassessed waters in this analysis.

EPA estimated the potential costs of additional agricultural BMPs by evaluating land use data. BMP programs designed for each type of agricultural operation and their costs were taken from a study of agricultural BMPs to help meet TMDL targets in the Caloosahatchee River, St. Lucie River, and Lake Okeechobee watersheds. Three types of BMP programs were identified in this study. The first program, called the "Owner

Implemented BMP program," consists of a set of BMPs that land owners might implement without additional incentives. The second program, called the "Typical BMP program," is the set of BMPs that land owners might implement under a reasonably funded cost share program or a modest BMP strategy approach. The third program, called the "Alternative BMP program," is a more expensive program designed to supplement the "Owner Implemented BMP program" and "Typical BMP program" if additional reductions are necessary.

The BMPs in the "Owner Implemented BMP Program" and "Typical BMP Program" are similar to the BMPs verified as effective by FDEP and adopted by FDACS. EPA did not find BMPs in the "Alternative BMP Program" similar to the BMPs in the FDACS BMP manual, despite the NRC suggestion that the "Alternative BMP Program" would be needed to meet NNC. EPA has also found no indication that the "Alternative BMP Program," which includes edge-of-farm stormwater chemical treatment, has been implemented through TMDLs to meet water quality standards for nutrients in watersheds with significant contributions from agriculture (e.g., Lake Okeechobee). EPA also found that TMDLs cite the Florida Department of Agriculture and Consumer Services' (FDACS) BMP manual as a source of approved BMPs. Therefore, for purposes of this analysis, EPA believes it is reasonable to assume that nutrient controls for agricultural sources are best represented by the combination of the "Owner Implemented BMP Program" and "Typical BMP Program" and not the more stringent "Alternative BMP Program" controls. This assumption corroborates EPA's intent for the nutrient criteria to provide the same level of protection as Florida's narrative criteria.

Table VI(C)(2) summarizes the potential incremental costs of BMPs on agricultural lands in the watersheds of incrementally impaired estuaries, coastal waters and south Florida inland flowing waters for each agricultural category. This analysis indicates that incremental agricultural costs resulting from the proposed numeric nutrient criteria may be estimated at $0.3 - $0.7 million per year.

Table VI(C)(2). Potential Incremental Agricultural BMP Costs

Agricultural Category	Area Potentially Needing Controls (acres)[a]	"Owner Implemented BMP Program" plus "Typical BMP Program" Unit Costs (2010$/ac/yr)[b]	Total "Owner Implemented BMP Program" and "Typical BMP Program" Costs (2010$/yr)
Animal Feeding	20 - 39	$18.56	$400 - $700
Citrus	0	$156.80	$0
Fruit Orchards[c]	0 - 7	$156.80	$0 - $1,100
Cow Calf Production, Improved Pastures	1,115 - 4,568	$15.84	$17,700 - $72,400
Cow Calf Production, Rangeland and Wooded Pasture	1,145 - 1,995	$4.22	$4,800 - $8,400
Cow Calf Production, Unimproved Pastures	299 - 1,346	$4.22	$1,300 - $5,700
Cropland and Pasture Land (general)[d]	10,195 - 18,467	$27.26	$277,900 - $503,300
Dairies	0	$334.40	$0
Field Crop (Hayland) Production	479 - 1,397	$18.56	$8,900 - $25,900
Horse Farms	34 - 123	$15.84	$500 - $1,900
Ornamental Nursery	4 - 8	$70.00	$300 - $600
Floriculture[e]	0	$70.00	$0
Row Crop	228 - 246	$70.40	$16,100 - $17,300
Sod/Turf Grass	0	$35.20	$0
Other Areas[f]	565 - 1,069	$18.56	$10,500 - $19,800
Total[g]	14,085 - 29,265	--	$338,300 - $657,200

Table VI(C)(2). Potential Incremental Agricultural BMP Costs

Agricultural Category	Area Potentially Needing Controls (acres)[a]	“Owner Implemented BMP Program” plus ”Typical BMP Program” Unit Costs (2010$/ac/yr)[b]	Total “Owner Implemented BMP Program” and ”Typical BMP Program” Costs (2010$/yr)

Note: Detail may not add to total due to independent rounding.
a. Low end of range represents acres associated with impaired assessed waters assuming none of the unassessed waters would be impaired under the proposed rule; high end of range represent low end plus controls on the watersheds associated with impaired unassessed waters (estimated based on proportional impairment to assessed waters) for which EPA has not already identified a need for controls for baseline or impaired assessed waters. Based on GIS analysis of land use data from five water management districts (for entire State)
b. Cost estimates from SWET (2008); representative of 2010 prices (personal communication with D. Bottcher, 2010).
c. Owner/typical BMP unit costs based on costs for citrus crops.
d. Owner/typical BMP unit costs based on average costs for improved pastures, unimproved/wooded pasture, row crops, and field crops.
e. Owner/typical BMP unit costs based on costs for ornamental nurseries.
f. Includes FLUCCS Level 3 codes 2230, 2400, 2410, and 2540.
g. Excludes land not in production.

3. Septic System Costs

Some nutrient reductions from septic systems may be necessary for incrementally impaired waters to meet the numeric nutrient criteria in this proposed rule. Several nutrient-related TMDLs in Florida identify septic systems as a significant source of nitrogen and phosphorus pollution. Some of the ways to address pollution from septic systems may include greater use of inspection programs and repair of failing systems, upgrading existing systems to advanced nutrient removal, installation of decentralized cluster systems where responsible management entities would ensure reliable operation and maintenance, and connecting households and businesses to wastewater treatment plants. Because of the cost, time, and issues associated with new wastewater treatment plant construction, EPA assumed that the most likely strategy to reduce nutrient loads from septic systems would be to upgrade existing conventional septic systems to advanced nutrient removal systems.

Septic systems in close proximity to surface waters are more likely to contribute nutrient loads to waters than distant septic systems. Florida Administrative Code provides that in most cases septic systems should be at least 75 feet from surface waters (F.A.C. 64e-6.005(3)). In addition, many of Florida's existing nutrient-related TMDLs identify nearby failing septic systems as contributing to nutrient impairments in surface waters.

For this economic analysis, EPA assumed that some septic systems located near incrementally impaired waters may be required to upgrade to advance nutrient removal systems. However, the distance that septic systems can be safely located relative to these surface waters depends on a variety of site-specific factors. Because of this uncertainty, EPA assumed that septic systems located within 500 feet of any water (based on land use types) in watersheds containing or, in the case of coastal waters, surrounding incrementally impaired estuaries, coastal waters or south Florida inland flowing waters may need to be upgraded from conventional to advanced nutrient removal systems. The NRC agreed with the 500-ft threshold, but found that the exclusion of septic systems in springsheds is a deficiency of EPA's analysis. This proposed rule does not include criteria for springsheds.

EPA used GIS analysis of data obtained from the Florida Department of Health [222] that provides the location of active septic systems in the State to identify the potentially affected septic systems. This analysis yielded 5,952 to 10,784 active septic systems that may be affected by the proposed rule.

[222] FDOH. 2010. *Bureau of Onsite Sewage GIS Data Files*. Florida Department of Health, Division of Environmental Health. <http://www.doh.state.fl.us/Environment/programs/EhGis/EhGisDownload.htm>.

EPA evaluated the cost of upgrading existing septic systems to advanced nutrient removal systems. The NRC also recommended that EPA consider permeable reactive barriers (PRB) in their technology costs and take into account any additional Florida-specific costs related to septic system upgrades (e.g., performance-based treatment systems, under Florida regulations, need to be designed by Florida licensed professional engineers). EPA included this technology in the cost analysis, resulting in the range of upgrade capital costs from $3,300 to $8,800 per system. See the Economic Analysis for further detail. For O&M costs, EPA relied on a study that compared the annual costs associated with various septic system treatment technologies including conventional onsite sewage treatment and disposal system and fixed film activated sludge systems. Based on this study, EPA estimated the incremental O&M costs for an advanced system to be $650 per year.[223] In addition, homeowners would also incur a biennial permit fee of $100 (or $50 per year) for the upgraded system. Thus, based on annual O&M costs of $700 and annualizing capital costs at 7% over 20 years, total annual costs could range from approximately $1,000 to $1,500 for each upgrade. EPA estimated the total annual costs of upgrading septic systems by multiplying this range of unit costs with the number of systems identified for upgrade. Using this method, total annual costs for upgrading septic systems in incrementally impaired watersheds could range from $6.0 million to $16.2 million.

[223] Chang, N., M. Wanielista, A. Daranpob, F. Hossain, Z. Xuan, J. Miao, S. Liu, Z. Marimon, and S. Debusk. 2010. *Onsite Sewage Treatment and Disposal Systems Evaluation for Nutrient Removal*. FDEP Project #WM 928. Report Submitted to Florida Department of Environmental Protection, by Stormwater Management Academy, Civil, Environmental, and Construction Engineering Department, University of Central Florida.

D. Governmental Costs

The proposed rule may result in the identification of incrementally impaired waters that would require the development of additional TMDLs. As the principal State regulatory agency implementing water quality standard, FDEP may incur costs associated with developing additional TMDLs. EPA's analysis identified 95 (based on the analysis of assessed waters) to 183 (including potentially impaired unassessed waters) incrementally impaired waters (WBIDs).

Because current TMDLs for estuaries and coastal waters in Florida include an average of approximately four WBIDs each, EPA estimates that the State of Florida may need to develop and adopt approximately 24 to 46 additional TMDLs. The NRC recommended applying Florida-specific TMDL development costs from a FDEP report detailing FDEP TMDL program costs. EPA used a range of costs from a 2001 EPA study that found the cost of developing a TMDL at different levels of aggregation and the Florida-specific TMDL cost estimates are within this range of costs.[224,225] For this analysis, EPA used the estimates for a single cause of impairment and adjusted the costs to account for the possibility that a TMDL may need to address more than one pollutant (because most of the incrementally impaired waters in EPA's analysis exceeded the criteria for more than one pollutant). Under this assumption, EPA estimated the average TMDL cost to be approximately $47,000 ($28,000 on average for one pollutant, plus $6,000 on average for the other pollutant and adjusted to 2010 dollars). EPA also

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[224] USEPA. 2001. *The National Costs of the Total Maximum Daily Load Program (Draft Report)*. EPA-841-D-01-003. U.S. Environmental Protection Agency, Office of Water, Washington DC.

[225] EPA did not adjust these estimates to account for potential reductions in resources required to develop TMDLs given that scientifically based numeric targets were developed as part of this proposed rule. Costs for these TMDLs are thus likely to be an overestimate.

estimated unit costs based on the high end of typical TMDL development costs, plus an additional $6,000 for the second nutrient. Escalating to 2010 dollars, the high range of TMDL development cost of $212,000. For 24 to 46 TMDLs, total costs for incremental TMDL development could be $1.1 million to $10.2 million.

FDEP currently operates its TMDL schedule on a five-phase cycle that rotates through Florida's five basins over five years. Under this schedule, completion of TMDLs for high priority waters will take 9 years; it will take an additional 5 years to complete the process for medium priority waters. Assuming all the incremental impairments are high priority and FDEP develops the new TMDLs over a 9-year period, annual costs could be $0.1 to $1.1 million.

Should the State of Florida submit current TMDL targets as Federal site specific alternative criteria (SSAC) for EPA review and approval, EPA believes it is reasonable to assume that information used in the development of the TMDLs will substantially reduce the time and effort needed to provide a scientifically defensible justification for such applications. If EPA's assumption is incorrect and there were to be increased costs for the SSAC process, EPA expects that such cost underestimation would be cancelled out by continuing to include the costs of developing the scientifically based numeric targets for new TMDLs. Thus, EPA did not separately analyze any incremental costs associated with SSAC.

Similarly, state and local agencies regularly monitor TN and TP in ambient waters. These data are the basis for the extensive IWR database maintained by the State of Florida. Because Florida is currently monitoring TN, TP, and chlorophyll-*a* concentrations in many waters, EPA assumed that the rule is unlikely to have a significant impact on costs related to water quality monitoring activities.

E. DPVs

EPA is proposing several options for DPVs. For this analysis, EPA assumed that the DPVs equal the numeric nutrient criteria for the segment to which the stream discharges. If the State of Florida were to choose any of the other three proposed options for DPVs, then these costs may be over- or underestimated. To estimate whether the DPVs are being met, EPA used the same minimum data requirements (e.g., four data points in one year with at least one data point each in summer and winter seasons) and attainment criteria (no more than one exceedance in a three-year period) for evaluating the criteria. EPA used data from estuary pour points from any station within 500 feet of and within the same WBID as the pour point. For south Florida pour points EPA did not use the data from the technical report, but used all data from the WBID in which the pour point is located to assess impairment.

For this analysis, EPA assumed that any WBID containing a pour point exceeding the criteria would be designated as impaired. EPA then identified the watersheds that contain or surround, in the case of coastal waters, those incrementally impaired WBIDs. See Appendix G of the economic analysis for more information.

Table VI(E). Summary of Potential Incremental Costs Associated with DPVs

Source Category	Total Potential Incremental Annual Cost ($/year)
Municipal Wastewater	$29.4 - $29.6
Industrial Dischargers	$0.0
Urban Stormwater	$9.5 - $185.1
Agriculture	$0.5 - $0.9
Septic Systems	$2.0 - $3.0
Government/Program Implementation[1]	$0.0 - $0.1
Total	$41.4- $218.6

1. Assuming 3 TMDLs for 13 WBIDs (approximately 4 WBIDs per TMDL) over a 9-year period.

F. Summary of Costs

Table VI(F) summarizes EPA's estimates of potential incremental costs associated with additional State and private sector activities to meet the numeric criteria supporting State designated uses. Note, these total costs include costs associated with unassessed waters. Because of uncertainties in the pollution controls ultimately implemented by the State of Florida, actual costs may vary depending on the site-specific source reductions needed to meet the new numeric criteria.

Table VI(F). Summary of Potential Annual Costs [1] (2010 dollars)

Sector	Annual Cost (millions)[2]
Municipal Wastewater	\$44.1 - \$49.7
Industrial Dischargers	\$15.2
Urban Stormwater	\$131.9 - \$330.9
Agriculture	\$0.3 - \$0.7
Septic Systems	\$6.0 - \$16.2
Government/Program Implementation (TMDLs)	\$0.1 - \$1.1
Downstream Protection Values	\$41.4 - \$218.6
Total	\$239.0 - \$632.4

1. Includes costs for assessed, unassessed, and DPVs.
2. Low end of range represents estimated costs under the assumption that none of the unassessed waters would be impaired under the proposed rule; high end of range represents costs associated with the assumption of proportional impairment of unassessed waters.

EPA also calculated the potential costs to Florida households. Given the uncertainty regarding the magnitude of the estimated costs ultimately borne by households, EPA sought to minimize that uncertainty with a selective though matched set of potential costs and potentially affected households. Although GIS analysis could be used to overlay maps of affected populations and facilities with incrementally impaired watersheds, a simpler more direct approach is to assume that all households in Florida are either served by a wastewater treatment plant or septic system, and pay taxes that would support implementation programs conducted by the State. In addition, because the sector with the largest costs is urban stormwater, EPA decided to include this sector as well. Thus, EPA decided to look at the total costs of the two rules across all households in Florida. Also, given the cost-pass-through of agriculture costs and industrial costs to consumers outside the State of Florida, EPA did not consider them for the estimate of average costs per households in Florida. Therefore, EPA also calculated the total costs for municipal wastewater and stormwater controls, septic upgrades, and government/program implementation costs for both the proposed rule and the Inland rule and compared this sum to the total number of households in the State. This may underestimate actual household costs if some costs are not borne equally by households statewide, but instead are concentrated within the watersheds for which controls are needed. EPA's total estimated annual cost for compliance with this proposed rule, and the Inland rule, represents \$44 to \$108 per household per year for both rules across all households in Florida. This equals \$3.60 to \$9 per month per household in Florida. Please refer to Section 13 in the Economic Analysis for more information.

EPA also considered whether the potential costs of this proposed rule could result in employment impacts. Environmental regulations can both increase and decrease employment, and whether the net effect is positive or negative depends on many factors. See Chapter 13 of the Economic Analysis for further discussion.

G. Benefits

Since elevated concentrations of nutrients in surface waters can result in adverse ecological effects, human health impacts, and negative economic impacts, EPA expects the proposed numeric nutrient criteria to result in significant ecological, human health, and economic benefits to Florida. For example, excess nutrients in water can cause eutrophication, which can lead to harmful (sometimes toxic) algal blooms, loss of rooted plants, and decreased dissolved oxygen. In turn, these results can lead to adverse impacts on aquatic life, fishing, swimming, wildlife watching, camping, and drinking water. Excess nutrients can also cause: nuisance surface scum, reduced food for herbivorous wildlife, fish kills, alterations in fish communities, and unsightly shorelines that can decrease property values. Excessive nutrient loads can also lead to harmful algal blooms (HABs), which can cause a range of adverse human health effects including dermal, gastrointestinal, neurological, and respiratory problems, and in severe cases, may even result in fatalities.

Nutrient impairment is currently a major concern for many bays, estuaries, and coasts within the United States, and is particularly severe for many Florida waters. FDEP's 2010 report identifies approximately 569 square miles (364,160 acres) of estuaries (about 23 percent of assessed estuarine area) and 102 square miles (65,280 acres) of coastal waters (about 1.5 percent of assessed coastal waters) as impaired by nutrients. These impairments may have a significant impact on the value of environmental goods and services provided by the affected waterbodies. For example, the losses of submerged aquatic vegetation resulting from eutrophication can have significant economic impacts. In 2009, Florida seagrass communities supported an estimated harvest of $23 million for just six species of commercial fish and shellfish.[226]

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[226] Crist, C. 2010. *Seagrass Awareness Month*. Proclamation by the Governor Charlie Crist of the State of Florida. Florida Department of Environmental Protection.

In Florida's environment and economy, the tourism-focused goods and services provided by its bays, estuaries, and coastal waters are particularly valuable. The tourism industry of Florida's nearshore counties contributes approximately $12.4 billion (2004 dollars) to the State's economy annually.[227] Coral reefs are especially important contributors to Florida's tourism sector. Reef-related recreational expenditures on activities such as snorkeling, scuba diving, fishing, and glass bottom boating in four counties in southeastern Florida for a one year period in 2000-2001 totaled $5.4 billion.[228]

The proposed rule will help reduce nitrogen and phosphorus concentrations in Florida's estuaries, coastal waters and south Florida inland flowing waters. In turn, this reduction will improve ecological function and prevent further degradation that can result in substantial economic benefits to Florida citizens. EPA's economic analysis document describes in detail many of the potential benefits associated with meeting the numeric criteria in the proposed rule for nitrogen and phosphorus, including reduced human health risks, ecological benefits and functions, improved recreational opportunities, aesthetic enhancements and others.

1. Monetized Benefits Estimates

Reducing nutrient concentrations will increase services provided by water resources to recreational users. For example, some coastal waters that are not usable for

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[227] NOEP. 2006. *Coastal Economy Data*. National Ocean Economics Program. <www.oceaneconomics.org/Market/coastal/coastalEcon.asp>.

[228] Johns, G.M., V.R. Leeworthy, F.W. Bell, and M.A. Bonn. 2001. *Socioeconomic Study of Reefs in SoutheastFlorida*. Final Report prepared by Hazen and Sawyer, Hollywood, FL, for Broward County, Palm Beach County, Miami-Dade County, Monroe County, Florida Fish and Wildlife Conservation Commission, and National Oceanic and Atmospheric Administration.

recreation may become available following implementation of the rule, thereby expanding recreation options for residential users and tourists. Other waters that are available for recreation can become more attractive for users by making recreational trips more enjoyable. Individuals may also take trips more frequently if they enjoy their recreational activities more. In addition to recreational improvements, the proposed rule is expected to generate nonuse benefits from bequest, altruism, and existence motivations. Individuals may value the knowledge that water quality is being maintained, ecosystems are being protected, and populations of individual species are healthy, independently from any use value.

EPA used a benefits transfer function based on meta-analysis of surface water valuation studies to estimate both use and nonuse benefits from improvements in surface water. This approach is based on the method used to quantify nonmarket benefits in the 2009 *Environmental Impact and Benefits Assessment for Final Effluent Guidelines and Standards for the Construction and Development Category* (EPA, 2009), also used in the economic analysis of the Inland Rule. The approach quantifies benefits based on reach-specific baseline water quality and the estimated change in pollutant concentrations. The approach translates reductions in nutrients into an indicator of overall water quality (via a "water quality ladder," or WQL) and values these improvements in terms of household willingness to pay (WTP) for the types of uses (e.g., as fishing and swimming) that are supported by different water quality levels.

EPA calculated the baseline WQL scores for incrementally affected waters by comparing the water quality observations to criteria. For coastal waters, only Chl-*a* criteria are applicable, and for these waters, EPA estimated baseline WQL scores based on Chl-*a* exceedances only. For other marine waters, EPA developed estimates of baseline water quality based on comparing the water quality observations to the applicable criteria in the following order: 1) exceedances of proposed TN criteria; 2) exceedances of proposed TP criteria; and 3) exceedances of proposed Chl-*a* criteria. The baseline WQL score is based on the percent exceedance of the applicable criterion value. EPA assumes all incrementally impaired waters will meet the proposed criteria and estimated the potential changes for each waterbody. EPA estimated that up to 163 unassessed WBIDs may be incrementally impaired, but water quality data for these waters are not available. To estimate the potential benefits associated with these potentially impaired unassessed waters, EPA estimated the same percent exceedance of the potentially impaired assessed waters. Because EPA's estimates of monetized benefits only reflect the water quality improvements for WBIDs, and not HUC-12s, these potential benefits are underestimated and should not be directly compared to costs, which include HUC-12 costs. EPA then estimated monetized benefit values of these water quality improvements using benefits transfer based on a meta-regression of 45 studies that value water quality improvements in surface waters. Using the meta-analysis EPA estimated a household WTP function with independent variables that characterize 1) the underlying study and methodology used, 2) demographic and other characteristics of the surveyed populations, 3) geographic region and scale, and 4) resource characteristics and improvements. More details on the meta-analysis can be found in the Economic Analysis.

Using this function, EPA derived household WTP estimates for both full time and part time residents of the State. EPA estimated that seasonal residents live in the State for approximately four months of the year; therefore EPA weighted household WTP values for seasonal residents by one third. EPA then weighted household WTP estimates by the percentage of State water miles that are expected to improve. EPA estimated total benefits by multiplying the weighted household WTP value with the total number of benefiting households. EPA estimated the number of full time residents by dividing the total State population by average household size for the State as provided by the U.S. Census Bureau's 2010 American Community Survey (U.S. Census Bureau, 2010). The number of part-time households in Florida is based on Smith and House (2006), who used survey data to estimate the number, timing, and duration of temporary moves to Florida at peak seasons. EPA used the Smith and House (2006) results and U.S. Census Bureau (2010) statistics on household size to estimate the number of part-time households in Florida. Total monetized benefits, including monetized benefits of unassessed waters, may be in the range from \$39.0 million to \$53.4 million annually, as shown in Table VI(F). The range reflects EPA's assumptions regarding the location of unassessed waters that might be incrementally impaired.

Because EPA's estimates of monetized benefits only reflect use and nonuse values associated with water quality improvements to Florida residents (full and part time), these potential benefits are likely underestimated compared to costs. The population considered in the benefits analysis of the rule does not include households outside of Florida that may also hold values for water resources in the State of Florida. Even if per household values for out-of-State residents are small, they may be significant in the aggregate if these values are held by a substantial number of out-of-State households. EPA notes that four times as many out-of-State and foreign tourists visit the State's saltwater beaches each year as State residents do. Not including out-of-State residents in the analysis is likely to result in an underestimation of the total benefits of improved water quality. Although these monetized benefits estimates do not account for all potential economic benefits arising from the proposed rule, they help to demonstrate the economic importance of restoring and protecting Florida waters from the impacts of nitrogen and phosphorus pollution.

Table VI(F): Potential Annual State Benefits Associated with the Proposed Criteria Including Unassessed Waters (2010 dollars)

WTP Estimate	Average Benefit per Mile[1]	Total Benefits (millions)[2]
Lower 5% Bound	$8,200	$17.2 - $23.6
Mean	$18,500	$39.0 - $53.4
Upper 95% Bound	$34,500	$72.5 - $99.4

1. Total benefits divided by 2,102 incrementally impaired assessed miles.
2. Benefits per mile times the number of incrementally impaired miles; based on between 2,102 and 2,882 potentially improved miles. The low end of the range represents assessed waters only, and the high end of the range includes unassessed waters.

VII. Statutory and Executive Order Reviews

A. Executive Orders 12866 (Regulatory Planning and Review) and 13563 (Improving Regulation and Regulatory Review)

Under Executive Order 12866 (58 FR 51735, October 4, 1993), this action is a "significant regulatory action." Accordingly, EPA submitted this action to the Office of Management and Budget (OMB) for review under Executive Orders 12866 and 13563 (76 FR 3821, January 21, 2011) and any changes made in response to OMB recommendations have been documented in the docket for this action. This proposed rule does not establish any requirements directly applicable to regulated entities or other sources of nitrogen and phosphorus pollution. Moreover, existing narrative water quality criteria in State law already require that nutrients not be present in waters in concentrations that cause an imbalance in natural populations of flora and fauna in estuaries and coastal waters in Florida and in south Florida inland flowing waters.

B. Paperwork Reduction Act

This action does not impose any direct new information collection burden under the provisions of the Paperwork Reduction Act, 44 U.S.C. 3501 et seq. Actions to implement these standards may entail additional paperwork burden. Burden is defined at 5 CFR 1320.3(b). This action does not include any information collection, reporting, or record-keeping requirements.

C. Regulatory Flexibility Act

The Regulatory Flexibility Act (RFA) generally requires an agency to prepare a regulatory flexibility analysis of any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act or any other statute unless the agency certifies that the rule will not have significant economic impact on a substantial number of small entities. Small entities include small businesses, small organizations, and small governmental jurisdictions.

For purposes of assessing the impacts of this action on small entities, small entity is defined as: (1) A small business as defined by the Small Business Administration's (SBA) regulations at 13 CFR 121.201; (2) a small governmental jurisdiction that is a government of a city, county, town, school district or special district with a population of less than 50,000; and (3) a small organization that is any not-for-profit enterprise that is independently owned and operated and is not dominant in its field.

Under the CWA water quality standards program, states must adopt water quality standards for their waters and must submit those water quality standards to EPA for review and approval or disapproval; if the Agency disapproves a state standard and the state does not adopt appropriate revisions to address EPA's disapproval, EPA must promulgate standards consistent with the statutory and regulatory requirements. EPA also has the authority to promulgate water quality standards in any case where the Administrator determines that a new or revised standard is necessary to meet the requirements of the CWA. State standards approved by EPA (or EPA-promulgated standards) are implemented through various water quality control programs including the NPDES program, which limits discharges to navigable waters except in compliance with an NPDES permit. The CWA requires that all NPDES permits include any limits on discharges that are necessary to meet applicable water quality standards.

Thus, under the CWA, EPA's promulgation of water quality standards establishes standards that the State of Florida implements through the NPDES permit process. The State has discretion in developing discharge limits, as needed to meet the standards. This proposed rule does not itself establish any requirements that are applicable to small entities. As a result of this action, the State of Florida will need to ensure that permits it issues include any limitations on discharges necessary to comply with the standards established in the final rule. In doing so, the State will have a number of choices associated with permit writing (e.g., relating to compliance schedules, variances, etc.). While Florida's implementation of the rule may ultimately result in new or revised permit conditions for some dischargers, including small entities, EPA's action, by itself, does not impose any of these requirements on small entities; that is, these requirements are not self-implementing. Thus, I certify that this rule will not have a significant economic impact on a substantial number of small entities.

D. Unfunded Mandates Reform Act

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA), Public Law 104-4, establishes requirements for Federal agencies to assess the effects of their regulatory actions on state, local, and tribal governments and the private sector. Under section 202 of the UMRA, EPA generally must prepare a written statement, including a cost-benefit analysis, for proposed and final rules that include a "Federal mandate" that may result in expenditures to state, local, and Tribal governments, in the aggregate, or to the private sector, of $100 million or more in any one year. A "Federal mandate," is any provision in federal statute or regulation that would impose an enforceable duty on State, local or Tribal governments or the private sector.[229] Before promulgating an EPA rule for which a written statement is needed under section 202, section 205 of the UMRA generally requires EPA to identify and consider a reasonable number of regulatory alternatives and adopt the least costly, most cost-effective or least burdensome alternative that achieves the objectives of the rule. The provisions of section 205(a) do not apply when they are inconsistent with law. Moreover, section 205(b) allows EPA to adopt an alternative other than the least costly, most cost-effective or least burdensome alternative if the Administrator publishes with the final rule an explanation of why that alternative was not adopted. Before EPA establishes any regulatory requirements that may significantly or uniquely affect small governments, including Tribal governments, it must

[229] A "Federal mandate" does not include conditions of Federal assistance and generally does not include duties arising from participation in a voluntary Federal program.

have developed under section 203 of the UMRA a small government agency plan. The plan must provide for notifying potentially affected small governments, enabling officials of affected small governments to have meaningful and timely input in the development of EPA regulatory proposals with significant Federal intergovernmental mandates, and informing, educating, and advising small governments on compliance with the regulatory requirements.

This proposed rule contains no Federal mandates (under the regulatory provisions of Title II of the UMRA) for state, local, or Tribal governments or the private sector. As these water quality criteria are not self-implementing, EPA's proposed rule does not regulate or affect any entity. Because this proposed rule does not regulate or affect any entity, it therefore is not subject to the requirements of sections 202 and 205 of UMRA.

EPA determined that this proposed rule contains no regulatory requirements that might significantly or uniquely affect small governments. Moreover, water quality standards, including those promulgated here, apply broadly to dischargers and are not uniquely applicable to small governments. Thus, this proposed rule is not subject to the requirements of section 203 of UMRA.

E. Executive Order 13132 (Federalism)

This action does not have federalism implications. It will not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government, as specified in Executive Order 13132. EPA's authority and responsibility to promulgate Federal water quality standards when state standards do not meet the requirements of the CWA is well established and has been used on various occasions in the past. The proposed rule would not substantially affect the relationship between EPA and the States and Territories, or the distribution of power or responsibilities between EPA and the various levels of government. The proposed rule would not alter Florida's considerable discretion in implementing these water quality standards. Further, this proposed rule would not preclude Florida from adopting water quality standards that EPA concludes meet the requirements of the CWA, either before or after promulgation of the final rule, which would eliminate the need for Federal standards. Thus, Executive Order 13132 does not apply to this proposed rule.

Although section 6 of Executive Order 13132 does not apply to this action, EPA communicated with the State of Florida to discuss the Federal rulemaking process. In the spirit of Executive Order 13132, and consistent with EPA policy to promote communications between EPA and State and local governments, EPA specifically solicits comment on this proposed rule from State and local officials.

F. Executive Order 13175 (Consultation and Coordination with Indian Tribal Governments)

Subject to the Executive Order 13175 (65 FR 67249, November 9, 2000) EPA may not issue a regulation that has tribal implications, that imposes substantial direct compliance costs, and that is not required by statute, unless the Federal government provides the funds necessary to pay the direct compliance costs incurred by Tribal governments, or EPA consults with tribal officials early in the process of developing the proposed regulation and develops a tribal summary impact statement. EPA has concluded that this action may have tribal implications. However, the rule will neither impose substantial direct compliance costs on tribal governments, nor preempt Tribal law.

In the State of Florida, there are two Indian tribes, the Seminole Tribe of Florida and the Miccosukee Tribe of Indians of Florida, with flowing waters. Both tribes have been approved for treatment in the same manner as a state (TAS) status for CWA sections 303 and 401 and have federally-approved water quality standards in their respective jurisdictions. These tribes are not subject to this proposed rule. However, this rule may impact the tribes because the numeric criteria for Florida will apply to waters adjacent to the tribal waters.

EPA consulted with Tribal officials early in the process of developing this regulation to permit them to have meaningful and timely input into its development. At a consultation teleconference held on March 1, 2012, EPA summarized the available information regarding this proposed rule, and requested comments on the proposal and its possible effects on tribal waters. Information relevant to this proposed action and the related Tribal consultation is posted on the EPA Tribal Portal site at http://www.epa.gov/tribal/consultation/index.htm. EPA specifically solicits additional comment on this proposed rule from tribal officials.

G. Executive Order 13045 (Protection of Children From Environmental Health and Safety Risks)

This action is not subject to EO 13045 (62 FR 19885, April 23, 1997) because it is not economically significant as defined in EO 12866, and because the Agency believes that this rule will result in the reduction of environmental health and safety risks that could present a disproportionate risk to children.

H. Executive Order 13211 (Actions That Significantly Affect Energy Supply, Distribution, or Use)

This rule is not a "significant energy action" as defined in Executive Order 13211, "Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use" (66 FR 28355 (May 22, 2001)), because it is not likely to have a significant adverse effect on the supply, distribution, or use of energy.

I. National Technology Transfer Advancement Act of 1995

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 ("NTTAA"), Public Law 104–113, section 12(d) (15 U.S.C. 272 note) directs EPA to use voluntary consensus standards in its regulatory activities unless to do so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (e.g., materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies. The NTTAA directs EPA to provide Congress, through OMB, explanations when the Agency decides not to use available and applicable voluntary consensus standards.

This proposed rulemaking does not involve technical standards. Therefore, EPA is not considering the use of any voluntary consensus standards.

J. Executive Order 12898 (Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations)

Executive Order (EO) 12898 (Feb. 16, 1994) establishes Federal executive policy on environmental justice. Its main provision directs Federal agencies, to the greatest extent practicable and permitted by law, to make environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations in the United States.

EPA has determined that this proposed rule does not have disproportionately high and adverse human health or environmental effects on minority or low-income populations because it would afford a greater level of protection to both human health and the environment if these numeric nutrient criteria are promulgated for Class I, Class II and Class III waters in the State of Florida.

List of Subjects in 40 CFR Part 131

Environmental protection, Water quality standards, Nitrogen and phosphorus pollution, Nutrients, Florida.

Dated: November 30, 2012.

Lisa P. Jackson,
Administrator.

For the reasons set out in the preamble, EPA proposes to amend 40 CFR Part 131 as follows:

PART 131 – WATER QUALITY STANDARDS

1. The authority citation for Part 131 continues to read as follows:

Authority: 33 U.S.C. 1251 *et seq*.

Subpart D-[Amended]

2. Section 131.45 is added to read as follows:

§ 131.45 Water Quality Standards for the State of Florida's Estuaries, Coastal Waters, and South Florida Inland Flowing Waters

(a) *Scope*. This section promulgates numeric criteria for nitrogen and phosphorus pollution for Class I, Class II, and Class III waters in the State of Florida. This section also contains provisions for site-specific alternative criteria.

(b) *Definitions*. — (1) *Canal* means a trench, the bottom of which is normally covered by water with the upper edges of its two sides normally above water.

(2) *Coastal water* means all marine waters that have been classified as Class II (Shellfish Propagation or Harvesting) or Class III (Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife) water bodies pursuant to Section 62-302.400, F.A.C., extending to three nautical miles from shore that are not classified as estuaries.

(3) *Estuary* means predominantly marine regions of interaction between rivers and nearshore ocean waters, where tidal action and river flow mix fresh and salt water. Such areas include bays, mouths of rivers, and lagoons that have been classified as Class II (Shellfish Propagation or Harvesting) or Class III (Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife) water bodies pursuant to Section 62-302.400, F.A.C., excluding wetlands.

(4) *Everglades Agricultural Area (EAA)* means those lands described in Florida Statute Section 373.4592 (1994) subsection (15).

(5) *Everglades Protection Area (EvPA)* means Water Conservation Areas 1 (which includes the Arthur R. Marshall Loxahatchee National Wildlife Refuge), 2A, 2B, 3A, and 3B, and the Everglades National Park.

(6) *Inland flowing waters* means inland predominantly fresh surface water streams that have been classified as Class I (Potable Water Supplies) or Class III (Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife) water bodies pursuant to Section 62–302.400, F.A.C., excluding wetlands (e.g., sloughs).

(7) *Marine Lake* means a slow-moving or standing body of marine water that occupies an inland basin that is not a stream, spring, or wetland.

(8) *Predominantly fresh waters* means surface waters in which the chloride concentration at the surface is less than 1,500 milligrams per liter.

(9) *Predominantly marine waters* means surface waters in which the chloride concentration at the surface is greater than or equal to 1,500 milligrams per liter.

(10) *South Florida inland flowing waters* means inland flowing waters in the South Florida Nutrient Watershed Region, which encompasses the waters south of Lake Okeechobee, the Caloosahatchee River (including Estero Bay) watershed, and the St. Lucie watershed.

(11) *State* means the State of Florida, whose transactions with the U.S. EPA in matters related to 40 CFR 131.45 are administered by the Secretary, or officials delegated such responsibility, of the Florida Department of Environmental Protection (FDEP), or successor agencies.

(12) *Stream* means a free-flowing, predominantly fresh surface water in a defined channel, and includes rivers, creeks, branches, canals, freshwater sloughs, and other similar water bodies.

(13) *Surface water* means water upon the surface of the earth, whether contained in bounds created naturally or artificially or diffused. Water from natural springs shall be classified as surface water when it exits from the spring onto the Earth's surface.

(14) *Tidal creek* means a relatively small coastal tributary with variable salinity that lies at the transition zone between terrestrial uplands and the open estuary.

(c) *Criteria for Florida Waters.*

(1) *Criteria for Estuaries.*

The applicable total nitrogen (TN), total phosphorus (TP), and chlorophyll *a* criteria for estuaries are shown in Table 1.

Table 1. EPA's Numeric Criteria for Florida's Estuaries (in geographic order Northwest to Northeast)

			Proposed Criteria		
Perdido Bay	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-*a**[1] (µg/L)
	Upper Perdido Bay	0101	0.59	0.042	5.2
	Big Lagoon	0102	0.26	0.019	4.9
	Central Perdido Bay	0103	0.47	0.031	5.8
	Lower Perdido Bay	0104	0.34	0.023	5.8
Pensacola Bay	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Blackwater Bay	0201	0.53	0.022	3.9
	Upper Escambia Bay	0202	0.43	0.025	3.7
	East Bay	0203	0.50	0.021	4.2
	Santa Rosa Sound	0204	0.34	0.018	4.1
	Lower Escambia Bay	0205	0.44	0.023	4.0
	Upper Pensacola Bay	0206	0.40	0.021	3.9
	Lower Pensacola Bay	0207	0.34	0.020	3.6
	Santa Rosa Sound	0208	0.33	0.020	3.9
	Santa Rosa Sound	0209	0.36	0.020	4.9
Choctawhatchee Bay	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Eastern Choctawhatchee Bay	0301	0.47	0.025	8.1
	Central Choctawhatchee Bay	0302	0.36	0.019	3.8
	Western Choctawhatchee Bay	0303	0.21	0.012	2.4
St. Andrews Bay	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)

	East Bay	0401	0.31	0.014	4.6
	St. Andrews Sound	0402	0.14	0.009	2.3
	Eastern St. Andrews Bay	0403	0.24	0.021	3.9
	Western St. Andrews Bay	0404	0.19	0.016	3.1
	Southern St. Andrews Bay	0405	0.15	0.013	2.6
	North Bay 1	0406	0.22	0.012	3.7
	North Bay 2	0407	0.22	0.014	3.7
	North Bay 3	0408	0.21	0.016	3.4
	West Bay	0409	0.23	0.022	3.8
St. Joseph Bay	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	St. Joseph Bay	0501	0.25	0.018	3.8
Apalachicola Bay	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	St. George Sound	0601	0.53	0.019	3.6
	Apalachicola Bay	0602	0.51	0.019	2.7
	East Bay	0603	0.76	0.034	1.7
	St. Vincent Sound	0605	0.52	0.016	11.9
	Apalachicola Offshore	0606	0.30	0.008	2.3
Alligator Harbor	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Alligator Harbor	0701	0.36	0.011	2.8
	Alligator Offshore	0702	0.33	0.009	3.1
	Alligator Offshore	0703	0.33	0.009	2.9
Ochlockonee Bay[+]	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Ochlockonee-St. Marks Offshore	0825	0.79	0.033	2.7
	Ochlockonee Offshore	0829	0.47	0.019	1.9
	Ochlockonee Bay	0830	0.66	0.037	1.8
	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	St. Marks River Offshore	0827	0.51	0.022	1.7
	St. Marks River	0828	0.55	0.030	1.2
Big Bend/ Apalachee Bay[+]	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Econfina Offshore	0824	0.59	0.028	4.6
	Econfina	0832	0.55	0.032	4.4

	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Fenholloway	0822	1.15	0.444	1.9
	Fenholloway Offshore	0823	0.48	0.034	10.3
	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Steinhatchee-Fenholloway Offshore	0821	0.40	0.023	4.1
	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Steinhatchee River	0819	0.67	0.077	1.0
	Steinhatchee Offshore	0820	0.34	0.018	3.5
	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Steinhatchee Offshore	0818	0.39	0.032	4.8
Suwannee River+	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Suwannee Offshore	0817	0.78	0.049	5.2
Springs Coast+	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Waccasassa River Offshore	0814	0.38	0.019	3.9
	Cedar Keys	0815	0.32	0.019	4.1
	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Crystal River	0812	0.35	0.013	1.3
	Crystal-Homosassa Offshore	0813	0.36	0.013	2.1
	Homosassa River	0833	0.47	0.032	1.9
	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (ug/L)
	Chassahowitzka River	0810	0.32	0.010	0.7
	Chassahowitzka River Offshore	0811	0.29	0.009	1.7
	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)

	Weeki Wachee River	0808	0.32	0.010	1.6
	Weeki Wachee Offshore	0809	0.30	0.009	2.1
	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Pithlachascotee River	0806	0.50	0.022	2.4
	Pithlachascotee Offshore	0807	0.32	0.011	2.5
	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Anclote River	0804	0.48	0.037	4.7
	Anclote Offshore	0805	0.31	0.011	3.2
	Anclote Offshore South	0803	0.29	0.008	2.6
Lake Worth Lagoon/ Loxahatchee	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	North Lake Worth Lagoon	1201	0.55	0.067	4.7
	Central Lake Worth Lagoon	1202	0.57	0.089	5.3
	South Lake Worth Lagoon	1203	0.48	0.034	3.6
	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Lower Loxahatchee	1301	0.68	0.028	2.7
	Middle Loxahatchee	1302	0.98	0.044	3.9
	Upper Loxahatchee	1303	1.25	0.072	3.6
St. Lucie	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Lower St. Lucie	1401	0.58	0.045	5.3
	Middle St. Lucie	1402	0.90	0.120	8.4
	Upper St. Lucie	1403	1.22	0.197	8.9
Indian River Lagoon	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Mosquito Lagoon	1501	1.18	0.078	7.5
	Banana River	1502	1.17	0.036	5.7

	Upper Indian River Lagoon	1503	1.63	0.074	9.2
	Upper Central Indian River Lagoon	1504	1.33	0.076	9.2
	Lower Central Indian River Lagoon	1505	1.12	0.117	8.7
	Lower Indian River Lagoon	1506	0.49	0.037	4.0
Halifax River	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Upper Halifax River	1601	0.75	0.243	9.4
	Lower Halifax River	1602	0.63	0.167	9.6
Guana, Tolomato, Matanzas, Pellicer	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Upper GTMP	1701	0.77	0.144	9.5
	Lower GTMP	1702	0.53	0.108	6.1
Lower St. Johns River	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Lower St. Johns River	1801	0.75	0.095	2.5
	Trout River	1802	1.09	0.108	3.6
	Trout River	1803	1.15	0.074	7.7
Nassau River	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Lower Nassau	1901	0.33	0.113	3.2
	Middle Nassau	1902	0.40	0.120	2.4
	Upper Nassau	1903	0.75	0.125	3.4
St. Marys River	SEGMENT	SEGMENT ID	TN* (mg/L)	TP* (mg/L)	Chl-a*[1] (µg/L)
	Lower St. Marys River	2002	0.27	0.045	3.0
	Middle St. Marys River	2003	0.44	0.036	2.7

[1] Chlorophyll *a* is defined as corrected chlorophyll, or the concentration of chlorophyll *a* remaining after the chlorophyll degradation product, phaeophytin *a*, has been subtracted from the uncorrected chlorophyll *a* measurement.

* For a given water body, the annual geometric mean of TN, TP, or chlorophyll *a*, concentrations shall not exceed the applicable criterion concentration more than once in a three-year period.

[+] In these four areas (collectively referred to as the “Big Bend region”), coastal and estuarine waters are combined. Criteria for the Big Bend region apply to the coastal and estuarine waters in that region.

(2) *Criteria for Tidal Creeks.*

The applicable total nitrogen (TN), total phosphorus (TP), and chlorophyll *a* criteria for predominantly marine tidal creeks are shown in §131.45(c)(1), Table 1. The applicable TN and TP criteria for predominantly freshwater tidal creeks are shown in Table 2.

Table 2. EPA's Numeric Criteria for Florida's Predominantly Freshwater Tidal Creeks

Nutrient Watershed Region	Instream Protection Value Criteria	
	TN (mg/L) *	TP (mg/L) *
Panhandle West [a]	0.67	0.06
Panhandle East [b]	1.03	0.18
North Central [c]	1.87	0.30
West Central [d]	1.65	0.49
Peninsula [e]	1.54	0.12

Watersheds pertaining to each Nutrient Watershed Region (NWR) were based principally on the NOAA coastal, estuarine, and fluvial drainage areas with modifications to the NOAA drainage areas in the West Central and Peninsula Regions that account for unique watershed geologies. For more detailed information on regionalization and which WBIDs pertain to each NWR, see the Technical Support Document.

[a] Panhandle West region includes: Perdido Bay Watershed, Pensacola Bay Watershed, Choctawhatchee Bay Watershed, St. Andrews Bay Watershed, Apalachicola Bay Watershed.

[b] Panhandle East region includes: Apalachee Bay Watershed, and Econfina/Steinhatchee Coastal Drainage Area.

[c] North Central region includes the Suwannee River Watershed.

[d] West Central region includes: Peace, Myakka, Hillsborough, Alafia, Manatee, Little Manatee River Watersheds, and small, direct Tampa Bay tributary watersheds south of the Hillsborough River Watershed.

[e] Peninsula region includes: Waccasassa Coastal Drainage Area, Withlacoochee Coastal Drainage Area, Crystal/Pithlachascotee Coastal Drainage Area, small, direct Tampa Bay tributary watersheds west of the Hillsborough River Watershed, Sarasota Bay Watershed, small, direct Charlotte Harbor tributary watersheds south of the Peace River Watershed, Caloosahatchee River Watershed, Estero Bay Watershed, Kissimmee River/Lake Okeechobee Drainage Area, Loxahatchee/St. Lucie Watershed, Indian River Watershed, Daytona/St. Augustine Coastal Drainage Area, St. Johns River Watershed, Nassau Coastal Drainage Area, and St. Marys River Watershed.

[*] For a given water body, the annual geometric mean of TN or TP concentrations shall not exceed the applicable criterion concentration more than once in a three-year period.

(3) *Criteria for Marine Lakes.*

The applicable total nitrogen (TN), total phosphorus (TP) and chlorophyll *a* criteria for marine lakes are shown in Table 3.

Table 3. EPA's Numeric Criteria for Florida's Marine Lakes

Long Term Average Lake Color[a] and Alkalinity	EPA Final Chl-a[b,*] μg/L	EPA Final TN and TP Criteria [Range]	
		TN mg/L	TP mg/L
Colored lakes[c]	20	1.27 [1.27-2.23]	0.05 [0.05-0.16]
Clear lakes, high alkalinity[d]	20	1.05 [1.05-1.91]	0.03 [0.03-0.09]
Clear lakes, low alkalinity[e]	6	0.51 [0.51-0.93]	0.01 [0.01-0.03]

[a] Platinum-cobalt units (PCU) assessed as true color free from turbidity
[b] Chl-a is defined as corrected chlorophyll, or the concentration of chl-a remaining after the chlorophyll degradation product, phaeophytin a, has been subtracted from the uncorrected chl-a measurement.
[c] Long-term color > 40 PCU and alkalinity > 20 mg/L $CaCO_3$
[d] Long-term color ≤ 40 PCU and alkalinity > 20 mg/L $CaCO_3$
[e] Long-term color ≤ 40 PCU and alkalinity ≤ 20 mg/L $CaCO_3$
* For a water body, the annual geometric mean of chl-a, TN or TP concentrations shall not exceed the applicable criterion concentration more than once in a three-year period.

(4) *Criteria for Coastal Waters.*

The applicable chlorophyll *a* criteria for coastal waters are shown in Table 4.

Table 4. EPA's Numeric Criteria for Florida's Coastal Waters

Coastal Region	**Coastal Segment[+]**	**Approximate Location**	**Chlorophyll$_{RS}$-*a*[1]* (mg/m^3)**
Panhandle	1	Alabama border	2.41
	2	Pensacola Bay Pass	2.57
	3		1.44
	4		1.16
	5		1.06
	6		1.04
	7		1.14
	8	Choctawhatchee Bay Pass	1.23
	9		1.08

	10		1.09
	11		1.11
	12		1.18
	13		1.45
	14	St. Andrews Bay Pass	1.74
	15	St. Joseph Bay Pass	2.75
	16		2.39
	17	Southeast St. Joseph Bay	3.47
West Florida Shelf	18		3.96
	19	Tampa Bay Pass	4.45
	20		3.37
	21		3.25
	22		2.95
	23		2.79
	24		2.98
	25		3.24
	26	Charlotte Harbor	4.55
	27		4.22
	28		3.67
	29		4.16
	30		5.70
	31		4.54
	32		4.03
	33	Fort Myers	4.61
Atlantic Coast	34	Biscayne Bay	0.92
	35		0.26
	36		0.26
	37		0.24
	38		0.21
	39		0.21
	40		0.20
	41		0.20
	42		0.21
	43		0.25
	44		0.57
	45	St. Lucie Inlet	1.08
	46		1.42
	47		1.77
	48		1.55
	49		1.44
	50		1.53
	51		1.31
	52		1.40
	53		1.80
	54	Canaveral Bight	2.73
	55		2.33
	56		2.28
	57		2.06
	58		1.92
	59		1.76
	60		1.72

	61		2.04
	62		1.92
	63		1.86
	64		1.95
	65		2.41
	66		2.76
	67		2.80
	68		3.45
	69	Nassau Sound	3.69
	70		3.78
	71	Georgia border	4.22

[1] Chlorophyll$_{RS}$-*a* is remotely sensed calculation of chlorophyll *a* concentrations.
* For a given water body, the annual geometric mean of the chlorophyll *a* concentration shall not exceed the applicable criterion concentration more than once in a three-year period.
[+] Please see TSD for location of Coastal Segments (Volume 2: Coastal Waters, Section 1.3).

(5) *Criteria for South Florida Inland Flowing Waters.*

The applicable criteria for south Florida inland flowing waters that flow into downstream estuaries include the downstream protection value (DPV) for total nitrogen (TN) and total phosphorus (TP) derived pursuant to the provisions of §131.45(c)(6). These criteria are not applicable to waters within the lands of the Miccosukee and Seminole Tribes, the Everglades Protection Area (EvPA), or the Everglades Agricultural Area (EAA).

(6) *Criteria for Protection of Downstream Estuaries and South Florida marine waters.* (i) A downstream protection value (DPV) for stream tributaries that flow into a downstream estuary or south Florida marine water (i.e., downstream water) is the allowable concentration of total nitrogen (TN) and/or total phosphorus (TP) applied at the point of entry into the downstream water. The applicable DPV for any stream flowing into a downstream water shall be determined pursuant to paragraphs (c)(6)(ii), (iii), (iv), or (v) of this section. The methods available to derive DPVs should be considered in the order listed. Contributions from stream tributaries upstream of the point of entry location must result in attainment of the DPV at the point of entry into the downstream water. If

the DPV is not attained at the point of entry into the downstream water, then the collective set of streams in the upstream watershed does not attain the DPV, which is an applicable water quality criterion for the water segments in the upstream watershed. The State or EPA may establish additional DPVs at upstream tributary locations that are consistent with attaining the DPV at the point of entry into the downstream water. The State or EPA also have discretion to establish DPVs to account for a larger watershed area (i.e., include waters beyond the point of reaching water bodies that are not streams as defined by this rule).

(ii) In instances where available data and/or resources provide for use of a scientifically defensible and protective system-specific application of water quality simulation models with results that protect the designated uses and meet all applicable numeric nutrient criteria for the downstream water, the State or EPA may derive the DPV for TN and TP from use of a system-specific application of water quality simulation models. The State or EPA may designate the wasteload and/or load allocations from a TMDL established or approved by EPA as DPV(s) if the allocations from the TMDL will protect the downstream water's designated uses and meet all applicable numeric nutrient criteria for the downstream water.

(iii) When the State or EPA has not derived a DPV for a stream pursuant to paragraph (c)(6)(ii) of this section, and where a reference condition approach is used to derive the downstream water’s TN, TP and chlorophyll *a* criteria, then the State or EPA may derive the DPV for TN and TP using a reference condition approach based on TN and TP concentrations from the stream pour point, coincident in time with the data record from which the downstream receiving water segment TN and TP criteria were developed, and using the same data screens and reference condition approach as were applied to the downstream water's data.

(iv) When the State or EPA has not derived a DPV pursuant to paragraph (c)(6)(ii) or (c)(6)(iii) of this section, then the State or EPA may derive the DPV for TN and TP using dilution models based on the relationship between salinity and nutrient concentrations.

(v) When the State or EPA has not derived a DPV pursuant to paragraph (c)(6)(ii), (c)(6)(iii), or (c)(6)(iv) of this section, then the DPV for TN and TP is the applicable TN and TP criteria for the receiving segment of the downstream water as described in §131.45(c)(1), or as described in Section 62-302.532(a)-(h), F.A.C. for downstream waters where EPA-approved State criteria apply.

(vi) The State and EPA shall maintain a record of DPVs they derive based on the methods described in paragraphs (c)(6)(ii), (iii), (iv), and (v) of this section, as well as a record supporting their derivation, and make such records available to the public. The State and EPA shall notify one another and provide a supporting record within 30 days of derivation of DPVs pursuant to paragraphs (c)(6)(i), (ii), (iii), (iv), or (v) of this section. DPVs derived pursuant to these paragraphs do not require EPA approval under Clean Water Act §303(c) to take effect.

(d) *Applicability*. (1) The criteria in paragraphs (c)(1) through (6) of this section apply to certain Class I, Class II, and Class III waters in Florida, and apply concurrently with other applicable water quality criteria, except when:

(i) State water quality standards contain criteria that are more stringent for a particular parameter and use;

(ii) The Regional Administrator determines that site-specific alternative criteria apply pursuant to the procedures in paragraph (e) of this section; or

(iii) The State adopts and EPA approves a water quality standards variance to the Class I, Class II, or Class III designated use pursuant to §131.13 that meets the applicable provisions of State law and the applicable Federal regulations at §131.10.

(2) The criteria established in this section are subject to the State's general rules of applicability in the same way and to the same extent as are the other Federally-adopted and State-adopted numeric criteria when applied to the same use classifications.

(e) *Site-specific Alternative Criteria*.

(1) The Regional Administrator may determine that site-specific alternative criteria shall apply to specific surface waters in lieu of the criteria established in paragraph (c) of this section. Any such determination shall be made consistent with §131.11.

(2) To receive consideration from the Regional Administrator for a determination of site-specific alternative criteria, an entity shall submit a request that includes proposed alternative numeric criteria and supporting rationale suitable to meet the needs for a technical support document pursuant to paragraph (e)(3) of this section. The entity shall provide the State a copy of all materials submitted to EPA, at the time of submittal to EPA, to facilitate the State providing comments to EPA. Site-specific alternative criteria may be based on one or more of the following approaches.

(i) Replicate the process for developing the estuary criteria in paragraph (c)(1) of this section.

(ii) Replicate the process for developing the tidal creek criteria in paragraph (c)(2) of this section.

(iii) Replicate the process for developing the marine lake criteria in paragraph (c)(3) of this section.

(iv) Replicate the process for developing the coastal criteria in paragraph (c)(4) of this section.

(v) Replicate the process for developing the south Florida inland flowing water criteria in paragraph (c)(5) of this section.

(vi) Conduct a biological, chemical, and physical assessment of water body conditions.

(vii) Use another scientifically defensible approach protective of the designated use.

(3) For any determination made under paragraph (e)(1) of this section, the Regional Administrator shall, prior to making such a determination, provide for public notice and comment on a proposed determination. For any such proposed determination, the Regional Administrator shall prepare and make available to the public a technical support document addressing the specific surface waters affected and the justification for each proposed determination. This document shall be made available to the public no later than the date of public notice issuance.

(4) The Regional Administrator shall maintain and make available to the public an updated list of determinations made pursuant to paragraph (e)(1) of this section as well as the technical support documents for each determination.

(5) Nothing in this paragraph (e) shall limit the Administrator's authority to modify the criteria in paragraph (c) of this section through rulemaking.

(f) *Effective date.* This section is effective [date 60 days after publication of final rule].

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