# *2020 Integrated Water Quality Assessment for Florida: Sections 303(d), 305(b), and 314 Report and Listing Update*

**Division of Environmental Assessment and Restoration**
**Florida Department of Environmental Protection**

**June 2020**

**2600 Blair Stone Rd.**
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# Letter to Floridians

**FLORIDA DEPARTMENT OF**
**Environmental Protection**

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Tallahassee, FL 32399-2400

**Ron DeSantis**
Governor

**Jeanette Nuñez**
Lt. Governor

**Noah Valenstein**
Secretary

June 16, 2020

Dear Floridians:

It is with great pleasure that we present to you the 2020 Integrated Water Quality Assessment for Florida. This report meets the Federal Clean Water Act reporting requirements; more importantly, it presents a comprehensive analysis of the quality of our waters. This report would not be possible without the monitoring efforts of organizations throughout the state, including state and local governments, universities, and volunteer groups who agree that our waters are a central part of our state's culture, heritage, and way of life.

In Florida, monitoring efforts at all levels result in substantially more monitoring stations and water quality data than most other states in the nation. These water quality data are used annually for the assessment of waterbody health by means of a comprehensive approach. Hundreds of assessments of individual waterbodies are conducted each year. Additionally, as part of this report, a statewide water quality condition is presented using an unbiased random monitoring design. These efforts allow us to understand the state's water conditions, make decisions that further enhance our waterways, and focus our efforts on addressing problems.

The department implements a wide range of programs to protect and restore Florida's surface waters. At the heart of these efforts, particularly in identifying water quality problems and establishing restoration objectives, is the Division of Environmental Assessment and Restoration. Throughout this report you will find links to resources such as interactive maps that present information on water quality trends and strategies and activities underway to benefit water quality.

Florida's rivers, streams, lakes, estuaries, and coastal waters are spectacularly beautiful. More than that, they are essential natural resources, supplying the water necessary for aquatic life, both large and microscopic; drinking water; recreation; industry; fishing and shellfish harvesting; and agriculture. Protecting these abundant water resources, supporting restoration efforts, and preserving them for the future is your responsibility and ours.

We encourage all those interested in Florida' s waterways to read this report, gain a better understanding of Florida's water quality conditions, and engage in local efforts to protect and restore water quality. It has been a pleasure for us to compile this information for your use.

Regards,

Julie Espy, Director
Division of Environmental Assessment and Restoration

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# List of Acronyms and Abbreviations

| | |
|---|---|
| µg/L | Micrograms Per Liter |
| µg/kg | Micrograms Per Kilogram |
| µS/cm | MicroSiemens Per Centimeter |
| AEQA | Aquatic Ecology and Quality Assurance (Section) |
| AFFF | Aqueous Film Forming Foams |
| AGM | Annual Geometric Mean |
| ALK | Total Alkalinity |
| ATAC | Allocation Technical Advisory Committee |
| BDL | Below Detection Limit |
| BioRecon | Biological Reconnaissance |
| BMAP | Basin Management Action Plan |
| BMP | Best Management Practice |
| BOD | Biochemical Oxygen Demand |
| BRL | Banana River Lagoon |
| Ca | Calcium |
| $CaCO_3$ | Calcium Carbonate |
| Cb | Confidence Bounds |
| CERCLA | Comprehensive Environmental Response Compensation and Liability Act |
| CFU | Colony-Forming Unit |
| CHAN | Change Analysis |
| CHNEP | Charlotte Harbor National Estuary Program |
| Chl-*a* | Chlorophyll *a* |
| Cl | Chloride |
| cm | Centimeter |
| $CO_2$ | Carbon Dioxide |
| CWA | Clean Water Act |
| dbHydro | Database Hydrologic (South Florida Water Management District Database) |
| DEAR | Division of Environmental Assessment and Restoration |
| DEP | Florida Department of Environmental Protection |
| Diff. | Difference |
| DO | Dissolved Oxygen |
| DOC | Dissolved Organic Carbon |
| DWRA NPS | Division of Water Restoration Assistance Nonpoint Source Section |
| E | Early |
| EC | Emerging Contaminant |
| E. coli | *Escherichia coli* |
| Entero | *Enterococci* |
| EPA | U.S. Environmental Protection Agency |

| | |
|---|---|
| ERC | Environmental Regulation Commission |
| Est. | Estimate |
| F.A.C. | Florida Administrative Code |
| FC | Fecal Coliform |
| FDACS | Florida Department of Agriculture and Consumer Services |
| FDOH | Florida Department of Health |
| FIB | Fecal Indicator Bacteria |
| F.S. | Florida Statutes |
| FWC | Florida Fish and Wildlife Conservation Commission |
| FWRA | Florida Watershed Restoration Act |
| FWRI | Fish and Wildlife Research Institute |
| FY | Fiscal Year |
| GIS | Geographic Information System |
| HA | Habitat Assessment |
| HAB | Harmful Algal Bloom |
| HAL | Health Advisory Levels |
| HDG | Human Disturbance Gradient |
| HHC | Human Health–Based Criteria |
| HUC | Hydrologic Unit Code |
| IRL | Indian River Lagoon |
| ISD | Insufficient Data |
| ISE | Insufficient Evidence |
| IWR | Impaired Surface Waters Rule |
| K | Potassium |
| L | Late |
| LVI | Lake Vegetation Index |
| LVS | Linear Vegetation Survey |
| MCL | Maximum Contaminant Level |
| MDL | Method Detection Limit |
| Mg | Magnesium |
| mg/kg | Milligrams Per Kilogram |
| mg/L | Milligrams Per Liter |
| mL | Milliliter |
| MPN | Most Probable Number |
| MS4 | Municipal Separate Storm Sewer System |
| MST | Microbial Source Tracking |
| N | Nitrogen |
| n | Number |
| NA | Not Applicable |
| Na | Sodium |

| | |
|---|---|
| NEEPP | Northern Everglades and Estuaries Protection Program |
| NELAC | National Environmental Laboratory Accreditation Conference |
| ng/L | Nanograms Per Liter |
| NHD | National Hydrography Dataset |
| NNC | Numeric Nutrient Criteria |
| $NO_3$ | Nitrate |
| $NO_3$-$NO_2$ | Nitrate-Nitrite |
| NPDES | National Pollutant Discharge Elimination System |
| Nt | No Trend |
| OAWP | Office of Agricultural Water Policy (FDACS) |
| OC | Organochlorine |
| OFS | Outstanding Florida Spring |
| $OPO_4$ | Orthophosphate |
| P | Phosphorus |
| p Value | Probability Value |
| PAHs | Polycyclic Aromatic Hydrocarbons |
| PCBs | Polychlorinated Biphenyls |
| PCU | Platinum Cobalt Unit |
| PEC | Probable Effects Concentration |
| PFAS | Per and Polyfluoroalkyl Substances |
| PFOA | Perfluorooctanoic Acid |
| PFOS | Perfluorosulfonic Acid |
| ppb | Parts Per Billion |
| PQL | Practical Quantitation Limit |
| PRC | Performance Reference Compound |
| PRP | Potentially Responsible Parties |
| PWS | Public Water System |
| QA | Quality Assurance |
| QC | Quality Control |
| qPCR | Quantitative Polymerase Chain Reaction |
| RAP | Reasonable Assurance Plan |
| ROC | Regional Operations Center |
| RPS | Rapid Periphyton Survey |
| SBIO | Statewide Biological Database |
| SC | Specific Conductance |
| SCI | Stream Condition Index |
| SERCC | Southeast Regional Climate Center |
| SEAS | Shellfish Environmental Assessment Section |
| SFY | State Fiscal Year |
| SK | Seasonal Kendall |

| | |
|---|---|
| SMP | Strategic Monitoring Plan |
| $SO_4$ | Sulfate |
| SOC | Synthetic Organic Chemical |
| SOP | Standard Operating Procedure |
| spp. | Species |
| SS | Sen Slope |
| SSAC | Site-Specific Alternative Criterion |
| STCM | Storage Tank Contamination Monitoring |
| STORET | Storage and Retrieval (Database) |
| SWAPP | Source Water Assessment and Protection Program |
| TDS | Total Dissolved Solids |
| TEC | Threshold Effects Concentration |
| Temp | Temperature |
| Th-232 | Thorium 232 |
| TKN | Total Kjeldahl Nitrogen |
| TMDL | Total Maximum Daily Load |
| TN | Total Nitrogen |
| TOC | Total Organic Carbon |
| TP | Total Phosphorus |
| TR | Triennial Review |
| TSI | Trophic State Index |
| U-238 | Uranium 238 |
| USGS | U.S. Geological Survey |
| VOC | Volatile Organic Compound |
| WAS | Watershed Assessment Section |
| WBID | Waterbody Identification (Number) |
| WET | Watershed Evaluation and TMDL (Section) |
| WIN | Watershed Information Network |
| WL | Water Level |
| WMD | Water Management District |
| WPCS | Watershed Planning and Coordination Section |
| WQETP | Water Quality Evaluation and Total Maximum Daily Load Program |
| ZOD | Zone of Discharge |

# Executive Summary

## Contents

- The **Introduction** describes the federal assessment and reporting requirements met by this report.
- **Chapter 1** summarizes current issues of environmental interest and ongoing water quality initiatives.
- **Chapter 2** summarizes the 2016–18 water quality results from the Status and Trend Monitoring Networks and describes long-term trends in surface water and groundwater quality.
- **Chapter 3** summarizes significant surface water quality findings for strategic monitoring, including the attainment of designated uses.
- **Chapter 4** discusses the state's Total Maximum Daily Load (TMDL) Program and priorities.
- **Chapter 5** discusses the state's Basin Management Action Plan (BMAP) Program.
- **Chapter 6** presents significant groundwater quality findings, summarizes groundwater contaminant sources, and characterizes groundwater–surface water interaction.
- The **Appendices** contain important background information and supporting data.

## Purpose

This report provides an overview of the status and overall conditions of Florida's surface water and groundwater quality. It also addresses the Section 303(d), 305(b) and 314 reporting requirements of the federal Clean Water Act (CWA). Section 305(b) requires each state to report every two years to the U.S. Environmental Protection Agency (EPA) on the condition of its surface waters, Section 303(d) requires each state to report on its impaired waterbodies (those not meeting water quality standards), and Section 314 requires states to report on the status and trends of significant publicly owned lakes. Using the information from all the states, EPA provides the U.S. Congress with a national inventory of water quality conditions and develops priorities for future federal actions to protect and restore aquatic resources.

## Issues of Environmental Interest and Water Quality Initiatives

**Chapter 1** discusses current issues of environmental interest and ongoing water quality initiatives, including the following:

- Carried out a pilot project designed to examine the presence of priority emerging contaminants (ECs).
- Estimated the extent of Florida's surface waters potentially affected by pesticides. **Appendix A** includes a table summarizing detections and exceedances of 108 pesticides and degradants in a project jointly implemented by the Florida Department of Environmental Protection (DEP) and Florida Department of Agriculture and Consumer Services (FDACS).

- Continued the implementation of microbial source tracking (MST) to investigate and identify potential sources of elevated fecal indicator bacteria in waterbodies.

- Continued the use of chemical wastewater tracers, such as sucralose, to identify pollutant sources and trends in the environment, and to differentiate between natural and man-made sources.

- Continued the monitoring of freshwater harmful algal blooms (HABs).

- Assessed per and polyfluoroalkyl substances (PFAS) around Florida's fire college sites and nearby drinking water wells.

- Initiated a statewide fish consumption survey under contract with the University of Florida’s Bureau of Economic and Business Research Survey Research Center. When completed, the results of the survey will be used to revise human health–based water quality criteria.

- Formally initiated the Triennial Review (TR) of Florida’s water quality standards on March 29, 2019, through the publication of Notices of Rule Development; held three public hearings to solicit input on the scope of the TR in May 2019; and presented proposed revisions at four public workshops held in November 2019.

- Held public meetings on the preliminary results from the South Florida Canal Aquatic Life Study in Ft. Myers and West Palm Beach in February 2020.

## Statewide Probabilistic and Trend Monitoring Results

The Status Monitoring Network uses an EPA-designed probabilistic strategy to estimate, with known confidence, the quality of fresh water in Florida, including rivers, streams, canals, lakes, and groundwater resources. DEP collects standard physical/chemical and biological data in these waters and assesses the water quality health of each resource throughout the state each year. Analyses in this report are provided for data collected from 2016 to 2018. Additionally, analyses are provided for surface and groundwater data collected from 2000 to 2003, compared with those collected from 2015 to 2017 for surface water, and from 2016 to 2018 for groundwater.

The Trend Monitoring Network consists of 76 flowing surface water stations (e.g., rivers and streams) and 49 groundwater stations (47 wells and 2 springs) located throughout Florida that are sampled either monthly or quarterly. These data are used to identify water quality changes over time (i.e., trends). DEP collects a suite of physical/chemical and biological data similar to that collected at the Status Monitoring Network at these trend stations. Trend analyses for surface water stations were conducted on data collected from 1998 to 2018, and for groundwater on data collected from 2009 to 2019.

These analyses indicate that the main impacts to Florida's ground and surface waters are from nutrients and fecal indicator bacteria (FIB). Probabilistic analyses of the state's lake and flowing water resources using 2016 to 2018 data indicate that nutrient enrichment is most prevalent in lakes and canals, while the FIB *Escherichia coli (E. coli)* is most prevalent in streams, with 28 % of the state's stream miles failing the threshold for this indicator. The probabilistic analyses for groundwater for the same period show total coliform bacteria, in both confined and unconfined aquifers, as the potable water indicator with the highest failure rate, with 14 % of wells expected to have failures of the threshold.

Data analyses of trends show that while nutrient loads may be decreasing in flowing surface waters, lakes were found to have slightly increasing total phosphorus (TP) and a more pronounced increase in chlorophyll *a*. No significant statewide FIB trends were found for the surface water resources. Groundwater trend analyses, in association with a review of climate data for the periods of record, provide additional insight into these nutrient results. While groundwater showed no change in nutrients, pH decreases were observed. For surface water, pH decreased in flowing waters, yet increased in lakes.

A likely driver for the surface and groundwater pH changes is the documented increase in rainfall over the periods of record. The interaction of precipitation with atmospheric carbon dioxide ($CO_2$) produces carbonic acid, a known rock-weathering agent. As limestone dissolves, the buffering capacity and pH of associated waters are known to increase. Because of the interconnection between surface and groundwater in Florida lakes and the relatively long residence time of water, increased limestone dissolution may be leading to the observed increase in lake pH. Also, limestone dissolution may liberate TP from the rock matrix, thus explaining the observed increase in lakes.

## Designated Use Support in Surface Waters

**Chapter 3** summarizes the state's designated use support determinations and results based on surface water quality assessments performed under the Impaired Surface Waters Rule (IWR), Chapter 62-303, Florida Administrative Code (F.A.C.). **Appendix C** lists the state's water quality classifications. This report summarizes results for those assessments performed through 2019, including the third cycle for Basin Groups 2 through 5 and the fourth cycle for Basin Group 1.

Based on the assessments performed, DEP assessed 4,209 waterbody segments and found 1,841 were impaired. Of these impairments, 1,136 segments required a TMDL. The most frequently identified causes of impairment included DO, bacteria, and nutrients.

**Appendix D** lists over 187 publicly owned lakes identified as impaired, for which TMDLs will be required or are under development. **Appendices E** and **F** contain more information on biological assessment methodologies. **Appendix G** outlines the delisting process under the IWR.

## TMDL Program and Priorities

TMDLs, discussed in **Chapter 4**, must be developed for waterbody segments placed on DEP's Verified List of Impaired Waters. They establish the maximum amount of a pollutant that a waterbody can assimilate without causing exceedances of water quality standards. In Florida, most nutrient TMDLs are adopted as site-specific Hierarchy 1 water quality criteria, as defined in the numeric nutrient criteria (NNC) implementation document (DEP 2013a).

As of January 10, 2020, DEP has adopted a total of 447 TMDLs. Of these, 262 were developed for DO, nutrients, and/or un-ionized ammonia, 179 were developed for bacteria, and 5 were for other parameters such as iron, lead, and turbidity. In addition, the state has adopted a statewide TMDL for mercury, based on fish consumption advisories affecting over 1,100 waterbody segments.

## Basin Management Action Plan (BMAP) Program

**Chapter 5** provides information on adopted BMAPs. A BMAP is a framework for water quality restoration, containing local and state commitments to reduce pollutant loading through current and future projects and strategies. BMAPs contain a comprehensive set of solutions, such as permit limits on wastewater facilities, urban and agricultural best management practices (BMPs), and conservation programs designed to implement pollutant reductions established by a TMDL. These broad-based plans are developed with local stakeholders and rely on local input and commitment for development and successful implementation. BMAPs are adopted by DEP Secretarial Order and are legally enforceable. DEP's Florida Basin Management Action Plans website provides more information on BMAP restoration activities, including locations, status, and specifics on restoration projects.

## Groundwater Monitoring and Assessment

**Chapter 6** summarizes groundwater monitoring results for public water systems (PWS) from 2017 to 2019 and frequently monitored springs from 2018 through 2019. Overall, the water quality of the evaluated potable aquifers is good for the parameters monitored by DEP. Spring monitoring showed nitrate levels below the established drinking water standard but in excess of developed TMDLs.

DEP evaluated groundwater contaminants of concern using recent sampling data from PWS wells. Data from August 2017 through August 2019 showed that radionuclides (a natural condition), salinity (as sodium), and primary metals (mostly arsenic and lead) exceeded primary drinking water standards most often in untreated water (but not the water that is delivered to customers, which meets drinking water standards). Nitrate remains the biggest issue in surface waters that receive significant inputs of groundwater, since it can cause excessive algal growth and can impair clear water systems, particularly springs.

# Introduction

This report provides an overview of the status and overall conditions of Florida's surface water and groundwater quality. Under the federal Clean Water Act (CWA), the U.S. Environmental Protection Agency (EPA) and its state partners have developed an integrated assessment to address water quality monitoring strategies, data quality and quantity needs, and data interpretation methodologies. Florida uses this Integrated Report to report on whether water quality standards are being attained, document the availability of data for each waterbody segment, identify water quality trends, and provide management information for setting priorities to protect and restore Florida's aquatic resources. The report must be submitted to EPA every two years and meet the following requirements:

- Section 305(b) of the CWA requires states and other jurisdictions to submit water quality reports to the EPA. These 305(b) reports describe surface water and groundwater quality and trends, the extent to which these waters are attaining their designated uses (such as drinking water and recreation), and any major impacts to these water resources.
- Section 303(d) of the CWA also requires states to identify waters that are not supporting their designated uses, submit to EPA a list of these impaired waters (referred to as the 303[d] list), and develop total maximum daily loads (TMDLs) for them. A TMDL represents the maximum amount of a given pollutant that a waterbody can assimilate and still meet its designated uses.
- Section 314 of the CWA requires states to report on the status and trends of significant publicly owned lakes.

Federal guidance and requirements state that the following information should be provided:

- The extent to which the water quality of the state's waters provides for the protection and propagation of a balanced population of shellfish, fish, and wildlife and allows for recreational activities in and on the water.
- An estimate of the extent to which CWA control programs have improved or will improve water quality and recommendations for future actions.
- An estimate of the environmental, economic, and social costs and benefits needed to achieve CWA objectives and an estimate of the date for such achievements.
- A description of the nature and extent of nonpoint source pollution and recommendations needed to control each category of nonpoint sources.

- An assessment of the water quality of all publicly owned lakes, including lake trends, pollution control measures, and publicly owned lakes with impaired uses.

DEP's 2016 document, *Elements of Florida's Water Monitoring and Assessment Programs,* contains background information on Florida's water resources, monitoring and assessment approach, and water resource management programs.

# Chapter 1: Issues of Environmental Interest and Water Quality Initiatives

The Florida Department of Environmental Protection (DEP) works with many different programs and agencies throughout the state to address issues and problems affecting surface water and groundwater quality and quantity. These responsibilities are implemented through a variety of activities, including planning, regulation, watershed management, the assessment and application of water quality standards, nonpoint source pollution management, ambient water quality monitoring, groundwater protection, educational programs, and land management. This chapter describes some major issues of environmental interest and ongoing water quality initiatives being undertaken primarily by DEP.

## Monitoring of Emerging Contaminants (ECs) and Pesticides

There is public concern that unregulated contaminants, and their degradants, may be causing human health and ecological impacts as low levels of these compounds increasingly are being detected in water resources throughout the world. Commonly referred to as ECs, these contaminants include pharmaceuticals, personal care products, hormones, pesticides, detergents, plasticizers, and flame retardants. Some are introduced into the aquatic environment through discharges of treated wastewater, as standard wastewater treatment technologies do not remove many of these types of contaminants.

Based on recommendations from an internal workgroup, in 2009 DEP began developing lab methodologies for ultratrace-level analyses of compounds to be used as indicators for wastewater and pesticides. They include the artificial sweetener sucralose; the pharmaceuticals acetaminophen, carbamazepine, and primidone; and the pesticide imidacloprid. These compounds are hydrophilic, or attracted to water, and therefore may be highly mobile in the freshwater environment.

DEP's Division of Environmental Assessment and Restoration (DEAR) added wastewater tracers and imidacloprid to its Status and Trends Monitoring Networks (discussed in **Chapter 2**) to investigate the levels of ECs in Florida's fresh waters. DEAR sampled statewide for sucralose from both monitoring networks in 2012, and for sucralose, acetaminophen, carbamazepine, primidone, and imidacloprid from the Status Monitoring Network in 2015, 2016, and 2017. Results from these sampling events are provided in Seal et al. (2016) and Silvanima et al. (2018).

In 2013, a DEP workgroup recommended a study to determine the potential biological effects of ECs on aquatic organisms by employing screening assays to detect ecological effects, such as estrogenic activity. The priority ECs were selected based on factors such as global presence, exposure to humans and wildlife, bioaccumulative and toxic effects, persistence in the environment, and suspected endocrine disruption. The main objective of the study was to evaluate novel sampling techniques and technologies, analytical methods, and toxicological assays for ECs in Florida rivers. A complete writeup, including results, is found in Hogue et al. (2019).

The findings of the study are as follows:

- Sampling and chemical analyses for ECs are sensitive processes, in part because of the low laboratory detection limits, commonly less than 10 nanograms per liter (ng/L), used to determine the presence of these compounds. For this reason, chemical analyses are accompanied by lengthy quality control (QC) reports that must be carefully reviewed to determine data usability.

- For passive sampling devices, time-weighted averages of analyte concentrations are sufficient for determining biological exposure rates. To determine time-weighted average concentrations for these devices, the sampling rates (the uptake rate of a compound onto passive sampling material adjusted for flow dynamics) of individual compounds should be determined. Furthermore, performance reference compounds (PRCs) should be deployed with passive samplers so that site-specific uptake distributions can be determined for individual compounds.

- For test protocols that measure estrogenicity and androgenicity, the high level of color in Florida waters caused interference in detections. An increased understanding of site-specific sampling rates for estrogenic and androgenic compounds and further refinement of the laboratory methods used to determine estrogenicity and androgenicity are recommended for future studies.

- Future studies of ECs in Florida's waterbodies should focus on waterbodies directly affected by known sources of these substances (e.g., river segments continually impacted by wastewater overflows). This approach would reduce the burden of collecting and processing data by focusing on known contaminant sources.

## Testing for Pesticides in Surface Waters

As part of a project jointly implemented by DEP and the Florida Department of Agriculture and Consumer Services (FDACS), 42 surface waterbodies were selected for pesticide sampling in 2018 based on land use criteria. A total of 254 samples were collected and tested for 108 pesticides and pesticide degradants (**Appendix A**). As in previous years, there were frequent detections of numerous pesticides. In 2017, very few detections approached the EPA aquatic life benchmarks. However, in 2018, 3 insecticides—aldicarb, imidacloprid and malathion—were detected above EPA aquatic life benchmarks for invertebrates, with imidacloprid frequently found above the chronic aquatic life benchmark for invertebrates. These findings resulted from, in part, EPA's 2017 lowering of imidacloprid's aquatic life benchmark for invertebrates from 34,500 to 385 ng/L for acute effects and from 1,050 to10 ng/L for chronic effects. Additionally, in 2018, detections of the herbicides atrazine and imazapyr exceeded EPA's aquatic life benchmarks.

Of 47 herbicides and 2 herbicide degradants under analysis, 2,4-D, atrazine, bentazone, dithiopyr, fluridone, imazapyr, metolachlor and oxadiazon were found in 50 % or more of the samples. Six other herbicides (bromacil, diuron, glyphosphate and its degradants, hexazinone, norflurazon, and simazine) were detected in more than 25 % of the samples. Of 39 insecticides and 14 insecticide degradants analyzed, imidacloprid (62 % of 230 samples), fipronil and its 3 degradants (35 % of 208 samples), chlordane (14 % of 208 samples), chlorpyrifos ethyl (9 % of 208 samples), and malathion (8 % of 208 samples) had the highest detection rates.

Ten other insecticides (aldicarb, carbaryl, diazinon, dieldrin, disulfoton, ethion, ethoprop, methomyl, oxamyl, and terbufos) were detected in less than 5 % of the samples. Aldicarb and malathion were detected above EPA's chronic aquatic life benchmark once each. Imidacloprid was detected in 26 waterbodies above EPA aquatic life benchmarks. Eleven imidacloprid samples (5 %) had concentrations above the acute aquatic life benchmark, and 108 samples (47 %) had concentrations above the chronic aquatic life benchmark. Three of four fungicides were detected: metalaxyl (35 % of 208 samples), tebuconazole (20 % of 30 samples), and pyraclostrobin (4 % of 227 samples). None of these fungicide detections exceeded aquatic life benchmarks. Metalaxyl was the only fungicide detected in previous years.

Overall, 33 herbicides or their degradants, 22 insecticides or their degradants, and 3 fungicides were detected. There were no detections for 50 of the 108 analytes. Sixty-three percent of samples had detectable levels of imidacloprid, and 47 % of all samples contained imidacloprid concentrations above EPA aquatic life benchmarks. These findings indicate imidacloprid is a widely used insecticide, and residues from its use often are found in the environment at levels exceeding benchmarks for aquatic invertebrates.

The herbicide atrazine was detected in 179 of 208 samples (86 % detection rate), and the herbicide imazapyr was detected in 149 of 193 samples (77 % detection rate). The high detection rates indicate that these herbicides are used widely, and their residues frequently are found in the environment, although typically at low levels. Atrazine and imazapyr were found to exceed EPA’s aquatic life benchmarks in 2 of 208 and 1 of 193 samples collected, respectively.

In 2019, DEP's laboratory developed analytical methodologies for several recently developed pesticides, including the neonicotinoid insecticides acetamiprid, clothianidin, dinotefuran, and thiamethoxam. In August 2019, DEP added these insecticides to the analyte lists used for (1) the joint DEP–FDACS project, (2) the resampling of surface water Status and Trend Network stations (**Chapter 2**) with imidacloprid exceedances of EPA aquatic life benchmarks for invertebrates, and (3) strategic monitoring for determining impairment (**Chapter 3**).

## Implementing and Expanding Microbial Source Tracking (MST)

Human and animal waste can enter surface waters through various means. Sources include combined sewer overflows, aged or leaking sewer lines, septic system overflow, urban runoff, and feces from livestock, wildlife, and pets. MST is a set of techniques used to investigate and identify potential sources of elevated levels of fecal indicator bacteria in a waterbody. Indicator bacteria such as fecal coliforms, *Escherichia coli (E. coli),* and *Enterococci* commonly are found in the feces of humans and warm-blooded animals but also can grow freely in the environment. Standard microbiological culture–based methods cannot discriminate between enteric bacteria (from the gut of a host animal) and environmental bacteria (free-living and not associated with fecal waste or elevated health risks). MST is employed to distinguish between the many sources of fecal contamination, particularly to differentiate human from animal waste.

Listing a waterbody as impaired on the 303(d) list when there is no increased risk to human health creates unnecessary burdens for the Total Maximum Daily Load (TMDL) Program and others, including economic costs for local governments responsible for implementing those TMDLs. Knowing the potential source of contamination and origin of the bacteria allows everyone to focus their resources on solving the right problem more quickly.

To do that, DEP has devised a multipronged approach that fully uses the latest technologies available. These include the DEP Biology Program's development of a Molecular Biology Laboratory and the DEP Chemistry Program's development and validation of methods for chemical tracers. The Molecular Biology Laboratory offers real-time, quantitative polymerase chain reaction (qPCR) source marker analysis–based assays for humans, dogs, shorebirds, other birds, and ruminants. The molecular toolbox also includes EPA-patented qPCR markers for humans, cattle, and canines.

In addition, the laboratory implemented a method to distinguish DNA from live bacteria versus dead bacteria in a water sample. DEP will continue to evaluate additional source-specific markers and pathogen detection methods. The Molecular Biology group is working closely with other DEP programs to standardize the interpretation of qPCR results and establish meaningful thresholds for marker concentration in the context of human health risk. The improved and consistent interpretation of results will better inform stakeholders on mitigation and restoration strategies.

## Using Chemical Wastewater Tracers to Identify Pollutant Sources

Monitoring for chemical tracers in the environment is a powerful tool for characterizing potential anthropogenic pollutants and helping to identify sources. As instrument technology and the scientific understanding of chemical tracers continue to improve, it is now possible in many situations to use laboratory techniques to help detect unique chemical tracers present in certain types of waste streams. Based on a weight-of-evidence approach, these tracers can help identify or eliminate potential pollutant sources and thus provide a "toolbox" for developing a preponderance of evidence for environmental investigations.

DEP currently uses a number of chemical tracers with uniquely desirable characteristics for identifying sources of industrial, agricultural, pharmaceutical, hydraulic fracturing, and other ECs. By analyzing samples for tracer compounds and other known environmental pollutants, the combined information has proven extremely useful in identifying specific sources and pollution trends. Commonly used human wastewater tracers include artificial sweeteners (sucralose) and pharmaceuticals (acetaminophen, ibuprofen, naproxen, carbamazepine, and primidone).

The compound sucralose (trade name Splenda®) is almost ideal as a tracer. It is present in virtually every domestic wastewater discharge at detectable levels (10 to 40 parts per billion [ppb]), does not occur naturally, has low toxicity, is highly soluble in water, is not effectively metabolized or removed by wastewater treatment processes, and persists in the environment (with a 1- to 2-year environmental half-life). DEP's monitoring of sucralose has helped identify sites for more intensive study, track contaminant migration routes in surface water and groundwater, and distinguish between natural and human sources of bacteria.

To obtain the greatest value from chemical tracer data, it is important to collect samples over time and under varying hydrologic or flow conditions. Multiple samples collected over time can help to establish trends and correct sampling site or process variability. The usefulness of chemical tracers can be amplified by monitoring for more than one tracer simultaneously—e.g., where investigators take advantage of half-life, treatment survivability, or other unique qualities of multiple tracer compounds. The presence of short-lived tracer compounds may provide temporal information, while the presence of tracer compounds known to be destroyed by wastewater treatment may indicate a raw wastewater source. Ultimately, all the chemical tracer data can be used together to render a decision based on the weight of evidence.

Although sucralose has proven to be a useful tracer of human wastewater, it also has limitations in some applications. For lakes with low water turnover rates, for example, sucralose's long environmental half-life means that concentrations can build up over time, making it difficult to identify specific areas of wastewater inputs. Additionally, because sucralose survives wastewater treatment processes, it is not useful for differentiating treated municipal wastewater from untreated wastewater derived from leaking sewer lines or even aggregate septic tank leachate. In such cases, acetaminophen and/or carbamazepine have proven useful. Both have shorter environmental half-lives and may be effectively removed by treatment processes. Using tracers with different characteristics in conjunction with one another has allowed for better differentiation among sources.

In most cases chemical tracers are used as broad aggregate wastewater indicators rather than as an individual source identification tool. However, by using multiple tracers and trend data, coupled with MST tools, it may be feasible to identify specific sources. More generally, employing chemical tracers allows environmental investigators to better focus attention on specific areas of interest, without committing finite resources to remediate naturally occurring conditions.

## Monitoring of Harmful Algal Blooms (HABs)

A HAB is a rapidly forming, dense concentration of algae, diatoms, or cyanobacteria (blue-green algae) that may pose a risk to human health through direct exposure, the ingestion of contaminated drinking water, or the consumption of contaminated fish or shellfish. Cyanobacteria pose a potential risk to aquatic ecosystems when present in large quantities, as their decomposition contributes to oxygen depletion, or hypoxia, which can lead to increased mortality in local populations. In addition, some toxins may be harmful to domestic animals, wildlife, and fishes. Even nontoxic blooms can create low oxygen levels in the water column and/or reduce the amount of light reaching submerged plants.

It is currently impossible to predict when a bloom will occur and whether it will be toxic, making response, monitoring, and communication on a bloom complicated. There are federal guidelines for cyanobacteria toxins in recreational waters, but blooms can change quickly, making the guideline thresholds difficult to use for bloom management decisions. By the time toxin results are available, they may no longer be representative of the current bloom conditions in the waterbody. Therefore, public outreach regarding cyanobacteria blooms uses a precautionary approach that minimizes risk by taking the most conservative action early, rather than waiting for more detailed information.

For example, if the water is green or otherwise highly discolored, assume it is unsafe: keep people, pets, and livestock out of the water, and do not use bloom water for spray irrigation. While this approach may result in some lost recreational opportunities, DEP believes it is better to err on the side of protecting the public from adverse health impacts, rather than basing action levels on results that may no longer be representative of the actual risk.

Some HAB species are condensed by wind and current to form a thick layer of surface scum along the shoreline. Other species fill the entire water column rather than floating at the surface. Still others move throughout the water column to take advantage of varying levels of nutrients and light. Changes in the weather can cause blooms either to rise to the surface or to drop lower in the water column and out of sight.

Although it is well-known that elevated nutrients can cause HABs, other factors may exacerbate or mitigate the effects of those nutrients on algal growth. For instance, warm temperatures, reduced flow, wind-driven mixing of the water column and sediments, the absence of animals that eat algae, aquatic resource management practices (e.g., vegetation control on canal banks), and previous occurrences of blooms in an area may help to promote HABs where nutrients alone would not cause a bloom. Likewise, factors such as strong flow and heavy shading can prevent an algal bloom from occurring even where nutrients are elevated. Therefore, it is difficult to determine one single cause of all HABs.

Because most freshwater HABs are ephemeral and unpredictable, the state does not have a long-term freshwater HAB monitoring program that routinely samples fixed stations. Instead, DEP, the five water management districts (WMDs), Florida Department of Health (FDOH), Florida Fish and Wildlife Conservation Commission (FWC), and FDACS respond to HABs as soon as they are reported or observed. Nevertheless, DEP has implemented standard operating procedures (SOPs) for sampling cyanobacteria blooms and standardized forms for recording important information when investigating a bloom.

HAB response is coordinated in a manner that is complementary rather than duplicative. Each agency has identified staff to act as HAB contacts and as agency resources on issues related to bloom events. These contacts are referred to collectively as the Algal Bloom Response Team. When blooms are reported online, by phone or in person, or observed during normal fieldwork, staff contact one or more of the team members by email or phone to coordinate the appropriate follow-up actions.

Common ways to report HABs include DEP's online Algal Bloom Reporting Form and DEP's Algal Bloom Reporting Hotline ([1] 855–305–3903). For bloom response, DEP laboratory staff quickly identify the bloom species and determine whether the algae have the potential to produce toxins. DEP posts information on species composition and the level of toxins being produced to the DEP Algal Bloom Dashboard. This communication tool provides information on freshwater HABs and allows Algal Bloom Response Team members, other state and federal agencies, local governments, and the public to easily track bloom events, activities, and results.

Often, other water quality samples are collected along with the bloom identification sample, including chlorophyll and nutrient samples. The toxin, chlorophyll, and nutrient data are entered into DEP's Watershed Information Network (WIN) Database, and are publicly available. These water quality data also are used in the assessment and determination of impairment based on the Impaired Surface Waters Rule (IWR) (Chapter 62-303, Florida Administrative Code [F.A.C.]). Waterbodies deemed impaired are restored through the implementation of TMDLs and basin management action plans (BMAPs) (discussed in **Chapters 4** and **5**).

Because FDOH focuses on protecting public health, it takes a lead role when reported health incidents are associated with a bloom. When blooms affect waters permitted as public bathing beaches or other areas where there is the risk of human exposure, the agency may post the waterbody with warning signs. These actions typically are directed out of the local county health department, most often after consultation with staff from FDOH's Aquatic Toxins Program. FDOH also follows up on reports of sick or dead pets that may have been exposed to a bloom, since these events may predict potential human health threats. In 2009, the FWC's Florida Wildlife Research Institute (FWRI) and FDOH published a *Resource Guide for Public Health Response to Harmful Algal Blooms in Florida*, which provides recommendations on the materials needed to develop plans for local public health response to HABs. In addition, FDOH's Caspio web tool contains historical bloom response documentation through July 2019, after which the agency began using DEP's Algal Bloom Dashboard as its primary source of bloom response information.

The FWC's Fish Kill Hotline is used for reporting all types of fish kills and can identify when an algal bloom is suspected to be the cause. FWC predominantly documents and, when possible, determines the cause(s) of fish and wildlife deaths. The agency focuses on managing the living resources. It also maintains a red tide monitoring program that provides weekly updates on current red tide conditions in Florida's coastal waters. FWC and FDACS share responsibilities for the management of shellfish harvesting waters. DEP coordinates with the FWRI HAB research team on estuarine bloom response.

## Monitoring of Per and Polyfluoroalkyl Substances (PFAS)

PFAS comprises a group of synthetic chemicals in use since the 1940s. There is evidence that continued exposure to certain PFAS may lead to adverse health effects, including an increased risk of cancer. PFAS occurrence in the environment and detection in drinking water has been a concern for various states for many years, particularly in areas where these chemicals are manufactured. More recently, PFAS contamination has been found to be much more widespread than was originally understood. PFAS became a national environmental concern in 2018, evidenced by an increased number of meetings and conferences around the U.S. that were either dedicated to PFAS or had sessions devoted to PFAS, and by increased local and national press coverage. In February 2019, EPA announced a PFAS Action Plan as a response to the concerns of environmental scientists and the public about these persistent chemicals.

PFAS became a concern in Florida when monitoring indicated there could be groundwater contamination around sites where aqueous film–forming foams (AFFFs) have been used. AFFFs are firefighting foams that contain PFAS as major ingredients. Firefighting training facilities are heavy users of such foams, and their use could threaten the drinking water of nearby residences. The assessment of Florida's fire college sites for PFAS contamination, particularly for perfluorooctanoic acid (PFOA) and perfluorosulfonic acid (PFOS), began in the second half of 2018. DEP has developed and validated methods for the analysis of PFAS in water and soils. DEP and FDOH are targeting drinking water wells in the vicinity of impacted sites and providing filters for wells with PFOA/PFOS concentrations at or above the health advisory level (HAL) of a combined total of 70 ng/L.

## Revising Florida's Water Quality Standards

DEP made a number of revisions to Florida's water quality standards from 2016 to 2019, including those described below.

### *Revisions to Human Health–Based Criteria (HHC) for Surface Water Quality*

In 2016, DEP initiated rulemaking to revise Florida's HHC. The rulemaking included updates to the current HHC and new criteria for 39 priority pollutants that did not previously have criteria. DEP conducted public workshops in May 2016 and received written comments from a wide variety of stakeholders. The Florida Environmental Regulation Commission (ERC) approved the HHC at a public hearing on July 26, 2016, in Tallahassee, but the rule revisions were administratively challenged by four parties. After an administrative hearing, the administrative law judge upheld DEP's proposed revisions, but three of the parties then appealed the judge's decision to a Florida District Court of Appeals.

Subsequently, on February 9, 2018, DEP formally withdrew the revisions to the HHC and simultaneously initiated rule development to update the criteria. Staff are working with the University of Florida's Bureau of Economic and Business Research Survey Research Center to conduct a statewide survey of fish consumption rates by Floridians. The results of the survey will be used to determine the amount and types of fish commonly eaten by Floridians to ensure the criteria will protect all citizens.

### *New Surface Water Quality Classification (Class I-Treated)*

The 2016 Florida Legislature directed DEP to establish a new surface water classification for "treated potable water supplies" and reclassify certain waters to the new classification. As directed, DEP proposed the establishment of the new Class I-Treated, Treated Potable Water Supplies classification under Rule 62-302.400, F.A.C. DEP also revised the reclassification of the following six waterbodies from their existing Class III classification to the new category:

- Port St. Joe Canal (Gulf County).
- Alafia River (lower part) (Hillsborough County).
- Tampa Bypass Canal (Hillsborough County).
- Peace River (middle segment) (DeSoto County).
- Caloosahatchee River (middle segment) (Hendry County).

- Marco Lakes (Collier County).

Because the new classification includes potable water consumption as a designated use, this approach resulted in the new Class I-Treated classification having the same water quality criteria as Class I waters, except for fluorides, chlorides, dissolved solids, and nitrate, which are not derived using the risk-based targets used for other human health–based criteria. In addition to reclassifying these six waters in Rule 62-302.400, F.A.C., DEP incorporated maps of the reclassified waterbodies into the rule by reference.

DEP conducted rulemaking for the new surface water classification and reclassification of these waterbodies concurrently with the proposed revisions to HHC. Both were approved by the ERC during the July 26, 2016 hearing. However, the new classification and reclassifications are not yet in effect because the HHC criteria were withdrawn. Once revised HHC are adopted, DEP will submit the new HHC and the new Class I-Treated classification to EPA for review.

### *Triennial Review (TR) of Florida's Water Quality Standards*

DEP formally initiated the TR on March 29, 2019, through the publication of Notices of Rule Development. DEP held public hearings to solicit input on the scope of the TR in Tallahassee (May 14), Hobe Sound (May 15), and Orlando (May 16), and presented proposed revisions at public workshops held in Tallahassee (November 4), Ft. Myers (November 5), Ft. Lauderdale (November 6), and Jacksonville (November 7).

Some of the proposed revisions include the following: (1) revision of the freshwater and marine cadmium criteria, (2) addition of cyanotoxin criteria, (3) revision of the turbidity criterion to include a narrative provision that better protects coral reef and hardbottom communities, (4) adoption of site-specific alternative criteria (SSAC) for dissolved oxygen (DO) for 11 waters previously listed as impaired because of natural conditions, (5) incorporation of compliance authorization provisions into Florida's water quality standards, and (6) revision of the document *Implementation of Florida's Numeric Nutrient Standards* (DEP 2013a).

## Completing the South Florida Canal Aquatic Life Study

In 2016, DEP completed the South Florida Canal Aquatic Life Study, a comprehensive assessment of south Florida canals and their associated aquatic life. Numerous analyses of study data described existing canal conditions and evaluated factors influencing the aquatic life present. Initial analyses indicated that (1) the canals frequently did not meet Class III water quality criteria for DO and chlorophyll/nutrients, and (2) there was no consistent relationship between the biological communities and expected influencing factors (e.g., habitat quality and quantity, DO, nutrients, and flow). Subsequent analyses showed the canals had significant differences in water quality and biology, both locally and regionally, and provided additional insight into the more localized/site-specific nature of factors influencing the biological communities. DEP reported on the results in the document *Preliminary Results of the South*

*Florida Canal Aquatic Life Study* (Payne 2019). DEP held public workshops in Ft. Myers (February 19, 2020) and West Palm Beach (February 20, 2020) to present the study results to the public and take public comments.

# Chapter 2: Statewide Probabilistic and Trend Assessments

## Background

Initiated in 2000, DEP's probabilistic Status Monitoring Network (Status Network) provides an unbiased, cost-effective sampling of the state's water resources. Florida has adopted a probabilistic design so that the condition of the state's surface and groundwater resources can be estimated with known statistical confidence. Data produced by the Status Network fulfill CWA 305(b) reporting needs and complement CWA 303(d) reporting.

In addition, DEP has designed a Trend Monitoring Network (Trend Network) to monitor water quality changes over time in rivers, streams, canals, and aquifers (via wells). To achieve this goal, fixed locations are sampled at fixed intervals (monthly or quarterly). The Trend Network complements the Status Network by providing spatial and temporal information about water resources and potential changes from anthropogenic or natural influences, including extreme events (e.g., droughts and hurricanes).

Taking guidance from the EPA document, *Elements of a State Monitoring and Assessment Program* (EPA 2003), DEP developed and annually updates the *Florida Watershed Monitoring Status and Trend Program Design Document* (DEP 2018a), which provides details of both monitoring networks.

## Water Resources Monitored

The Status and/or Trend Monitoring Networks include the following four water resource categories (the *Design Document* [DEP 2018a] provides additional details on each of these resources):

- **Groundwater (confined and unconfined aquifers):** Groundwater includes those portions of Florida's aquifers that have the potential for supplying potable water or affecting the quality of current potable water supplies. However, this does not include groundwater that lies directly within or beneath a permitted facility's zone of discharge (ZOD) and water influenced by deep well injection (Class I and II wells).

- **Rivers and streams:** Rivers and streams include linear waterbodies with perennial flow, defined as waters of the state under Chapters 373 and 403, Florida Statutes (F.S.).

- **Canals (excluding drainage and irrigation ditches as defined below):** Canals include man-made linear waterbodies that are waters of the state. Chapter 312.020, F.A.C., provides the following definitions: A canal is a trench, the bottom of which is normally covered by water, with the upper edges of its two sides normally above water. A channel is a trench, the bottom of which is normally covered entirely by water, with the upper edges of its sides normally below water. Drainage and irrigation ditches are man-made trenches dug for the purpose of draining water from the land, or for transporting water for use on the land, and are not built for navigational purposes.

- **Lakes (Status Monitoring Network only):** Lakes include natural bodies of standing water and reservoirs that are waters of the state and are designated as lakes and ponds on the U.S. Geological Survey (USGS) National Hydrography Dataset (NHD). This category does not include many types of artificially created waterbodies, or streams/rivers impounded for agricultural use or private water supply.

DEP does not use the Status or Trend Monitoring Network to monitor estuaries, wetlands, or marine waters.

## Summary of Status Network Surface Water Results

### *Introduction*

DEP uses the Status Network to report on surface water resource conditions for the entire state. This section summarizes the statewide results of the combined 2016 through 2018 assessments. Three years of data provide a larger sample size and increased confidence in statewide water resource assessments and data sufficiency for regional water resource assessments. The analysis protocols for the Status Network are provided in the *Status Network Data Analysis Protocols* document (DEP 2018b).

DEP used the Status Network to assess rivers, streams, canals, large lakes, and small lakes. **Table 2.1** summarizes the miles of rivers, streams, and canals, and acres and numbers of large and small lakes, for the waters assessed. The measurements for these resources are specific to the Status Network and may vary from those identified in other sections of this report. From 2016 through 2018, approximately 15 samples were collected annually from each resource, in each of 6 zones. The zones correspond to the state's 5 water management district (WMD) boundaries, with the South Florida WMD divided into eastern and western regions.[1]

[1] See p. 14 of the *Florida Watershed Monitoring Status and Trend Program Design Document* (DEP 2018) for zone locations.

**Table 2.1. Summary of surface water resources assessed by the Status Network's probabilistic monitoring, 2016–18**

**Note:** The estimates in the table do not include coastal or estuarine waters. These calculations are from the 1:24,000 NHD.

| Waterbody Type | Assessed |
|---|---|
| **Rivers** | 2,621 miles/4,218 kilometers |
| **Streams** | 15,465 miles/24,888 kilometers |
| **Canals** | 2,480 miles/3,990 kilometers |
| **Large Lakes** | 1,739 lakes (959,339 acres/388,231 hectares) |
| **Small Lakes** | 1,813 lakes (28,107 acres/11,374 hectares) |

The indicators selected for surface water reporting include *E. coli* bacteria, DO, total nitrogen (TN), total phosphorus (TP) and chlorophyll *a*. **Tables 2.2a** through **2.2d** summarize the indicators and their threshold values. See the *Design Document* (DEP 2018a) for a complete list of indicators used in the Status Monitoring Network.

The main source of information for these indicators is Chapter 62-302, F.A.C., which contains the surface water quality standards for Florida. DEP derived the water quality thresholds from the following:

- Rule 62-302.530, F.A.C., Criteria for Surface Water Classifications.
- Chapter 62-550, F.A.C., Drinking Water Standards.
- *Implementation of Florida's Numeric Nutrient Standards* (DEP 2013a).
- Technical Support Document: *Derivation of Dissolved Oxygen Criteria to Protect Aquatic Life in Florida's Fresh and Marine Waters* (DEP 2013b; modified 2019).
- Chapter 62-303, F.A.C., Identification of Impaired Surface Waters.
- Rule 62-520.420, F.A.C., Standards for Class G-I and Class G-II Ground Water.

It is important to note that the diversity of Florida's aquatic ecosystems results from a large natural variation in some water quality parameters. For example, surface waters dominated by groundwater inflows or flows from wetland areas may naturally have lower DO levels (see **Chapter 6**).

## Table 2.2a. Nutrient indicators used to assess river, stream, and canal resources

mg/L = Milligrams per liter
NA = Not applicable; no numeric threshold. The narrative criterion in Paragraph 62-302.530(47)(b), F.A.C., applies.
[1] Not applied as criteria, but rather as a threshold used to estimate the impairment of state waters. These thresholds are used in the analysis of Status Monitoring Network data, based on single samples. The analysis and representation of these data are not intended to infer verified impairment, as defined in Chapter 62-303, F.A.C.
[2] The nutrient thresholds for rivers, streams, and canals depend on the nutrient region (**Figure 2.1**).

| Nutrient Region[2] | TP Threshold[1] (mg/L) | TN Threshold[1] (mg/L) | Designated Use |
|---|---|---|---|
| **Panhandle West** | ≤ 0.06 | ≤ 0.67 | Aquatic Life |
| **Panhandle East** | ≤ 0.18 | ≤ 1.03 | Aquatic Life |
| **North Central** | ≤ 0.30 | ≤ 1.87 | Aquatic Life |
| **Peninsula** | ≤ 0.12 | ≤ 1.54 | Aquatic Life |
| **West Central** | ≤ 0.49 | ≤ 1.65 | Aquatic Life |
| **South Florida** | NA | NA | Aquatic Life |

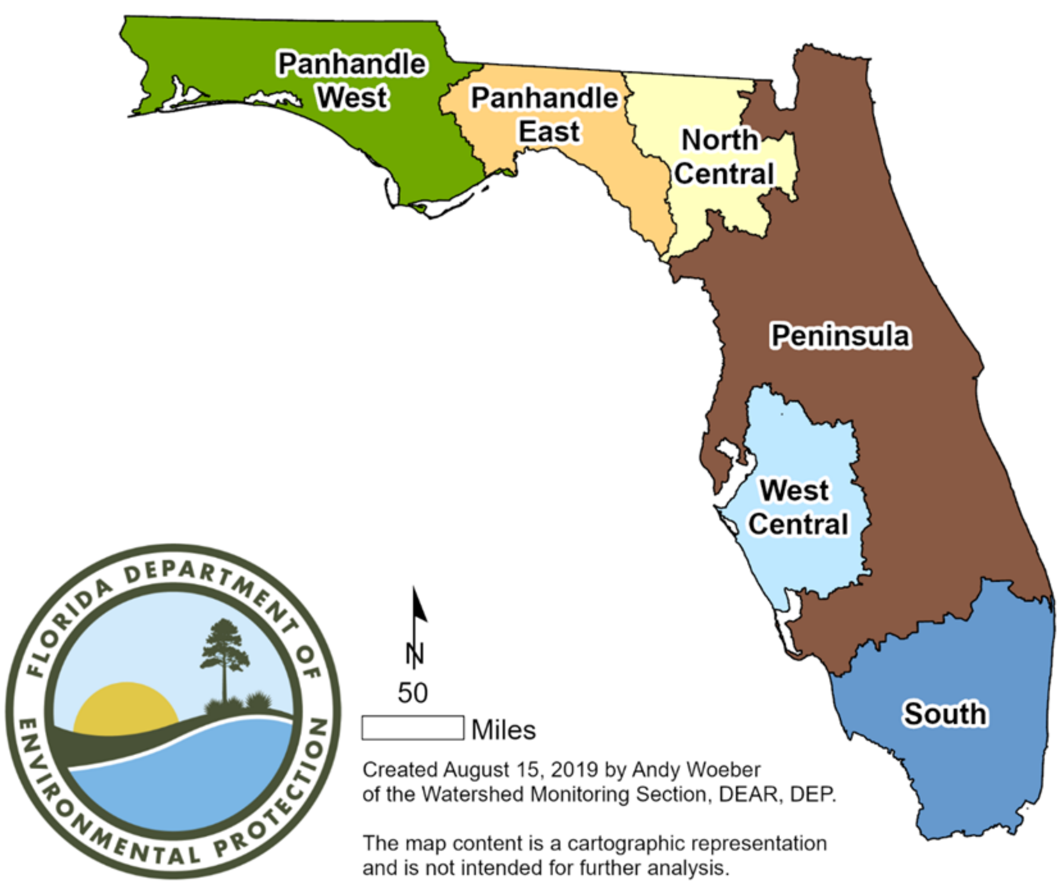



**Figure 2.1. Nutrient regions for river, stream, and canal resources**

## Table 2.2b. Nutrient indicators used to assess lake resources

PCU = Platinum cobalt units; $CaCO_3$ = Calcium carbonate; µg/L = Micrograms per liter; mg/L = Milligrams per liter
[1] Not applied as criteria, but rather as a threshold used to estimate the impairment of state waters. These thresholds are used in the analysis of Status Monitoring Network data, based on single samples. The analysis and representation of these data are not intended to infer verified impairment, as defined in Rule 62-303, F.A.C.
[2] For lakes with color > 40 PCU in the West Central Nutrient Region (**Figure 2.1**), the TP threshold is 0.49 mg/L.

| Lake Color and Alkalinity | Chlorophyll *a* Threshold[1] (µg/L) | TP Threshold[1] (mg/L) | TN Threshold[1] (mg/L) | Designated Use |
|---|---|---|---|---|
| **Color > 40 PCU** | ≤ 20 | ≤ 0.16[2] | ≤ 2.23 | Aquatic Life |
| **Color ≤ 40 PCU and Alkalinity > 20 mg/L $CaCO_3$** | ≤ 20 | ≤ 0.09 | ≤ 1.91 | Aquatic Life |
| **Color ≤ 40 PCU and Alkalinity ≤ 20 mg/L $CaCO_3$** | ≤ 6 | ≤ 0.03 | ≤ 0.93 | Aquatic Life |

## Table 2.2c. DO thresholds used to assess surface water resources

[1] Not applied as criteria, but rather as a threshold used to estimate the impairment of state waters. These thresholds are used in the analysis of Status Monitoring Network data, based on single samples. The analysis and representation of these data are not intended to infer verified impairment, as defined in Chapter 62-303, F.A.C.
[2] The DO threshold for lakes, rivers, streams, and canals depends on the bioregion (**Figure 2.2**).

| Bioregion[2] | DO Threshold[1] (% saturation) | Designated Use |
|---|---|---|
| **Panhandle** | ≥ 67 | Aquatic Life |
| **Big Bend** | ≥ 34 | Aquatic Life |
| **Northeast** | ≥ 34 | Aquatic Life |
| **Peninsula** | ≥ 38 | Aquatic Life |
| **Everglades** | ≥ 38 | Aquatic Life |

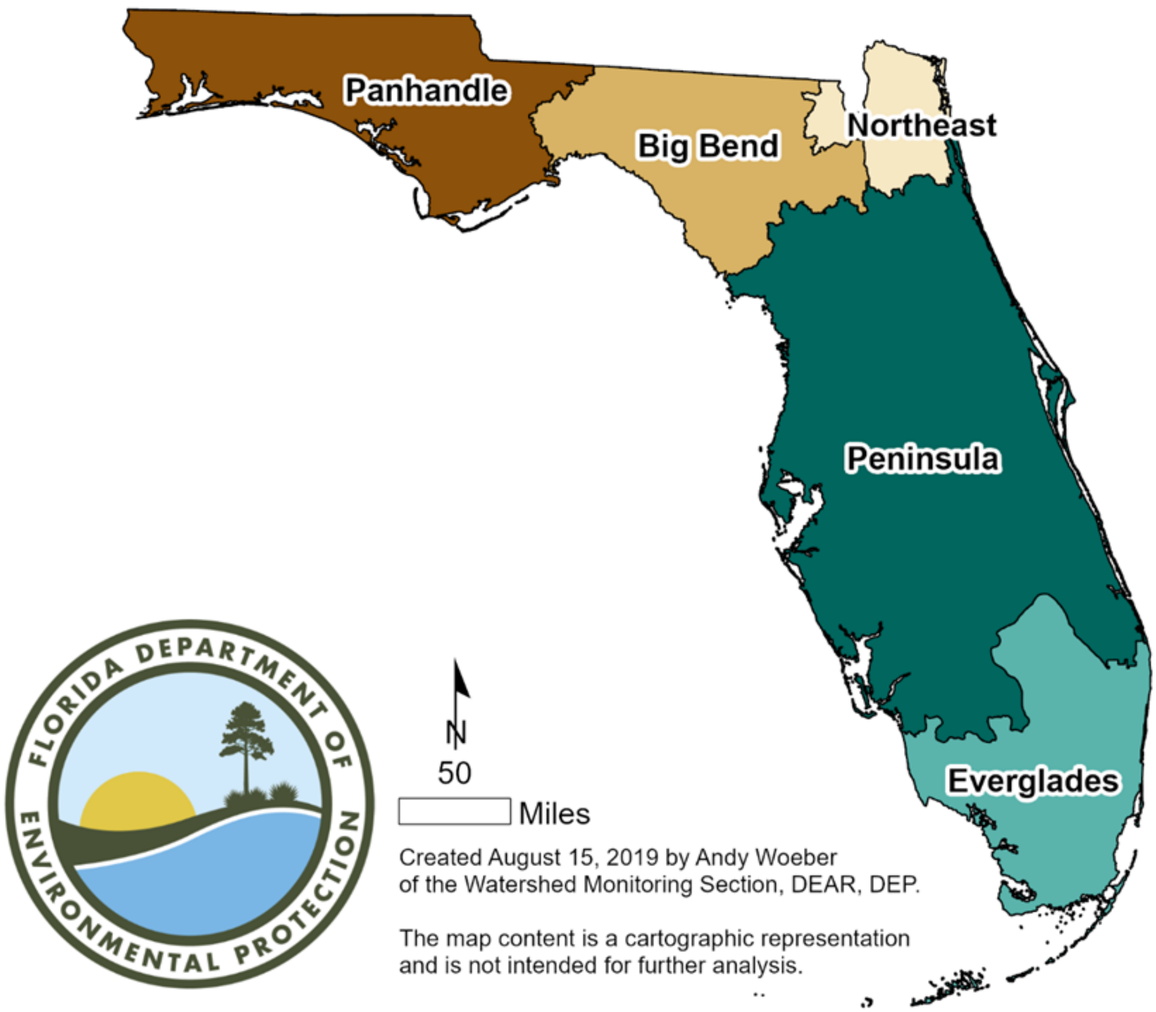



**Figure 2.2. Bioregions for lake, river, and stream resources**

## Table 2.2d. Additional indicators for aquatic life and recreation use with water quality thresholds

µg/L = Micrograms per liter; Ml = Milliliters
[1] Not criteria, but rather a threshold used to estimate the impairment of state waters. These thresholds are used in the analysis of Status Monitoring Network data, based on single samples. The analysis and representation of these data are not intended to infer verified impairment, as defined in Chapter 62-303, F.A.C. The chlorophyll thresholds apply to rivers, streams, and canals only. **Table 2.2b** lists chlorophyll criteria for lakes**.**

| Indicator/ Aquatic Life and Recreational Use (Surface Water) | Threshold |
|---|---|
| **Chlorophyll *a*[1]** | ≤ 20 µg/L |
| ***E. coli*** | < 410 colonies/100mL |

## *Results for Rivers, Streams, Canals, Large Lakes, and Small Lakes*

The following pages present the statewide surface water Status Network results for rivers, streams, large lakes, and small lakes. For each resource, there is a map showing the sample site locations (**Figures 2.3** through **2.7**) and a table of the statewide results for each indicator for a particular resource (**Tables 2.3b** through **2.3f**). **Table 2.3a** explains the terms used in the statewide summary tables. These results, in addition to the regional results for each zone, are also available through an interactive ArcGIS online web application, Status Network Report Card.

**Table 2.3a. Explanation of terms used in Tables 2.3b through 2.3f**

| Term | Explanation |
|---|---|
| **Analyte** | Indicators chosen to assess condition of waters of state. |
| **Target Population** | Estimate of actual extent of resource from which threshold results were calculated. Excludes percent of waters determined not to fit definition of resource type. |
| **Number of Samples** | Number of samples used for statistical analysis. |
| **% Meeting Threshold** | Percent estimate of target population that meets specific indicator threshold value. |
| **Meeting Threshold 95 % Confidence Bounds (CB)** | Upper and lower bounds for 95 % confidence of percent meeting specific indicator threshold value. |
| **Assessment Period** | Duration of probabilistic survey sampling event. |

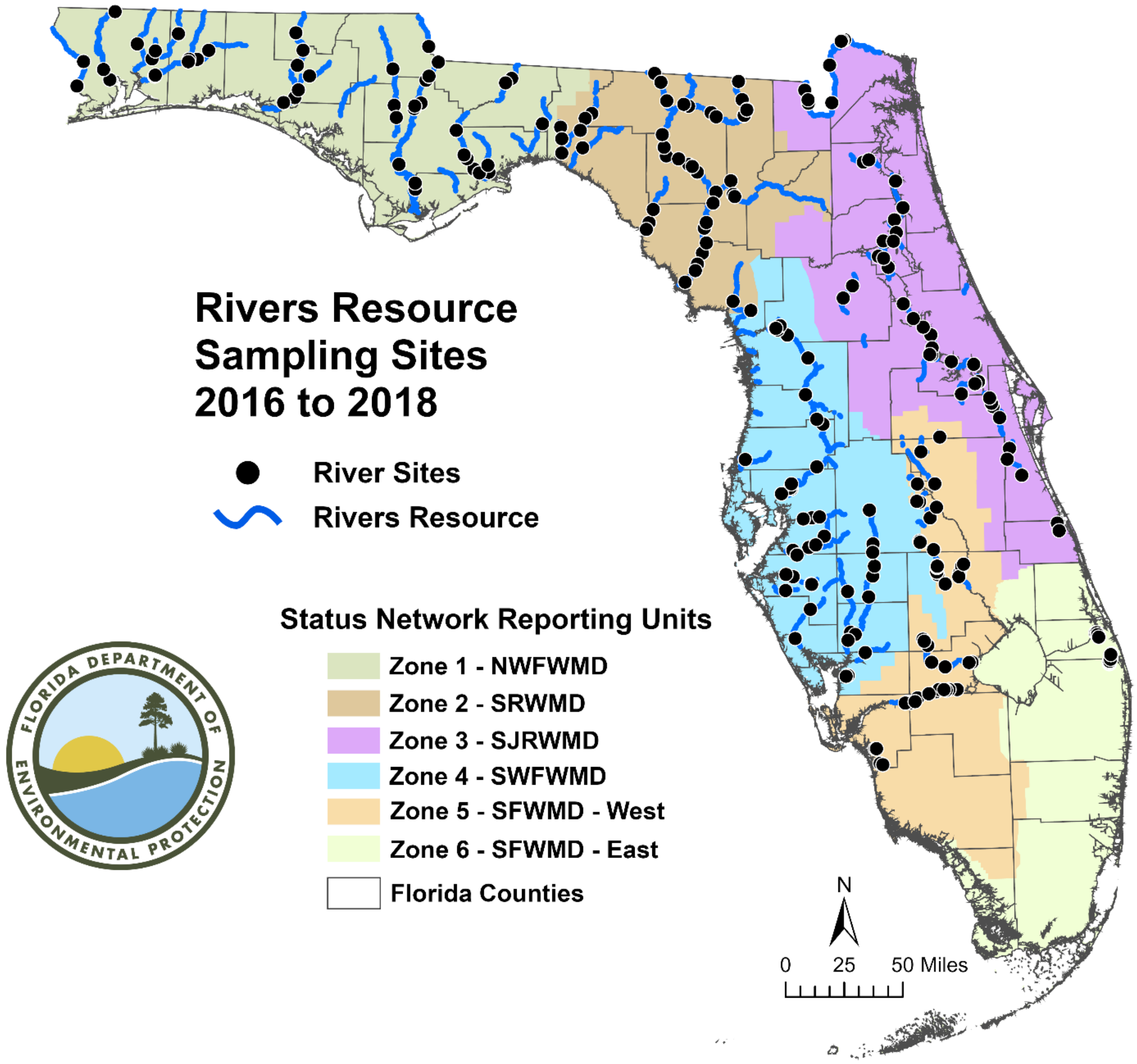



**Figure 2.3. Statewide Status Network river sample locations**

**Table 2.3b. Statewide percentage of rivers meeting threshold values for indicators calculated using probabilistic monitoring design**

CB = Confidence bounds

| Analyte | Target Population (miles) | Number of Samples | % Meeting Threshold | Meeting Threshold 95 % CB | Assessment Period |
|---|---|---|---|---|---|
| **TN** | 2,621 | 265 | 75.4 | 71.4–79.4 | 2016–18 |
| **TP** | 2,621 | 266 | 85.5 | 82.5–88.5 | 2016–18 |
| **Chlorophyll *a*** | 2,621 | 266 | 90.9 | 88.4–93.4 | 2016–18 |
| ***E. coli* Bacteria** | 2,621 | 263 | 92.1 | 88.9–95.4 | 2016–18 |
| **DO** | 2,621 | 266 | 93.9 | 91.2–96.6 | 2016–18 |

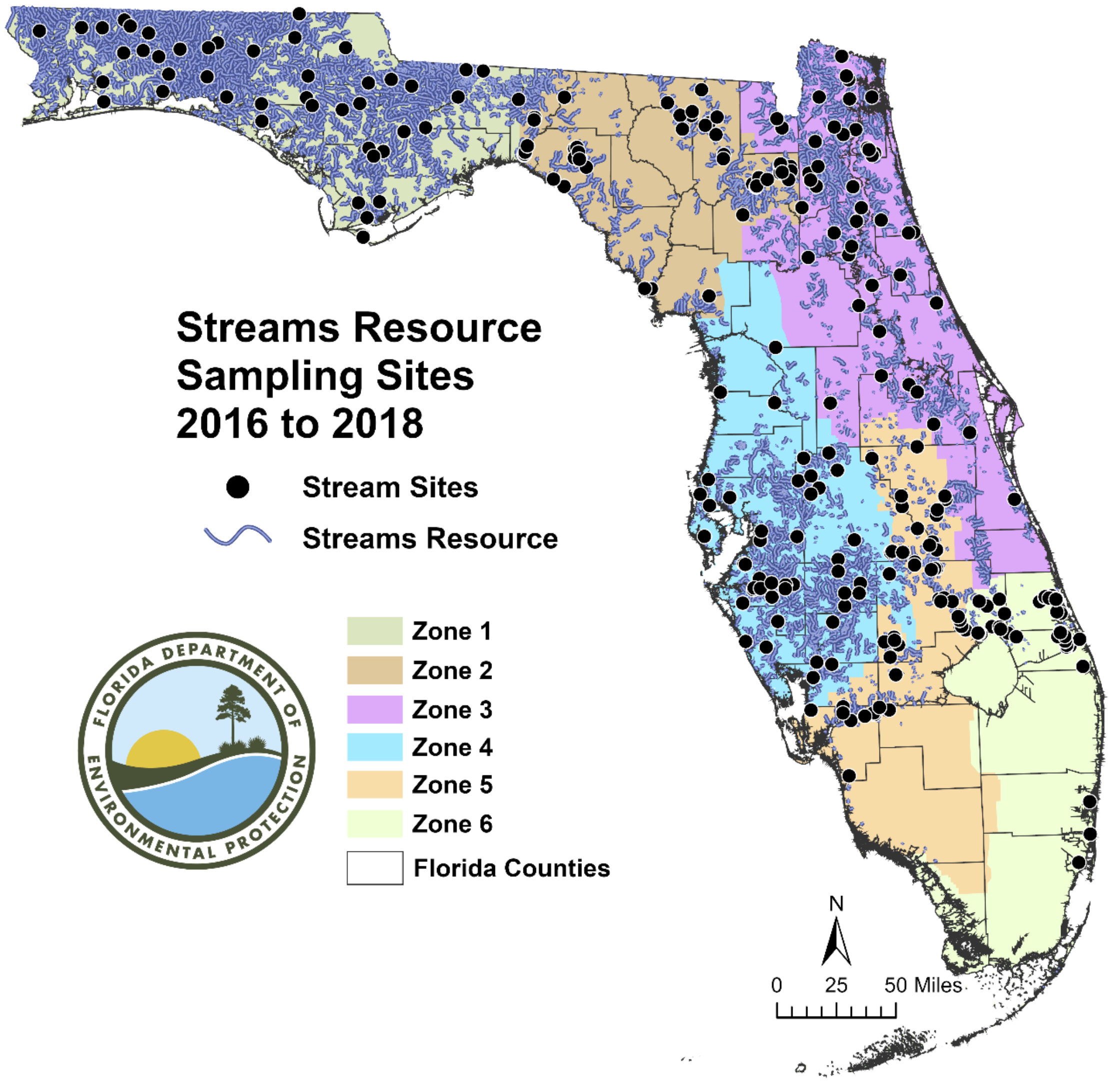



**Figure 2.4. Statewide Status Network stream sample locations**

**Table 2.3c. Statewide percentage of streams meeting threshold values for indicators calculated using probabilistic monitoring design**

CB = Confidence bounds

| Analyte | Target Population (miles) | Number of Samples | % Meeting Threshold | Meeting Threshold 95 % CB | Assessment Period |
|---|---|---|---|---|---|
| **TN** | 15,465 | 262 | 72.4 | 66.4-78.3 | 2016–18 |
| **TP** | 15,465 | 262 | 87.0 | 84.1–89.9 | 2016–18 |
| **Chlorophyll *a*** | 15,465 | 264 | 98.0 | 96.8–99.3 | 2016–18 |
| ***E. coli* Bacteria** | 15,465 | 263 | 72.0 | 65.5–78.5 | 2016–18 |
| **DO** | 15,465 | 266 | 76.2 | 70.4–82.1 | 2016–18 |

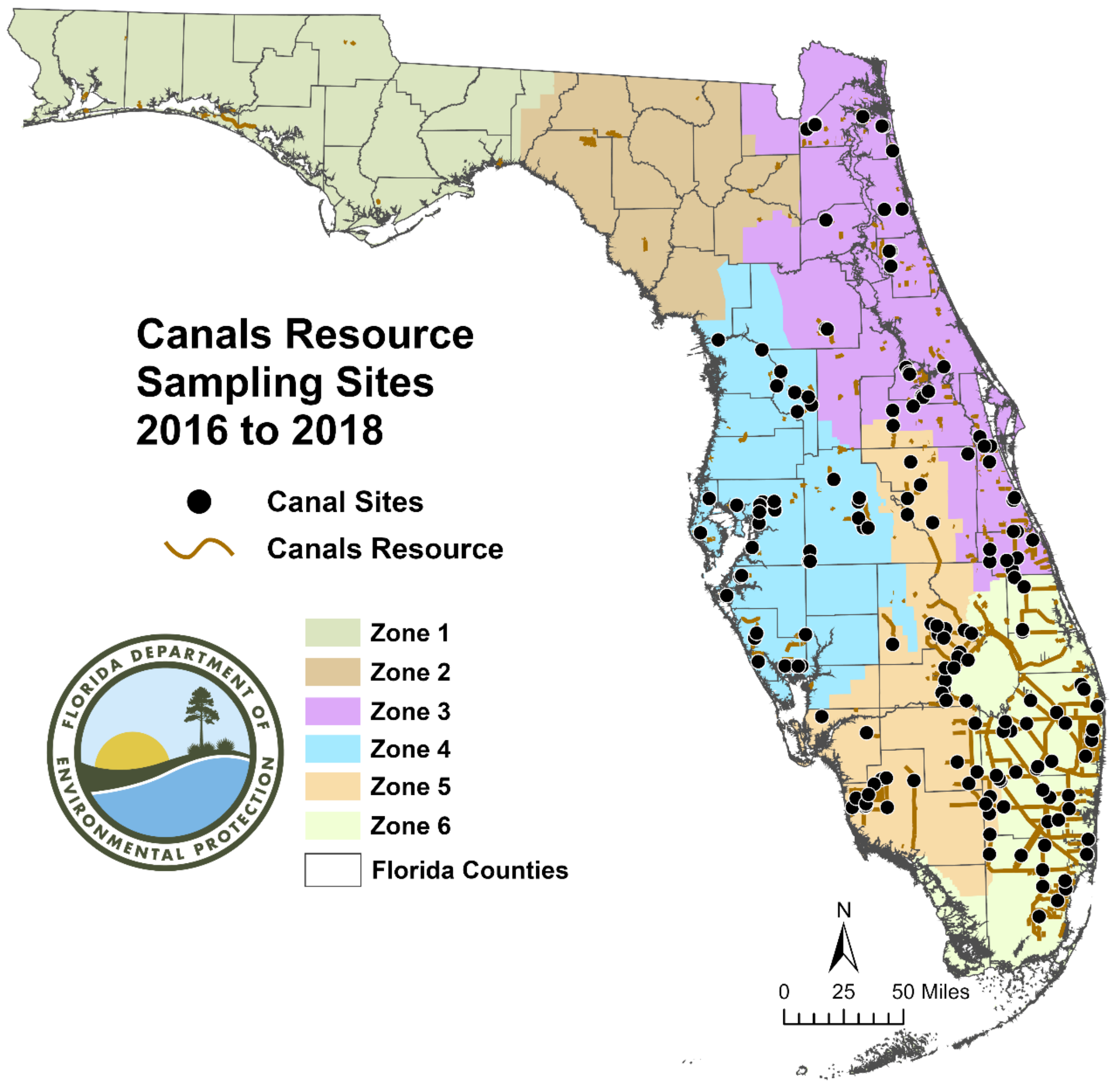



**Figure 2.5. Statewide Status Network canal sample locations**

**Table 2.3d. Statewide percentage of canals meeting threshold values for indicators calculated using probabilistic monitoring design**

CB = Confidence bounds

| Analyte | Target Population (miles) | Number of Samples | % Meeting Threshold | Meeting Threshold 95 % CB | Assessment Period |
|---|---|---|---|---|---|
| **TN** | 2,480 | 122 | 73.6 | 59.7–87.5 | 2016–18 |
| **TP** | 2,480 | 122 | 62.3 | 48.5–76.1 | 2016–18 |
| **Chlorophyll *a*** | 2,480 | 178 | 82.7 | 77.2–88.1 | 2016–18 |
| ***E. coli* Bacteria** | 2,480 | 177 | 91.3 | 88.4–94.2 | 2016–18 |
| **DO** | 2,480 | 179 | 93.8 | 90.5–97.1 | 2016–18 |

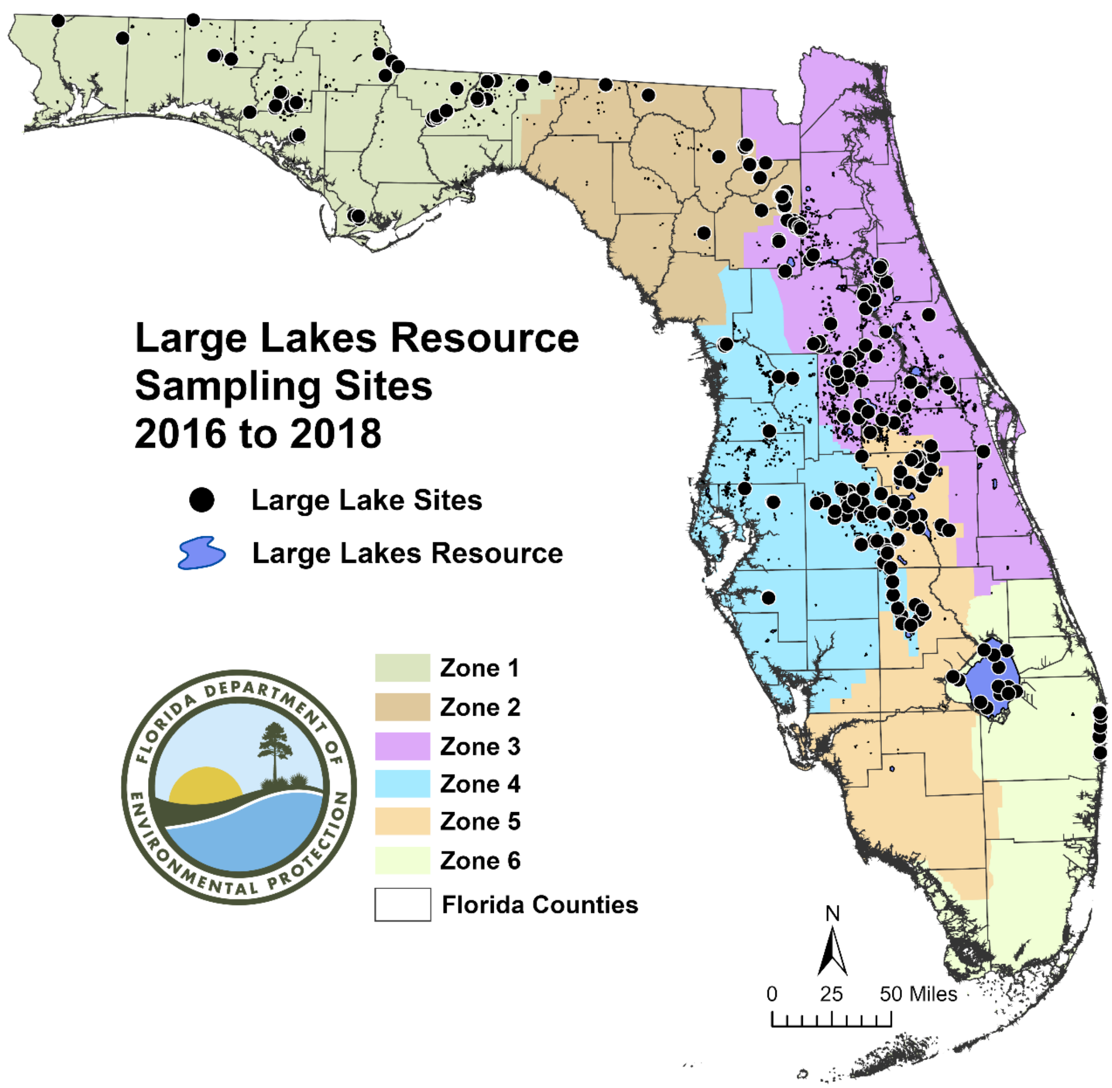



**Figure 2.6. Statewide Status Network large lake sample locations**

**Table 2.3e. Statewide percentage of large lakes meeting threshold values for indicators calculated using probabilistic monitoring design**

CB = Confidence bounds

| Analyte | Target Population (acres) | Number of Samples | % Meeting Threshold | Meeting Threshold 95 % CB | Assessment Period |
|---|---|---|---|---|---|
| **TN** | 959,339 | 270 | 81.4 | 74.6–88.3 | 2016–18 |
| **TP** | 959,339 | 270 | 73.0 | 65.9–80.1 | 2016-18 |
| **Chlorophyll *a*** | 959,339 | 269 | 63.5 | 57.1–69.8 | 2016-18 |
| ***E. coli* Bacteria** | 959,339 | 270 | 100.0 | 100.0 | 2016–18 |
| **DO** | 959,339 | 270 | 98.2 | 97.0–99.3 | 2016–18 |

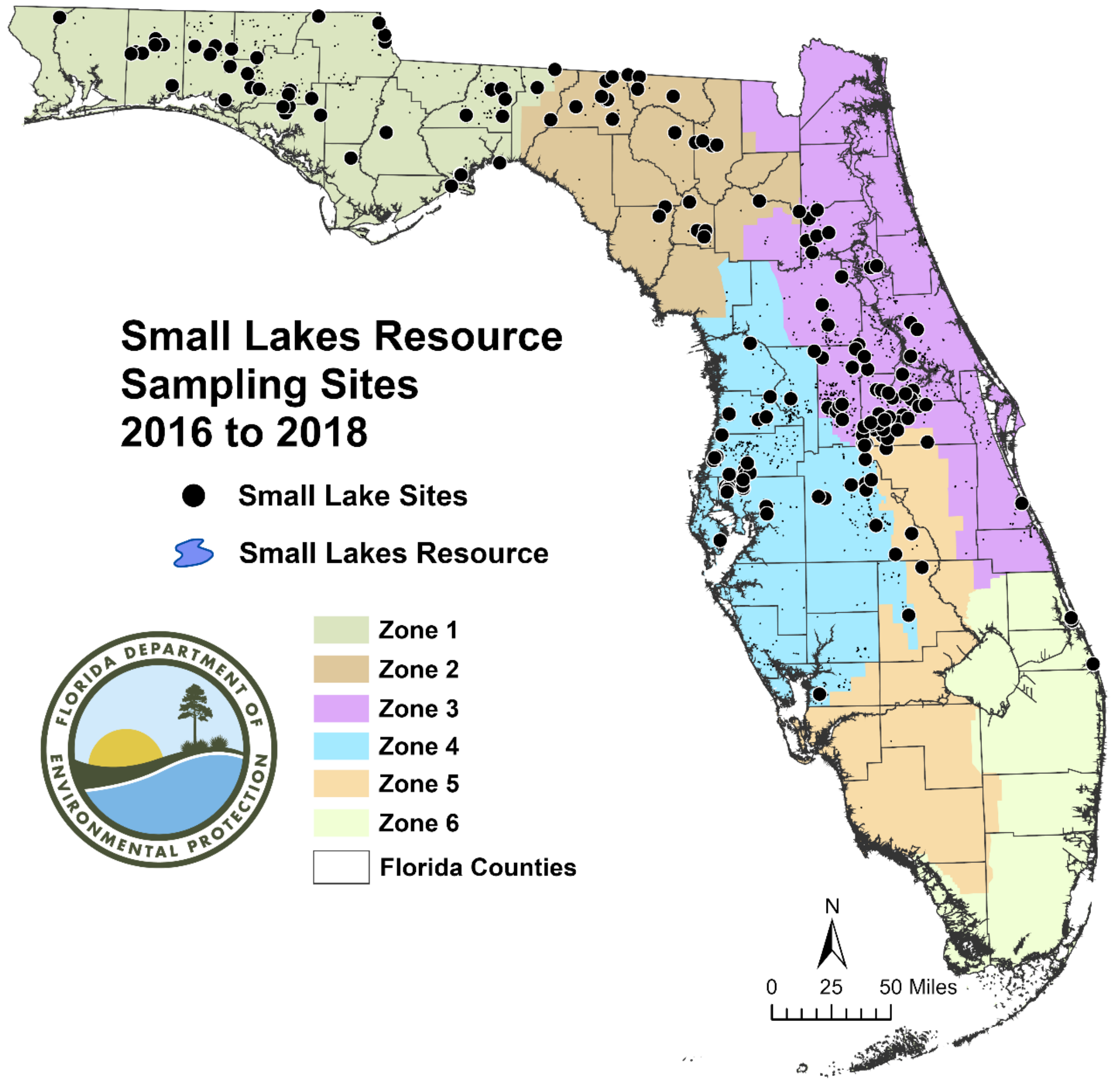



**Figure 2.7. Statewide Status Network small lake sample locations**

**Table 2.3f. Statewide percentage of small lakes meeting threshold values for indicators calculated using probabilistic monitoring design**

CB = Confidence bounds

| Analyte | Target Population (acres) | Number of Samples | % Meeting Threshold | Meeting Threshold 95 % CB | Assessment Period |
|---|---|---|---|---|---|
| **TN** | 28,107 | 233 | 97.1 | 94.6–99.6 | 2016–18 |
| **TP** | 28,107 | 232 | 93.2 | 90.7–95.7 | 2016-18 |
| **Chlorophyll *a*** | 28,107 | 231 | 69.7 | 63.5–76.0 | 2016-18 |
| ***E. coli* Bacteria** | 28,107 | 232 | 100.0 | 100.0 | 2016–18 |
| **DO** | 28,107 | 233 | 80.1 | 74.7–85.5 | 2016–18 |

## *Sediment Quality Evaluation*

### Background

In aquatic environments, sediments provide many essential ecological functions, but at the same time may be a source of contamination and recycled nutrients. Sediment contaminants, such as trace metals, pesticides, and excess nutrients, accumulate over time from upland discharges, the decomposition of organic material, and even atmospheric deposition. The results of periodic water quality monitoring alone cannot be used to fully evaluate aquatic ecosystems. DEP has no sediment standards (criteria) and no statutory authority to establish these criteria. Therefore, it is important to use scientifically defensible thresholds to estimate the condition of sediments.

The interpretation of marine and freshwater sediment trace metals data, which can vary naturally by two orders of magnitude in Florida, is not straightforward because metallic elements are natural sediment constituents. Sediment quality is an important variable for environmental managers to evaluate in restoration and dredging projects. For sediment metals data analysis, DEP uses two interpretive tools, available in two publications: *A Guide to the Interpretation of Metals Concentrations in Estuarine Sediments* (Schropp and Windom 1988) and *Development of an Interpretive Tool for the Assessment of Metal Enrichment in Florida Freshwater Sediment* (Carvalho et al. 2002). These tools use a statistical normalization technique to predict background concentrations of metals in sediments, regardless of sediment composition.

During the 1990s, several state and federal agencies developed concentration-based sediment guidelines to evaluate biological effects from sediment contaminants. To develop its sediment guidelines, DEP selected the weight-of-evidence approach to evaluate a database of studies containing paired sediment chemistry and associated biological responses from benthic organisms. For interpreting sediment contaminant data, DEP uses the guidelines in *Approach to the Assessment of Sediment Quality in Florida Coastal Waters* (MacDonald 1994) and *Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters* (MacDonald Environmental Sciences and USGS 2003).

Rather than using traditional pass/fail criteria, DEP's weight-of-evidence approach created two guidelines for each sediment contaminant: the lower guideline is the threshold effects concentration (TEC), and the higher guideline is the probable effects concentration (PEC). A value below the TEC indicates a low probability of harm to sediment-dwelling organisms. Conversely, sediment values above the PEC have a high probability of biological harm.

### Sediment Evaluation for Large and Small Lakes

Of the Status Network surface water resource categories, DEP selected large and small lakes for sediment contaminant evaluation, since lakes integrate runoff within watersheds. Staff collected a total of 477 samples from the state's 2 lake resources from 2016 to 2018: 232 from small lakes and 245 from large lakes. Samples were analyzed for certain abundant metals (aluminum and iron), a suite of trace metals, and 3 sediment nutrients (nitrogen, phosphorus, and total carbon). To ensure accurate metals data, samples were prepared for chemical analysis using EPA Method 3052 (the total digestion method) rather than EPA 200.2 method (the total recoverable method). DEP used the freshwater geochemical metals tool and the freshwater biological effects guidance values in tandem to evaluate lake sediment chemistry data (**Table 2.4a**).

When the concentration of a metal exceeded the TEC and was less than or equal to the PEC, staff evaluated the metal concentration using the sediment statistical normalization tool. If a metal concentration was within the predicted natural range, the sediment sample did not exceed the TEC because of natural metal concentrations. If a metal concentration was greater than the predicted natural range, the sediment sample exceeded Florida's sediment guidelines for that metal. **Tables 2.4b** and **2.4c** list the results.

Most sites that appear to exceed the TEC in fact exhibit expected sediment metal concentrations. Lead, zinc, chromium, and copper, which is still employed widely as an aquatic herbicide, have the most elevated concentrations in the dataset compared with natural areas. Elevated lead and zinc concentrations often are caused by stormwater input, and not surprisingly sediment metals are highest in lakes in urbanized areas. The largest number of lake sites with elevated metals occurs in peninsular Florida. Arsenic, chromium, and mercury rarely exceed the sediment guidelines. Silver, cadmium, and nickel met 100 % of the TEC threshold concentration and had no exceedances.

**Table 2.4a. DEP freshwater lake sediment contaminant thresholds for metals**

mg/kg = Milligrams per kilogram

| Metal | TEC (mg/kg) | PEC (mg/kg) |
|---|---|---|
| **Arsenic** | 9.8 | 33 |
| **Cadmium** | 1.00 | 5 |
| **Chromium** | 43.4 | 111 |
| **Copper** | 32 | 149 |
| **Silver** | 1 | 2.2 |
| **Nickel** | 23 | 48 |
| **Lead** | 36 | 128 |
| **Mercury** | 0.18 | 1.06 |
| **Zinc** | 121 | 459 |

### Table 2.4b. Statewide percentage of large lakes meeting sediment contaminant threshold values, 2016–18

**Note:** All table values reflect results after applying metals normalization analysis.

| Metal | % Meeting TEC Threshold | % Not Meeting TEC Threshold | % Not Meeting PEC Threshold | % of Stations > TEC Because of Natural Metal Concentrations |
|---|---|---|---|---|
| Arsenic | 92.3 | 0.8 | 0.0 | 6.9 |
| Cadmium | 95.9 | 0.0 | 0.0 | 4.1 |
| Chromium | 81.6 | 9.8 | 0.0 | 8.6 |
| Copper | 89.3 | 7.4 | 0.8 | 2.5 |
| Silver | 100.0 | 0.0 | 0.0 | 0.0 |
| Nickel | 95.1 | 0.0 | 0.0 | 4.9 |
| Lead | 78.8 | 13.5 | 0.8 | 6.9 |
| Mercury | 70.6 | 4.1 | 0.0 | 25.3 |
| Zinc | 90.6 | 6.9 | 0.0 | 2.5 |

### Table 2.4c. Statewide percentage of small lakes meeting sediment contaminant threshold values, 2016–18

**Note:** All table values reflect results after applying metals normalization analysis.

| Metal | % Meeting TEC Threshold | % Not Meeting TEC Threshold | % Not Meeting PEC Threshold | % of Stations > TEC Because of Natural Metal Concentrations |
|---|---|---|---|---|
| Arsenic | 78.5 | 2.6 | 0.4 | 18.5 |
| Cadmium | 82.7 | 0.9 | 0.0 | 16.4 |
| Chromium | 71.6 | 0.9 | 0.8 | 26.7 |
| Copper | 72.0 | 13.8 | 9.5 | 4.7 |
| Silver | 99.6 | 0.4 | 0.0 | 0.0 |
| Nickel | 96.6 | 0.0 | 0.4 | 3.0 |
| Lead | 57.3 | 20.7 | 9.5 | 12.5 |
| Mercury | 50.3 | 8.5 | 0.4 | 40.8 |
| Zinc | 72.5 | 13.3 | 5.6 | 8.6 |

In 2018, DEP's Central Laboratory analyzed sediment samples for a suite of organic contaminants in 72 small lake and 80 large lake samples. Sediment samples were analyzed for 20 polycyclic aromatic hydrocarbons (PAHs), 7 polychlorinated biphenyls (PCBs), and 73 pesticides (organochlorine [OC] and organophosphate insecticides and herbicides). PAHs were detected in 7 % of the small lake samples and 10 % of the large lake samples. PCBs, banned from use since 1979, were detected in only 2 small lake samples.

Pesticides were detected more frequently. Even DDT, banned in 1987, was detected in 2 small lake samples, but the 2 DDT degradants, DDD and DDE, were detected in 24 % and 55 % of the small lake samples, and 10 % and 59 % of the large lake samples, respectively. Although banned in 1988, the widely used termiticide chlordane and its degradants were detected in 8 % of small lake and 5 % of large lake samples. Other pesticides rarely detected included dieldrin, aldrin, heptachlor, mirex, permethrin, and diuron.

The relatively high rates of detection for the legacy OC pesticides is a testament to their persistence in aquatic systems and reflects the recent ability of DEP's Central Laboratory to detect these compounds at levels below a single part per billion (micrograms per kilogram [µg/kg]). DEP has freshwater sediment guidelines for some of these legacy OC pesticides. For most of the samples with OC detections, the TEC guideline is often exceeded but rarely is the PEC guideline exceeded. Of the 14 lakes with chlordane detections, 7 small lake samples exceeded the PEC.

For those lake sediments with high PAH concentrations, the source is usually stormwater runoff from transportation corridors and commercial property. Four small lakes had significant PAH detections above the PEC guidelines.

### *Discussion of Rivers, Streams, Canals, Large Lakes, and Small Lakes*

The water quality results indicate that, for recreational use and aquatic life support, Florida's flowing waters and lakes are in relatively good health. However, an inspection of the indicators listed in **Tables 2.3b** through **2.3f** reveals the following: 28 % of stream miles, 26 % of canal miles, and 25 % of river miles failed the TN threshold; 38 % of canal miles failed for TP; and 17 % of canal miles failed for chlorophyll *a*. In streams, failures for *E. coli* were 28 %. In lakes, the nutrient response indicator, chlorophyll *a*, had the highest threshold failure percentage for aquatic life support, with greater than 30 % of both large and small lakes above the chlorophyll *a* threshold. DEP has developed numerous TMDLs and BMAPs, as well as designated priority restoration areas, to address both TN and TP inputs (see **Chapters 4** and **5**).

The results for lakes indicate that, for aquatic life support, the sediment quality of Florida's lakes is generally good. However, an inspection of the indicators listed in **Tables 2.4b** and **2.4c** shows generally lower sediment contamination levels in large lakes compared with small lakes. The sediment metals copper, lead, and zinc are a concern in small lakes, which have the highest exceedances of the TEC and PEC for these metals. Also, of the organic contaminants examined in 2018, the legacy OC pesticides were the most commonly detected compounds, and several small lakes were found to have chlordane and PAHs above the PEC. Not surprisingly, small lakes have worse sediment quality than large lakes, as small lakes may be affected more by sedimentation simply because of the higher lake-shore-to-lake-area ratio.

## Summary of Status Network Groundwater Results

DEP has monitored groundwater quality since 1986 in both confined and unconfined aquifers. The Status Network groundwater monitoring program uses a probabilistic monitoring design to estimate confined and unconfined aquifer water quality across the state. This estimate, by necessity, is based on the sampling of wells and springs representing both the confined and unconfined aquifers. The wells and springs used in this evaluation include private, public, monitoring, and agricultural irrigation wells.

The assessment period for this report is January 2016 through December 2018. **Table 2.5** describes the groundwater indicators used in the analyses and lists drinking water standards (thresholds). Some of the more important analytes include total coliform bacteria, nitrate-nitrite, trace metals such as arsenic and lead, and sodium (salinity), all of which are threats to drinking water quality.

**Table 2.5. Status Network physical/other indicators for potable water supply for groundwater with water quality thresholds**

mg/L = Milligrams per liter; µg/L = Micrograms per liter; mL = Milliliter
[1] Counts may be expressed as colony-forming units (CFU) or most probable number (MPN), depending on the analytical method used.

| Indicator | Threshold for Potable Water Supply (groundwater) |
|---|---|
| **Fluoride** | ≤ 4 mg/L |
| **Arsenic** | ≤ 10 µg/L |
| **Cadmium** | ≤ 5 µg/L |
| **Chromium** | ≤ 100 µg/L |
| **Lead** | ≤ 15 µg/L |
| **Nitrate-Nitrite** | ≤ 10 mg/L as N |
| **Sodium** | ≤ 160 mg/L |
| **Fecal Coliform Bacteria** | < 2 counts[1]/100mL |
| **Total Coliform Bacteria** | ≤ 4 counts[1]/100mL |

For each Status Network groundwater resource (confined aquifers and unconfined aquifers), this chapter contains a map showing the sample site locations (**Figures 2.8** and **2.9)** and a table listing the statewide results for each indicator by aquifer resource (**Tables 2.6b** and **2.6c**). **Table 2.6a** contains the legend for the terms used in **Tables 2.6b** and **2.6c**. **Tables 2.6b** and **2.6c** provide an estimate of the quality of Florida's confined and unconfined aquifers by listing the percentage of the resource that meets a potable water threshold. These results, in addition to regional results for each zone, are also available through an interactive ArcGIS Online web application, Status Network Report Card.

**Table 2.6a. Legend for terms used in Tables 2.6b and 2.6c**

| Term | Explanation |
|---|---|
| **Analyte** | Indicators chosen to base assessment of condition of waters of state. |
| **Target Population** | Total number of wells in list frames from which inferences were calculated. Excludes percent of wells that were determined to not fit definition of resource. |
| **Number of Samples** | Number of samples used for statistical analysis. |
| **% Meeting Threshold** | Percent estimate of target population that meets specific indicator threshold value. |
| **Meeting Threshold 95% Confidence Bounds (CB)** | Upper and lower bounds for 95 % confidence of percent meeting specific indicator threshold value. |
| **Assessment Period** | Duration of probabilistic survey sampling event. |

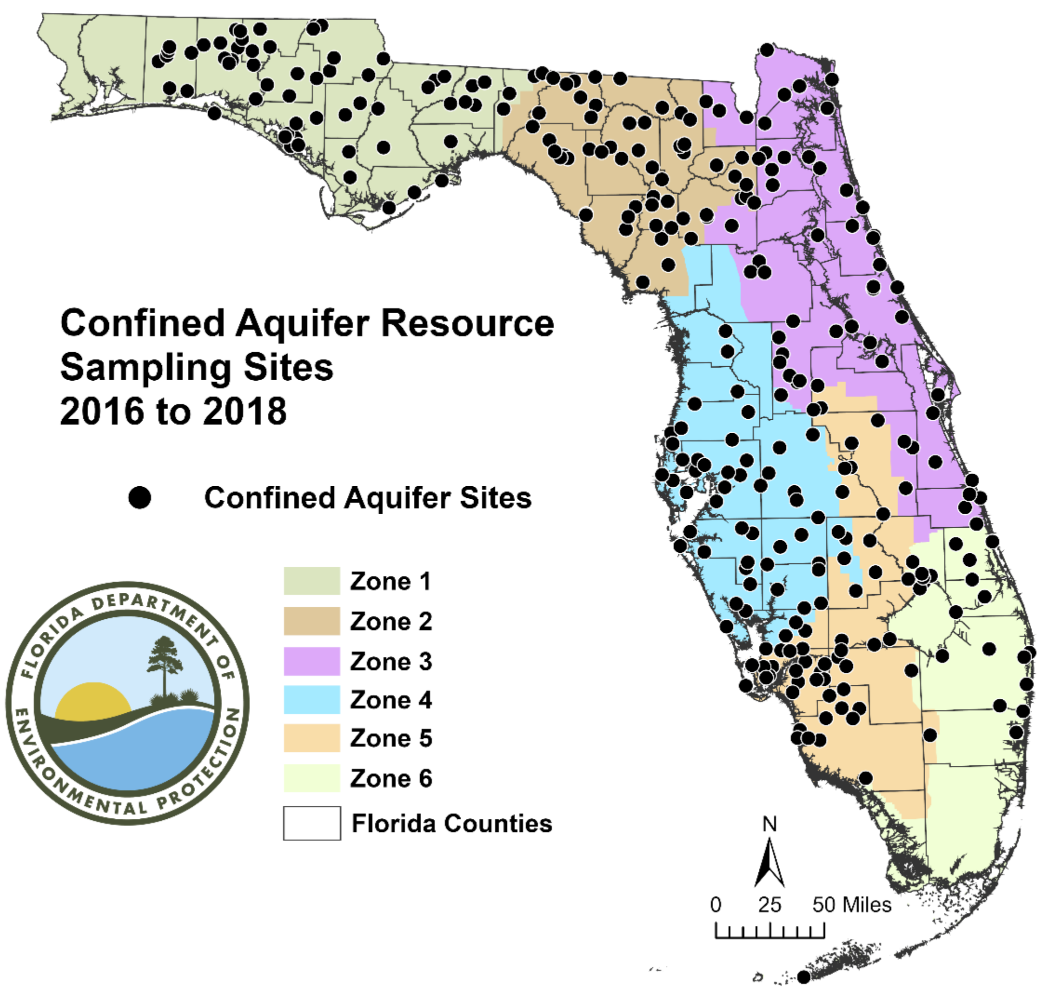



**Figure 2.8. Statewide Status Network confined aquifer well locations**

**Table 2.6b. Statewide percentage of confined aquifer wells expected to meet threshold values for indicators calculated using probabilistic monitoring design**

CB = Confidence bounds

| Analyte | Target Population (wells) | Number of Samples | % Meeting Threshold | Meeting Threshold 95 % CB | Assessment Period |
|---|---|---|---|---|---|
| Arsenic | 14,944 | 319 | 98.4 | 96.7–100.0 | 2016–18 |
| Cadmium | 14,944 | 319 | 100.0 | 100.0 | 2016–18 |
| Chromium | 14,944 | 319 | 99.1 | 97.6–100.0 | 2016–18 |
| Lead | 14,944 | 319 | 99.0 | 97.5–100.0 | 2016–18 |
| Nitrate-Nitrite | 14,944 | 319 | 99.3 | 98.7–99.9 | 2016–18 |
| Sodium | 14,944 | 319 | 95.8 | 94.9–96.8 | 2016–18 |
| Fluoride | 14,944 | 319 | 100.0 | 100.0 | 2016–18 |
| Fecal Coliform Bacteria | 14,944 | 316 | 96.2 | 92.4–100.0 | 2016–18 |
| Total Coliform Bacteria | 14,944 | 316 | 85.2 | 79.1–91.3 | 2016–18 |

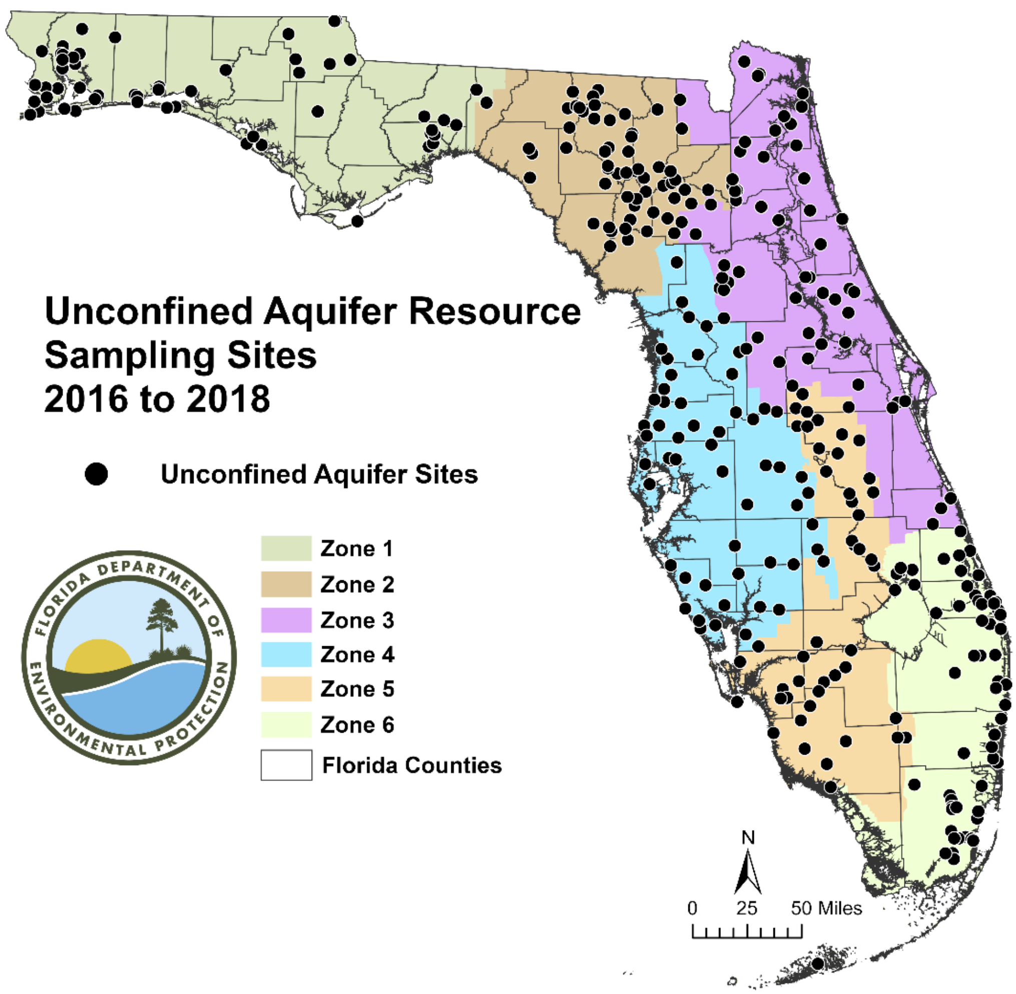



**Figure 2.9. Statewide Status Network unconfined aquifer well locations**

**Table 2.6c. Statewide percentage of unconfined aquifer wells expected to meet threshold values for indicators calculated using probabilistic monitoring design**

CB = Confidence bounds

| Analyte | Target Population (wells) | Number of Samples | % Meeting Threshold | Meeting Threshold 95 % CB | Assessment Period |
|---|---|---|---|---|---|
| Arsenic | 19,270 | 321 | 98.4 | 96.6–100.0 | 2016–18 |
| Cadmium | 19,270 | 321 | 100.0 | 100.0 | 2016–18 |
| Chromium | 19,270 | 321 | 100.0 | 100.0 | 2016–18 |
| Lead | 19,270 | 321 | 97.4 | 94.7–100.0 | 2016–18 |
| Nitrate-Nitrite | 19,270 | 321 | 99.0 | 98.1–100.0 | 2016–18 |
| Sodium | 19,270 | 321 | 98.2 | 96.8–99.6 | 2016–18 |
| Fluoride | 19,270 | 321 | 100.0 | 100.0 | 2016–18 |
| Fecal Coliform Bacteria | 19,270 | 311 | 98.7 | 98.1–99.4 | 2016–18 |
| Total Coliform Bacteria | 19,270 | 309 | 87.7 | 82.9–92.5 | 2016–18 |

### *Discussion of Confined and Unconfined Aquifers*

Water quality results indicate that Florida's potable groundwater is in generally good condition. All drinking water indicators showed greater than 90 % passing values, except for total coliform bacteria (< 90 %). Florida's ground and surface waters are highly interconnected. Therefore, groundwater entering surface water systems may trigger failures of aquatic life support indicators, especially for DO and the nutrients TN and TP. DEP has developed BMAPs and targeted restoration areas to address these issues, which are discussed in more detail in **Chapter 5**.

## Water Quality Trend Detection

### *Periods of Record*

In this report, the periods of record differ between the surface water and groundwater trend analyses. For surface water, laboratory analyses were conducted on raw (total) rather than dissolved constituents from 1998 to 2018. In contrast, prior to 2009, groundwater samples were filtered, and analyses were conducted on dissolved constituents. Beginning in 2009, groundwater sample analyses changed from dissolved to total constituents. To be consistent with surface water, groundwater trend analyses in this report are based on raw water data collected from 2009 to 2019.

### *Monotonic and Step Trends*

Helsel and Hirsch (2002) categorize trend tests into those using data collected throughout a single period (monotonic trends) and those comparing data collected in two or more nonoverlapping periods (step trends). DEP used Trend Network (monotonic) data for trend determination at individual stations and for statewide trends. Additionally, Status Network data collected in the early and late periods (steps) were evaluated to determine statewide trends.

The following methods were used to identify water quality changes over time (trend detection):

1. Seasonal Kendall (SK) test for individual station water quality indicator trend detection.
2. Change Analysis (CHAN) for statewide water quality indicator trend detection.

For all trend analyses run, statistical significance is defined as the probability of accepting the null hypothesis of no change (probability value [p-value] is < 5 %).

### Seasonality

Gilbert (1987) stated that when testing for trends using time series data, variations added by regularly spaced cycles make it more difficult to detect trends if they exist. Regarding environmental data, Gilbert mentioned that major cycles are often referred to as seasonality. To address this issue, Hirsch and Slack (1984) developed the SK test. It removes the effect of the seasonal cycles. DEP used the SK test to look for trends for each indicator at each surface water and groundwater Trend Network site. R software (R Core Team 2017) and the kendallSeasonalTrendTest function in the EnvStats R package (Millard 2013) were used to perform these analyses.

As with seasonal cyclicity, in flowing surface waters highly variable flow rates make it more difficult to detect trends. Where available, data on flow rates from associated USGS gauging stations were collected at the same time as surface water samples. DEP adjusted surface water quality data for flow before conducting the SK trend analyses. In contrast, groundwater flow rates generally are much slower, and DEP did not need to make flow adjustments prior to performing the SK analyses for groundwater.

If a trend existed for either flow-adjusted or nonflow-adjusted data, DEP determined the corresponding slope by using the Sen Slope (SS) estimator, which measures the median difference between all observations over the time series (Gilbert 1987). The SS provides an estimate of the magnitude of change for a water quality indicator over the period of record. Reporting a trend as increasing or decreasing indicates the direction of the slope and does not necessarily indicate impairment or improvement of the analyte being measured. For a detailed explanation of the information goals of the Trend Monitoring Network, including data sufficiency and analysis methods, see Appendix C of the *Design Document* (DEP 2018a).

## Surface and Groundwater Trends for Individual Stations

### *Surface Water Results*

The Surface Water Trend Network consists of 78 fixed sites sampled monthly (**Figure 2.10**); however, as of June 2019, only 76 stations had sufficient data for analysis. Thirty-seven surface water stations were adjusted for flow, while the remaining 39 stations were not flow adjusted. Trend analyses, using the SK test, were conducted for the period from November 1998 through December 2018. Water quality indicators examined include total nitrate-nitrite ($NO_3$-$NO_2$), total Kjeldahl nitrogen (TKN), TN, TP, total organic carbon (TOC), specific conductance (SC), chlorophyll *a* (Chl-*a*), *Enterococci* (Entero), *E. coli*, pH, and DO. For flow-adjusted sites, **Table 2.7a** displays trends as a result of the SK test for the parameter at each trend site. **Table 2.7b** does the same for nonflow-adjusted sites.

Graphics showing the surface water trend results are available through an interactive ArcGIS Online web application, the Surface Water Trend Report Card map. This application presents a series of statewide indicator maps showing the trends, or the lack of them, found at each of the 76 sites for each indicator tested.

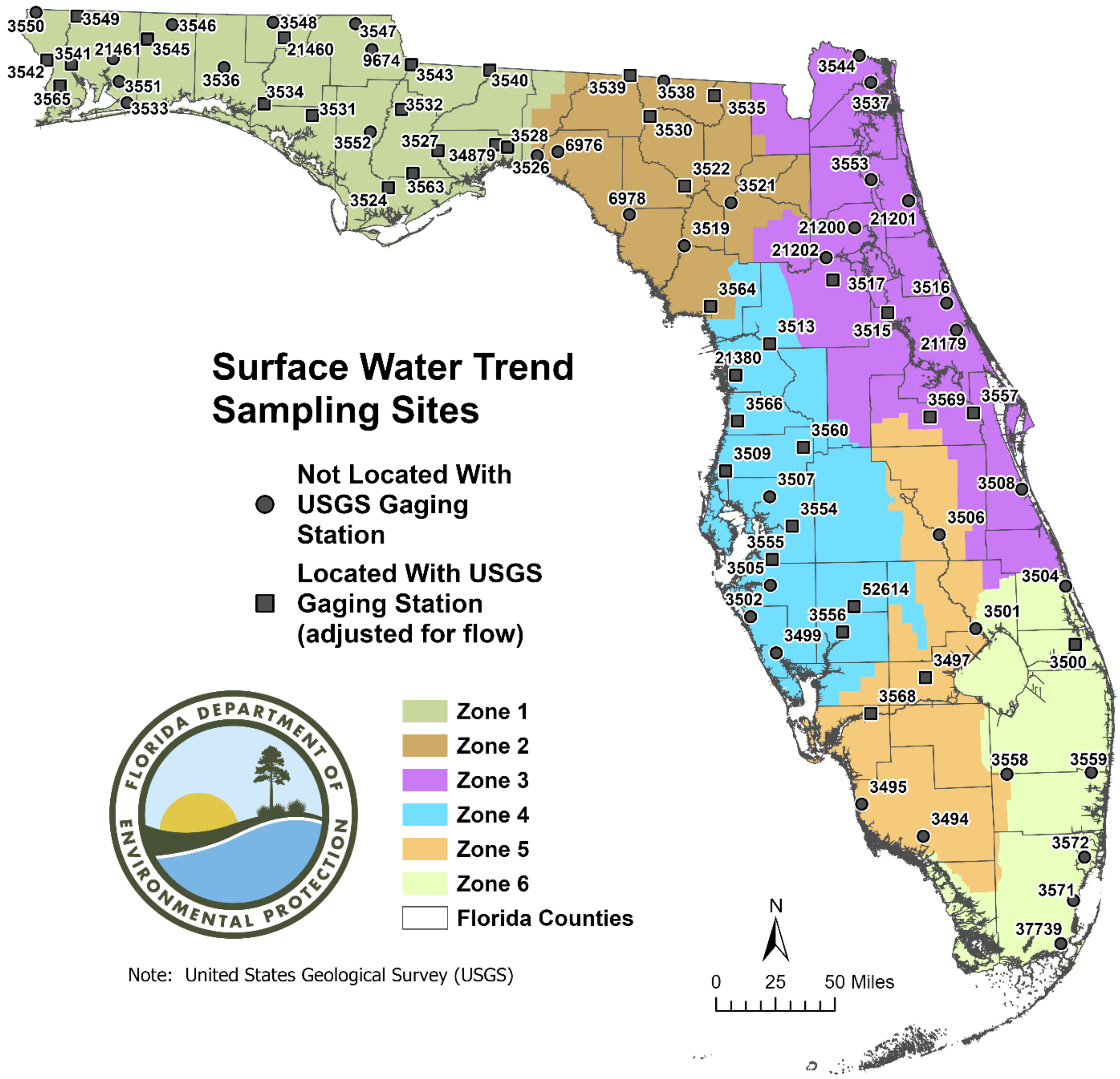



**Figure 2.10. Surface Water Trend Network sites**

## Table 2.7a. Trends for specified analytes for 37 stations from the Surface Water Trend Monitoring Network associated with a USGS gauging station and adjusted for river flow

**Note:** A positive trend is indicated with a plus sign (+), a negative trend is indicated with a minus sign (-), no trend is indicated by a lower-case letter "o," insufficient data to determine a trend is indicated by (ISD), and insufficient evidence to determine a trend is indicated by (ISE). Unless otherwise noted, analyses are based on data collected between November 1998 and December 2018.

| Station | River/Stream | $NO_3$-$NO_2$ | TKN | TN | TP | TOC | SC | Chl-*a* | Entero | *E. coli* | pH | DO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **3554** | Alafia | - | o | - | - | o | + | + | - | o | + | + |
| **3509** | Anclote | - | - | - | - | o | - | - | + | o | - | + |
| **3524** | Apalachicola | + | o | + | - | o | + | + | o | o | o | o |
| **3543** | Apalachicola | + | o | + | - | o | o | + | - | o | o | o |
| **3545** | Blackwater | + | o | o | - | o | o | - | - | o | - | o |
| **3568** | Caloosahatchee | - | - | - | - | o | - | + | o | o | + | + |
| **3561/52614** | Charlie Creek | o | o | o | o | o | o | o | o | + | o | + |
| **3534** | Choctawhatchee | + | o | + | - | o | + | + | - | o | - | o |
| **3531** | Econfina Creek | + | o | + | o | o | + | - | - | o | + | + |
| **3565** | Eleven-Mile Creek | - | - | - | - | - | - | o | + | + | - | + |
| **3541** | Escambia | + | + | + | + | o | o | + | - | o | - | + |
| **3549** | Escambia | + | + | + | + | o | o | + | o | o | - | o |
| **3497** | Fisheating Creek | o | - | - | o | o | - | + | o | o | + | + |
| **21380** | Homosassa | + | - | + | o | - | o | ISE | o | ISE | o | + |
| **3569** | Little Econ | o | - | - | - | - | + | + | o | o | + | + |
| **3555** | Little Manatee | o | o | o | - | o | - | - | o | o | o | o |
| **3563** | New | + | o | o | + | o | o | + | o | o | o | o |
| **3527** | Ochlockonee | o | + | + | o | + | o | + | o | o | - | o |
| **3540** | Ocklocknee | o | - | o | - | o | o | o | o | o | o | - |
| **3517** | Oklawaha | + | o | + | o | + | + | o | o | o | o | o |
| **3556** | Peace | o | o | - | - | o | o | + | o | + | - | o |
| **3542** | Perdido | - | o | - | - | + | - | - | - | o | - | o |
| **3515** | St. Johns | o | - | - | o | o | o | o | o | o | o | o |
| **3557** | St. Johns | o | - | - | o | - | - | + | - | o | o | o |
| **3500** | St. Lucie | o | - | - | - | o | - | + | - | o | + | + |
| **3528** | St. Marks | o | + | + | + | o | o | - | - | o | o | - |
| **34879** | St. Marks | - | o | - | o | o | o | o | o | o | - | - |
| **3522** | Suwannee | + | o | + | - | o | + | o | - | o | + | o |
| **3530** | Suwannee | + | o | + | o | o | + | + | - | + | o | o |
| **3535** | Suwannee | o | + | + | + | o | o | + | + | o | + | o |
| **3532** | Telogia Creek | + | o | + | o | o | o | - | o | o | - | o |
| **3564** | Waccasassa | + | + | + | o | + | o | o | o | o | o | o |
| **3566** | Weeki Wachee | + | + | + | - | ISE | + | ISE | o | + | - | o |
| **3513** | Withlacoochee | + | o | o | o | o | o | o | - | o | - | o |
| **3539** | Withlacoochee | + | o | o | o | o | + | + | o | + | + | o |
| **3560** | Withlacoochee | o | - | - | o | - | o | o | - | o | o | + |
| **21460** | Wright's Creek | o | o | - | o | o | o | o | - | o | - | - |

## Table 2.7b. Trends for specified analytes for 39 stations from the Surface Water Trend Monitoring Network for which flow adjustment was not done

**Note:** A positive trend is indicated with a plus sign (+), a negative trend is indicated with a minus sign (-), no trend is indicated by a lower-case letter "o," insufficient data to determine a trend is indicated by (ISD), and insufficient evidence to determine a trend is indicated by (ISE). Unless otherwise noted, analyses are based on data collected between November 1998 and December 2018.

| Station | River/Stream | $NO_3$-$NO_2$ | TKN | TN | TP | TOC | SC | Chl-*a* | Entero | *E. coli* | pH | DO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3570/37739 | Aerojet Canal | + | + | o | - | o | + | + | + | o | + | + |
| 3538 | Alapaha | o | o | o | - | + | o | o | - | o | o | o |
| 3536 | Alaqua Creek | - | o | o | - | o | + | - | - | o | - | o |
| 3526 | Aucilla | + | + | + | o | o | o | - | - | o | + | o |
| 3494 | Barron | o | + | + | o | + | o | + | o | o | - | + |
| 21461 | Big Coldwater Creek | + | o | o | - | o | + | - | - | o | - | - |
| 3571 | Black Creek Canal | + | o | + | o | - | o | + | + | o | o | + |
| 3550 | Brushy Creek | - | - | - | - | o | - | - | - | + | - | + |
| 3504 | C-25 Canal | o | o | o | + | + | o | + | + | o | o | o |
| 3506 | C-38 Canal | o | o | o | o | - | o | + | o | o | - | - |
| 3552 | Chipola | + | o | + | - | o | + | o | - | o | o | o |
| 3548 | Choctawhatchee | + | o | + | o | o | o | + | o | o | - | o |
| 3547 | Cowarts Creek | + | + | + | + | o | o | o | o | o | o | o |
| 3533 | East Bay | - | - | - | - | o | o | - | o | o | - | o |
| 6976 | Econfina | o | + | + | o | + | - | - | o | o | o | o |
| 3495 | Golden Gate Canal | + | o | o | - | - | o | + | o | o | + | + |
| 3559 | Hillsboro Canal | o | - | - | - | - | o | o | - | o | + | + |
| 3507 | Hillsborough | o | o | - | o | o | o | + | o | o | - | o |
| 3508 | Indian River Lagoon | + | - | - | - | o | o | + | - | + | + | + |
| 9674 | Jackson Blue | + | + | + | o | o | + | ISD | o | ISD | - | o |
| 3501 | Kissimmee | o | - | o | o | - | o | + | - | o | o | + |
| 3505 | Manatee | + | + | + | o | + | o | + | - | o | o | + |
| 3572 | Miami | o | - | - | - | - | - | + | o | o | o | + |
| 3558 | Miami Canal | - | - | - | - | - | - | o | o | o | o | o |
| 21201 | Moultrie Creek | + | o | o | o | + | + | + | o | + | + | o |
| 3499 | Myakka | o | + | + | o | o | + | + | - | + | o | + |
| 3537 | Nassau | o | - | - | o | + | o | + | o | o | o | - |
| 21202 | Orange Creek | o | o | + | o | o | - | o | - | o | o | - |
| 3502 | Phillippe Creek | o | + | + | o | o | o | + | + | o | - | o |
| 21200 | Rice Creek | o | o | o | o | o | o | o | - | o | o | o |
| 3521 | Santa Fe | + | + | + | o | o | o | - | o | + | o | + |
| 21179 | Spruce Creek | + | o | o | - | o | o | o | o | o | o | o |
| 3553 | St. Johns | o | - | - | - | o | - | + | o | o | o | - |
| 3544 | St. Marys | - | - | - | o | o | - | - | o | o | o | - |
| 6978 | Steinhatchee | + | + | + | + | + | - | - | o | + | o | o |
| 3519 | Suwannee | + | + | + | o | + | o | - | o | o | o | o |
| 3516 | Tomoka | + | o | o | o | o | o | o | + | o | + | o |
| 3546 | Yellow | + | o | + | o | o | o | + | o | o | - | o |
| 3551 | Yellow | + | o | + | o | o | + | o | o | o | - | o |

## *Groundwater Results*

The Groundwater Trend Network currently consists of 49 fixed sites used to obtain chemistry and field data in confined and unconfined aquifers (**Figure 2.11**). Trend analyses, using the SK test, were conducted for the period from January 2009 through June 2019. Of the 49 groundwater sites, 22 wells were used to sample confined aquifers, while 25 wells and 2 springs were used to sample unconfined aquifers. At some locations, multiple wells tapped either different aquifers or different depths of the same aquifer. These are shown in **Figure 2.11** as bubble groupings.

Water quality indicators examined include temperature (Temp), SC, DO, pH, water level (WL), total dissolved solids (TDS), TOC, $NO_3$-$NO_2$, TKN, TN, orthophosphate ($OPO_4$), TP, total potassium (K), total sulfate ($SO_4$), total sodium (Na), total chloride (Cl), total calcium (Ca), total magnesium (Mg), and total alkalinity (ALK). For confined aquifers, **Table 2.8a** displays trends as a result of the SK test for each parameter at each trend site. **Table 2.8b** does the same for unconfined aquifers.

Groundwater trend results are available through an interactive ArcGIS Online web application, the Groundwater Trend Report Card map. This application presents a series of statewide indicator maps showing the trends, or the lack of them, found at each of the wells and springs for each indicator tested.

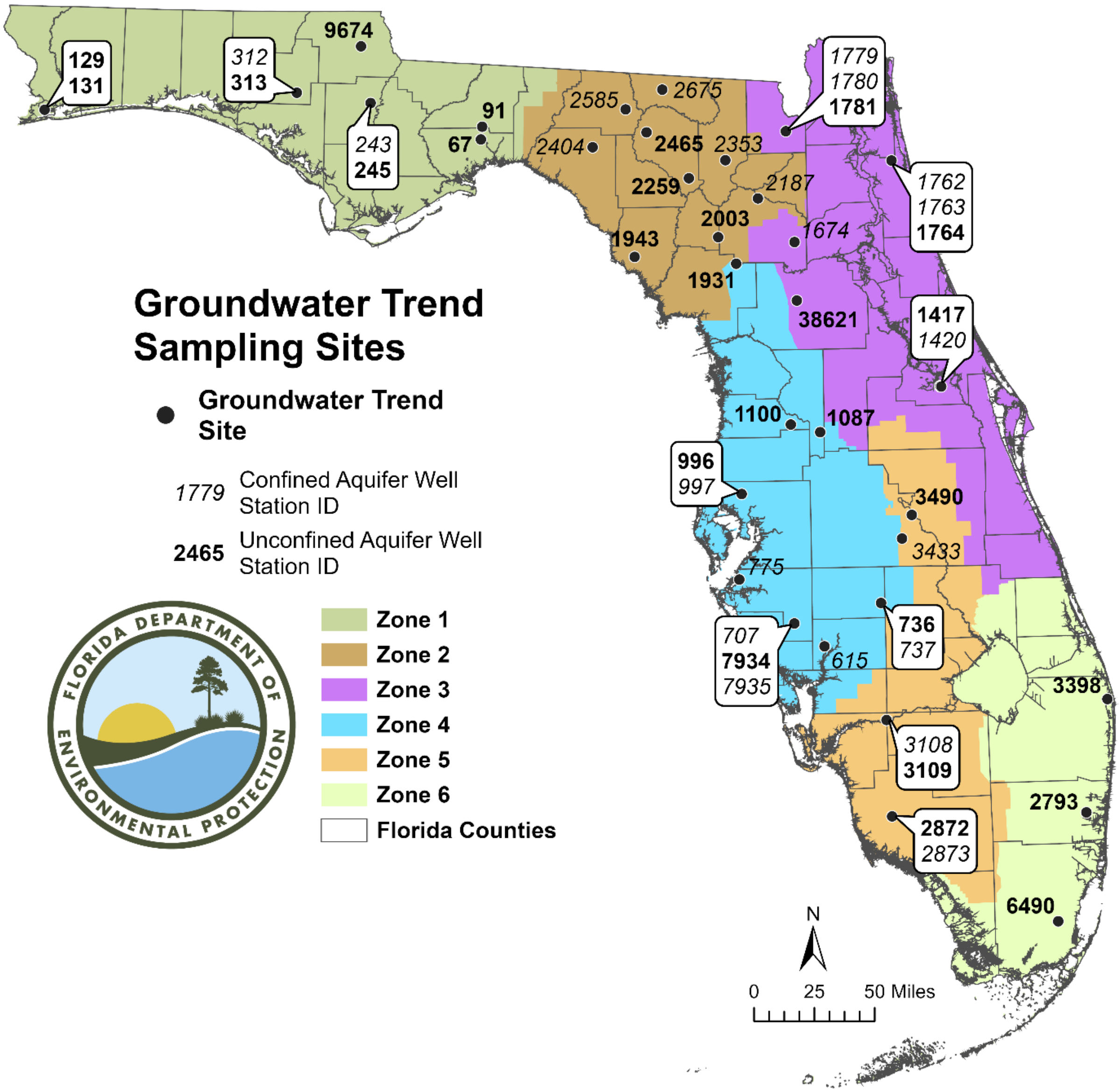



**Figure 2.11. Groundwater Trend Network sites**

## Table 2.8a. Trends for specified analytes for 22 stations in the Groundwater Trend Monitoring Network, Confined Aquifers

**Note**: A positive trend is indicated with a plus sign (+), a negative trend is indicated with a minus sign (-), insufficient evidence of a trend is indicated by the lower-case letter "o," and insufficient data to determine a trend is indicated by (ISD). Unless otherwise noted, analyses are based on data collected between January 2009 and June 2019.

| Station | Temp | SC | DO | pH | WL | TDS | TOC | $NO_3$-$NO_2$ | TKN | TN | $OPO_4$ | P | K | $SO_4$ | Na | Cl | Ca | Mg | ALK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 243 | - | + | + | - | + | o | o | o | o | o | o | o | o | o | o | o | o | o | o |
| 312 | o | - | + | - | + | - | o | o | o | o | o | o | o | - | o | o | - | + | - |
| 615 | + | o | - | o | o | o | o | o | o | o | o | o | o | o | o | o | o | o | o |
| 707 | o | + | o | - | + | + | o | o | o | o | o | o | o | + | o | o | + | + | - |
| 737 | - | o | - | - | o | o | o | o | o | - | - | - | o | o | o | o | - | + | + |
| 775 | o | + | o | - | + | o | o | o | o | o | - | o | o | o | o | o | o | o | o |
| 997 | o | + | o | o | o | o | o | o | o | o | o | o | o | o | + | + | + | + | o |
| 1420 | + | o | o | o | o | o | o | o | o | o | o | o | o | o | o | o | o | o | - |
| 1674 | + | - | + | o | o | - | o | o | o | o | + | o | o | o | + | - | o | o | o |
| 1762 | + | o | o | o | o | o | o | o | o | o | o | o | o | o | o | o | o | o | o |
| 1763 | + | o | o | o | o | + | o | o | o | o | o | o | o | - | o | o | o | o | + |
| 1779 | + | o | o | o | + | o | o | o | o | o | o | o | o | - | o | - | o | o | o |
| 1780 | + | o | o | o | + | o | o | o | o | o | - | - | o | - | - | - | o | o | o |
| 2187 | o | o | o | - | + | o | o | o | o | o | - | o | o | + | o | - | + | o | o |
| 2353 | + | + | o | + | o | + | o | o | o | o | + | + | + | o | + | + | + | o | + |
| 2404 | o | o | o | o | o | o | - | o | o | o | o | - | - | - | o | o | o | o | o |
| 2585 | o | o | o | o | o | o | o | o | o | o | + | o | o | - | o | o | o | o | + |
| 2675 | + | - | o | + | + | o | o | o | o | o | + | o | o | - | o | o | o | o | o |
| 2873 | - | o | o | o | + | o | - | - | o | o | - | - | o | o | - | - | o | o | o |
| 3108 | - | - | - | o | o | o | o | o | o | o | - | - | - | - | - | - | - | - | + |
| 3433 | + | + | - | - | ISD | o | o | o | o | o | o | + | o | o | o | + | + | o | o |
| 7935 | o | o | o | o | + | o | o | o | o | o | - | o | o | o | o | - | + | o | o |

## Table 2.8b. Trends for specified analytes for 27 stations in the Groundwater Trend Monitoring Network, Unconfined Aquifers

**Note:** A positive trend is indicated with a plus sign (+), a negative trend is indicated with a minus sign (-), insufficient evidence of trend is indicated a lower-case letter "o," and insufficient data to determine a trend is indicated by (ISD). Unless otherwise noted, analyses are based on data collected between January 2009 and June 2019.

| Station | Temp | SC | DO | pH | WL | TDS | TOC | $NO_3$-$NO_2$ | TKN | Total N | $OPO_4$ | P | K | $SO_4$ | Na | Cl | Ca | Mg | ALK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 67 | o | o | o | - | ISD | o | o | - | o | - | - | - | o | o | o | o | o | o | o |
| 91 | + | o | - | - | o | o | o | o | o | o | o | o | o | o | o | - | o | o | o |
| 129 | o | + | o | - | + | o | o | o | o | o | o | o | - | o | o | o | + | + | o |
| 131 | + | + | + | - | o | o | o | o | o | o | o | o | o | - | o | o | o | - | o |
| 245 | o | + | + | - | + | o | o | + | o | + | o | o | o | o | o | o | o | + | o |
| 313 | + | + | - | - | + | o | o | o | o | o | o | o | o | + | + | + | o | + | o |
| 736 | - | - | - | - | o | - | - | - | o | - | - | - | - | - | + | + | - | o | - |
| 996 | o | + | - | + | o | + | + | o | + | o | o | o | o | - | o | - | + | - | + |
| 1087 | - | o | - | o | + | o | o | o | o | o | o | o | o | - | o | o | o | o | o |
| 1100 | - | - | o | - | + | o | o | o | o | o | o | + | o | - | o | - | o | o | o |
| 1417 | + | o | o | + | o | o | o | - | o | - | + | + | o | - | - | o | o | o | o |
| 1764 | + | + | o | - | o | + | + | o | + | o | - | o | + | + | + | + | o | + | o |
| 1781 | + | - | - | - | + | - | o | o | o | o | - | o | o | - | - | o | - | - | - |
| 1931 | + | + | o | - | + | + | o | o | o | + | + | o | o | + | + | + | + | + | + |
| 1943 | + | + | - | o | o | o | o | o | o | o | o | o | o | - | - | - | o | + | o |
| 2003 | + | + | + | - | + | + | - | + | - | + | - | - | - | o | + | o | + | + | + |
| 2259 | + | o | o | o | + | o | o | + | + | + | + | + | + | + | + | + | o | o | - |
| 2465 | + | - | o | + | o | - | o | - | o | - | o | o | o | - | - | - | - | - | - |
| 2793 | + | + | + | o | o | o | - | o | - | o | o | o | o | - | + | o | o | o | + |
| 2872 | - | - | - | o | + | o | - | - | - | - | o | - | - | - | + | o | o | o | o |
| 3109 | + | - | - | o | o | - | + | o | - | o | o | - | - | - | - | - | - | - | o |
| 3398 | + | o | + | o | o | o | - | o | o | o | - | - | o | o | + | + | o | o | o |
| 3490 | + | - | - | - | o | o | o | o | o | o | o | o | o | o | o | - | o | - | + |
| 6490 | + | + | + | o | - | o | o | o | + | o | o | o | o | - | + | + | o | - | o |
| 7934 | o | o | - | - | + | o | + | + | + | + | o | o | o | - | + | + | o | - | + |
| 9674 | o | + | o | o | ISD | + | o | + | o | + | o | o | o | o | o | + | o | o | o |
| 38621 | + | + | o | - | + | + | o | o | o | o | o | o | o | o | + | + | + | o | + |

## *Indicators that May Be Exhibiting Statewide Trends*

DEP used the following methodology to identify indicators that may be exhibiting statewide trends. All surface water and groundwater stations were analyzed for trends. Only those analytes displaying significant trends in at least half of the surface or groundwater stations analyzed were included in the statewide trend analysis. Once this was determined, for each remaining analyte, the percentage of stations with increasing trends was compared with the percentage of stations with decreasing trends, and the greater percentage was noted. The number of stations with the greater percentage was divided by the total number of stations displaying trends, and a subjective cutoff was set at 67 %. If the percentage of stations with trends was less than 67 %, the analyte was eliminated from further analyses.

### Discussion of Surface Water Trends

**Table 2.9** reveals that several indicators changed over the 1998 to 2018 period. The concentrations of $NO_3$-$NO_2$ for both flow-adjusted and nonflow-adjusted sites increased during this period, and the concentration of TP decreased. Chlorophyll *a* increased at the flow-adjusted sites only.

**Table 2.9. Surface water trend summary (1999–2018)**

**Note:** Percentages are calculated by number of trends (increasing, decreasing, or no trend), divided by the total number of stations. Flow-adjusted site percentages were calculated based on a sample size of 37 stations that are associated with a USGS gauging station and adjusted for water flow. Nonflow-adjusted site percentages were calculated based on a sample size of 39 stations.

**% Flow-Adjusted Sites**

| Indicator | Increasing Trend (%) | Decreasing Trend (%) | No Trend (%) |
|---|---|---|---|
| **$NO_3$-$NO_2$** | 45.9 | 16.3 | 37.8 |
| **TP** | 13.6 | 43.2 | 43.2 |
| **Chlorophyll *a*** | 48.6 | 20.0 | 31.4 |

**% Nonflow-Adjusted Sites**

| Indicator | Increasing Trend (%) | Decreasing Trend (%) | No Trend (%) |
|---|---|---|---|
| **$NO_3$-$NO_2$** | 48.7 | 12.8 | 38.5 |
| **TP** | 7.6 | 36.0 | 56.4 |
| **Chlorophyll *a*** | 47.4 | 26.3 | 26.3 |

A large percentage of sites had increasing $NO_3$-$NO_2$ concentrations. These nutrients are essential for living organisms. However, an overabundance of nutrients in surface water can cause adverse health and ecological effects, including excessive plant and algal growth. Sources for these nutrients include animal waste, decaying plant debris, fertilizers, and urban drainage. Although many management and restoration efforts are under way to reduce $NO_3$-$NO_2$ concentrations entering surface waters, most of these efforts are relatively new and improvements that may be occurring are not yet apparent at the scale of this analysis.

TP concentrations decreased at a large percentage of sites when adjusted for flow. This reduction may indicate that the amount of phosphorus entering Florida's surface waters is being reduced through the successful implementation of stormwater management plans, as well as the implementation of best management practices (BMPs) and restoration plans associated with waters found to be impaired for nutrients.

### Groundwater Trends Discussion

**Table 2.10** shows that several indicators changed over the 2009 to 2019 period. For confined aquifers, Temp increased. For unconfined aquifers, Temp and WL increased and pH decreased, while concentrations of Na increased and $SO_4$ concentrations decreased.

**Table 2.10. Groundwater trend summary (2009–19)**

**Note:** Percentages were based on sample sizes of 22 confined stations and 27 unconfined stations for all of the analytes with the exception of WL. Percentages were based on 21 confined stations and 25 unconfined stations, as 1 confined and 2 unconfined stations had insufficient data for analyses.

**% Confined Stations**

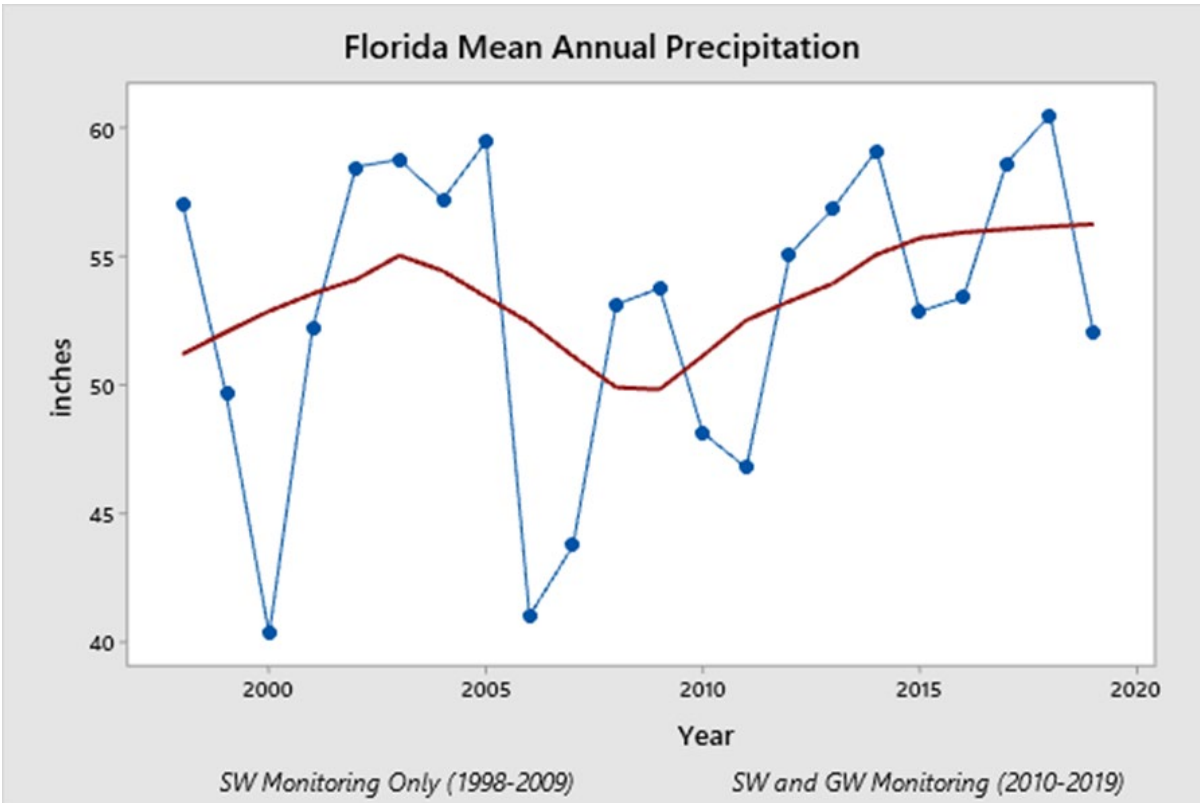
| Indicator | Increasing Trend (%) | Decreasing Trend (%) | No Trend (%) |
|---|---|---|---|
| **Temp** | 45 | 18 | 36 |
| **WL** | 48 | 0 | 52 |
| **pH** | 9 | 32 | 59 |
| **Na** | 14 | 14 | 73 |
| **$SO_4$** | 9 | 36 | 55 |

**% Unconfined Stations**

| Indicator | Increasing Trend (%) | Decreasing Trend (%) | No Trend (%) |
|---|---|---|---|
| **Temp** | 63 | 15 | 22 |
| **WL** | 44 | 8 | 48 |
| **pH** | 11 | 56 | 33 |
| **Na** | 44 | 19 | 37 |
| **$SO_4$** | 15 | 52 | 33 |

For groundwater, the analytes are classified into groups. The *rock matrix* analytes, Ca, Mg, and Alk, along with and to a lesser extent sulfate, are representative of the rocks (limestones and dolostones) making up the major aquifers in Florida. None of these analytes changed. The analytes Na, Cl, SC, and K, along with sulfate, are considered *saline* indicators. Of the saline indicators, Na and $SO_4$ changed over the period of record. Temperature, pH, and WL are a group of miscellaneous indicators, and all three changed.

One plausible driver of the observed changes is rainfall. Annual mean Florida precipitation data are available from the Southeast Regional Climate Center (SERCC 2020a). **Figure 2.12** shows a plot for the period from 1998 to 2019. The figure also displays a LOWESS smoothing curve. Note the period of record differences for surface and groundwater.

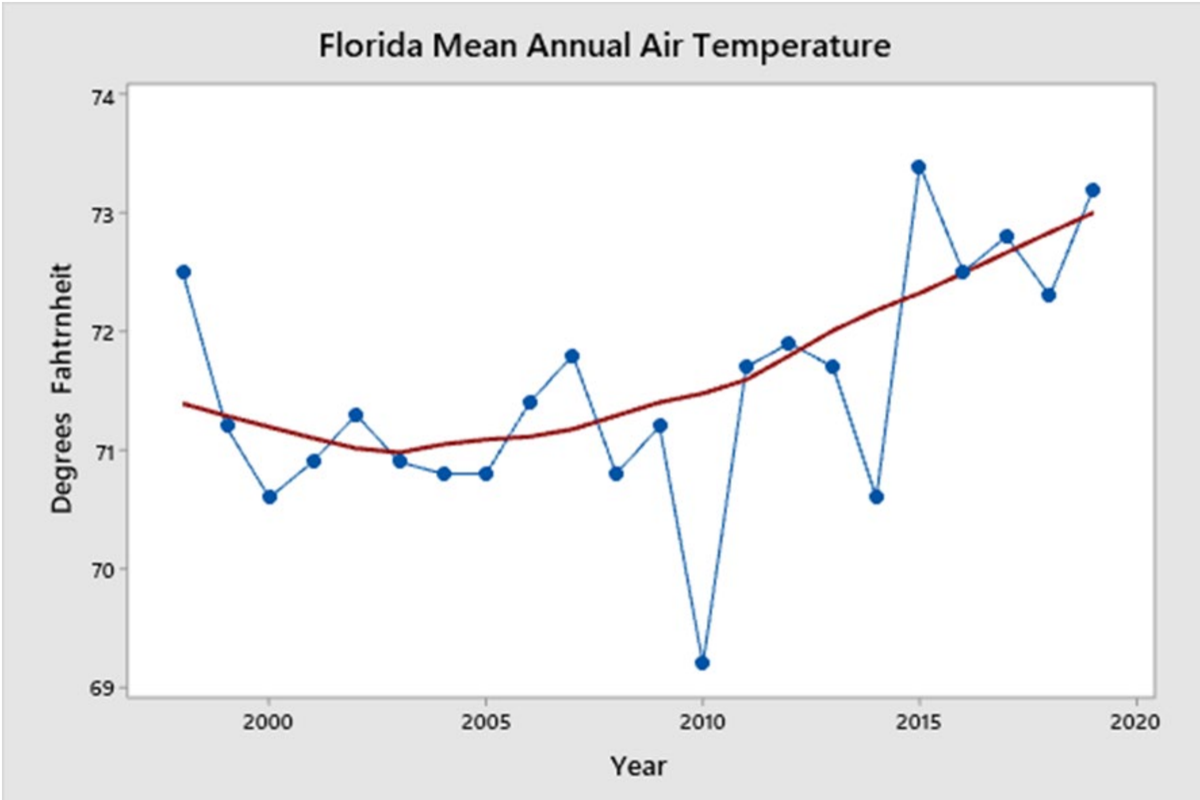



Thick solid line = LOWESS moving average. Data from SERCC (2020a).

**Figure 2.12. Florida mean annual precipitation, 1998–2019**

Verdi et al. (2006) indicated that from 1999 to 2000, Florida experienced a severe drought. Data from SERCC (2020a) also reveal below-normal rainfall for the same period. However, since the end of the drought, the state has received more precipitation, which is more acidic than groundwater in Florida's aquifers. With the increase in precipitation, recharge to unconfined aquifers has increased, resulting in the observed WL increases and pH decreases.

For annual Florida mean temperature, using data available from SERCC (2020b), **Figure 2.13** shows a plot for the period from 1999 to 2019, with a LOWESS smoothing curve. The state's air temperature increased during the period of record, potentially warming rainfall temperatures. Warmer aquifer recharge water may explain the observed Temp increases in unconfined aquifers, which subsequently could lead to Temp increases in confined aquifers.




Thick solid line = LOWESS moving average. Data from SERCC (2020a).

**Figure 2.13. Florida mean annual air temperature, 1998–2019**

## Statewide Surface and Groundwater Trends

### *Introduction*

The SK test was used to analyze for trends at individual Trend Network surface water and groundwater monitoring sites primarily because it is a nonparametric test (no underlying data distribution assumptions) and addresses serial correlation effects. For the examination of regional trends, the effects of both serial and spatial correlation must be addressed. To accommodate this need, the randomly selected status stations, generally sampled only once within separate periods, were used for a comparison of regional data collected between an early and a late period. For this report, region is defined as the entire state of Florida. The analysis methodology chosen is a type of two-sample (step) trend test (Helsel and Hirsch 2002, pp. 348–351).

### *Overview of Change Analysis*

In addition to providing analyses for a specific contiguous period, Status Network monitoring data may be used to compare summarized data from one period with those from another period. The methodology is referred to as change analysis (CHAN), as described in Kincaid and Olsen (2019). This test accounts for both serial and areal/spatial autocorrelation. CHAN analyses used the Change Analysis function in R software's (R Core Team 2017) package spsurvey (Kincaid and Olsen 2019). Individual R scripts were written for each water resource analyzed.

Status Network surface water monitoring data collected from flowing waters and lakes from 2000 to 2003 were compared with flowing waters and lakes data collected from 2015 to 2017, while Status Network confined and unconfined aquifer data collected from 2009 to 2011 were compared with confined and unconfined aquifer data collected from 2016 to 2018. These periods were selected to generally correspond with the period of record used for the SK test analyses provided above. Prior to running CHAN, several data preparatory steps were necessary, as follows:

1. ESRI's ArcGIS was used to determine site locations from the early period's sampled sites that did not fall onto the extent of resource coverages used for either the 2017 surface water resource site selections or the 2018 groundwater site/well selections. Sites that did not fall on the more current resource coverages were removed from the sampled sites' list for the early period.

2. As flowing waters and lake target populations differed between the early and late periods, the three current flowing water resources and two lake resources were combined into two datasets: flowing waters and lakes. This also increased the sample sizes of the respective datasets, as a relatively large number of sites were removed from the early period because they were in locations excluded from the 2018 coverages. This was unnecessary for confined and unconfined aquifer wells, as their target population definitions did not change significantly between periods.

3. An R software project was created for each of the four resources (flowing waters, lakes, and confined and unconfined aquifers) defined in Step 2, and data from the remaining early period sites that were not excluded by Step 1 were then imported from the production Oracle database into four respective R dataframes.

4. Data from the combined more current period for each of the four water resources were then imported into each of the dataframes created in Step 3. A factor column defining the period then was added to each of the dataframes and populated.

5. Analyte/indicator value distributions were then examined for missing, below detection limit (BDL), and outlier values by running a statistical summary using the R package EnvStats (Millard 2013). Unusual values were tagged as "points in need of examination" and provided to the data manager and quality assurance (QA) officer for review.

6. R scripts were written for each of the four water resources to provide graphics of the data distributions, run the change analyses, and export the results into a tab delimited text file that was used to provide graphics of the results.

Next, the CHAN test was used to generate spatial-weight matrices for each water resource by using the extent of each respective water resource in each of the six Status Network reporting units. Once this was done, the change analysis function then generated statewide spatially weighted mean values, plus upper and lower CBs for water quality indicators from both the early and late periods.

For surface water, the subset of indicators examined included Chl-*a*, pH, DO, SC, Temp, $NO_3$-$NO_2$, TKN, TN, TP, and TOC. Except for Chl-*a* and Temp, the subset of indicators for confined and unconfined aquifers was the same as those for surface water.

The CHAN test calculates the difference in spatially weighted means for each indicator between the early (E) and late (L) periods and a 95 % confidence interval for the difference. These values are referred to as difference estimates. If the CBs for the estimate of the difference of the means between the 2 periods (L minus E) does not include 0, there is statistical evidence that the values differ. Note that CHAN does not calculate p-values. However, if 0 does not lie within the 95 % CBs for the difference estimate, the p-value is known to be $< 0.05$.

## *Change Analysis Test Results*

**Appendix B** contains the results of the CHAN tests for each analyte. For flowing waters, DO increased, while SC, pH, and concentrations of TKN, TN, and TP decreased from 1998 to 2017. For lakes, DO, Temp, pH, and concentrations of Chl-*a* and TP increased from 1998 to 2018, while TOC concentrations decreased. For both confined and unconfined aquifers, DO and pH decreased for the more recent period of record (2009–18).

**Table 2.11** summarizes the indicator results displaying statewide change based on the CHAN trend tests. Most indicators provided significant results with very little difference between the spatially adjusted means. Notable exceptions include (1) flowing waters, with SC decreasing 92.84 microSiemens per centimeter (µS/cm) over the 20-year period; (2) lakes, with Chl-*a* increasing 14.08 µg/L and TOC decreasing 1.62 mg/L over the 20-year period; and (3) unconfined and confined aquifers, with DO increasing 1.27 and 0.91 mg/L, respectively over the 20-year period.

## Table 2.11. Statewide significant change analysis results

E = Early; L = Late; N = Number of samples; Diff. = Difference; Est. = Estimate; CB = Confidence bounds; mg/L = Milligrams per liter; SU = Standard units; µS/cm = MicroSiemens per centimeter; C = Degrees Celsius
DO = Dissolved oxygen; SC = Specific conductance; TKN = Total Kjeldahl nitrogen; TN = Total nitrogen; TP = Total phosphorus; Chl-*a* = Chlorophyll *a*; Temp = Temperature; TOC = Total organic carbon

For each test, p-value < 0.05.

| Resource | Indicator | E Mean & N | L Mean & N | Diff. Est. | CB | Direction |
|---|---|---|---|---|---|---|
| **Flowing Surface Waters** | DO | 5.51 (767) | 5.88 (710) | 0.37 mg/L | 0.14 to 0.59 mg/L | Up |
| **Flowing Surface Waters** | pH | 6.55 (767) | 6.09 (710) | -0.46 SU | -0.59 to -0.33 SU | Down |
| **Flowing Surface Waters** | SC | 471.81 (767) | 378.97 (711) | -92.84 µS/cm | -180.44 to -5.24 µS/cm | Down |
| **Flowing Surface Waters** | TKN | 1.00 (767) | 0.83 (707) | -0.17 mg/L | -0.25 to -0.10 mg/L | Down |
| **Flowing Surface Waters** | TN | 1.25 (765) | 1.04 (707) | -0.21 mg/L | -0.31 to -0.05 mg/L | Down |
| **Flowing Surface Waters** | TP | 0.22 (768) | 0.13 (709) | -0.080 µg/L | -0.105 to -0.057 µg/L | Down |
| **Lakes** | Chl-*a* | 18.37 (491) | 32.46 (500) | 14.08 µg/L | 5.60 to 22.56 µg/L | Up |
| **Lakes** | DO | 8.00 (491) | 8.38 (501) | 0.37 mg/L | 0.11 to 0.64 mg/L | Up |
| **Lakes** | pH | 7.38 (491) | 7.77 (501) | 0.38 SU | 0.23 to 0.54 SU | Up |
| **Lakes** | Temp | 24.26 (491) | 25.00 (501) | 0.79 C | 0.19 to 1.39 C | Up |
| **Lakes** | TOC | 16.46 (491) | 14.84 (501) | -1.62 mg/L | -2.65 to -0.59 mg/L | Down |
| **Lakes** | TP | 0.083 (491) | 0.093 (500) | 0.010 µg/L | 0.001 to 0.020 µg/L | Up |
| **Unconfined Aquifers** | DO | 3.98 (300) | 2.71 (321) | -1.27 mg/L | -1.87 to -0.68 mg/L | Down |
| **Unconfined Aquifers** | pH | 6.58 (300) | 5.92 (321) | -0.66 SU | -0.82 to -0.51 SU | Down |
| **Confined Aquifers** | DO | 2.92 (303) | 2.01 (319) | -0.91 mg/L | -1.48 to -0.33 mg/L | Down |
| **Confined Aquifers** | pH | 7.55 (303) | 7.44 (319) | -0.12 SU | -0.22 to -0.01 SU | Down |

## Synthesis of Trend Analyses Results

This section compares the CHAN indicator results, which used randomly selected status stations, with SK indicator results, which used individual trend stations. For flowing waters, TP decreased on a statewide basis over the periods of record for both CHAN and many SK sites. However, the nitrogen species indicators showed differing results between the two analyses. In the CHAN analysis, TN and TKN decreased statewide over the period of record, while the SK analyses showed no statewide change for either indicator. In contrast, the SK analysis showed an increase in $NO_3$-$NO_2$ at many surface water trend sites, while the CHAN analysis found no significant changes for $NO_3$-$NO_2$ at these sites (**Appendix B**).

These dichotomies can be explained by the fact that most trend sites used in the SK analyses were on rivers. The CHAN analyses, on the other hand, included a roughly equal number of river, stream, and canal sites, to better assess all flowing waters. Therefore, while the SK analyses found increasing $NO_3$-$NO_2$ for rivers, any river increases in the CHAN analyses may have been offset by the inclusion of canals and streams with neutral or decreasing trends.

With a population currently growing at a rate of nearly 800 people per day (U.S. Census Bureau 2020), Florida has the potential for increasing amounts of $NO_3$-$NO_2$ and TP originating from human sources. Although nutrient management through agricultural BMPs and environmental restoration plans are providing reductions of TP and $NO_3$-$NO_2$, the contributions from human wastewater and lawn fertilization are still present. In response, Florida is taking measures to decrease nitrogen loading from septic systems in highly vulnerable groundwater basins, such as those associated with Outstanding Florida Springs (Section 373.807, F.S.) by providing incentives for homeowners to upgrade existing septic systems where central sewer is unavailable. The Florida Statutes require the reduction of fertilizer runoff from residential properties through the adoption of DEP's "Model Ordinance for Florida-Friendly Fertilizer Use on Urban Landscapes" for municipalities located within the watershed of a waterbody, or waterbody segment, that is listed as impaired by nutrients (Section 403.9337, F.S.).

For confined and unconfined aquifers, pH decreased over the period of record for both the CHAN and many SK site analyses. One possible cause of this decrease is the increase in rainfall over the period of record. Precipitation interacts with atmospheric $CO_2$ and creates carbonic acid, leading to rainfall with a lower pH. With the increase in atmospheric $CO_2$ over the period of record (2 Degrees Institute 2020), in association with the increase in precipitation, the pH of rainfall likely decreased over of the period of record. Extrapolating from the rainfall data in **Figure 2.12**, it appears that precipitation from 2009 to 2019 provided significant groundwater recharge. Furthermore, Florida went into an active hurricane/precipitation period from 2012 to 2018. These events could lead to pH decreases in unconfined aquifers and eventually may decrease pH in confined aquifers.

As Florida trend monitoring does not include lakes, the only lake data available are from the Status Network, and only CHAN can be used for analysis. CHAN shows the lakes have (1) no change for $NO_3$-$NO_2$, (2) no change for TN (as opposed to a decrease in flowing waters), (3) a slight increase in TP (as opposed to a decrease in flowing waters), (4) increases in DO, pH, Temp, and Chl-*a* (as opposed to no change in flowing waters), and (5) a decrease in TOC (as opposed to no change in flowing waters).

A disparity was found between pH results in flowing waters and groundwater, and those found for lakes. Increased amounts of carbonic acid, as noted above, in association with the longer residence times of lakes (versus flowing waters), may be increasing the dissolution rate of limestones. As limestone dissolves, the buffering capacity and pH of associated waters increase. Because of the interconnection between surface and groundwater, plus the relatively long residence time of water in lakes, increased limestone dissolution may be leading to the observed pH increase in lakes.

Additionally, limestone dissolution may liberate TP from the rock matrix, which explains the observed TP increase in lakes. Increased TP and temperature, along with increased precipitation in recent years (**Figure 2.12**), are potential drivers for regional algal blooms throughout the state; these may then be responsible for the decrease in TOC.

# Chapter 3: Designated Use Support in Surface Waters

## Background

Florida's surface waters are protected for the designated use classifications listed in **Appendix C**. DEP's Watershed Assessment Section (WAS) assesses the health of surface waters through the implementation of the Impaired Surface Waters Rule (IWR) (Chapter 62-303, F.A.C.). The rule contains a legislatively authorized methodology for DEP to assess water quality and determine whether individual surface waters are impaired (i.e., do not attain water quality standards) under ambient conditions. The IWR is used in conjunction with the state's Water Quality Standards (Chapter 62-302, F.A.C.) and Quality Assurance Rule (Chapter 62-160, F.A.C.). The latter governs sample collection and analysis procedures.

The IWR is implemented using DEP's watershed management approach. Under this approach, which is based on a 5-year basin rotation, Florida's 52 hydrologic unit code (HUC) basins (51 HUCs plus the Florida Keys) are distributed among 29 drainage basins , which are then placed in 1 of the 5 basin groups located in the 5 DEP regulatory districts. There are 4 drainage basins in the Northeast District and 5 drainage basins each in the Northwest, Central, Southwest, South, and Southeast Districts. One drainage basin in each district is assessed each year (except for the Northeast). One complete rotation through each of the five basin groups is referred to as a cycle. This chapter summarizes the results of the assessments performed through 2019, including the third cycle for Basin Groups 2 through 5 and the fourth cycle for Basin Group 1 waters. These assessments reflect water quality criteria changes for nutrients and DO (as percent saturation) for Groups 1 through 5, and recreational bacteria and total ammonia for Groups 1, 4, and 5.

As part of the assessment process, DEP uses all available data in Florida's Storage and Retrieval (STORET) Database and Watershed Information Network (WIN), the successor to Florida STORET. As of November 2019, WIN contains data from 67 providers, including data collected under the Strategic Monitoring Plan (SMP). The SMP goal is to ensure that segments with waterbody identification (WBID) numbers have sufficient data to verify whether potentially impaired waters are in fact impaired and, to the extent possible, determine the causative pollutant for waters listed as not meeting the applicable criteria for DO or biological health. SMP monitoring typically occurs over multiple years and includes the collection of chemical and biological data. These data are combined with any other available data at the time of the assessment.

Because of limited resources, monitoring is prioritized based on the EPA's Integrated Report assessment categories, listed in **Table 3.1a**. Waterbodies in **Table 3.1a** are counted only once using the following hierarchical approach:

- Category 5 – If there is at least one assessment in Category 5.
- Category 4e – If there is at least one assessment in Category 4e, and none in 5.

- Category 4b – If there is at least one assessment in Category 4b, and none of the above.
- Category 4a – If there is at least one assessment in Category 4a, and none of the above.
- Category 4c – If there is at least one assessment in Category 4c, and none of the above.
- Category 2 – If there is at least one assessment in Category 2, and none of the above.
- Category 3c – If there is at least one assessment in Category 3c, and none of the above.
- Category 3b – If there is at least one assessment in Category 3b, and none of the above.

Table 3.1a. Distribution of assessment results by waterbody type and assessment category (number of WBIDs)

**Note:** There are no waters in EPA Category 1 (attaining all designated uses) because DEP does not sample for all uses. Category 2 comprises waters attaining all the uses that are sampled for.

The EPA Integrated Report categories are as follows:
1—Attains all designated uses.
2—Attains some designated uses.
3a—No data and information are available to determine if any designated use is attained.
3b—Some data and information are available, but they are insufficient for determining if any designated use is attained.
3c—Meets Planning List criteria and is potentially impaired for one or more designated uses.
4a—Impaired for one or more designated uses and a TMDL has been completed.
4b—Impaired for one or more designated uses, but no TMDL is required because an existing or proposed pollutant control mechanism provides reasonable assurance that the water will attain standards in the future.
4c—Impaired for one or more designated uses but no TMDL is required because the impairment is not caused by a pollutant.
4d—Waterbody indicates nonattainment of water quality standards, but DEP does not have enough information to determine a causative pollutant; or current data show a potentially adverse trend in nutrients or nutrient response variables; or there are exceedances of stream nutrient thresholds, but DEP does not have enough information to fully assess nonattainment of the stream nutrient standard.
4e—Waterbody indicates nonattainment of water quality standards and pollution control mechanisms, or restoration activities are in progress or planned to address nonattainment of water quality standards, but DEP does not have enough information to fully evaluate whether proposed pollution mechanisms will result in attainment of water quality standards.
5—Water quality standards are not attained and a TMDL is required.

| Waterbody Type | EPA Cat. 2 | EPA Cat. 3b | EPA Cat. 3c | EPA Cat. 4a | EPA Cat. 4b | EPA Cat. 4c | EPA Cat. 4d | EPA Cat. 4e | EPA Cat. 5 | Number of Waterbody Segments Assessed |
|---|---|---|---|---|---|---|---|---|---|---|
| **Beach** | 295 | | | 1 | | | | | 59 | 355 |
| **Coastal** | 95 | 4 | | | 12 | | 1 | 3 | 30 | 145 |
| **Estuary** | 164 | 38 | 7 | 27 | 2 | 17 | 33 | 19 | 316 | 623 |
| **Lake** | 586 | 164 | 68 | 43 | 1 | 40 | 99 | 13 | 185 | 1,199 |
| **Spring** | 4 | 11 | 1 | 31 | | 31 | 1 | 30 | 20 | 129 |
| **Stream** | 307 | 303 | 97 | 99 | | 136 | 272 | 18 | 526 | 1,758 |
| **Total** | **1,451** | **520** | **173** | **201** | **15** | **224** | **406** | **83** | **1,136** | **4,209** |

## 303(d) Listed Waters

Only those WBID/analyte combinations placed in EPA Category 5 as a result of IWR assessments are included on the state's Verified List of Impaired Waters adopted by Secretarial Order. For these listings, water quality standards are not being met, and the development of a TMDL is required. The list of these waters subsequently is submitted to EPA as the annual update to Florida's 303(d) list.

Although water quality standards are not met for EPA Category 4, these waterbodies are not included on the state's Verified List because a TMDL currently is not required. Nevertheless, for Subcategories 4d or 4e, TMDLs may be required later, and these waterbodies are included on the 303(d) list.

### *Assessment Results*

Lakes are a particular focus of EPA's Integrated Report guidance, under Section 314 of the CWA. **Appendix D** lists 187 publicly owned lakes identified as impaired, for which a TMDL will be needed. Many of these lakes have mercury in fish tissue impairments that are covered by the statewide TMDL. Currently, 68 of these lakes are on DEP's priority list for TMDL development through 2022. Forty-five of the lakes already have a TMDL adopted into state rule, and 14 have a TMDL alternative approved or in progress.

In Florida, the most frequently identified causes of impairment for rivers and streams, and for lakes and estuarine segments, include DO, fecal coliform, nutrients, and chlorophyll *a*. **Table 3.1b** lists the 15 most frequently identified impairments by waterbody type.

**Table 3.1b. Fifteen most frequently identified impairments by waterbody type**

SEAS = DEP Shellfish Environmental Assessment Section
**Note:** Counts exclude assessments in Category 4c.

| Identified Cause | Lake | Stream | Coastal | Estuary | Spring | Beach | Total Impairments Identified |
|---|---|---|---|---|---|---|---|
| **DO (percent saturation)** | 55 | 455 | 2 | 132 | 9 | | 653 |
| **Fecal Coliform** | 12 | 423 | | 131 | | | 566 |
| **Nutrients (TN)** | 146 | 114 | 15 | 88 | | | 363 |
| **Nutrients (TP)** | 158 | 151 | 1 | 43 | 1 | | 354 |
| **Nutrients (chlorophyll *a*)** | 167 | 55 | 4 | 117 | 1 | | 344 |
| **Biology** | 102 | 80 | | | | | 182 |
| **Fecal Coliform (SEAS classification)** | | 3 | 10 | 106 | | | 119 |
| **Iron** | 6 | 52 | 1 | 40 | | | 99 |
| **Nutrients (nitrate-nitrite)** | | 10 | 1 | 1 | 75 | | 87 |
| **Nutrients (macrophytes)** | | 68 | | | | | 68 |
| **Nutrients (algal mats)** | 1 | 27 | | 2 | 37 | | 67 |
| **Bacteria (beach advisories)** | | | | | | 61 | 61 |
| ***Enterococci*** | | | | 55 | | | 55 |
| **Copper** | 2 | 4 | 10 | 37 | 1 | | 54 |
| ***E. coli*** | | 49 | | | | | 49 |

**Tables 3.2a** and **3.2b** and **Figures 3.1a and 3.1b** present the distribution of the impairment-specific subgroup summary assessments for fecal indicator bacteria and nutrients by waterbody type and EPA reporting category.

### Table 3.2a. Assessment results for fecal indicator bacteria by waterbody type and assessment category (number of WBIDs)

**Note:** There are no waters in EPA Category 1 (attaining all designated uses) because DEP does not sample for all uses. Category 2 comprises waters attaining all the uses that are sampled for.

The EPA Integrated Report categories are as follows:
1—Attains all designated uses.
2—Attains some designated uses.
3a—No data and information are available to determine if any designated use is attained (not displayed).
3b—Some data and information are available, but they are insufficient for determining if any designated use is attained.
3c—Meets Planning List criteria and is potentially impaired for one or more designated uses.
4a—Impaired for one or more designated uses and a TMDL has been completed.
4b—Impaired for one or more designated uses, but no TMDL is required because an existing or proposed pollutant control mechanism provides reasonable assurance that the water will attain standards in the future.
4c—Impaired for one or more designated uses but no TMDL is required because the impairment is not caused by a pollutant.
4d—Waterbody indicates nonattainment of water quality standards, but DEP does not have enough information to determine a causative pollutant; or current data show a potentially adverse trend in nutrients or nutrient response variables; or there are exceedances of stream nutrient thresholds, but DEP does not have enough information to fully assess nonattainment of the stream nutrient standard.
4e—Waterbody indicates nonattainment of water quality standards and pollution control mechanisms, or restoration activities are in progress or planned to address nonattainment of water quality standards, but DEP does not have enough information to fully evaluate whether proposed pollution mechanisms will result in attainment of water quality standards.
5—Water quality standards are not attained and a TMDL is required.

| Waterbody Type | EPA Cat. 2 | EPA Cat. 3b | EPA Cat. 3c | EPA Cat. 4a | EPA Cat. 4b | EPA Cat. 4c | EPA Cat. 4d | EPA Cat. 4e | EPA Cat. 5 | Total Number of Assessments |
|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal** | 83 | 11 | | | | | | | 10 | 104 |
| **Estuary** | 187 | 61 | 14 | 33 | | | 3 | 5 | 217 | 520 |
| **Lake** | 378 | 404 | 15 | | | | | | 12 | 809 |
| **Spring** | 53 | 34 | | | | | | | | 87 |
| **Stream** | 350 | 572 | 77 | 110 | | 1 | 7 | 6 | 339 | 1,462 |
| **Beach** | 295 | | | 2 | | | | | 59 | 356 |
| **Total** | **1,346** | **1,082** | **106** | **145** | **0** | **1** | **10** | **11** | **637** | **3,338** |

## Table 3.2b. Assessment results for nutrients by waterbody type and assessment category (number of WBIDs)

**Note:** There are no waters in EPA Category 1 (attaining all designated uses) because DEP does not sample for all uses. Category 2 comprises waters attaining all the uses that are sampled for.

The EPA Integrated Report categories are as follows:
1—Attains all designated uses.
2—Attains some designated uses.
3a—No data and information are available to determine if any designated use is attained (not displayed)
3b—Some data and information are available, but they are insufficient for determining if any designated use is attained.
3c—Meets Planning List criteria and is potentially impaired for one or more designated uses.
4a—Impaired for one or more designated uses and a TMDL has been completed.
4b—Impaired for one or more designated uses, but no TMDL is required because an existing or proposed pollutant control mechanism provides reasonable assurance that the water will attain standards in the future.
4c—Impaired for one or more designated uses but no TMDL is required because the impairment is not caused by a pollutant.
4d— Waterbody indicates nonattainment of water quality standards, but DEP does not have enough information to determine a causative pollutant; or current data show a potentially adverse trend in nutrients or nutrient response variables; or there are exceedances of stream nutrient thresholds, but DEP does not have enough information to fully assess nonattainment of the stream nutrient standard.
4e—Waterbody indicates nonattainment of water quality standards and pollution control mechanisms, or restoration activities are in progress or planned to address nonattainment of water quality standards, but DEP does not have enough information to fully evaluate whether proposed pollution mechanisms will result in attainment of water quality standards.
5—Water quality standards are not attained and a TMDL is required.

| Waterbody Type | EPA Cat. 2 | EPA Cat. 3b | EPA Cat. 3c | EPA Cat. 4a | EPA Cat. 4b | EPA Cat. 4c | EPA Cat. 4d | EPA Cat. 4e | EPA Cat. 5 | Total Number of Assessments |
|---|---|---|---|---|---|---|---|---|---|---|
| **Estuary** | 310 | 77 | 25 | 46 | 2 | | | 25 | 93 | 578 |
| **Coastal** | 37 | 21 | 3 | | 23 | | | 4 | 12 | 100 |
| **Lake** | 550 | 367 | 42 | 54 | 1 | | 1 | 9 | 153 | 1,177 |
| **Spring** | 18 | 27 | 2 | 31 | | | | 30 | 19 | 127 |
| **Stream** | 873 | 426 | 59 | 36 | | | 133 | 15 | 112 | 1,654 |
| **Total** | **1,788** | **918** | **131** | **167** | **26** | | **134** | **83** | **389** | **3,636** |

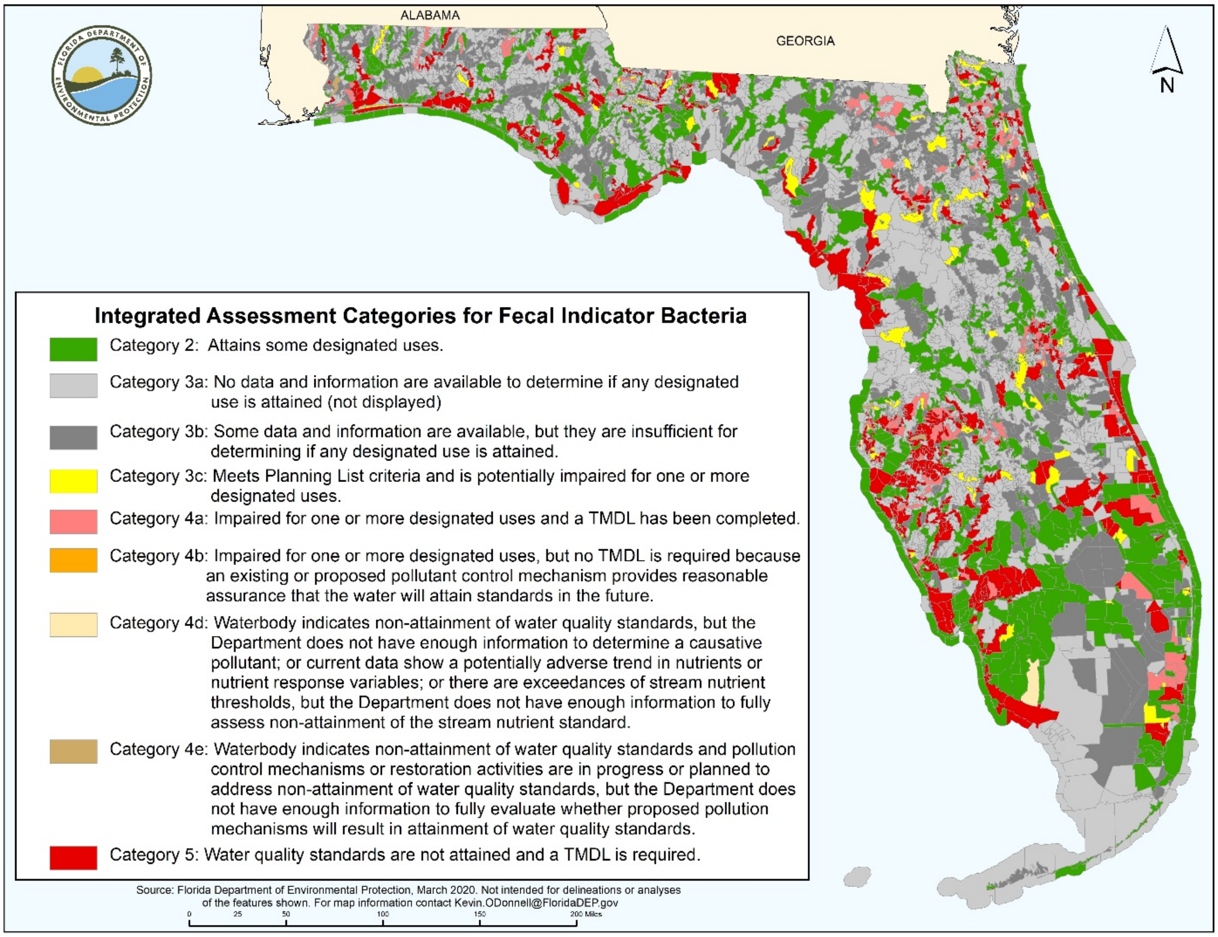



**Figure 3.1a. Results of Florida's surface water quality assessment: EPA assessment categories for fecal indicator bacteria**

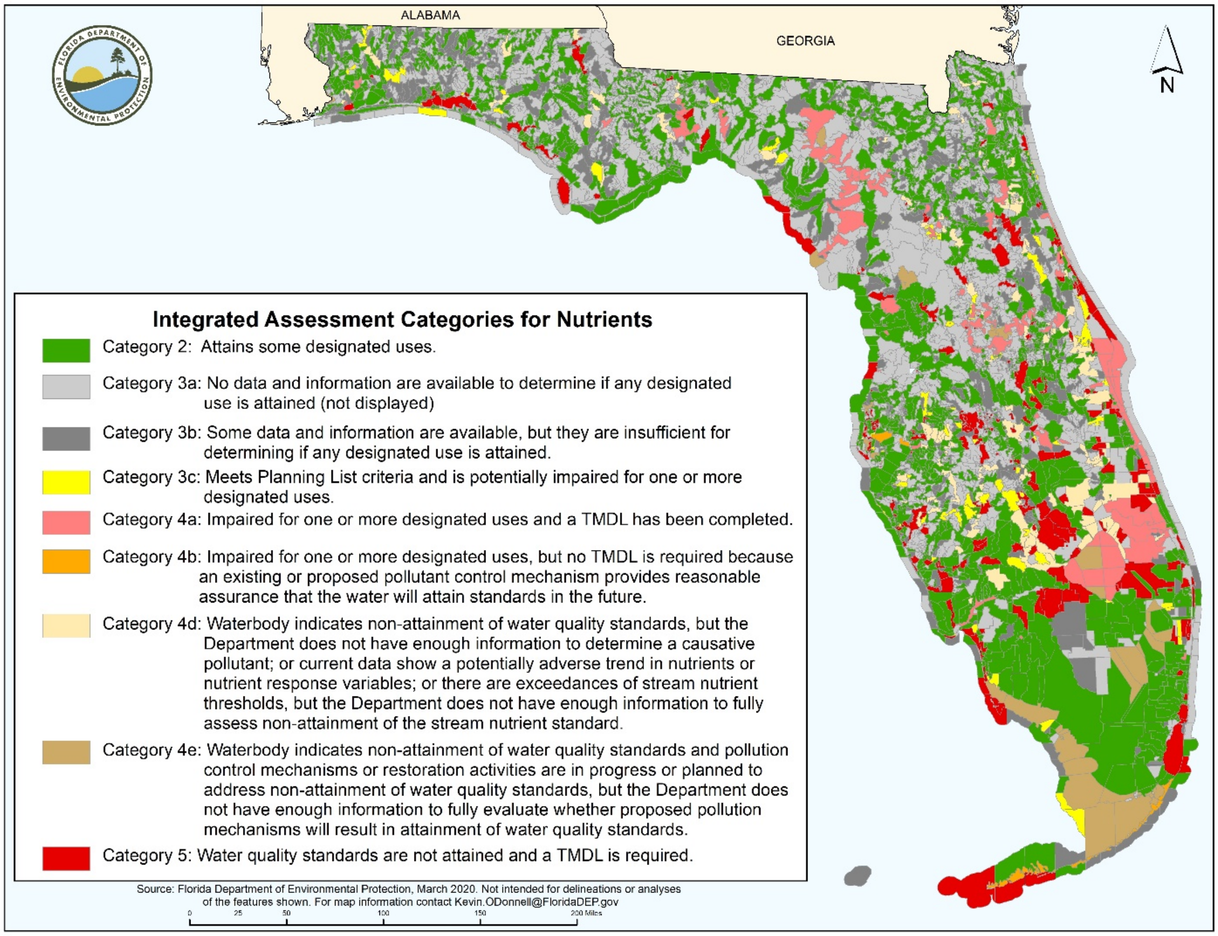



**Figure 3.1b. Results of Florida's surface water quality assessment: EPA assessment categories for nutrients**

## *Impairment Summary*

**Tables 3.3a** through **3.3d** summarize the number and size of waterbody segments/analyte combinations identified as impaired for which a TMDL may be required (i.e., in Subcategories 4d, 4e, or 5) by the specific impairment identified. **Chapter 4** contains more information on developing TMDLs in Florida. Since a single WBID may be impaired for multiple analytes, the totals presented do not necessarily reflect the total size of waterbodies identified as impaired, but rather the total of all waterbody segment/analyte combinations.

The number of acres identified as impaired for lakes includes and is influenced largely by the assessment results for Lake Okeechobee. Covering an area of 320,331 acres, Lake Okeechobee is the largest lake in the state and is included among the Category 5 waters.

In addition, all fresh waters listed as impaired for mercury in fish tissue prior to 2013 were addressed by a statewide TMDL completed in 2012. These segments have been delisted and placed in EPA Category 4a. As new assessments are carried out, if data indicate additional impairments in new WBIDs not originally included in the TMDL the listings are included on the basin's draft Verified List for review and comment by the public. DEP then reviews these listings to confirm they are caused by the same sources identified in the existing TMDL, and once confirmed they are added to the TMDL and placed instead in EPA Category 4a.

**Table 3.3a. Miles of rivers/streams impaired by cause**

DO = Dissolved oxygen; TP = Total phosphorus = TN = Total nitrogen; SEAS = DEP Shellfish Environmental Assessment Section
**:** Some stream WBIDs previously were classified as lakes and were assessed for nutrients based on the Trophic State Index (TSI). These WBIDs will be reevaluated during the appropriate assessment cycle.

| Identified Cause | Waterbody Type | Units | Number of Stream Segments Identified as Impaired | Total Number of Stream Miles |
|---|---|---|---|---|
| **DO (percent saturation)** | Stream | Miles | 428 | 20,437 |
| **Fecal Coliform** | Stream | Miles | 302 | 8,272 |
| **Nutrients (TP)** | Stream | Miles | 136 | 8,948 |
| **Nutrients (TN)** | Stream | Miles | 97 | 5,757 |
| **Biology** | Stream | Miles | 77 | 2,674 |
| **Nutrients (macrophytes)** | Stream | Miles | 64 | 5,263 |
| **Iron** | Stream | Miles | 51 | 2,702 |
| ***E. coli*** | Stream | Miles | 49 | 851 |
| **Nutrients (chlorophyll *a*)** | Stream | Miles | 42 | 3,610 |
| **Lead** | Stream | Miles | 23 | 353 |
| **Nutrients (algal mats)** | Stream | Miles | 15 | 627 |
| **Specific Conductance** | Stream | Miles | 7 | 451 |
| **DO** | Stream | Miles | 6 | 234 |
| **Un-Ionized Ammonia** | Stream | Miles | 4 | 130 |
| **Copper** | Stream | Miles | 4 | 56 |
| **Chloride** | Stream | Miles | 3 | 425 |
| **Fecal Coliform (SEAS classification)** | Stream | Miles | 3 | 139 |
| **Silver** | Stream | Miles | 2 | 29 |
| **Turbidity** | Stream | Miles | 1 | 464 |
| **Dissolved Solids** | Stream | Miles | 1 | 20 |
| **Total Ammonia** | Stream | Miles | 1 | 19 |
| **Arsenic (in fish tissue)** | Stream | Miles | 1 | 13 |
| **Nutrients (chlorophyll *a* trend)** | Stream | Miles | 1 | 11 |
| **Total** | | | **1,318** | **61,483** |

## Table 3.3b. Acres of lakes impaired by cause

TP = Total phosphorus = TN = Total nitrogen; DO = Dissolved oxygen; PCBs = Polychlorinated biphenyls

| Identified Cause | Waterbody Type | Units | Number of Lake Segments Identified as Impaired | Total Water Area for Lake Segments Identified as Impaired |
|---|---|---|---|---|
| **Nutrients (chlorophyll *a*)** | Lake | Acres | 119 | 142,042 |
| **Nutrients (TP)** | Lake | Acres | 113 | 133,211 |
| **Nutrients (TN)** | Lake | Acres | 103 | 157,960 |
| **Biology** | Lake | Acres | 91 | 124,682 |
| **DO (percent saturation)** | Lake | Acres | 53 | 13,,587 |
| **Lead** | Lake | Acres | 12 | 7,557 |
| **Fecal Coliform** | Lake | Acres | 12 | 2,098 |
| **Iron** | Lake | Acres | 6 | 278,754 |
| **Silver** | Lake | Acres | 2 | 282 |
| **Copper** | Lake | Acres | 2 | 118 |
| **Pesticides (in fish tissue)** | Lake | Acres | 1 | 30,526 |
| **Un-Ionized Ammonia** | Lake | Acres | 1 | 848 |
| **pH** | Lake | Acres | 1 | 661 |
| **Nutrients (other information)** | Lake | Acres | 1 | 479 |
| **Specific Conductance** | Lake | Acres | 1 | 356 |
| **PCBs (based on fish consumption advisory)** | Lake | Acres | 1 | 245 |
| **Turbidity** | Lake | Acres | 1 | 147 |
| **Total** | | | **520** | **893,552** |

## Table 3.3c. Acres of estuaries impaired by cause

DO = Dissolved oxygen; SEAS = DEP Shellfish Environmental Assessment Section; TN = Total nitrogen; TP = Total phosphorus

| Identified Cause | Waterbody Type | Units | Number of Estuary Segments Identified as Impaired | Total Water Area for Estuary Segments Identified as Impaired |
|---|---|---|---|---|
| **DO (percent saturation)** | Estuary | Acres | 116 | 69,614 |
| **Fecal Coliform (SEAS classification)** | Estuary | Acres | 106 | 799,542 |
| **Fecal Coliform** | Estuary | Acres | 93 | 135,649 |
| **Nutrients (chlorophyll *a*)** | Estuary | Acres | 81 | 378,856 |
| **Nutrients (TN)** | Estuary | Acres | 56 | 395,862 |
| ***Enterococci*** | Estuary | Acres | 52 | 18,207 |
| **Iron** | Estuary | Acres | 40 | 55,000 |
| **Copper** | Estuary | Acres | 37 | 25,871 |
| **Fecal Coliform (3)** | Estuary | Acres | 35 | 218,294 |
| **Nutrients (TP)** | Estuary | Acres | 10 | 59,016 |
| **pH** | Estuary | Acres | 2 | 26,278 |
| **Lead** | Estuary | Acres | 2 | 4,804 |
| **Dioxin (in fish tissue)** | Estuary | Acres | 1 | 0.36 |
| **Total** | | | **631** | **2,186,993** |

**Table 3.3d. Miles of coastal waters impaired by cause**

TN = Total nitrogen; SEAS = DEP Shellfish Environmental Assessment Section; DO = Dissolved oxygen; TP = Total phosphorus

| Identified Cause | Waterbody Type | Units | Number of Coastal Segments Identified as Impaired | Total Water Size for Coastal Segments Identified as Impaired |
|---|---|---|---|---|
| **Nutrients (other information)** | Coastal | Miles | 23 | 333 |
| **Nutrients (TN)** | Coastal | Miles | 15 | 341 |
| **Fecal Coliform (SEAS Classification)** | Coastal | Miles | 10 | 312 |
| **Copper** | Coastal | Miles | 10 | 181 |
| **Nutrients (chlorophyll *a*)** | Coastal | Miles | 4 | 168 |
| **Fecal Coliform (3)** | Coastal | Miles | 3 | 85 |
| **DO (Percent Saturation)** | Coastal | Miles | 2 | 45 |
| **Nutrients (TP)** | Coastal | Miles | 1 | 42 |
| **Iron** | Coastal | Miles | 1 | 31 |
| **Total** | | | **69** | **1,539** |

## *Biological Assessment*

Under the IWR, biological assessments can provide the basis for impairment determinations, or can support assessment determinations made for other parameters (as is the case for some waterbodies with naturally low DO concentrations where it may be possible to demonstrate that aquatic life use is fully supported by using biological information). **Appendices E** and **F** contain more information on biological assessment methodologies.

Biological assessment tools consist of the Stream Condition Index (SCI), Rapid Periphyton Survey (RPS), and Linear Vegetation Survey (LVS) for rivers and streams, and the Lake Vegetation Index (LVI) for lakes. **Table 3.4** lists the distribution of biological assessment results based on the type of bioassessment (SCI and LVI).

Of the biological data examined for the Group 2, Cycle 3 to Group 1, Cycle 4 assessment period, 24 % of the SCI scores were below the average score of 40, and 17 % of the SCI scores were below the minimum score of 35 associated with a healthy, well-balanced aquatic community (however, 2 temporally independent SCI results with an average less than 40 would be required for an impairment determination).

**Table 3.4. Distribution of biological assessment results by bioassessment method**

**SCI**

N/A = Not applicable

| Biological Assessment Method and Date | Assessment Result | Number of Results Not Meeting Aquatic Life Use Support | Total Number of Results |
|---|---|---|---|
| **SCI_2012** | ≥ 40 | N/A | 2,481 |
| **SCI_2012** | < 40 | 775 | 775 |
| **Total SCI** | | **775** | **3,256** |

**LVI**

| Biological Assessment Method and Date | Assessment Result | Number of Results Not Meeting Aquatic Life Use Support | Total Number of Results |
|---|---|---|---|
| **LVI_2012** | ≥ 43 | N/A | 1,480 |
| **LVI_2012** | < 43 | 769 | 769 |
| **Total LVI** | | **769** | **2,249** |

### *Delisting*

**Appendix G** discusses the delisting process.

## Drinking Water Use Support

While earlier sections of this chapter summarized all assessment results, this section focuses on assessment results for waterbodies designated as Class I (potable water supply). Of Florida's public drinking water systems, 13 % receive some or all of their water from a surface water source.

For Class I waters, the nonattainment of criteria unrelated to drinking water use does not necessarily affect a waterbody's suitability as a potable water supply. In fact, those Class I impairments identified in the IWR assessments have been for uses other than providing safe drinking water. **Table 3.5** lists the status of rivers/streams, lakes/reservoirs, and springs designated for drinking water use in each of EPA's 5 reporting categories. Note that Lake Okeechobee is a Class I waterbody and comprises 320,331 acres of the 337,520 total acres of Class I lakes.

## Table 3.5. Waterbodies designated for drinking water use by assessment category (results for assessments including criteria for all use support)

**Note:** The EPA Integrated Report categories are as follows:
1—Attains all designated uses.
2—Attains some designated uses.
3a—No data and information are available to determine if any designated use is attained.
3b—Some data and information are available, but they are insufficient for determining if any designated use is attained.
3c—Meets Planning List criteria and is potentially impaired for one or more designated uses.
4a—Impaired for one or more designated uses and a TMDL has been completed.
4b—Impaired for one or more designated uses, but no TMDL is required because an existing or proposed pollutant control mechanism provides reasonable assurance that the water will attain standards in the future.
4c—Impaired for one or more designated uses but no TMDL is required because the impairment is not caused by a pollutant.
4d— Waterbody indicates non-attainment of water quality standards, but DEP does not have enough information to determine a causative pollutant; or current data show a potentially adverse trend in nutrients or nutrient response variables; or there are exceedances of stream nutrient thresholds, but DEP does not have enough information to fully assess nonattainment of the stream nutrient standard.
4e—Waterbody indicates nonattainment of water quality standards and pollution control mechanisms, or restoration activities are in progress or planned to address nonattainment of water quality standards, but DEP does not have enough information to fully evaluate whether proposed pollution mechanisms will result in attainment of water quality standards.
5—Water quality standards are not attained and a TMDL is required.

* These impairments are not related to criteria specifically designed to protect drinking water supplies.

### Rivers/Streams

| Waterbody Type | Assessment Category | Assessment Status | Number of WBIDs |
|---|---|---|---|
| **Rivers/Streams** | 2 | Not Impaired | 9 |
| **Rivers/Streams** | 3a | No Data | 25 |
| **Rivers/Streams** | 3b | Insufficient Data | 8 |
| **Rivers/Streams** | 3c | Planning List | 2 |
| **Rivers/Streams** | 4a | TMDL Complete | 7 |
| **Rivers/Streams** | 4b | Reasonable Assurance | 0 |
| **Rivers/Streams** | 4c | Natural Condition | 4 |
| **Rivers/Streams** | 4d | No Causative Pollutant | 11 |
| **Rivers/Streams** | 4e | Ongoing Restoration | 0 |
| **Rivers/Streams** | 5* | Impaired | 21 |

### Lakes/Reservoirs

| Waterbody Type | Assessment Category | Assessment Status | Number of WBIDs |
|---|---|---|---|
| **Lakes/Reservoirs** | 2 | Not Impaired | 5 |
| **Lakes/Reservoirs** | 3a | No Data | 2 |
| **Lakes/Reservoirs** | 3b | Insufficient Data | 0 |
| **Lakes/Reservoirs** | 3c | Planning List | 1 |
| **Lakes/Reservoirs** | 4a | TMDL Complete | 4 |
| **Lakes/Reservoirs** | 4b | Reasonable Assurance | 0 |
| **Lakes/Reservoirs** | 4c | Natural Condition | 0 |
| **Lakes/Reservoirs** | 4d | No Causative Pollutant | 3 |
| **Lakes/Reservoirs** | 5* | Impaired | 11 |

### Springs

| Waterbody Type | Assessment Category | Assessment Status | Number of WBIDs |
|---|---|---|---|
| **Springs** | 2 | Not Impaired | 0 |
| **Springs** | 3a | No Data | 0 |
| **Springs** | 3b | Insufficient Data | 0 |
| **Springs** | 3c | Planning List | 0 |
| **Springs** | 4a | TMDL Complete | 0 |
| **Springs** | 4b | Reasonable Assurance | 0 |
| **Springs** | 4c | Natural Condition | 4 |
| **Springs** | 4d | No Causative Pollutant | 0 |
| **Springs** | 5* | Impaired | 0 |

## *Overlap of Source Water Areas and Impaired Surface Waters*

In 2019, there were 5,100 public drinking water systems statewide, 18 of which obtain their supplies from surface water. An additional 56 systems wholly or partially purchase water from these 18 systems.

DEP compared the adopted Verified List of Impaired Waters with the coverage of the source water assessment areas generated for the Source Water Assessment and Protection Program (SWAPP). The modeled source water assessment area coverage for community drinking water systems used a 3-day travel time to the intake within surface waters and their 100-year floodplains. **Table 3.6** lists the river/stream miles (including springs) and square miles of lakes/reservoirs that overlap source water areas for community water systems impaired for fecal coliform, *E. coli*, or *Enterococci*.

**Table 3.6. Summary of river/stream miles and lake/reservoir acres identified as impaired for fecal coliform, *E. coli*, or *Enterococci* overlapping source water areas of community water systems**

| Surface Water Type | Length or Area of Impaired Surface Waters Overlapping Source Water Areas in Basin Groups 1–5 |
|---|---|
| **Streams/Rivers** | 744 miles |
| **Lakes/Reservoirs** | 1,187 acres |

# Chapter 4: TMDL Program and Priorities

DEP must develop TMDLs for waterbody segments added to DEP's Verified List of Impaired Waters per the requirements of the federal CWA and Florida Watershed Restoration Act (FWRA) (Chapter 403.067, F.S.). A TMDL establishes the maximum amount of a pollutant that a waterbody can receive without causing exceedances of water quality standards. As such, TMDL development is an important step toward restoring the state's waters to their designated uses. BMAPs and permits issued for point sources all use TMDLs as the basis for their water quality goals. In Florida, DEP adopts most nutrient TMDLs as site-specific water quality criteria as defined in the document *Implementation of Florida's Numeric Nutrient Standards* (DEP 2013a). DEP's TMDL Program website contains more detailed information on the program.

In 2014, DEP provided EPA with a priority framework document addressing how its 303(d) and TMDL Programs will achieve a long-term vision for implementing Section 303(d) of the CWA. The document focused on Florida's transition away from a pace-driven TMDL development schedule towards a new approach based on recovery potential screening. In 2015 DEP updated the approach by (1) explaining the significant changes to the its priority-setting process since 2014, and (2) expanding the planning horizon for TMDL development through 2022, in keeping with the 303(d) long-term vision.

One important change from previous TMDL priority-setting efforts is a new focus on waters where the TMDL and BMAP (**Chapter 5**) approach is the best of the available options for restoration. The resultant list of priorities is therefore best interpreted as "those impaired waters where [DEP] expects to develop a site-specific TMDL."

This process is used to select impaired waters where site-specific TMDLs are appropriate and the most effective path to successful restoration. While annual and two-year plans will need to be developed, DEP does not intend to reprioritize every year. Instead, two check-in periods will allow time to incorporate updated information from future IWR Database runs and assessment lists, reprioritize the workload, complete any TMDLs behind schedule, and prepare a new plan for 2023 and beyond (see **Table 4.1**).

The current list of waters prioritized for TMDLs is available online. It includes the waterbodies and the type of TMDL that will be developed between now and 2022.

The first check-in period extended from October 2018 to March 2019. DEP updated the priority list by incorporating new sampling data, updated assessment status, and public comments. More information and a story map on the new changes can be found on the Site-Specific TMDL Prioritization web page.

To date, DEP has adopted a total of 447 TMDLs. Of these, 262 were developed for DO, nutrients, and/or un-ionized ammonia; 179 were developed for bacteria; and 5 were for other parameters such as iron, lead, and turbidity. In addition, DEP adopted a statewide TMDL for mercury, based on fish consumption advisories affecting over 1,100 waterbody segments. These TMDLs represent areas in all basin groups and cover many of the largest watersheds in the state (e.g., St. Johns River, St. Lucie Estuary). DEP has many more TMDLs in various stages of development.

**Table 4.1. Overall timeline for long-term vision priorities (Fiscal Year [FY] 2016–FY 2022)**

| State Fiscal Year (SFY) | Federal FY | Calendar Quarter | Comments |
|---|---|---|---|
| SFY 15–16 | FY 15 | July to Sept. 2015 | Establish plan |
| SFY 15–16 | FY 16 | Oct. to Dec. 2015 | Beginning of plan |
| SFY 15–16 | FY 16 | Jan to Mar. 2016 | |
| SFY 15–16 | FY 16 | Apr. to June 2016 | |
| SFY 16–17 | FY 16 | July to Sept. 2016 | Annual planning |
| SFY 16–17 | FY 17 | Oct. to Dec. 2016 | |
| SFY 16–17 | FY 17 | Jan. to Mar. 2017 | |
| SFY 16–17 | FY 17 | Apr. to Jun. 2017 | |
| SFY 17–18 | FY 17 | July to Sept. 2017 | Annual planning |
| SFY 17–18 | FY 18 | Oct. to Dec. 2017 | |
| SFY 17–18 | FY 18 | Jan. to Mar. 2018 | |
| SFY 17–18 | FY 18 | Apr. to Jun. 2018 | |
| SFY 18–19 | FY 18 | July to Sept. 2018 | Annual planning |
| SFY 18–19 | FY 19 | Oct. to Dec. 2018 | Check-in Period 1 (reprioritize) |
| SFY 18–19 | FY 19 | Jan. to Mar. 2019 | |
| SFY 18–19 | FY 19 | Apr. to June 2019 | |
| SFY 19–20 | FY 19 | July to Sept. 2019 | Annual planning |
| SFY 19–20 | FY 20 | Oct. to Dec. 2019 | |
| SFY 19–20 | FY 20 | Jan. to Mar. 2020 | |
| SFY 19–20 | FY 20 | Apr. to June 2020 | |
| SFY 20–21 | FY 20 | July to Sept. 2020 | Annual planning |
| SFY 20–21 | FY 21 | Oct. to Dec. 2020 | |
| SFY 20–21 | FY 21 | Jan. to Mar. 2021 | |
| SFY 20–21 | FY 21 | Apr. to June 2021 | |
| SFY 21–22 | FY 21 | July to Sept. 2021 | Annual planning |
| SFY 21–22 | FY 22 | Oct. to Dec. 2021 | |
| SFY 21–22 | FY 22 | Jan. to Mar. 2022 | |
| SFY 21-–22 | FY 22 | Apr. to June 2022 | Check-in Period 2 (reprioritize) |
| SFY 22–23 | FY 22 | July to Sept. 2022 | |
| SFY 22–23 | FY 23 | Oct. to Dec. 2022 | New plan begins |

# Chapter 5: BMAP Program

Florida's primary mechanism for implementing TMDLs adopted through Section 403.067, F.S., is the basin management action plan (BMAP). Once the decision is made to initiate and ultimately develop a BMAP, the effort cannot be completed without significant input from all stakeholders, collaboration with local entities, and stakeholder commitment to implement BMAP restoration projects. While a BMAP is developed for a specific basin and is unique based on the basin and type of impairment, at a minimum all BMAPs include restoration projects and management strategies, implementation schedules and milestones, allocations or reduction requirements, funding strategies, and tracking mechanisms.

BMAP implementation uses an adaptive management approach that continually solicits cooperation and agreement from stakeholders on the pollutant reduction assignments. The foundation of all BMAPs is the water quality restoration projects that state and local entities commit to developing and completing. DEP, in cooperation with local stakeholders, annually reviews, updates, and assesses these projects to ensure the progression towards the established milestones. During the collaborative review process, stakeholders may update and revise projects, and DEP may require additional restoration projects. Because BMAPs are adopted by Secretarial Order, they are enforceable and DEP has the statutory authority to take enforcement actions if necessary.

To date, DEP has adopted 30 BMAPs and is working on developing or updating numerous other BMAPs statewide. **Table 5.1** summarizes the status of all BMAPs. While the majority address nutrient impairments, DEP also has adopted BMAPs that target fecal indicator bacteria contamination. To address these sources, DEP developed a guidance manual, *Restoring Bacteria-Impaired Waters* (DEP 2018c), based on experiences in collaborating with local stakeholders around the state. The manual provides local stakeholders with useful information on identifying sources of fecal indicator bacteria in their watersheds and examples of management actions to address these sources.

In January 2016, the Florida Legislature adopted statutes directing DEP to develop or update BMAPs for impaired Outstanding Florida Springs (OFS) and impaired waters that are part of the Northern Everglades and Estuaries Protection Program (NEEPP). Revisions to Chapter 373, F.S., outlined specific updates and actions for OFS and NEEPP BMAPs. Revisions to Chapter 403, F.S., outlined specific updates and actions for all BMAPs, along with the schedules for those updates and actions. DEP conducted well over 100 stakeholder meetings, technical workshops, and noticed public meetings in the preparation for the revised BMAPs. In June 2018, DEP adopted 13 OFS BMAPs, 8 of which are now effective (5 are pending the outcome of legal challenges). DEP has also prepared 5-year reviews for the NEEPP BMAPs and completed all technical and BMAP development work for these BMAPs by January 2020. The Lake Okeechobee, St. Lucie, and Caloosahatchee updated BMAPs were adopted in February 2020.

Beyond the requirements to update BMAPs, the 2016 legislation also directed DEP to develop a statewide annual report for all BMAPs. The report is due to the Legislature by July 1 of each year, and DEP has met this deadline in each of the last two years.

**Table 5.1. Summary of BMAPs**

TN = Total nitrogen; TP = Total phosphorus; FC = Fecal coliform; DO = Dissolved oxygen; BOD = Biochemical oxygen demand; $NO_3$ = Nitrate; $OPO_4$ = Orthophosphate

| BMAP | BMAP Status | Parameter(s) Addressed | Implementation Status |
|---|---|---|---|
| **Upper Oklawaha River Basin** | Adopted August 2017 | TP | The BMAP was updated in 2014. |
| **Orange Creek** | Adopted May 2008 | TN/TP/FC | The BMAP was updated in 2014. |
| **Long Branch** | Adopted May 2008 | FC/DO | The BMAP, adopted in 2008, is currently being reviewed for any necessary updates as restoration efforts continue. |
| **Lower St. Johns River Basin Main Stem** | Adopted October 2008 | TN/TP | The BMAP, adopted in 2008, is currently being reviewed for any necessary updates as restoration efforts continue. |
| **Hillsborough River** | Adopted September 2009 | FC | The BMAP, adopted in 2009, is currently being reviewed for any necessary updates as source identification efforts continue. |
| **Lower St. Johns River Basin Tributaries I** | Adopted December 2009 | FC | The BMAP, adopted in 2011, is currently being reviewed for any necessary updates as source identification efforts continue. |
| **Lake Jesup** | Adopted May 2010; amended July 2019 | TN/TP/ Un-ionized ammonia | The BMAP, adopted in 2010, was revised and amended in July of 2019 to add additional information on sources and allocations. |
| **Lower St. Johns River Basin Tributaries II** | Adopted August 2010 | FC | The BMAP, adopted in 2010, is currently being reviewed for any necessary updates as source identification efforts continue. |
| **Bayou Chico (Pensacola Basin)** | Adopted October 2011 | FC | The BMAP, adopted in 2011, is currently being reviewed for any necessary updates as source identification efforts continue. |
| **Santa Fe River Basin** | Pending | $NO_3$/DO | The BMAP was updated and adopted in June 2018 to meet new requirements outlined in the Florida Springs and Aquifer Protection Act and is currently under administrative challenge. |
| **Lake Harney, Lake Monroe, Middle St. Johns River, and Smith Canal** | Adopted August 2012 | TN/TP | The BMAP, adopted in 2012, is currently being reviewed for any necessary updates. |
| **Caloosahatchee Estuary Basin** | Adopted November 2012; updated January 2020 | TN | The NEEPP BMAP, adopted in 2012, covers the Tidal Caloosahatchee Watershed. A formal 5-Year Review of the BMAP was submitted to the Florida Legislature and Governor in November 2017 and updated to meet new requirements outlined in Executive Order 19-12 in January 2020. |

| BMAP | BMAP Status | Parameter(s) Addressed | Implementation Status |
|---|---|---|---|
| **Everglades West Coast** | Adopted November 2012 | TN/DO | The BMAP, adopted in 2012, covers the impaired waterbodies Hendry Creek and Imperial River. It is being reviewed to identify whether any updates are necessary as the end of the first phase of implementation nears. |
| **Banana River Lagoon (BRL)** | Adopted February 2013 | TN/TP | The BMAP was adopted in 2013, in conjunction with the Central Indian River Lagoon (IRL) and North IRL BMAPs. All three BMAPs are being reviewed to identify whether any updates are necessary as the end of the first phase of implementation nears. |
| **Central IRL** | Adopted February 2013 | TN/TP | The BMAP was adopted in 2013, in conjunction with the North IRL and BRL BMAPs. All three BMAPs are being reviewed to identify whether any updates are necessary as the end of the first phase of implementation nears. |
| **North IRL** | Adopted February 2013 | TN/TP | The BMAP was adopted in 2013, in conjunction with the Central IRL and BRL BMAPs. All three BMAPs are being reviewed to identify whether any updates are necessary as the end of the first phase of implementation nears. |
| **St. Lucie River and Estuary Basin** | Adopted June 2013; updated January 2020 | TN/TP/BOD | The NEEPP BMAP, adopted in 2013, covers the watershed that contributes to the St. Lucie Estuary. A formal 5-Year Review of the BMAP was submitted to the Florida Legislature and Governor in June 2018. The BMAP was updated to meet new requirements outlined in Executive Order 19-12 in January 2020. |
| **Alafia River Basin** | Adopted March 2014 | FC/TN/TP/DO | The BMAP, adopted in 2014 and in its third year of implementation, is currently being reviewed for any necessary updates. |
| **Manatee River Basin** | Adopted March 2014 | FC/TN/TP/DO | The BMAP, adopted in 2014 and in its third year of implementation, is currently being reviewed for any necessary updates. |
| **Orange Creek – Phase 2** | Adopted July 2014; amended July 2019 | TN/TP/FC | The BMAP, adopted in 2014, was revised and amended in July 2019 to add information on sources and allocations. |
| **Upper Oklawaha River Basin – Phase 2** | Adopted July 2014, amended July 2019 | TP | The BMAP, adopted in 2014, was revised and amended in July 2019 to add information on sources and allocations. |
| **Lake Okeechobee Basin** | Adopted December 2014; updated January 2020 | TP | The NEEPP BMAP, adopted in 2014, covers the nine subwatersheds comprising the Lake Okeechobee Watershed. The BMAP was updated to meet new requirements outlined in Executive Order 19-12 in January 2020. |

| BMAP | BMAP Status | Parameter(s) Addressed | Implementation Status |
|---|---|---|---|
| **Silver Springs Group and Silver River** | Pending | $NO_3$ | The BMAP was updated and adopted in June 2018 to meet new requirements as outlined in the Florida Springs and Aquifer Protection Act of 2016, and is currently under administrative challenge. |
| **Upper Wakulla River and Wakulla Springs** | Adopted June 2018 | $NO_3$ | The BMAP, which was revised to meet the requirements of the Florida Springs and Aquifer Protection Act of 2016, was adopted on June 30, 2018. |
| **Wekiva River, Rock Springs Run, and Little Wekiva Canal** | Pending | $NO_3$/TP/DO | The BMAP was updated and adopted in June 2018 to meet new requirements outlined in the Florida Springs and Aquifer Protection Act of 2016, and is currently under administrative challenge. |
| **Rainbow Springs and Rainbow Run** | Pending | $NO_3$ | The BMAP was updated and adopted in June 2018 to meet new requirements outlined in the Florida Springs and Aquifer Protection Act of 2016, and is currently under administrative challenge. |
| **Jackson Blue Spring** | Adopted June 2018 | $NO_3$ | The BMAP, which was revised to meet requirements of the Florida Springs and Aquifer Protection Act of 2016, was adopted on June 30, 2018. |
| **Volusia Blue Springs** | Pending | $NO_3$ | The BMAP was developed and adopted in June 2018 to meet new requirements outlined in the Florida Springs and Aquifer Protection Act of 2016, and is currently under administrative challenge. |
| **Kings Bay/Crystal River** | Adopted June 2018 | TN/TP/$NO_3$/$OPO_4$ | The BMAP, which was developed to meet requirements of the Florida Springs and Aquifer Protection Act of 2016, was adopted on June 30, 2018. |
| **Weeki Wachee Spring and Spring Run** | Adopted June 2018 | $NO_3$ | The BMAP, which was developed to meet requirements of the Florida Springs and Aquifer Protection Act of 2016, was adopted on June 30, 2018. |
| **Middle and Lower Suwannee River Basin** | Pending | TN | The BMAP was updated and adopted in June 2018 to meet new requirements outlined in the Florida Springs and Aquifer Protection Act of 2016, and is currently under administrative challenge. |

# Chapter 6: Groundwater Monitoring and Assessment

## Groundwater Quality Issues and Contaminants of Concern, Including Potable Water Issues

Information from public water system (PWS) sampling data (including both treated and untreated) is used to summarize the parameter categories most frequently above the primary maximum contaminant levels (MCLs) in Florida's potable supply aquifers. Parameter results are for wells, entry points into a water system, and composite samples. While individual sample results collected for this report may exceed an MCL, this does not translate directly into the exceedance reaching consumers because of (1) the compositing of several waters into a single result, or (2) averaging the subsequent sample results below the MCL.

The data evaluated are compiled from a two-year period of record (August 2017–August 2019). Data exceeding specific groundwater MCLs during this period were used to identify current issues and contaminants of concern.

**Figure 6.1** summarizes statewide findings by contaminant category. **Table 6.1** summarizes contaminant categories listing the numbers of exceedances reported for PWS from August 2017 through July 2019. Fourteen of the 29 major basins had exceedances. The contaminants of concern categories are volatile organic compounds (VOCs), synthetic organic chemicals (SOCs) (such as pesticides), nitrate, primary metals, salinity (sodium), and radionuclides. This report is limited to contaminants with potable groundwater primary MCLs.

### *VOCs*

Volatile organics can be highly mobile and persistent in groundwater, and incidences of groundwater contamination by VOCs historically have been widespread in mainly urban areas. Two systems had VOC exceedances during the current two-year reporting period. The only contaminant exceeding the MCL was carbon tetrachloride.

### *SOCs*

One system had an exceedance for bis-2-ethyl-hexyl-phthalate. The detection of this phthalate ester is frequently a byproduct of sampling or analytical procedures, but without QA documentation it is difficult to determine if the contaminant was present in groundwater.

### *Nitrate*

Elevated nitrate concentrations in groundwater are associated with inorganic fertilizers, animal waste, and domestic wastewater and residuals. Nitrate has been found at concentrations greater than the MCL of 10 mg/L in public systems. Over the past 2 years, samples from 3 systems had nitrate detections above the MCL. FDACS works with agricultural professionals to implement

BMPs in many areas of the state to reduce nitrogen loading to groundwater from agricultural operations.

### Primary Metals

Four primary metal MCL exceedances were recorded in public systems during the period of record: arsenic, mercury, lead, and cadmium.

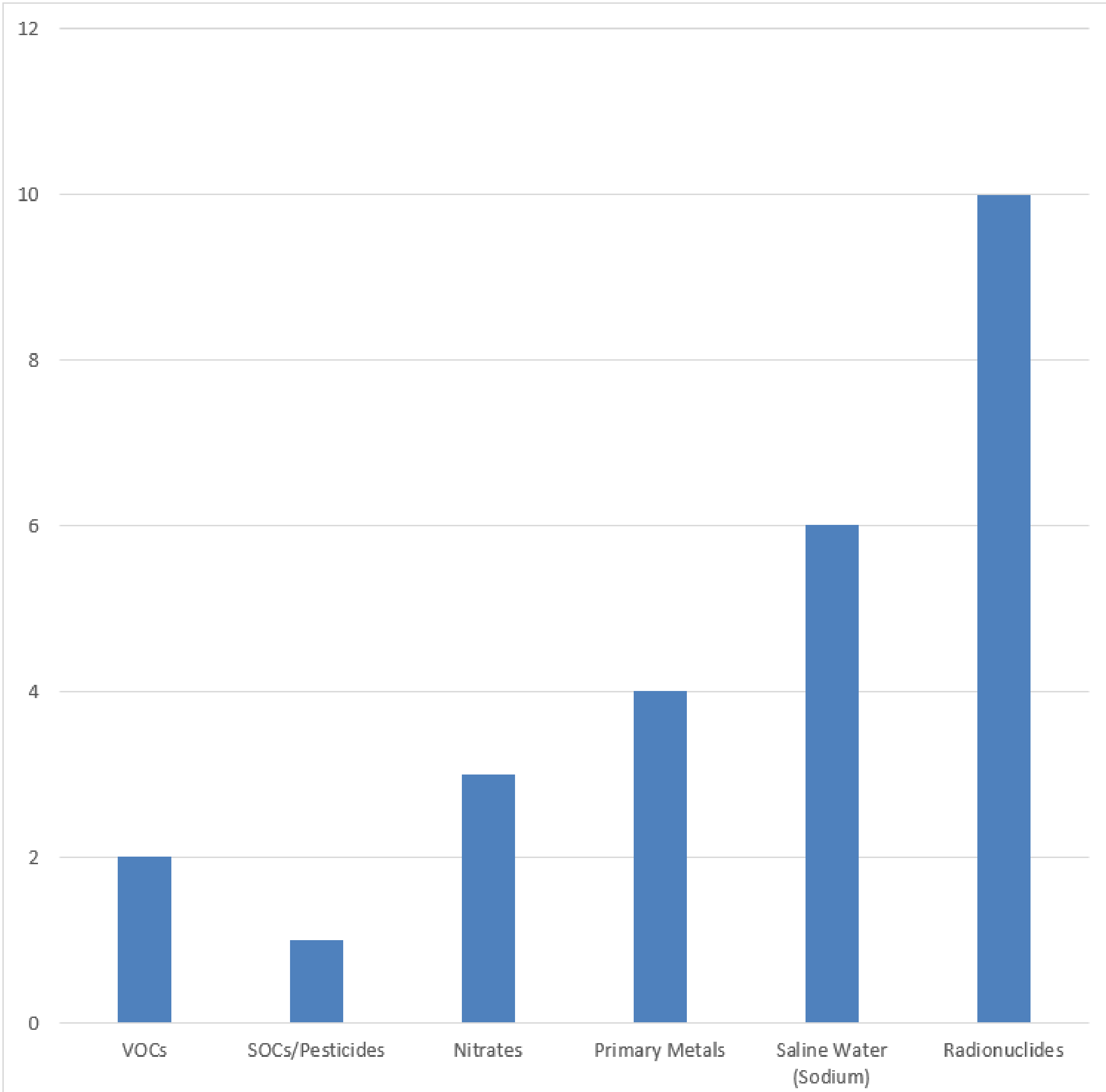
### Saline Water (Sodium)

In several areas of the state, the upward seepage of brackish water from deeper zones also has been an issue. In this report, sodium MCL exceedances were used as an indicator of possible saline water impacts.

Both sodium and chloride are potential indicators of saline water. Chlorides can also be associated with anthropogenic sources such as wastewater and fertilizer. Over the recent two-year period, a total of six sodium exceedances were documented.

### Radionuclides

In Florida, most elevated radionuclide levels are caused by natural conditions, which may result in MCL exceedances and potential health concerns. Natural radionuclides occur as trace elements in bedrock and soil from radioactive decay series, including uranium-238 (U-238) and thorium-232 (Th-232). Elevated radionuclide levels in Florida occur most frequently in phosphate mineral deposits that are common in some areas of the state. Radionuclide categories with MCL exceedances in groundwater samples from PWS include combined radium-226 and 228, combined uranium, and gross alpha. A total of 10 exceedances occurred in the two-year reporting period.




**Number of Exceedances (period of record August 2017–July 2019)**

**Figure 6.1. Statewide summary of PWS with primary MCL exceedances reported in the recent two-year period**

## Table 6.1. Summary of recent exceedances of primary groundwater standards in treated and untreated samples from groundwater systems

**Contaminant Categories and Number of Water Systems with Samples Exceeding Primary Standards (period of record August 2017–July 2019)**

| Basin–Aquifer | VOCs in PWS | SOCs/Pesticides in PWS | Nitrate in PWS | Primary Metals in PWS | Saline Water (Sodium) in PWS | Radionuclides in PWS |
|---|---|---|---|---|---|---|
| Charlotte Harbor–Intermediate Aquifer | 0 | 0 | 0 | 0 | 1 | 0 |
| Choctawhatchee–St. Andrew–Floridan Aquifer | 0 | 0 | 0 | 1 | 0 | 0 |
| Fisheating Creek–Floridan Aquifer | 0 | 0 | 1 | 0 | 0 | 0 |
| Indian River Lagoon–Floridan Aquifer | 0 | 0 | 0 | 0 | 1 | 0 |
| Kissimmee River–Floridan Aquifer | 0 | 0 | 1 | 0 | 0 | 0 |
| Lake Worth Lagoon–Palm Beach Coast–Surficial Aquifer | 0 | 0 | 0 | 0 | 1 | 0 |
| Lower St. Johns–Floridan Aquifer | 1 | 0 | 0 | 0 | 0 | 0 |
| Middle St. Johns–Floridan Aquifer | 0 | 0 | 0 | 0 | 1 | 0 |
| Upper St. Johns–Floridan Aquifer | 0 | 0 | 0 | 0 | 1 | 0 |
| Ocklawaha–Floridan Aquifer | 0 | 0 | 1 | 1 | 0 | 0 |
| Sarasota Bay–Peace–Myakka–Surficial Aquifer, Floridan Aquifer, Intermediate Aquifer | 0 | 0 | 0 | 0 | 1 | 5 |
| Springs Coast–Floridan Aquifer | 0 | 1 | 0 | 0 | 0 | 0 |
| Suwannee–Floridan Aquifer | 0 | 0 | 0 | 0 | 0 | 1 |
| Tampa Bay Tributaries–Floridan Aquifer | 1 | 0 | 0 | 2 | 0 | 4 |
| **Statewide Summary—Aug. 2017 – July 2019** | **2** | **1** | **3** | **4** | **6** | **10** |

## Summary of Groundwater Contaminant Sources

EPA's Source Water Assessment guidance lists a range of potential groundwater contaminant sources that states may evaluate in their source water assessments. DEP's 2004 Florida Source Water Assessment identified the top five potential sources of contamination in Florida as (1) underground storage tanks (not leaking), (2) gasoline service stations (including historical gas stations), (3) municipal sanitary waste treatment and disposal (commercial, domestic, and industrial waste), (4) known contamination sites/plumes (equivalent to DEP's delineated areas), and (5) drycleaning facilities. Several of these sources commonly have been the focus of waste cleanup and monitoring activities in Florida.

However, there are also instances where groundwater has been degraded as the result of nonpoint activities. This section discusses the most significant groundwater degradation sources, based on waste cleanup, monitoring, and restoration actions undertaken by DEP and other agencies concerned with groundwater quality.

### *Petroleum Facilities*

DEP's Storage Tank Contamination Monitoring (STCM) Database contains information on all storage tank facilities registered with DEP and tracks information about active storage tanks, storage tank history, and petroleum cleanup activity. Currently, the database lists approximately 37,000 registered petroleum storage tank facilities in Florida that have reported contaminant discharges. DEP has addressed almost half (18,000) of these to date. Petroleum sites and petroleum problems are concentrated in the most populated areas of the state and along major transportation corridors. The main petroleum constituents found in groundwater are benzene, toluene, ethylbenzene, xylenes, and methyl tert-butyl ether.

Florida's Petroleum Cleanup Programs carry out the technical oversight, management, and administrative activities necessary to prioritize, assess, and cleanup sites contaminated by petroleum and petroleum product discharges from stationary petroleum storage systems. Sites include those eligible for state-funded cleanup, as well as nonprogram or voluntary cleanup sites funded by responsible parties.

### *Drycleaning Solvent Facilities*

Approximately 1,400 drycleaning facilities (mainly retail) have signed up for contaminant cleanup eligibility under DEP's Drycleaning Solvent Cleanup Program because of evidence of contamination. Of those, 236 sites are being assessed actively and may be under remedial action, while 194 sites have been cleaned up. The remaining sites await funding. Drycleaning solvent constituents (tetrachloroethene, trichloroethene, dichloroethenes, and vinyl chloride) are among the most mobile and persistent contaminants in the environment.

The Florida Legislature established a state-funded program, administered by DEP, to clean up properties contaminated by drycleaning facility or wholesale supply facility operations

(Chapter 376, F.S.). The drycleaning industry sponsored the statute to address environmental, economic, and liability issues resulting from drycleaning solvent contamination. The program limits the liability of the owner, operator, and real property owner of drycleaning or wholesale supply facilities for cleaning up drycleaning solvent contamination, if the parties meet the eligibility conditions stated in the law.

### Waste Cleanup and Monitoring Sites

DEP's Waste Cleanup Program maintains lists of contamination sites for various programs. These include the federal Superfund Program (authorized under the Comprehensive Environmental Response Compensation and Liability Act [CERCLA]), state-funded cleanup sites, and contaminated sites that undergo cleanup by potentially responsible parties (PRPs). There are currently 103 active federal and state waste cleanup sites, including landfills, dumps, wood preserving waste, industrial solvent disposal, electroplaters, petroleum, pesticides, waste oil disposal, and drycleaners. There are approximately 1,700 sites on DEP's list of currently open PRP sites. Many of the sites have documented groundwater contamination.

### Nonpoint Sources

Sometimes, degraded groundwater quality is associated with multiple sources or land use practices in an area rather than a single contaminant source. The cumulative effect of human activities through leaching from nonpoint pollution sources can create groundwater quality problems. In urban areas, groundwater may receive contaminants from a variety of sources, including residential septic systems, leaking sewer lines, urban stormwater, residential fertilizers, pesticide applications, and pet waste. In more rural areas, significant nonpoint sources can include fertilizers and pesticides used on agricultural fields, animal wastes from pastures and confined animal-feeding operations, wastewater application sites, and road and utility rights-of-way. The magnitude of the impacts depends on the vulnerability of the groundwater resource. Groundwater is particularly vulnerable in karst (limestone) areas, where discharges can have a direct, unfiltered pathway to the drinking water resource via sinkholes.

Nitrate-nitrogen is the most common nonpoint source contaminant found in Florida's groundwater at concentrations exceeding the MCL. Most nitrate exceedances occur in rural agricultural areas. Agricultural BMPs promulgated to agricultural producers by the FDACS Office of Agricultural Water Policy (OAWP) can help reduce nitrogen loading to groundwater from these activities. FDACS currently has BMP manuals for citrus, sod, nurseries, specialty fruit and nut crops, vegetable and agronomic crops, cow/calf, dairy, poultry, equine, and state-imperiled wildlife. The Florida Forest Service promulgates the BMP manual for silviculture production activities.

## Groundwater–Surface Water Interaction

### Setting and Pathways

Florida's surface waters depend on groundwater contributions. For example, in many areas surface water flows into groundwater through sinkholes or reversing springs. Spring-fed stream systems can depend almost entirely on groundwater discharge. Canals also can contain mostly groundwater. Other streams and lakes may receive over half of their total inflows via groundwater seepage, and natural estuaries rely on groundwater seepage as a significant source of fresh water. In areas where the Floridan aquifer system is near the surface, and in the southern parts of the state where porous limestone is present near the surface, conduit systems in carbonate aquifers efficiently deliver groundwater to streams and canals at high rates. In other areas of the state, groundwater discharge occurs as seepage from the surficial aquifer system.

### Groundwater Influence on Impaired Surface Waters

Nutrients, DO, and iron are the groundwater parameters most likely to influence water quality in impaired or potentially impaired surface waters.

In contrast, nutrients and salinity are the most significant water quality concerns facing Florida's springs. **Table 6.2** lists frequently sampled springs, including Florida OFS and the recent results for some key water quality parameters.

#### Nutrients

Excessive nutrient enrichment causes the impairment of many surface waters, including springs. Nitrogen (N) and phosphorus (P) are the two major nutrient groups monitored. Both are essential for plant life, including the growth of algae.

## Table 6.2. Median concentrations of selected parameters in frequently monitored springs (2018–19)

**Notes:** Nitrate concentrations shown with an asterisk and in boldface type exceed DEP's proposed nitrate criterion for spring vents; phosphorus concentrations shown with an asterisk and in boldface type are higher than the lowest algal growth–based threshold from research (Stevenson et al. 2007).

| Basin | Spring Name | Associated Spring Group | Nitrate (mg/L) | TP (mg/L) | DO (mg/L) | Specific Conductance (µS/cm) | Sodium (mg/L) |
|---|---|---|---|---|---|---|---|
| **Apalachicola–Chipola** | Jackson Blue Spring | | **3.7*** | 0.025 | 7.29 | 278 | 1.8 |
| **Choctawhatchee–St. Andrew** | Cypress Spring | Holmes Creek | **0.36*** | 0.024 | 4.83 | 213 | 4.3 |
| **Choctawhatchee–St. Andrew** | Gainer Spring #1C | Gainer | 0.20 | 0.014 | 1.64 | 145 | 1.9 |
| **Choctawhatchee–St. Andrew** | Morrison Spring | | 0.20 | 0.023 | 3.77 | 230 | 1.9 |
| **Middle St. Johns** | Alexander Spring | | 0.038 | **0.049*** | 2.5 | 1,133 | 134 |
| **Middle St. Johns** | Apopka Spring | | **3.30*** | **0.038*** | 2.69 | 285 | 7.0 |
| **Middle St. Johns** | DeLeon Spring | | **0.75*** | **0.065*** | 0.98 | 874 | 86 |
| **Middle St. Johns** | Fern Hammock Springs | | 0.11 | **0.027*** | 7.01 | 117 | 2.4 |
| **Middle St. Johns** | Gemini Springs | | **1.38*** | **0.098*** | 0.86 | 2,062 | 268 |
| **Middle St. Johns** | Juniper Spring | | 0.09 | **0.032*** | 6.97 | 121 | 2.4 |
| **Middle St. Johns** | Rock Spring | | **1.27*** | **0.086*** | 0.97 | 283 | 6.1 |
| **Middle St. Johns** | Salt Spring (Marion) | | 0.11 | 0.019 | 3.43 | 6,337 | 1054 |
| **Middle St. Johns** | Silver Glen Springs | | 0.05 | **0.033*** | 3.31 | 1,871 | 234 |
| **Middle St. Johns** | Volusia Blue Spring | | **0.49*** | **0.081*** | 0.87 | 2,294 | 323 |
| **Middle St. Johns** | Wekiwa Spring | | **1.19*** | **0.119*** | 0.48 | 373 | 9.77 |
| **Ochlockonee–St. Marks** | Wakulla Spring | | **0.40*** | **0.030*** | 1.64 | 309 | 5.6 |
| **Ocklawaha** | Silver Spring Main | Silver | **1.23*** | **0.048*** | 2.19 | 496 | 7.0 |
| **Springs Coast** | Chassahowitzka Spring Main | Chassa-howitzka | **0.55*** | 0.023 | 5.06 | 1306 | 147 |
| **Springs Coast** | Homosassa Spring #1 | Homosassa | **0.73*** | 0.018 | 3.98 | 4,425 | 692 |
| **Springs Coast** | Hunter Spring | Kings Bay | **0.66*** | 0.023 | 5.15 | 463 | 41 |
| **Springs Coast** | Tarpon Hole Spring | Kings Bay | 0.22 | **0.046*** | 2.15 | 2,562 | 329 |
| **Springs Coast** | Weeki Wachee Main Spring | Weeki Wachee | **0.90*** | 0.007 | 1.82 | 351 | 5.5 |
| **Suwannee** | Columbia Spring | | **0.38*** | **0.122*** | 2.65 | 290 | 6.2 |
| **Suwannee** | Devil's Eye Spring (Gilchrist) | Ginnie–Devil's | **2.2*** | **0.040*** | 4.22 | 406 | 3.9 |
| **Suwannee** | Falmouth Spring | | **1.50*** | **0.064*** | 0.80 | 395 | 3.3 |
| **Suwannee** | Fanning Springs | | **6.3*** | **0.073*** | 2.21 | 506 | 5.8 |

| Basin | Spring Name | Associated Spring Group | Nitrate (mg/L) | TP (mg/L) | DO (mg/L) | Specific Conductance (µS/cm) | Sodium (mg/L) |
|---|---|---|---|---|---|---|---|
| **Suwannee** | Gilchrist Blue Spring | | **2.5*** | **0.033*** | 4.67 | 384 | 3.3 |
| **Suwannee** | Hornsby Spring | | **0.65*** | **0.089*** | 0.53 | 415 | 6.9 |
| **Suwannee** | Ichetucknee Head | Ichetucknee | **0.84*** | **0.026*** | 4.35 | 337 | 2.6 |
| **Suwannee** | Lafayette Blue Spring | | **1.8*** | **0.123*** | 2.96 | 282 | 4.8 |
| **Suwannee** | Madison Blue Spring | | **1.95*** | **0.042*** | 2.08 | 279 | 3.1 |
| **Suwannee** | Manatee Spring | | **2.73*** | **0.030*** | 1.43 | 504 | 4.4 |
| **Suwannee** | Peacock Springs | | **3.39*** | **0.052*** | 2.77 | 390 | 3.1 |
| **Suwannee** | Poe Spring | | 0.34 | **0.081*** | 0.94 | 414 | 6.2 |
| **Suwannee** | Treehouse Spring | | **0.44*** | **0.117*** | 2.24 | 320 | 6.4 |
| **Suwannee** | Troy Spring | | **1.47*** | **0.103*** | 2.75 | 261 | 3.4 |
| **Suwannee** | Wacissa Spring #2 | Wacissa | **0.41*** | **0.042*** | 3.26 | 268 | 3.4 |
| **Tampa Bay Tributaries** | Lithia Springs Major | | **2.49*** | **0.066*** | 2.22 | 572 | 18.9 |
| **Withlacoochee** | Rainbow Spring #1 | Rainbow | **2.62*** | **0.028*** | 7.05 | 158 | 3.1 |

*Nitrogen*

Nitrogen forms the backbone of several ions, including nitrate and nitrite. These ions are found extensively in the environment. The nitrate ion occurs in the highest concentrations in groundwater and springs. While nitrate and nitrite are frequently analyzed and reported together as one concentration (nitrate-nitrite nitrogen), the nitrite contribution is always significantly less, generally by an order of magnitude. The majority of nitrate in groundwater and springs comes from anthropogenic sources such as inorganic fertilizer, domestic wastewater, and animal waste. Elevated nitrogen concentrations are of the greatest concern in clear surface water systems, such as springs and some rivers and estuaries, where phytoplankton in the water column and attached algae can cause biological imbalances.

Historically, nitrogen was only a minor constituent of spring water, and typical nitrate concentrations in Florida were less than 0.2 mg/L until the early 1970s. Since then, nitrate concentrations greater than 1 mg/L have been found in many springs. With sufficient phosphorus in the water column, seemingly low nitrogen concentrations can lead to the degradation of biological systems caused by the overgrowth of algae and sometimes aquatic plants.

Research into the relationship of nutrients to algal growth in springs has provided some science-based values that can serve as thresholds. In a DEP-funded study, Michigan State University researchers found that species reductions occurred at nitrogen concentrations below 0.591 mg/L for the algal genus *Vaucheria* spp. and below 0.250 mg/L for the more prevalent *Lyngbya wollei* (Stevenson et al. 2007). DEP's spring run–related TMDLs for the Wekiva River and Rock Springs Run identified a reference threshold of 0.286 mg/L to reduce the overall periphyton biomass concentration to an acceptable level. The TMDL developed for the Suwannee River and several springs provided a statistical analysis of the range of nitrate concentrations above which periphyton growth would occur.

Based on this combined body of research, DEP adopted a surface water standard for spring vents of 0.35 mg/L nitrate-nitrite ($NO_3 + NO_2$) as an annual geometric mean, not to be exceeded more than once in any three-calendar-year period (Chapter 62-302.530(47)(b), F.A.C.). More than 75 % (30 out of 39) of the springs listed in **Table 6.2** have $NO_3$-$NO_2$ concentrations greater than the threshold. The springs with the highest nitrate concentrations listed in the table are located in agricultural areas of the Suwannee, Middle St. Johns, Apalachicola, and Withlacoochee Basins. The lowest concentrations in springs are found in conservation lands and forestlands of the Upper Middle St. Johns Basin and the Choctawhatchee–St. Andrew Basin, where there are few sources of nitrate.

*Phosphorus*

Phosphorus, the other essential nutrient governing algal growth in aquatic systems, can originate from natural or anthropogenic sources. In many parts of the state, naturally occurring phosphorus is a significant source of phosphate in both surface water and groundwater. Anthropogenic sources of phosphorus include fertilizer, animal waste, human wastewater and biosolids, and industrial wastewater effluent. Because phosphorus originates from multiple sources, it is difficult to discern whether the phosphorus found in groundwater and springs is naturally occurring or comes from human activities.

Phosphorus has a critical concentration that is much lower than the nitrogen threshold. Stevenson et al. (2007) found that when nitrogen was present at elevated concentrations, the phosphorus thresholds for *Vaucheria* spp. and *L. wollei* were 0.026 and 0.033 mg/L, respectively. Ambient phosphorus concentrations in groundwater in springshed recharge areas are frequently higher than the algae-based thresholds offered by Stevenson et al. Of the springs listed in **Table 6.2,** 77 % (30 out of 39) have phosphorus concentrations greater than the lower algal-based threshold identified in Stevenson's work (0.026 mg/L). The springs listed in the table with the highest phosphorus concentrations are in the Middle St. Johns and Suwannee Basins.

**DO**

Low DO is a normal characteristic of groundwater. This is because the primary source of oxygen in water is from dissolution from the atmosphere, and groundwater is not in prolonged contact with air. In instances where groundwater contributions to surface waterbodies are significant, low DO is a typical consequence, and many DO exceedances in Florida waters are attributable to groundwater discharge.

Springs receive their water from the Upper Floridan aquifer, which is recharged mainly by precipitation. Springs with relatively shallow flow systems respond rapidly to precipitation events, and these springs have chemical characteristics that are more similar to those of rainwater than to deeper springs, whose discharge water has had a longer residence time in the aquifer material. Thus, DO concentration provides useful information about the relative age of water coming from springs. Rainwater and "newer" groundwater typically have higher DO levels, and springs with high DO levels are most vulnerable to surface water quality impacts from nearby sources.

In **Table 6.2**, springs with the highest DO concentrations include Jackson Blue Spring, Rainbow Spring #1, Fern Hammock Spring, and Juniper Spring. These all have contributing conduit systems that are shallow and capable of rapidly assimilating rainfall. Jackson Blue Spring and Rainbow Spring #1 are both located in agricultural areas and have among the highest nitrate concentrations of all springs being monitored. Fern Hammock and Juniper Spring are situated in a large conservation area, which is why their nitrate concentrations are lower.

Conversely, the springs with lower DO obtain a large portion of their flow from "older," potentially deeper groundwater with potentially longer flow pathways from groundwater recharge areas. Springs with the lowest DO in **Table 6.2** include Volusia Blue, Wekiwa, and

Rock Springs in the Middle St. Johns Basin and Lafayette Blue and Troy Spring in the Suwannee Basin.

### Iron

Iron is another groundwater constituent that occurs naturally at high concentrations because of the leaching of ferric iron from iron-rich clay soils and sediment. Iron in the environment also has an affinity for organic materials. Streams with high iron concentrations typically have a high to moderate groundwater component, low DO, and high dissolved organic carbon (DOC) content. Many of the iron exceedances in surface waters in Florida are caused by this set of natural conditions.

### Specific Conductance

Specific conductance can be an indicator of groundwater discharge to surface waters. In some basins, the specific conductance of groundwater discharging to surface water (quite often via springs) is higher than 1,000 µS/cm and may exceed the specific conductance standard (50 % above background, or 1,275 µS/cm, whichever is higher) for fresh surface waters.

### Salinity

Although most springs in Florida are considered fresh waters, springs can be characterized by their salinity analyte levels and mineral content. Salinity analytes evaluated in this assessment include specific conductance and sodium. In some cases, changes in concentrations of these indicators may indicate drought, sea-level rise, and/or anthropogenic influences. Increasing salinity trends also can be caused by a lack of recharge during low-rainfall periods, overpumping the aquifer, or a combination of the two. Coastal springs cannot be easily evaluated for short-term salinity trends because of the tidal cycle. However, long-term increasing trends for salinity indicators in coastal springs could indicate saltwater intrusion.

Salinity trends have increased in many Florida springs. The more saline springs listed in **Table 6.2**, from recent data, include Silver Glen Spring, Salt Spring (Marion), Homosassa Spring #1, Chassahowitzka Spring Main, Volusia Blue Spring, Tarpon Hole Spring, and Alexander Spring. Of these, Silver Glen, Salt, Volusia Blue, and Alexander Springs are in a region of the Middle St. Johns Basin where a geologic fault zone along the St. Johns River provides a pathway for saline water from the Lower Floridan aquifer to migrate vertically upward (upwell) to zones intersecting these springs. In densely populated areas, groundwater withdrawals enhance this upwelling.

Along the Springs Coast, where Homosassa, Chassahowitzka, and Tarpon Hole Springs are located, salinity in springs is related to the proximity of the Gulf of Mexico. Here, salinity increases can occur during drought conditions where the aquifer gradients are lower, and the influence of groundwater withdrawals is more pronounced. The landward movement of the saline water wedge along the coastline also may be influenced by slight increases in sea level. Increases in spring salinity also influence receiving waters.

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# Appendices

## Appendix A: Selected Pesticide Analyte Detections and Exceedances

[1] Chlorpyrifos Aquatic Life Criteria: Maximum Concentration = 0.083 parts per billion (ppb)
[2] Chlorpyrifos Aquatic Life Criteria Continuous Concentration = 0.041 ppb. Analytes in **bold** indicate a positive detection.
Detected in >10 % of samples collected.
Exceeded an aquatic life benchmark value.

Benchmark values from: https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/aquatic-life-benchmarks-and-ecological-risk%23benchmarks%09
https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table.

**Notable Detections**
**Pesticide**

| | |
|---|---|
| Aldicarb | 1 detect above invert chronic toxicity threshold. |
| Atrazine | 1 detect above fish chronic toxicity threshold; 2 detects above invertebrate chronic toxicity threshold. |
| Imazapyr | 1 detect above vascular plant acute toxicity threshold. |
| Imidacloprid | 11 detects above invert acute toxicity threshold; 108 detects above aquatic invertebrate chronic toxicity threshold. |
| Malathion | 1 detect above invert acute toxicity threshold; 1 detect above invertebrate chronic toxicity threshold. |

| Pesticide Name | Pesticide Class | Number Detects | Number Samples | Number Exceeding | MDL (µg/L) | Range (µg/L) | Fish Acute (µg/L) | Fish Chronic (µg/L) | Invert Acute (µg/L) | Invert Chronic (µg/L) | Algae Acute (µg/L) | Plants Acute (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2,4,5-T | Herbicide | 0 | 4 | - | 0.004 | - | - | - | - | - | - | - |
| 2,4-D | **Herbicide** | **134** | **230** | **0** | 0.002 | 0.0021 – 2.5 | > 40,800 | 23,600 | 12,500 | 16,050 | 3,880 | 299.2 |
| 2,4-DB | Herbicide | 0 | 4 | - | 0.008 | - | - | - | - | - | - | - |
| 3-Hydroxycarbofuran | Degradate | 0 | 209 | - | 0.002 | - | - | - | - | - | - | - |
| Acetochlor | **Herbicide** | **7** | **208** | **0** | 0.00024 | 0.00025 – 1.1 | 190 | 130 | 4,100 | 22.1 | 1.43 | 3.4 |
| Acifluorfen | Herbicide | 0 | 4 | - | 0.002 | - | - | - | - | - | - | - |
| Alachlor | **Herbicide** | **4** | **208** | **0** | 0.00025 | 0.001 – 0.014 | 900 | 187 | 1,250 | 110 | 1.64 | 2.3 |
| Aldicarb | **Insecticide** | **4** | **209** | **1** | 0.020 | 0.04 – 2.5 | 26 | 0.46 | 10 | 1 | > 50,000 | > 88,700 |
| Aldicarb Sulfone | **Degradate** | **6** | **209** | **-** | 0.002 | 0.004 – 0.25 | 21,000 | - | 140 | - | - | - |
| Aldicarb Sulfoxide | **Degradate** | **5** | **209** | **-** | 0.002 | 0.004 – 0.25 | 3,570 | - | 21.5 | - | - | - |
| Aldrin | Insecticide | 0 | 210 | - | 0.0039 | - | - | - | - | - | - | - |
| Alpha BHC | Degradate | 0 | 210 | - | 0.002 | - | - | - | - | - | - | - |
| Alpha Chlordane | Degradate | 0 | 210 | - | 0.001 | - | - | - | - | - | - | - |
| Ametryn | **Herbicide** | **49** | **208** | **0** | 0.00031 | 0.00046 – 0.0053 | 1,800 | 700 | 14,000 | 240 | 3.67 | 10 |
| AMPA | **Degradate** | **85** | **210** | **0** | 0.1 | 0.11 – 5.7 | 249,500 | - | 341,500 | - | - | - |
| Atrazine | **Herbicide** | **179** | **208** | **2** | 0.00023 | 0.00025 – 36 | 2,650 | 5 | 360 | 60 | 1 | 4.6 |
| Atrazine desethyl | **Degradate** | **87** | **208** | **0** | 0.0014 | 0.0015 – 0.98 | - | 300 | 330 | 30 | 390 | - |
| Azinphos methyl | Insecticide | 0 | 208 | - | 0.0021 | 0.0016 | - | - | - | - | - | - |

| Pesticide Name | Pesticide Class | Number Detects | Number Samples | Number Exceeding | MDL (µg/L) | Range (µg/L) | Fish Acute (µg/L) | Fish Chronic (µg/L) | Invert Acute (µg/L) | Invert Chronic (µg/L) | Algae Acute (µg/L) | Plants Acute (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bentazon | Herbicide | 130 | 230 | 0 | 0.0008 | 0.00095 – 0.093 | >95,000 | 9,830 | 31,150 | 101,200 | 4,500 | 5,350 |
| Beta-BHC | Degradate | 0 | 220 | - | 0.004 | - | - | - | - | - | - | - |
| Bromacil | Herbicide | 66 | 208 | 0 | 0.00047 | 0.00051 – 5.2 | 18,000 | 3,000 | 60,500 | 8,200 | 6.8 | 45 |
| Butylate | Herbicide | 2 | 208 | 0 | 0.00037 | 0.00045 – 0.00047 | 105 | 300 | 5,500 | - | - | 4,600 |
| Carbaryl | Insecticide | 6 | 209 | 0 | 0.002 | 0.0025 – 0.25 | 110 | 6 | 0.85 | 0.5 | 660 | - |
| Carbofuran | Insecticide | 0 | 209 | - | 0.002 | - | - | - | - | - | - | - |
| Carbophenothion | Insecticide | 0 | 210 | - | 0.004 | - | - | - | - | - | - | - |
| Chlordane | Insecticide | 30 | 208 | 0 | 0.0026 | 0.0028 – 0.014 | 22 | 7 | 31 | 10 | 338 | - |
| Chlorothalonil | Fungicide | 0 | 210 | - | 0.0021 | 0.0051 | 5.25 | 3 | 1.8 | 0.6 | 6.8 | 630 |
| Chlorpyrifos ethyl | Insecticide | 18 | 208 | 0 | 0.00024 | 0.00028 – 0.017 | 0.9[1] | 0.57[2] | 0.05[1] | 0.04[2] | 140 | - |
| Chlorpyrifos methyl | Insecticide | 0 | 208 | - | 0.000096 | - | 7 | | 0.085 | - | - | - |
| Cyanazine | Herbicide | 0 | 208 | - | 0.00048 | - | - | - | - | - | - | - |
| Cypermethrin | Insecticide | 1 (IY) | 210 | 0 | 0.022 | 0.03 | 0.195 | 0.14 | 0.21 | 0.069 | - | - |
| DDD | Herbicide | 0 | 210 | - | 0.0031 | - | - | - | - | - | - | - |
| DDE | Herbicide | 0 | 210 | - | 0.0031 | - | - | - | - | - | - | - |
| DDT | Herbicide | 0 | 210 | - | 0.0031 | - | - | - | - | - | - | - |
| Delta-BHC | Degradate | 0 | 210 | - | 0.004 | - | - | - | - | - | - | - |
| Demeton | Insecticide | 0 | 208 | - | 0.0002 | - | - | - | - | - | - | - |
| Diazinon | Insecticide | 8 | 208 | 0 | 0.00012 | 0.00013 – 0.00069 | 45 | < 0.55 | 0.105 | 0.17 | 3,700 | - |
| Dicamba | Herbicide | 0 | 4 | - | 0.08 | - | - | - | - | - | - | - |
| Dichlorprop | Herbicide | 1 | 4 | 0 | 0.004 | 0.0043 | 500 | 1,700 | - | -- | 7,000 | 63 |
| Dicofol | Insecticide | 0 | 210 | - | 0.030 | - | - | - | - | - | - | - |
| Dieldrin | Insecticide | 4 | 210 | 0 | 0.004 | 0.0097 – 0.015 | 2.5 | 11 | 4.5 | 0.7 | - | - |
| Dimethenamid | Herbicide | 3 | 31 | 0 | 0.000095 | 0.00195 – 0.0075 | 3,150 | 300 | 6,000 | 1,020 | 14 | 8.9 |
| Dinoseb | Herbicide | 0 | 4 | - | 0.004 | - | - | - | - | - | - | - |
| Disulfoton | Insecticide | 1 | 208 | 0 | **0.00048** | 0.006 | 19.5 | 3 | 1.95 | 0.01 | - | - |
| Dithiopyr | Herbicide | 16 | 30 | 0 | 0.000095 | 0.000098 – 0.00091 | 235 | 56 | > 850 | 81 | 20 | - |
| Diuron | Herbicide | 106 | 230 | 0 | 0.002 | 0.0021 – 0.76 | 200 | 26 | 80 | 200 | 2.4 | 15 |
| Endosulfan I | Insecticide | 0 | 210 | - | 0.004 | - | - | - | - | - | - | - |
| Endosulfan II | Insecticide | 0 | 210 | - | 0.004 | - | - | - | - | - | - | - |
| Endosulfan sulfate | Degradate | 0 | 210 | - | 0.002 | - | - | - | - | - | - | - |

| Pesticide Name | Pesticide Class | Number Detects | Number Samples | Number Exceeding | MDL (µg/L) | Range (µg/L) | Fish Acute (µg/L) | Fish Chronic (µg/L) | Invert Acute (µg/L) | Invert Chronic (µg/L) | Algae Acute (µg/L) | Plants Acute (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Endothall** | Herbicide | 0 | 137 | - | 0.1 | - | - | - | - | - | - | - |
| **Endrin** | Insecticide | 0 | 210 | - | 0.002 | - | - | - | - | - | - | - |
| **Endrin aldehyde** | Degradate | 0 | 210 | - | 0.002 | - | - | - | - | - | - | - |
| **Endrin ketone** | Degradate | 0 | 210 | - | 0.002 | - | - | - | - | - | - | - |
| **EPTC** | **Herbicide** | **1** | **208** | **0** | **0.0012** | 0.012 | 7,000 | 40 | 3,250 | 800 | 1,400 | 5,600 |
| **Ethion** | **Insecticide** | **2** | **208** | **0** | **0.00014** | 0.0043 – 0.0094 | 36.5 | - | 0.028 | - | - | - |
| **Ethoprop** | **Insecticide** | **3** | **193** | **0** | **0.000094** | 0.0026 – 0.0048 | 150 | 24 | 22 | 0.8 | 8,400 | - |
| **Fenamiphos** | Insecticide | 0 | 218 | - | 0.00025 | - | - | - | - | - | - | - |
| **Fenuron** | **Herbicide** | **9** | **230** | **0** | **0.016** | 0.018 – 0.11 | 8,800 | 1,000 | 1,847 | - | 400 | - |
| **Fipronil** | **Insecticide** | **60** | **208** | **0** | **0.00024** | 0.00025 – 0.007 | 41.5 | 2.2 | 0.11 | 0.011 | 140 | > 100 |
| **Fipronil desulfinyl** | **Degradate** | **2** | **30** | **0** | 0.00013 | 0.00022 – 0.00068 | 10 | 0.54 | 100 | 10.31 | 140 | > 100 |
| **Fipronil sulfide** | **Degradate** | **78** | **208** | **0** | 0.00014 | 0.00015 – 0.0064 | 41.4 | 6.6 | 1.07 | 0.11 | 140 | - |
| **Fipronil sulfone** | **Degradate** | **89** | **208** | **0** | 0.00014 | 0.00015 – 0.015 | 12.5 | 0.67 | 0.36 | 0.037 | 140 | > 100 |
| **Fluridone** | **Herbicide** | **126** | **230** | **0** | 0.0004 | 0.00044 – 1 | 2,550 | 480 | 2,600 | 600 | 500 | - |
| **Fonofos** | Insecticide | 0 | 208 | - | 0.00019 | - | - | - | - | - | - | - |
| **Gamma-BHC** | Byproduct | 0 | 210 | - | 0.004 | - | - | - | - | - | - | - |
| **Gamma-Chlordane** | Byproduct | 0 | 210 | - | 0.001 | - | - | - | - | - | - | - |
| **Glufosinate** | Herbicide | 0 | 137 | - | 0.10 | - | - | - | - | - | - | - |
| **Glyphosate** | **Herbicide** | **89** | **210** | **0** | 0.10 | 0.12 – 180 | 21,500 | 25,700 | 26,600 | 49,900 | 12,100 | 11,900 |
| **Heptachlor** | Insecticide | 0 | 210 | - | 0.0015 | - | - | - | - | - | - | - |
| **Heptachlor epoxide** | **Degradate** | **4** | **210** | **0** | 0.0020 | 0.0023 – 0.0068 | 5.3 | 3.1 | 0.04 | 1.9 | >200,000 | - |
| **Hexazinone** | **Herbicide** | **96** | **208** | **0** | 0.00047 | 0.00051 – 0.51 | 137,000 | 17,000 | 75,800 | 20,000 | 7 | 37.4 |
| **Imazapyr** | **Herbicide** | **149** | **193** | **1** | 0.004 | 0.0041 – 55 | > 50,000 | 43,100 | > 50,000 | 97,100 | 12,200 | 24 |
| **Imidacloprid** | **Insecticide** | **144** | **230** | **108** | 0.002 | 0.0021 – 1.6 | 114,500 | 9,000 | 0.385 | 0.01 | >10,000 | - |
| **Linuron** | Herbicide | 0 | 230 | - | 0.004 | - | 1,500 | 5.58 | 60 | 0.09 | 13.7 | 2.5 |
| **Malathion** | **Insecticide** | **16** | **208** | **1** | 0.00033 | 0.00035 – 0.190 | 2.05 | 8.6 | 0.049 | 0.06 | 2,040 | 24,000 |
| **MCPA** | **Herbicide** | **1** | **4** | **0** | 0.002 | 0.014 | 48,000 | 12,000 | 41,000 | 11,000 | 160 | 130 |
| **MCPP** | **Herbicide** | **40** | **230** | **0** | 0.002 | 0.0021 – 0.047 | > 46,500 | 180,000 | > 45,500 | 50,800 | 14 | 1,300 |
| **Metalaxyl** | **Fungicide** | **72** | **208** | **0** | 0.00024 | 0.032 – 0.38 | 65,000 | 9,100 | 14,000 | 1,200 | 140,000 | 85,000 |
| **Methiocarb** | Insecticide | 0 | 209 | - | 0.002 | - | - | - | - | - | - | - |
| **Methomyl** | **Insecticide** | **3** | **209** | **0** | 0.002 | 0.0026 – 0.019 | 160 | 12 | 2.5 | 0.7 | - | - |

| Pesticide Name | Pesticide Class | Number Detects | Number Samples | Number Exceeding | MDL (µg/L) | Range (µg/L) | Fish Acute (µg/L) | Fish Chronic (µg/L) | Invert Acute (µg/L) | Invert Chronic (µg/L) | Algae Acute (µg/L) | Plants Acute (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Methoxychlor** | Insecticide | 0 | 210 | - | 0.004 | - | - | - | - | - | - | - |
| **Metolachlor** | Herbicide | 137 | 209 | 0 | 0.00024 | 0.00025 – 0.57 | 1,900 | 30 | 550 | 1 | 8 | 21 |
| **Metribuzin** | Herbicide | 41 | 208 | 0 | 0.00019 | 0.0002 – 0.52 | 21,000 | < 3,000 | 2,100 | 1,290 | 8.1 | 130 |
| **Mevinphos** | Insecticide | 0 | 208 | - | 0.00024 | - | - | - | - | - | - | - |
| **Mirex** | Insecticide | 0 | 210 | - | 0.0038 | - | - | - | - | - | - | - |
| **Molinate** | Herbicide | 0 | 208 | - | 0.00028 | - | - | - | - | - | - | - |
| **Norflurazon** | **Herbicide** | **53** | **208** | **0** | 0.00048 | 0.00048 – 2.2 | 4,050 | 770 | >7,500 | 1,000 | 9.7 | 58.2 |
| **Oxadiazon** | **Herbicide** | **21** | **30** | **0** | 0.000095 | 0.00018 – 0.047 | 600 | 33 | 1,090 | 33 | 5.2 | 41 |
| **Oxamyl** | **Insecticide** | **1** | **209** | **0** | 0.002 | 0.022 | 2,100 | 500 | 90 | 27 | 120 | 30,000 |
| **Parathion ethyl** | Insecticide | 0 | 208 | - | 0.00024 | - | - | - | - | - | - | - |
| **Parathion methyl** | Insecticide | 0 | 208 | - | 0.00024 | - | - | - | - | - | - | - |
| **Pendimethalin** | **Herbicide** | **9** | **208** | **0** | 0.00093 | 0.0011 – 0.11 | 69 | 6.3 | 140 | 14.5 | 5.2 | 12.5 |
| **Permethrin** | Insecticide | 0 | 210 | - | 0.00011 | - | - | - | - | - | - | - |
| **Phorate** | Insecticide | 0 | 208 | - | 0.00024 | - | - | - | - | - | - | - |
| **Picloram** | Herbicide | 0 | 4 | - | 0.05 | - | - | - | - | - | - | - |
| **Prodiamine** | **Herbicide** | **3** | **30** | **0** | 0.00017 | 0.00074 – 0.0071 | > 6.5 | - | > 6.5 | 1.5 | - | - |
| **Prometon** | Herbicide | 18 | 208 | 0 | 0.00085 | 0.00093 – 0.0044 | 6,000 | 19,700 | 12,850 | 3,450 | 98 | - |
| **Prometryn** | **Herbicide** | **5** | **208** | **0** | 0.00019 | 0.00021 – 0.00096 | 1,455 | 620 | 4,850 | 1,000 | 1.04 | 11.9 |
| **Propoxur** | Insecticide | 0 | 209 | - | 0.002 | - | - | - | - | - | - | - |
| **Pyraclostrobin** | **Fungicide** | **8** | **227** | **0** | 0.002 | 0.0022 – 0.081 | 3.1 | 2.35 | 7.85 | 4 | 1.5 | 1,197 |
| **Silvex** | Herbicide | 0 | 4 | - | 0.002 | - | - | - | - | - | - | - |
| **Simazine** | **Herbicide** | **71** | **208** | **0** | 0.00048 | 0.00053 – 0.23 | 3,200 | 60 | 500 | 40 | 6 | 67 |
| **Tebuconazole** | **Fungicide** | **6** | **30** | **0** | 0.00048 | 0.00048 – 0.0014 | 1,135 | 11 | 1,440 | 120 | 1,450 | 151 |
| **Terbufos** | **Insecticide** | **2** | **208** | **0** | 0.000094 | 0.00015 – 0.012 | 0.385 | 0.1 | 0.085 | 0.03 | > 1,850 | > 4,200 |
| **Terbuthylazine** | Herbicide | 0 | 208 | - | 0.00044 | - | 1,800 | - | 19,700 | - | - | - |
| **Toxaphene** | Insecticide | 0 | 208 | - | 0.0130 | - | 0.53 | 3.5 | 94 | 50 | 380 | - |
| **Triclopyr** | **Herbicide** | **1** | **230** | **0** | 0.0040 | 0.018 | 58,500 | - | 66,450 | - | 32,500 | - |
| **Trifluralin** | **Herbicide** | **2** | **210** | **0** | 0.0011 | 0.0015 – 0.0029 | 9.25 | 1.9 | 125.5 | 2.4 | 21.9 | 49.7 |

# Appendix B: Change Analysis Results Output

### Table B.1. Flowing water output

NT = No trend

| Trend | Type | Indicator | Statistic | DiffEst | StdError | LCB95Pct | UCB95Pct |
|---|---|---|---|---|---|---|---|
| **NT** | Statewide | Chl-*a* | Mean | -1.991414085 | 1.117183375 | -4.181053265 | 0.198225095 |
| **NT** | Statewide | CL | Mean | -19.65454215 | 13.62238125 | -46.35391877 | 7.044834478 |
| **UP** | Statewide | DO | Mean | 0.369063249 | 0.115201666 | 0.143272132 | 0.594854366 |
| **NT** | Statewide | $NO_3$-$NO_2$ | Mean | -0.042145136 | 0.042291573 | -0.125035096 | 0.040744825 |
| **DOWN** | Statewide | pHField | Mean | -0.458127767 | 0.065710231 | -0.586917454 | -0.32933808 |
| **DOWN** | Statewide | SCField | Mean | -92.83750127 | 44.69531631 | -180.4387115 | -5.236291024 |
| **NT** | Statewide | TempField | Mean | 0.051612796 | 0.14188315 | -0.226473069 | 0.329698661 |
| **DOWN** | Statewide | TKN | Mean | -0.171988877 | 0.038669881 | -0.247780451 | -0.096197303 |
| **DOWN** | Statewide | TN | Mean | -0.211890603 | 0.050157968 | -0.310198415 | -0.113582792 |
| **NT** | Statewide | TOC | Mean | 0.605098293 | 0.732048897 | -0.829691181 | 2.039887767 |
| **DOWN** | Statewide | TP | Mean | -0.081317601 | 0.012424504 | -0.105669181 | -0.05696602 |

### Table B.2. Lakes output

NT = No trend

| Trend | Type | Indicator | Statistic | DiffEst | StdError | LCB95Pct | UCB95Pct |
|---|---|---|---|---|---|---|---|
| **UP** | Statewide | Chl-*a* | Mean | 14.08399631 | 4.325882864 | 5.605421696 | 22.56257093 |
| **UP** | Statewide | DO | Mean | 0.373668169 | 0.135651343 | 0.107796423 | 0.639539915 |
| **NT** | Statewide | $NO_3$-$NO_2$ | Mean | 0.029666975 | 0.017786775 | -0.005194463 | 0.064528413 |
| **UP** | Statewide | pHField | Mean | 0.385016931 | 0.080966784 | 0.22632495 | 0.543708911 |
| **NT** | Statewide | SCField | Mean | 1.888413362 | 17.29872708 | -32.01646869 | 35.79329542 |
| **UP** | Statewide | TempField | Mean | 0.790690141 | 0.307618237 | 0.187769475 | 1.393610807 |
| **NT** | Statewide | TKN | Mean | 0.033331944 | 0.060828456 | -0.085889639 | 0.152553527 |
| **NT** | Statewide | TN | Mean | 0.063054038 | 0.058141926 | -0.050902042 | 0.177010118 |
| **DOWN** | Statewide | TOC | Mean | -1.620149796 | 0.527716616 | -2.654455357 | -0.585844235 |
| **UP** | Statewide | TP | Mean | 0.010383398 | 0.005031514 | 0.000521811 | 0.020244985 |

## Table B.3. Confined aquifer output

NT = No trend

| Trend | Type | Indicator | Statistic | DiffEst | StdError | LCB95Pct | UCB95Pct |
|---|---|---|---|---|---|---|---|
| **DOWN** | Statewide | DO | Mean | -0.905836714 | 0.294185233 | -1.482429175 | -0.329244253 |
| **NT** | Statewide | $NO_3$-$NO_2$ | Mean | 0.066773872 | 0.090662174 | -0.110920724 | 0.244468467 |
| **DOWN** | Statewide | pHField | Mean | -0.119089607 | 0.053380412 | -0.223713292 | -0.014465921 |
| **NT** | Statewide | SC | Mean | 76.91928896 | 131.6133622 | -181.0381608 | 334.8767387 |
| **NT** | Statewide | Temp | Mean | 0.109639682 | 0.0947274 | -0.076022609 | 0.295301974 |
| **NT** | Statewide | TKN | Mean | 0.010152714 | 0.016192473 | -0.021583949 | 0.041889378 |
| **NT** | Statewide | TN | Mean | 0.076926586 | 0.091151716 | -0.101727495 | 0.255580667 |
| **NT** | Statewide | TP | Mean | 0.017862514 | 0.012593624 | -0.006820535 | 0.042545562 |

## Table B.4. Unconfined aquifer output

NT = No trend

| Trend | Type | Indicator | Statistic | DiffEst | StdError | LCB95Pct | UCB95Pct |
|---|---|---|---|---|---|---|---|
| **DOWN** | Statewide | DO | Mean | -1.27424544 | 0.304605804 | -1.871261845 | -0.677229034 |
| **NT** | Statewide | $NO_3$-$NO_2$ | Mean | -0.138132001 | 0.194189791 | -0.518736998 | 0.242472995 |
| **DOWN** | Statewide | pHField | Mean | -0.664900844 | 0.077893745 | -0.817569779 | -0.512231908 |
| **NT** | Statewide | SC | Mean | 33.29400065 | 76.4469854 | -116.5393375 | 183.1273388 |
| **NT** | Statewide | Temp | Mean | 0.190253663 | 0.108489747 | -0.022382333 | 0.40288966 |
| **NT** | Statewide | TKN | Mean | -0.009252614 | 0.049652381 | -0.106569493 | 0.088064265 |
| **NT** | Statewide | TN | Mean | -0.156086391 | 0.204747389 | -0.557383899 | 0.245211117 |
| **NT** | Statewide | TP | Mean | -0.01313839 | 0.012254516 | -0.0371568 | 0.010880019 |

# Appendix C: Water Quality Classifications

All surface waters of the state are classified as follows:

**Rule 62-302.400, F.A.C., Classification of Surface Waters, Usage, Reclassification, Classified Waters.**

(1) All surface waters of the State have been classified according to designated uses as follows:

| | |
|---|---|
| **Class I** | **Potable water supplies** |
| **Class II** | **Shellfish propagation or harvesting** |
| **Class III** | **Fish consumption; recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife** |
| **Class III-Limited** | **Fish consumption; recreation or limited recreation; and/or propagation and maintenance of a limited population of fish and wildlife** |
| **Class IV** | **Agricultural water supplies** |
| **Class V** | **Navigation, utility and industrial use** |

(2) Classification of a waterbody according to a particular designated use or uses does not preclude use of the water for other purposes.

Water quality classifications are arranged in order of the degree of protection required, with Class I waters having generally the most stringent water quality criteria and Class V waters the least. However, 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. All waters of the state are considered to be Class III, except for those specifically identified in Rule 62-302.600, F.A.C., and must meet the "Minimum Criteria for Surface Waters," identified in Rule 62-302.500, F.A.C.

Class III-Limited surface waters also share most of the same water quality criteria as Class I, II, and III surface waters. The designated use for Class III-Limited surface waters is intended primarily for some wholly artificial and altered waters, in acknowledgment that many of these waters have physical or habitat limitations that preclude support of the same type of aquatic ecosystem as a natural stream or lake.

# Appendix D: Section 314 (CWA) Impaired Lakes in Florida, Group 1–5 Basins

## *Lake Trends for Nutrients*

Although assessments performed to identify impaired lake segments evaluate current nutrient status, the IWR incorporates additional methodologies to evaluate lake nutrient enrichment trends over time. The nutrient criteria in effect when the assessments in this report were performed are based on numeric criteria for chlorophyll *a*, TN, and TP. The numeric criteria rely on the direct evaluation of trends in the nutrient parameters (i.e., TN and TP), as well as trends in the nutrient response variable (chlorophyll *a*), in identifying nutrient trends over time. Paragraph 62-303.352(1)(c), F.A.C., provides details of the current methodology to identify both long- and short-term trends indicative of declining lake water quality.

The results presented in this report (**Table D.1**) were developed using the numeric nutrient criteria (NNC) (DEP 2013a), as well as both long- and short-term trends, as follows:

- For Planning List assessments, there is a statistically significant increasing trend in the annual geometric mean (AGM) at the 95 % confidence level in TN, TP, or chlorophyll *a* over a 10-year period using a Mann's one-sided, upper-tail test for trend, as described in *Nonparametric Statistical Methods* by M. Hollander and D. Wolfe (1999), pp. 376 and 724, which were incorporated by reference in Rule 62-303.351, F.A.C.

- For Study List Assessments. there is a statistically significant increasing trend in the AGM at the 95 % confidence level in TN, TP, or chlorophyll *a* over a seven-and-a-half-year period using a Mann's one-sided, upper-tail test for trend, as described in *Nonparametric Statistical Methods* (Hollander and Wolfe 1999), pp. 376 and 724, which were incorporated by reference in Rule 62-303.351, F.A.C.

- If the waterbody was placed on the Study List for an adverse trend in nutrient response variables pursuant to Paragraph 62-303.390(2)(a), F.A.C., DEP shall analyze the potential risk of nonattainment of the narrative nutrient criteria in Paragraph 62-302.530(47)(b), F.A.C. This analysis shall take into consideration the current concentrations of nutrient response variables, the slope of the trend, and the potential sources of nutrients (natural and anthropogenic). If there is a reasonable expectation that the waterbody will become impaired within five years, DEP shall place the waterbody on the Verified List to develop a TMDL that establishes a numeric interpretation pursuant to Paragraph 62-302.531(2)(a), F.A.C.

Since the IWR methodology focuses on the identification of impaired waters of the state, DEP's trend evaluation uses a one-sided statistical test. This means the methodology is not designed to identify water quality improvement trends over time. However, water quality improvement for a lake segment may be suggested if the AGM from the 10-year assessment period indicates impairment, and the AGM from the seven-and-a-half-year assessment period does not show an increasing trend.

### Table D.1. Impaired lakes of Florida

TN = Total nitrogen; TP = Total phosphorus; DO = Dissolved oxygen; TSI = Trophic State Index; PCBs = Polychlorinated biphenyls

**Note:** The most up-to-date Verified List of Impaired Waters, by basin group, is available on DEP's Watershed Assessment Section (WAS) website. The table lists waterbodies that are impaired and on the Verified List, or that are impaired and have a TMDL.

| Basin Group | WBID | Basin Group Name | Waterbody Name | Identified Parameters |
|---|---|---|---|---|
| **1** | 1165A | Ochlockonee–St. Marks | Otter Lake | Mercury (in fish tissue) |
| **1** | 1176A | Ochlockonee–St. Marks | Lake Ellen | Mercury (in fish tissue) |
| **1** | 1297X | Ochlockonee–St. Marks | Lake Talquin (West) | Mercury (in fish tissue); Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 1297Y | Ochlockonee–St. Marks | Lake Talquin (Center) | Mercury (in fish tissue); Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 1297Z | Ochlockonee–St. Marks | Lake Talquin (East) | Mercury (in fish tissue); Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 1463D | Tampa Bay | Lake Harvey | Biology |
| **1** | 1463E | Tampa Bay | Lake Helen | Biology |
| **1** | 1463H | Tampa Bay | Lake Allen | Biology |
| **1** | 1463K | Tampa Bay | Lake Virginia | Biology |
| **1** | 1463L | Tampa Bay | Lake Thomas | Mercury (in fish tissue) |
| **1** | 1463M | Tampa Bay | Little Lake Wilson | Fecal Coliform; Nutrients (chlorophyll *a*) |
| **1** | 1463P | Tampa Bay | Lake Linda | Biology |
| **1** | 1464A | Tampa Bay | Black Lake | DO (percent saturation); Nutrients (chlorophyll *a*) |
| **1** | 1464V | Tampa Bay | Lake Hiawatha | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 1464W | Tampa Bay | Lake Ann (Parker) | Biology; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 1464X | Tampa Bay | Lake Seminole | Biology |
| **1** | 1464Y | Tampa Bay | Lake Geneva | Biology |
| **1** | 1473W | Tampa Bay | Lake Juanita | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 1474A | Tampa Bay | Lake Wastena | Biology; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 1474W | Tampa Bay | Lake Dead Lady | Nutrients (chlorophyll *a*) |
| **1** | 1478G | Tampa Bay | Little Deer Lake | Biology |
| **1** | 1478H | Tampa Bay | Lake Reinheimer | DO (percent saturation) |

| Basin Group | WBID | Basin Group Name | Waterbody Name | Identified Parameters |
|---|---|---|---|---|
| **1** | 1486A | Tampa Bay | Lake Tarpon | Biology; Mercury (in fish tissue); Nutrients (chlorophyll *a*) |
| **1** | 1493D | Tampa Bay | Williams Lake | Biology; Nutrients (TN) |
| **1** | 1498Z | Tampa Bay | Dosson Lake | Biology |
| **1** | 1502A | Tampa Bay | Lake Estes | Biology |
| **1** | 1502C | Tampa Bay | Chapman Lake | Biology; Nutrients (chlorophyll *a*) |
| **1** | 1513C | Tampa Bay | Lake Raleigh | Biology |
| **1** | 1515 | Tampa Bay | Horse Lake | Biology |
| **1** | 1516E | Tampa Bay | Lake Ellen | Biology |
| **1** | 1516G | Tampa Bay | Bird Lake | Biology |
| **1** | 1519C | Tampa Bay | Lake Armistead | Biology |
| **1** | 1529A | Tampa Bay | Saint George Lake | Biology |
| **1** | 1530A | Tampa Bay | Moccasin Creek | Fecal Coliform; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 1574A | Tampa Bay | Alligator Lake | Biology; Nutrients (TP) |
| **1** | 1576A | Tampa Bay | Mango Lake | Biology; Nutrients (chlorophyll *a*); Nutrients (TP) |
| **1** | 1579A | Tampa Bay | Bellows Lake (East Lake) | Biology; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP); Nutrients (TSI) |
| **1** | 1603C | Tampa Bay | Beckett Lake | Biology; DO (percent saturation) |
| **1** | 1603E | Tampa Bay | Harbor Lake | Biology |
| **1** | 1605B | Tampa Bay | Gornto Lake | Biology |
| **1** | 1700A | Tampa Bay | Crescent Lake | Biology; Nutrients (chlorophyll *a*); Nutrients (TP) |
| **1** | 1731A | Tampa Bay | Lake Maggiore | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP); Specific Conductance |
| **1** | 2700 | Ocklawaha | Hammocks Lake | Biology; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 2705B | Ocklawaha | Newnans Lake | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP); Turbidity |
| **1** | 2706 | Ocklawaha | Lake Moon | Nutrients (TP) |
| **1** | 2713C | Ocklawaha | Holdens Pond | DO (percent saturation) |
| **1** | 2713D | Ocklawaha | Little Orange Lake | Mercury (in fish tissue); Nutrients (TP) |
| **1** | 2717 | Ocklawaha | Kanapaha Lake | DO (percent saturation) |
| **1** | 2718B | Ocklawaha | Bivans Arm | Turbidity |
| **1** | 2719A | Ocklawaha | Lake Alice | Mercury (in fish tissue) |
| **1** | 2720A | Ocklawaha | Alachua Sink | DO (percent saturation); Fecal Coliform; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 2723A | Ocklawaha | Cowpen Lake | Mercury (in fish tissue) |
| **1** | 2738A | Ocklawaha | Lochloosa Lake | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP); Nutrients (TSI trend); Nutrients (TSI) |
| **1** | 2740B | Ocklawaha | Lake Ocklawaha | Mercury (in fish tissue) |
| **1** | 2748X | Ocklawaha | Key Pond | DO (percent saturation) |

| Basin Group | WBID | Basin Group Name | Waterbody Name | Identified Parameters |
|---|---|---|---|---|
| **1** | 2749A | Ocklawaha | Orange Lake | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 2771A | Ocklawaha | Lake Eaton | Biology; Mercury (in fish tissue) |
| **1** | 2779A | Ocklawaha | Mill Dam Lake | Mercury (in fish tissue) |
| **1** | 2781A | Ocklawaha | Halfmoon Lake | DO (percent saturation); Mercury (in fish tissue) |
| **1** | 2782C | Ocklawaha | Lake Bryant | Mercury (in fish tissue) |
| **1** | 2783A | Ocklawaha | Doe Lake | Mercury (in fish tissue) |
| **1** | 2783B | Ocklawaha | Trout Lake | Mercury (in fish tissue) |
| **1** | 2783F | Ocklawaha | Lake Catherine | Mercury (in fish tissue) |
| **1** | 2783G | Ocklawaha | Lake Mary | Mercury (in fish tissue) |
| **1** | 2785A | Ocklawaha | Smith Lake | Mercury (in fish tissue) |
| **1** | 2790A | Ocklawaha | Lake Weir | Mercury (in fish tissue); Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 2790B | Ocklawaha | Little Lake Weir | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 2797A | Ocklawaha | Ella Lake | Mercury (in fish tissue) |
| **1** | 2803A | Ocklawaha | Holly Lake | Mercury (in fish tissue) |
| **1** | 2806A | Ocklawaha | Lake Umatilla | Biology |
| **1** | 2807A | Ocklawaha | Lake Yale | Mercury (in fish tissue); Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 2811 | Ocklawaha | West Emeralda Marsh Conservation Area | DO (percent saturation) |
| **1** | 2814A | Ocklawaha | Lake Griffin | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 2816A | Ocklawaha | Eldorado Lake | Mercury (in fish tissue) |
| **1** | 2817B | Ocklawaha | Lake Eustis | Biology; Nutrients (chlorophyll *a*); Nutrients (TP) |
| **1** | 2819A | Ocklawaha | Trout Lake | Biology; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 2821B | Ocklawaha | Lake Joanna | Mercury (in fish tissue) |
| **1** | 2825A | Ocklawaha | Silver Lake | Nutrients (TN) |
| **1** | 2829A | Ocklawaha | Lake Lorraine | DO (percent saturation) |
| **1** | 2831B | Ocklawaha | Lake Dora | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 2832A | Ocklawaha | Lake Denham | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 2834C | Ocklawaha | Lake Beauclair | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 2835D | Ocklawaha | Lake Apopka | Biology; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP); Pesticides (in fish tissue) |
| **1** | 2837A | Ocklawaha | Lake Jem | Biology |
| **1** | 2837B | Ocklawaha | Lake Carlton | Biology; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |

| Basin Group | WBID | Basin Group Name | Waterbody Name | Identified Parameters |
|---|---|---|---|---|
| **1** | 2838A | Ocklawaha | Lake Harris | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 2838B | Ocklawaha | Little Lake Harris | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 2839A | Ocklawaha | Lake Minneola | Biology; Mercury (in fish tissue) |
| **1** | 2839D | Ocklawaha | Lake Cherry | Mercury (in fish tissue) |
| **1** | 2839F | Ocklawaha | Lake Emma | Mercury (in fish tissue) |
| **1** | 2839M | Ocklawaha | Lake Louisa | Mercury (in fish tissue) |
| **1** | 2839N | Ocklawaha | Lake Minnehaha | Mercury (in fish tissue) |
| **1** | 2854A | Ocklawaha | Marshall Lake | Biology; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 2865A | Ocklawaha | Lake Florence | Biology |
| **1** | 2872A | Ocklawaha | Lake Roberts | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 2872C | Ocklawaha | Lake Lily | DO (percent saturation) |
| **1** | 2873C | Ocklawaha | Johns Lake | Biology; Mercury (in fish tissue) |
| **1** | 2875B | Ocklawaha | Lake Tilden | Biology |
| **1** | 2880A | Ocklawaha | Lake Glona | Mercury (in fish tissue) |
| **1** | 2890A | Ocklawaha | Lake Lowery | Mercury (in fish tissue) |
| **1** | 3212A | Lake Okeechobee | Lake Okeechobee | Iron; Mercury (in fish tissue); Nutrients (TP) |
| **1** | 3212B | Lake Okeechobee | Lake Okeechobee | Mercury (in fish tissue); Nutrients (TP) |
| **1** | 3212C | Lake Okeechobee | Lake Okeechobee | DO (percent saturation); Mercury (in fish tissue); Nutrients (TP) |
| **1** | 3212D | Lake Okeechobee | Lake Okeechobee | Iron; Mercury (in fish tissue); Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 3212E | Lake Okeechobee | Lake Okeechobee | Iron; Mercury (in fish tissue); Nutrients (TP) |
| **1** | 3212F | Lake Okeechobee | Lake Okeechobee | Iron; Mercury (in fish tissue); Nutrients (TP) |
| **1** | 3212G | Lake Okeechobee | Lake Okeechobee | Iron; Mercury (in fish tissue); Nutrients (TP) |
| **1** | 3212H | Lake Okeechobee | Lake Okeechobee | Iron; Mercury (in fish tissue); Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 3212I | Lake Okeechobee | Lake Okeechobee | Mercury (in fish tissue); Nutrients (TP) |
| **1** | 3259W | Everglades West Coast | Lake Trafford | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 3319A | Suwannee | Lake Alcyone | Mercury (in fish tissue) |
| **1** | 3321A | Suwannee | Lake Octahatchee | Mercury (in fish tissue) |
| **1** | 3322A | Suwannee | Lake Cherry | Mercury (in fish tissue); Nutrients (other information) |
| **1** | 3366A | Suwannee | Lake Francis | Nutrients (chlorophyll *a*); Nutrients (TP) |
| **1** | 3438A | Suwannee | Peacock Lake | DO (percent saturation) |
| **1** | 3459A | Suwannee | Lake Louise | Mercury (in fish tissue) |
| **1** | 3472 | Suwannee | Tenmile Pond | DO (percent saturation) |

| Basin Group | WBID | Basin Group Name | Waterbody Name | Identified Parameters |
|---|---|---|---|---|
| 1 | 3496A | Suwannee | Low Lake | DO (percent saturation) |
| 1 | 3499A | Suwannee | Lake Jeffery | Mercury (in fish tissue) |
| 1 | 3516A | Suwannee | Alligator Lake | Biology; Nutrients (chlorophyll *a*); Nutrients (TP) |
| 1 | 3530B | Suwannee | Swift Creek Pond | Mercury (in fish tissue) |
| 1 | 3566 | Suwannee | Lake Butler | Mercury (in fish tissue) |
| 1 | 3593A | Suwannee | Lake Crosby | Mercury (in fish tissue) |
| 1 | 3598B | Suwannee | Lake Rowell | Biology; Mercury (in fish tissue) |
| 1 | 3598D | Suwannee | Lake Sampson | Mercury (in fish tissue) |
| 1 | 3605G | Suwannee | Santa Fe Lake | Mercury (in fish tissue) |
| 1 | 3605H | Suwannee | Lake Alto | Mercury (in fish tissue) |
| 1 | 3635A | Suwannee | Hampton Lake | Mercury (in fish tissue) |
| 1 | 3731A | Suwannee | Lake Marion | DO (percent saturation) |
| 1 | 3738B | Suwannee | Bonable Lake | Mercury (in fish tissue) |
| 1 | 442 | Ochlockonee–St. Marks | Lake Iamonia | DO (percent saturation); Mercury (in fish tissue) |
| 1 | 540A | Ochlockonee–St. Marks | Lake Tallavana | Biology; Fecal Coliform; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP); Nutrients (TSI) |
| 1 | 546A | Ochlockonee–St. Marks | Lower Dianne Lake | Biology |
| 1 | 546C | Ochlockonee–St. Marks | Lake Monkey Business | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| 1 | 564A | Ochlockonee–St. Marks | Lake Arrowhead | Nutrients (chlorophyll *a*); Nutrients (TP) |
| 1 | 564B | Ochlockonee–St. Marks | Pine Hill Lake (Bockus Lake) | Biology |
| 1 | 564C | Ochlockonee–St. Marks | Petty Gulf Lake | Biology; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| 1 | 582B | Ochlockonee–St. Marks | Lake Jackson | DO (percent saturation); Mercury (in fish tissue) |
| 1 | 647A | Ochlockonee–St. Marks | Lake Tom John | Mercury (in fish tissue); Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| 1 | 647E | Ochlockonee–St. Marks | Lake McBride | DO (percent saturation) |
| 1 | 647F | Ochlockonee–St. Marks | Lake Kanturk | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| 1 | 647G | Ochlockonee–St. Marks | Alford Arm | DO (percent saturation) |
| 1 | 647I | Ochlockonee–St. Marks | Shakey Pond | Nutrients (chlorophyll *a*); Nutrients (TP) |
| 1 | 647J | Ochlockonee–St. Marks | Lake Killarney | Nutrients (chlorophyll *a*); Nutrients (TP) |
| 1 | 647K | Ochlockonee–St. Marks | Lake Kinsale | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| 1 | 689A | Ochlockonee–St. Marks | Lake Overstreet | DO (percent saturation) |
| 1 | 756B | Ochlockonee– | Lake Piney Z | Mercury (in fish tissue); |

| Basin Group | WBID | Basin Group Name | Waterbody Name | Identified Parameters |
|---|---|---|---|---|
| | | St. Marks | | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **1** | 756C | Ochlockonee–St. Marks | Lake Lafayette (Lower Segment) | DO (percent saturation) |
| **1** | 756F | Ochlockonee–St. Marks | Lake Lafayette (Upper Segment) | Nutrients (chlorophyll *a*); Nutrients (TP) |
| **1** | 791N | Ochlockonee–St. Marks | Lake Miccosukee | Mercury (in fish tissue) |
| **1** | 807C | Ochlockonee–St. Marks | Lake Munson | Lead; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP); Nutrients (TSI); PCBs (based on fish consumption advisory); Turbidity |
| **1** | 878A | Ochlockonee–St. Marks | Lake Bradford | Lead |
| **1** | 878D | Ochlockonee–St. Marks | Cascade Lake | Lead |
| **1** | 878E | Ochlockonee–St. Marks | Grassy Lake | DO (percent saturation) |
| **1** | 889A | Ochlockonee–St. Marks | Moore Lake | Mercury (in fish tissue) |
| **1** | 971C | Ochlockonee–St. Marks | Eagle Lake | DO (percent saturation) |
| **2** | 1424 | Tampa Bay Tributaries | Lake Pasadena | Mercury (in fish tissue) |
| **2** | 1443H | Tampa Bay Tributaries | Hillsborough Reservoir | Mercury (in fish tissue); Nutrients (TP) |
| **2** | 1451D | Tampa Bay Tributaries | Lake Padgett | Nutrients (TN); Nutrients (TP) |
| **2** | 1491B | Tampa Bay Tributaries | Galloway Lake | DO (percent saturation) |
| **2** | 1506A | Tampa Bay Tributaries | Meadow View Lake | Nutrients (chlorophyll *a*); Nutrients (TP) |
| **2** | 1522B | Tampa Bay Tributaries | Lake Thonotosassa | Biology; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP); Un-Ionized Ammonia |
| **2** | 1523C | Tampa Bay Tributaries | Cedar Lake (East) | DO (percent saturation) |
| **2** | 1537 | Tampa Bay Tributaries | Lake Wire | Lead |
| **2** | 1537A | Tampa Bay Tributaries | Lake Bonnet | Nutrients (chlorophyll *a*); Nutrients (TP) |
| **2** | 1543 | Tampa Bay Tributaries | Lake Hunter | Biology; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **2** | 1547A | Tampa Bay Tributaries | Lake Valrico | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **2** | 1610 | Tampa Bay Tributaries | Carter Road Park Lakes | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **2** | 1807B | Tampa Bay Tributaries | Lake Manatee Reservoir | Biology; Fecal Coliform; Mercury (in fish tissue) |
| **2** | 180A | Apalachicola - Chipola | Merritts Mill Pond | Nutrients (algal mats) |
| **2** | 2213G | Lower St. Johns | St. Johns River above Doctors Lake | Mercury (in fish tissue) |

| Basin Group | WBID | Basin Group Name | Waterbody Name | Identified Parameters |
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| **2** | 2213H | Lower St. Johns | St. Johns River above Julington Creek | Mercury (in fish tissue) |
| **2** | 2213I | Lower St. Johns | St. Johns River above Black Creek | Mercury (in fish tissue); Silver |
| **2** | 2213J | Lower St. Johns | St. Johns River above Palmo Creek | Mercury (in fish tissue) |
| **2** | 2213K | Lower St. Johns | St. Johns River above Tocoi | Mercury (in fish tissue); Nutrients (chlorophyll *a*); Nutrients (TP) |
| **2** | 2213L | Lower St. Johns | St. Johns River above Federal Point | Mercury (in fish tissue); Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **2** | 2389 | Lower St. Johns | Doctors Lake | Nutrients (chlorophyll *a*); Nutrients (TP) |
| **2** | 2509 | Lower St. Johns | Lake Geneva | Lead |
| **2** | 2509C | Lower St. Johns | Lake Magnolia | Mercury (in fish tissue) |
| **2** | 2509H | Lower St. Johns | Lily Lake | Lead |
| **2** | 2509K | Lower St. Johns | Lowry Lake (Sand Hill Lake) | Mercury (in fish tissue) |
| **2** | 2541 | Lower St. Johns | Georges Lake | Mercury (in fish tissue) |
| **2** | 2543F | Lower St. Johns | Lake Ross | Lead; Nutrients (TN) |
| **2** | 2575 | Lower St. Johns | Cue Lake | Mercury (in fish tissue) |
| **2** | 2575Q | Lower St. Johns | Mason Lake | Mercury (in fish tissue) |
| **2** | 2582A | Lower St. Johns | Rowan Lake | Nutrients (TN) |
| **2** | 2593A | Lower St. Johns | Davis Lake | DO (percent saturation) |
| **2** | 2606B | Lower St. Johns | Crescent Lake | Mercury (in fish tissue); Nutrients (chlorophyll *a*); Nutrients (TP) |
| **2** | 2615A | Lower St. Johns | Dead Lake | Mercury (in fish tissue); Nutrients (TN); Nutrients (TP) |
| **2** | 2617A | Lower St. Johns | Lake Broward | Mercury (in fish tissue) |
| **2** | 2630B | Lower St. Johns | Lake Disston | Lead; Mercury (in fish tissue) |
| **2** | 2667A | Lower St. Johns | Lake Dias | Mercury (in fish tissue) |
| **2** | 2671A | Lower St. Johns | Lake Daugharty | Mercury (in fish tissue) |
| **2** | 272 | Apalachicola–Chipola | Thompson Pond | DO (percent saturation) |
| **2** | 2892 | Middle St. Johns | Lake Margaret | Mercury (in fish tissue) |
| **2** | 2893A | Middle St. Johns | Lake George | Mercury (in fish tissue); Nutrients (chlorophyll *a*); Nutrients (TP) |
| **2** | 2893D | Middle St. Johns | Lake Monroe | Biology; Mercury (in fish tissue) |
| **2** | 2893H | Middle St. Johns | Mullet Lake | Mercury (in fish tissue) |
| **2** | 2893J | Middle St. Johns | Mud Lake | Mercury (in fish tissue) |
| **2** | 2893U | Middle St. Johns | Lake Beresford | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **2** | 2894 | Middle St. Johns | Lake Delancy | Mercury (in fish tissue) |
| **2** | 2899B | Middle St. Johns | Lake Kerr | Mercury (in fish tissue) |

| Basin Group | WBID | Basin Group Name | Waterbody Name | Identified Parameters |
|---|---|---|---|---|
| 2 | 2899C | Middle St. Johns | Little Lake Kerr | Mercury (in fish tissue) |
| 2 | 2905C | Middle St. Johns | Wildcat Lake | Mercury (in fish tissue) |
| 2 | 2916B | Middle St. Johns | South Grasshopper Lake | Mercury (in fish tissue) |
| 2 | 2917 | Middle St. Johns | Boyd Lake | Mercury (in fish tissue) |
| 2 | 2921 | Middle St. Johns | Lake Woodruff | Mercury (in fish tissue) |
| 2 | 2921C | Middle St. Johns | Lake Dexter | Mercury (in fish tissue) |
| 2 | 2921D1 | Middle St. Johns | Tick Island Mud Lake | Mercury (in fish tissue) |
| 2 | 2921E | Middle St. Johns | Spring Garden Lake | Mercury (in fish tissue) |
| 2 | 2925A | Middle St. Johns | Lake Ashby | Mercury (in fish tissue) |
| 2 | 2929B | Middle St. Johns | Lake Norris | Mercury (in fish tissue) |
| 2 | 2929C | Middle St. Johns | Lake Dorr | Mercury (in fish tissue) |
| 2 | 2953 | Middle St. Johns | Bethel Lake | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| 2 | 2954 | Middle St. Johns | Konomac Lake Reservoir | Mercury (in fish tissue) |
| 2 | 2956A1 | Middle St. Johns | Linden Lake | DO (percent saturation) |
| 2 | 2961 | Middle St. Johns | Lake Sylvan | Mercury (in fish tissue) |
| 2 | 2964A | Middle St. Johns | Lake Harney | Mercury (in fish tissue) |
| 2 | 2964A4 | Middle St. Johns | Lake Proctor | DO (percent saturation) |
| 2 | 2973F | Middle St. Johns | Deforest Lake | DO (percent saturation) |
| 2 | 2973G | Middle St. Johns | Amory Lake | Biology; DO (percent saturation) |
| 2 | 2981 | Middle St. Johns | Lake Jesup | Biology; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP); Un-Ionized Ammonia |
| 2 | 2986B | Middle St. Johns | Lake Myrtle | DO (percent saturation) |
| 2 | 2986D | Middle St. Johns | Lake Alma | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| 2 | 2986E | Middle St. Johns | Lake Searcy | Biology; Nutrients (TP) |
| 2 | 2986F | Middle St. Johns | Greenwood Lake | Nutrients (TP) |
| 2 | 2991D | Middle St. Johns | Horseshoe Lake (South) | Biology |
| 2 | 2997B | Middle St. Johns | Lake Howell | Biology; Nutrients (chlorophyll *a*) |
| 2 | 2997Q | Middle St. Johns | Lake Dot | Fecal Coliform |
| 2 | 2997R | Middle St. Johns | Lake Adair | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| 2 | 2997V | Middle St. Johns | Lake Gem (Orange County) | Biology; Nutrients (chlorophyll *a*); Nutrients (TP) |
| 2 | 2998D | Middle St. Johns | Lake Marion | Biology |
| 2 | 2998E | Middle St. Johns | Lake Adelaide | Biology; Nutrients (TP) |
| 2 | 3000A | Middle St. Johns | Lake Harriet | DO (percent saturation); Fecal Coliform |
| 2 | 3002E | Middle St. Johns | Lake Primavista | Biology; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| 2 | 3002I | Middle St. Johns | Lake Rose | Nutrients (chlorophyll *a*); Nutrients (TN) |

| Basin Group | WBID | Basin Group Name | Waterbody Name | Identified Parameters |
|---|---|---|---|---|
| **2** | 3002Q | Middle St. Johns | Kasey Lake | Fecal Coliform |
| **2** | 3002U | Middle St. Johns | Lake Pleasant | DO (percent saturation) |
| **2** | 3004A | Middle St. Johns | Bear Lake | Mercury (in fish tissue) |
| **2** | 3004G | Middle St. Johns | Bay Lake | Nutrients (chlorophyll *a*); Nutrients (TN) |
| **2** | 3004K | Middle St. Johns | Lake Wekiva (Orlando) | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **2** | 3004N | Middle St. Johns | Lake Fairview | Mercury (in fish tissue) |
| **2** | 3009 | Middle St. Johns | Bear Gulley Lake | Nutrients (chlorophyll *a*) |
| **2** | 3009A | Middle St. Johns | Waunatta Lake | Biology |
| **2** | 3009F | Middle St. Johns | Lake Florence | Nutrients (chlorophyll *a*) |
| **2** | 3009I | Middle St. Johns | Garden Lake | Biology |
| **2** | 3011A | Middle St. Johns | Lake Weston | Nutrients (chlorophyll *a*) |
| **2** | 3011C | Middle St. Johns | Lake Lucien | Mercury (in fish tissue) |
| **2** | 3036 | Middle St. Johns | Lake Frederica | Mercury (in fish tissue) |
| **2** | 3194C | St. Lucie–Loxahatchee | Savannas | Copper |
| **2** | 51A | Apalachicola–Chipola | Dead Lakes | Mercury (in fish tissue) |
| **2** | 51F | Apalachicola–Chipola | Dead Lake (West Arm) | Nutrients (TN) |
| **2** | 60 | Apalachicola–Chipola | Lake Seminole | Biology |
| **2** | 926A1 | Apalachicola–Chipola | Lake Mystic | Mercury (in fish tissue) |
| **3** | 1449A | Sarasota Bay–Peace–Myakka | Lake Deeson | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **3** | 1488B | Sarasota Bay–Peace–Myakka | Lake Rochelle | Nutrients (chlorophyll *a*); Nutrients (TN) |
| **3** | 1488C | Sarasota Bay–Peace–Myakka | Lake Haines | Nutrients (chlorophyll *a*); Nutrients (TN) |
| **3** | 1488D | Sarasota Bay–Peace–Myakka | Lake Alfred | Nutrients (chlorophyll *a*); Nutrients (TN) |
| **3** | 1488U | Sarasota Bay–Peace–Myakka | Lake Conine | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **3** | 1497A | Sarasota Bay–Peace–Myakka | Crystal Lake | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **3** | 1497B | Sarasota Bay–Peace–Myakka | Lake Parker | Biology; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **3** | 1497D1 | Sarasota Bay–Peace–Myakka | Lake Crago | Nutrients (chlorophyll *a*); Nutrients (TP) |
| **3** | 1497E | Sarasota Bay–Peace–Myakka | Lake Bonny | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **3** | 1497G | Sarasota Bay–Peace–Myakka | Lake Mirror | Nutrients (chlorophyll *a*); Nutrients (TP) |
| **3** | 1497H | Sarasota Bay–Peace–Myakka | Lake Morton | Nutrients (chlorophyll *a*); Nutrients (TP) |
| **3** | 1497J | Sarasota Bay–Peace–Myakka | Saddle Creek Lakes | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |

| Basin Group | WBID | Basin Group Name | Waterbody Name | Identified Parameters |
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| **3** | 15002 | Sarasota Bay–Peace–Myakka | Middle Lake Hamilton | Biology; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **3** | 1501 | Sarasota Bay–Peace–Myakka | Lake Lena | Nutrients (chlorophyll *a*); Nutrients (TN) |
| **3** | 1501B | Sarasota Bay–Peace–Myakka | Lake Ariana | Nutrients (chlorophyll *a*); Nutrients (TN) |
| **3** | 1501V | Sarasota Bay–Peace–Myakka | Spirit Lake | Nutrients (TN) |
| **3** | 1501W | Sarasota Bay–Peace–Myakka | Sears Lake | Nutrients (TP) |
| **3** | 15041 | Sarasota Bay–Peace–Myakka | Lake Hamilton | Nutrients (chlorophyll *a*); Nutrients (TN) |
| **3** | 15101 | Sarasota Bay–Peace–Myakka | Lake Eva | Nutrients (chlorophyll *a*); Nutrients (TN) |
| **3** | 1521 | Sarasota Bay–Peace–Myakka | Lake Lulu | Nutrients (chlorophyll *a*); Nutrients (TN) |
| **3** | 1521B | Sarasota Bay–Peace–Myakka | Lake Eloise | Nutrients (chlorophyll *a*); Nutrients (TN) |
| **3** | 1521D | Sarasota Bay–Peace–Myakka | Lake Shipp | Nutrients (chlorophyll *a*); Nutrients (TN) |
| **3** | 1521E | Sarasota Bay–Peace–Myakka | Lake May | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **3** | 1521F | Sarasota Bay–Peace–Myakka | Lake Howard | Biology; Nutrients (chlorophyll *a*); Nutrients (TN) |
| **3** | 1521G | Sarasota Bay–Peace–Myakka | Lake Mirror | Nutrients (chlorophyll *a*); Nutrients (TN) |
| **3** | 1521G1 | Sarasota Bay–Peace–Myakka | Spring Lake | Biology |
| **3** | 1521H | Sarasota Bay–Peace–Myakka | Lake Cannon | Nutrients (chlorophyll *a*); Nutrients (TN) |
| **3** | 1521I | Sarasota Bay–Peace–Myakka | Lake Hartridge | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **3** | 1521J | Sarasota Bay–Peace–Myakka | Lake Idylwild | Nutrients (chlorophyll *a*); Nutrients (TN) |
| **3** | 1521K | Sarasota Bay–Peace–Myakka | Lake Jessie | Nutrients (chlorophyll *a*); Nutrients (TN) |
| **3** | 1521L | Sarasota Bay–Peace–Myakka | Lake Marianna | Nutrients (chlorophyll *a*); Nutrients (TN) |
| **3** | 1521P | Sarasota Bay–Peace–Myakka | Deer Lake | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **3** | 1521Q | Sarasota Bay–Peace–Myakka | Lake Blue | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **3** | 1539C | Sarasota Bay–Peace–Myakka | Lake Annie | Nutrients (TN) |
| **3** | 1539D | Sarasota Bay–Peace–Myakka | Lake Otis | Nutrients (chlorophyll *a*); Nutrients (TN) |
| **3** | 1549B | Sarasota Bay–Peace–Myakka | Banana Lake | Biology; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **3** | 1549B1 | Sarasota Bay–Peace–Myakka | Lake Stahl | Biology; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **3** | 1549B2 | Sarasota Bay–Peace–Myakka | Little Banana Lake | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |

| Basin Group | WBID | Basin Group Name | Waterbody Name | Identified Parameters |
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| **3** | 1549C | Sarasota Bay–Peace–Myakka | Lake Bentley | Nutrients (chlorophyll *a*) |
| **3** | 1549D | Sarasota Bay–Peace–Myakka | Lake Horney | Nutrients (TP) |
| **3** | 1549E | Sarasota Bay–Peace–Myakka | Lake John | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **3** | 1549F | Sarasota Bay–Peace–Myakka | Lake Somerset | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **3** | 1549X | Sarasota Bay–Peace–Myakka | Hollingsworth Lake | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **3** | 1588A | Sarasota Bay–Peace–Myakka | Lake Mcleod | Mercury (in fish tissue); Nutrients (chlorophyll *a*) |
| **3** | 1590B | Sarasota Bay–Peace–Myakka | Lake Ashton (Lake Myrtle) | Mercury (in fish tissue) |
| **3** | 1613A | Sarasota Bay–Peace–Myakka | Lake Blue (South) | Nutrients (TN) |
| **3** | 1617A | Sarasota Bay–Peace–Myakka | Lake Effie | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **3** | 1623L | Sarasota Bay–Peace–Myakka | Lake Hancock | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **3** | 1623M | Sarasota Bay–Peace–Myakka | Eagle Lake | Mercury (in fish tissue); Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **3** | 1623T | Sarasota Bay–Peace–Myakka | Engle Lake | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **3** | 1623X | Sarasota Bay–Peace–Myakka | Reclaimed Mine Cut Lake | Nutrients (TN); Nutrients (TP) |
| **3** | 1623Z | Sarasota Bay–Peace–Myakka | Fort Meade Lakes | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **3** | 1677C | Sarasota Bay–Peace–Myakka | Lake Buffum | Biology; Mercury (in fish tissue); Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **3** | 1981 | Sarasota Bay–Peace–Myakka | Lake Myakka (Lower Segment) | Mercury (in fish tissue) |
| **3** | 1981C | Sarasota Bay–Peace–Myakka | Lake Myakka (Upper Segment) | Mercury (in fish tissue); Nutrients (TP) |
| **3** | 2041B | Sarasota Bay–Peace–Myakka | Shell Creek Reservoir (Hamilton Reservoir) | DO (percent saturation) |
| **3** | 210A | Choctawhatchee–St. Andrew | Double Pond | Mercury (in fish tissue) |
| **3** | 239A | Choctawhatchee–St. Andrew | Pate Lake | Mercury (in fish tissue) |
| **3** | 283 | Choctawhatchee–St. Andrew | Lake Juniper | Mercury (in fish tissue) |
| **3** | 28931 | Upper St. Johns | Sawgrass Lake | DO (percent saturation); Mercury (in fish tissue) |
| **3** | 28932 | Upper St. Johns | Lake Cone at Seminole | Mercury (in fish tissue) |
| **3** | 2893K | Upper St. Johns | Lake Poinsett | Mercury (in fish tissue) |
| **3** | 2893O | Upper St. Johns | Lake Washington | Biology; Mercury (in fish tissue) |
| **3** | 2893Q | Upper St. Johns | Lake Helen Blazes | DO (percent saturation); Mercury (in fish tissue) |
| **3** | 2893V | Upper St. Johns | Blue Cypress Lake | Mercury (in fish tissue) |

| Basin Group | WBID | Basin Group Name | Waterbody Name | Identified Parameters |
|---|---|---|---|---|
| 3 | 2893Y | Upper St. Johns | Lake Winder | Biology; Mercury (in fish tissue) |
| 3 | 2964B | Upper St. Johns | Puzzle Lake | Mercury (in fish tissue); Nutrients (TP) |
| 3 | 2964C | Upper St. Johns | Ruth Lake | Mercury (in fish tissue) |
| 3 | 2966A | Upper St. Johns | Buck Lake | Mercury (in fish tissue) |
| 3 | 2978A | Upper St. Johns | Loughman Lake | Mercury (in fish tissue) |
| 3 | 3008A | Upper St. Johns | Fox Lake | Mercury (in fish tissue) |
| 3 | 3008B | Upper St. Johns | South Lake | Mercury (in fish tissue) |
| 3 | 3064A | Upper St. Johns | Florence Lake | Biology |
| 3 | 3140 | Upper St. Johns | Lake Kenansville | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| 3 | 3245B | Lake Worth Lagoon–Palm Beach Coast | Lake Clarke | Biology; Fecal Coliform |
| 3 | 3245C1 | Lake Worth Lagoon–Palm Beach Coast | Lake Mangonia | Fecal Coliform |
| 3 | 3245C4 | Lake Worth Lagoon–Palm Beach Coast | Pine Lake | Fecal Coliform; Nutrients (chlorophyll *a*) |
| 3 | 3256A | Lake Worth Lagoon–Palm Beach Coast | Lake Osborne | Biology; Nutrients (chlorophyll *a*); Nutrients (TP) |
| 3 | 3262A | Lake Worth Lagoon–Palm Beach Coast | Lake Ida | Biology; Nutrients (chlorophyll *a*); Nutrients (TP) |
| 3 | 516 | Choctawhatchee–St. Andrew | Compass Lake | Mercury (in fish tissue) |
| 3 | 553A | Choctawhatchee–St. Andrew | Deerpoint Lake | Mercury (in fish tissue) |
| 3 | 555 | Choctawhatchee–St. Andrew | Gap Lake | Mercury (in fish tissue) |
| 3 | 61A | Choctawhatchee–St. Andrew | Sand Hammock Pond | Mercury (in fish tissue) |
| 3 | 662 | Choctawhatchee–St. Andrew | Porter Lake | Mercury (in fish tissue) |
| 3 | 780A | Choctawhatchee–St. Andrew | Rattlesnake Lake | Nutrients (TN); Nutrients (TP) |
| 3 | 786A | Choctawhatchee–St. Andrew | Bass Lake | DO (percent saturation); Nutrients (TN) |
| 3 | 959G | Choctawhatchee–St. Andrew | Fuller Lake | DO (percent saturation) |
| 4 | 10EA | Pensacola | Woodbine Springs Lake | Mercury (in fish tissue) |
| 4 | 1329B | Withlacoochee | Lake Rousseau | Mercury (in fish tissue) |
| 4 | 1329H | Withlacoochee | Lake Lindsey | DO (percent saturation) |
| 4 | 1329L | Withlacoochee | Tank Lake | DO (percent saturation) |
| 4 | 1329T | Withlacoochee | Blue Sink (Blue Sink Lake) | DO (percent saturation); Nutrients (TP) |
| 4 | 1329W | Withlacoochee | Bystre Lake | Nutrients (TP) |
| 4 | 1340A | Withlacoochee | Davis Lake | DO (percent saturation) |
| 4 | 1340C | Withlacoochee | Magnolia Lake | DO (percent saturation) |
| 4 | 1340D | Withlacoochee | Hampton Lake | DO (percent saturation) |
| 4 | 1340H | Withlacoochee | Hernando Lake | Mercury (in fish tissue) |

| Basin Group | WBID | Basin Group Name | Waterbody Name | Identified Parameters |
|---|---|---|---|---|
| **4** | 1340K | Withlacoochee | Cato Lake | DO (percent saturation) |
| **4** | 1340L | Withlacoochee | Cooter Lake | Biology; DO (percent saturation) |
| **4** | 1340N | Withlacoochee | Henderson Lake | Mercury (in fish tissue) |
| **4** | 1340P | Withlacoochee | Spivey Lake | DO (percent saturation) |
| **4** | 1340Q | Withlacoochee | Tussock Lake | DO (percent saturation) |
| **4** | 1340R | Withlacoochee | Tsala Apopka Lake (Floral City Arm) | Mercury (in fish tissue) |
| **4** | 1340V | Withlacoochee | Bradley Lake | DO (percent saturation) |
| **4** | 1342Y | Withlacoochee | Cherry Lake | Mercury (in fish tissue) |
| **4** | 1347 | Withlacoochee | Lake Okahumpka | Biology; Mercury (in fish tissue) |
| **4** | 1349A | Withlacoochee | Lake Deaton | Mercury (in fish tissue) |
| **4** | 1351B | Withlacoochee | Lake Panasoffkee | Mercury (in fish tissue) |
| **4** | 1403 | Withlacoochee | Clear Lake | Biology |
| **4** | 1466 | Withlacoochee | Lake Agnes | Biology; Mercury (in fish tissue); Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **4** | 1467 | Withlacoochee | Mud Lake | Biology |
| **4** | 1472B | Kissimmee River | Lake Hatchineha | Biology; Mercury (in fish tissue) |
| **4** | 1480 | Kissimmee River | Lake Marion | Mercury (in fish tissue); Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **4** | 1484B | Withlacoochee | Lake Juliana | Biology; Nutrients (chlorophyll *a*); Nutrients (TN) |
| **4** | 1532A | Kissimmee River | Lake Pierce | Mercury (in fish tissue); Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **4** | 1573A | Kissimmee River | Tiger Lake | Mercury (in fish tissue); Nutrients (TP) |
| **4** | 1573C | Kissimmee River | Lake Rosalie | Biology |
| **4** | 1573E | Kissimmee River | Lake Weohyakapka | Mercury (in fish tissue) |
| **4** | 1619A | Kissimmee River | Lake Wales | Nutrients (chlorophyll *a*); Nutrients (TN) |
| **4** | 1619D | Kissimmee River | Lake Moody | Nutrients (chlorophyll *a*) |
| **4** | 1619E | Kissimmee River | Lake Amoret | DO (percent saturation) |
| **4** | 1663 | Kissimmee River | Crooked Lake | Mercury (in fish tissue) |
| **4** | 1685A | Kissimmee River | Lake Arbuckle | Mercury (in fish tissue) |
| **4** | 1685D | Kissimmee River | Reedy Lake | Nutrients (chlorophyll *a*); Nutrients (TN) |
| **4** | 1685E | Kissimmee River | Lake Ida | Nutrients (TN) |
| **4** | 1706 | Kissimmee River | Lake Clinch | Mercury (in fish tissue); Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **4** | 1730 | Kissimmee River | Hickory Lake | Nutrients (chlorophyll *a*); Nutrients (TN) |
| **4** | 1730B | Kissimmee River | Livingston Lake | Mercury (in fish tissue); Nutrients (TP) |
| **4** | 1730D | Kissimmee River | Lake Adelaide | Nutrients (chlorophyll *a*); Nutrients (TN) |
| **4** | 1761H | Kissimmee River | Lake Lucas | DO (percent saturation) |

| Basin Group | WBID | Basin Group Name | Waterbody Name | Identified Parameters |
|---|---|---|---|---|
| **4** | 179A | Pensacola | Bear Lake | Mercury (in fish tissue) |
| **4** | 1813A | Kissimmee River | Dinner Lake | Mercury (in fish tissue) |
| **4** | 1813B | Kissimmee River | Lake Lotela | Mercury (in fish tissue) |
| **4** | 1813L | Kissimmee River | Lake Glenada | Nutrients (chlorophyll *a*) |
| **4** | 1842 | Kissimmee River | Lake Sebring | Mercury (in fish tissue) |
| **4** | 1856B | Kissimmee River | Lake Istokpoga | Biology; Mercury (in fish tissue); Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **4** | 1860B | Kissimmee River | Lake Josephine | Mercury (in fish tissue) |
| **4** | 1860D | Kissimmee River | Lake Jackson | Biology; Mercury (in fish tissue) |
| **4** | 1891A | Kissimmee River | Red Beach Lake | Mercury (in fish tissue) |
| **4** | 1906 | Kissimmee River | Lake Charlotte | Biology; Mercury (in fish tissue) |
| **4** | 1932A | Kissimmee River | Lake Grassy | Mercury (in fish tissue) |
| **4** | 1932B | Kissimmee River | Clay Lake | Mercury (in fish tissue) |
| **4** | 1932E | Kissimmee River | Lake Huntley | Mercury (in fish tissue) |
| **4** | 1932G | Kissimmee River | Lake Apthorpe | Mercury (in fish tissue) |
| **4** | 1932M | Kissimmee River | Blue Lake | Biology |
| **4** | 1938A | Kissimmee River | Lake June in Winter | Mercury (in fish tissue) |
| **4** | 1938C | Kissimmee River | Lake Placid | Mercury (in fish tissue); Nutrients (chlorophyll *a*) |
| **4** | 1938D | Kissimmee River | Lake Carrie | Biology |
| **4** | 1938E | Kissimmee River | Persimmon Lake | Nutrients (chlorophyll *a*); Nutrients (TN) |
| **4** | 1938F | Kissimmee River | Red Water Lake | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **4** | 1938H | Kissimmee River | Lake Annie | Mercury (in fish tissue) |
| **4** | 1938I | Kissimmee River | Lake Lachard | Biology |
| **4** | 2105A | Nassau - St. Marys | Hampton Lake | DO (percent saturation) |
| **4** | 2339 | Nassau - St. Marys | Ocean Pond | Mercury (in fish tissue) |
| **4** | 2392 | Nassau - St. Marys | Palestine Lake | Mercury (in fish tissue) |
| **4** | 25A | Pensacola | Lake Stone (Southwest of Century) | Mercury (in fish tissue) |
| **4** | 3168A | Kissimmee River | Lake Conway | Mercury (in fish tissue) |
| **4** | 3168E | Kissimmee River | Lake Anderson | Nutrients (chlorophyll *a*) |
| **4** | 3168F | Kissimmee River | Lake Bass | Nutrients (chlorophyll *a*); Nutrients (TN) |
| **4** | 3168H | Kissimmee River | Lake Holden | Biology; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **4** | 3168M | Kissimmee River | Lake Copeland | Biology |
| **4** | 3168N | Kissimmee River | Lake Olive | Biology |
| **4** | 3168Q | Kissimmee River | Lake Warren (Lake Mare Prairie) | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| **4** | 3168W | Kissimmee River | Bear Head Lake | Biology |
| **4** | 3168W3 | Kissimmee River | Lake Wade | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |

| Basin Group | WBID | Basin Group Name | Waterbody Name | Identified Parameters |
|---|---|---|---|---|
| 4 | 3168W4 | Kissimmee River | Lake of The Woods | Nutrients (TN); Nutrients (TP) |
| 4 | 3168W6 | Kissimmee River | Lake Warren | Nutrients (TN) |
| 4 | 3168W7 | Kissimmee River | Lake Bumby | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP); Silver |
| 4 | 3168X2 | Kissimmee River | Hourglass Lake | Nutrients (chlorophyll *a*) |
| 4 | 3168X4 | Kissimmee River | Lake Rabama | Nutrients (TP) |
| 4 | 3168X5 | Kissimmee River | Lake Condel | Fecal Coliform; Lead; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| 4 | 3168X8 | Kissimmee River | Lake Angel | Nutrients (chlorophyll *a*); Nutrients (TP) |
| 4 | 3168Y | Kissimmee River | Lake Lancaster | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| 4 | 3168Y2 | Kissimmee River | Lake Como (Orange County) | Nutrients (TP) |
| 4 | 3168Y3 | Kissimmee River | Lake Greenwood | Nutrients (TP) |
| 4 | 3168Y4 | Kissimmee River | Lake Davis | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| 4 | 3168Y6 | Kissimmee River | Lake Lurna | Nutrients (TP) |
| 4 | 3168Y8 | Kissimmee River | Lake Weldona | Nutrients (chlorophyll *a*) |
| 4 | 3168Z3 | Kissimmee River | Lake Arnold | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| 4 | 3168Z4 | Kissimmee River | Lake Giles | Nutrients (TP) |
| 4 | 3168Z9 | Kissimmee River | Lake Lawsona | Nutrients (TP) |
| 4 | 3169A2 | Kissimmee River | Lake Tyler | Biology |
| 4 | 3169C | Kissimmee River | Big Sand Lake | Lead; Mercury (in fish tissue) |
| 4 | 3169G3 | Kissimmee River | Lake Fran | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| 4 | 3169G4 | Kissimmee River | Lake Kozart | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| 4 | 3169G5 | Kissimmee River | Lake Walker | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| 4 | 3169G6 | Kissimmee River | Lake Richmond | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| 4 | 3169G8 | Kissimmee River | Lake Beardall | Nutrients (TP) |
| 4 | 3169Q | Kissimmee River | Rock Lake | Nutrients (TN) |
| 4 | 3169T | Kissimmee River | Lake Sandy | Nutrients (TP) |
| 4 | 3170B | Kissimmee River | Lake Russell | Mercury (in fish tissue) |
| 4 | 3170H1 | Kissimmee River | Lake Sheen | Mercury (in fish tissue) |
| 4 | 3170H2 | Kissimmee River | Pocket Lake | Mercury (in fish tissue) |
| 4 | 3170I | Kissimmee River | Lake Hickorynut | Nutrients (TN) |
| 4 | 3170Q | Kissimmee River | Lake Butler | Mercury (in fish tissue); Nutrients (TN) |
| 4 | 3170S | Kissimmee River | Lake Down | Mercury (in fish tissue) |
| 4 | 3170T | Kissimmee River | Lake Bessie | Mercury (in fish tissue) |
| 4 | 3170W | Kissimmee River | Lake Louise | Mercury (in fish tissue) |
| 4 | 3170Y | Kissimmee River | Lake Tibet Butler | Mercury (in fish tissue) |

| Basin Group | WBID | Basin Group Name | Waterbody Name | Identified Parameters |
|---|---|---|---|---|
| 4 | 3170Z1 | Kissimmee River | Little Fish Lake | Mercury (in fish tissue) |
| 4 | 3171 | Kissimmee River | Lake Hart | Lead; Mercury (in fish tissue) |
| 4 | 3171A | Kissimmee River | Lake Mary Jane | Lead; Mercury (in fish tissue) |
| 4 | 3171C | Kissimmee River | Red Lake | Copper |
| 4 | 3172 | Kissimmee River | East Lake Tohopekaliga | Mercury (in fish tissue) |
| 4 | 3173A | Kissimmee River | Lake Tohopekaliga | Biology; Mercury (in fish tissue) |
| 4 | 3174 | Kissimmee River | Lake Center | Biology |
| 4 | 3174D | Kissimmee River | Coon Lake | Biology |
| 4 | 3176 | Kissimmee River | Alligator Lake | Mercury (in fish tissue) |
| 4 | 3177 | Kissimmee River | Lake Gentry | Mercury (in fish tissue) |
| 4 | 3177A | Kissimmee River | Brick Lake | Mercury (in fish tissue) |
| 4 | 3180A | Kissimmee River | Lake Cypress | Biology; Mercury (in fish tissue); Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| 4 | 3183B | Kissimmee River | Lake Kissimmee | Biology; Mercury (in fish tissue); Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| 4 | 3183G | Kissimmee River | Lake Jackson (Osceola County) | Biology; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| 4 | 3184 | Kissimmee River | Lake Marian | Nutrients (chlorophyll *a*); Nutrients (TN);<br>Nutrients (TP) |
| 4 | 38A | Pensacola | Lake Jackson | Mercury (in fish tissue) |
| 5 | 1392B | Springs Coast | Lake Hancock | Biology; Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| 5 | 1409A | Springs Coast | Moon Lake | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP) |
| 5 | 1432A | Springs Coast | Lake Worrell | DO (percent saturation) |
| 5 | 1618 | Springs Coast | Lake Seminole | Nutrients (chlorophyll *a*); Nutrients (TN); Nutrients (TP); pH |
| 5 | 1650 | Springs Coast | Walsingham Reservoir | Mercury (in fish tissue) |

# Appendix E: Strategic Monitoring and Assessment Methodology for Surface Water

## *FWRA*

The 1999 FWRA (Section 403.067 et seq., F.S.) clarified the statutory authority of DEP to establish TMDLs, required DEP to develop a scientifically sound methodology for identifying impaired waters, specified that DEP could develop TMDLs only for waters identified as impaired using the new methodology, and directed DEP to establish an Allocation Technical Advisory Committee (ATAC) to assure the equitable allocation of load reductions when implementing TMDLs.

The 2005 FWRA amendments included provisions that removed the need for the ATAC and added the development and implementation of BMAPs to guide TMDL activities and reduce urban and agricultural nonpoint sources of pollution. Nevertheless, BMAPs are not mandatory for the implementation of TMDLs. The Legislature established a long-term funding source that provided $20 million per year for urban stormwater retrofitting projects to reduce pollutant loadings to impaired waters. However, over the years the level of funding has been inconsistent.

The FWRA also requires FDACS and DEP to adopt rules for BMPs. As Florida already had an urban stormwater regulatory program, this new authority was particularly important in strengthening Florida's agricultural nonpoint source management program. The law requires DEP to verify the effectiveness of BMPs in reducing pollutant loads. The BMP rules and associated BMP manuals are available from the FDACS OAWP website. DEP can take enforcement action against permittees who do not implement the BMPs they agreed to implement in the BMAP.

## *IWR*

DEP uses the methodology in Florida's IWR (Chapter 62-303, F.A.C.) to evaluate water quality data and identify impaired waters. The rule also addresses data sufficiency, data quality, and delisting requirements. **Appendix F** contains detailed information on the IWR.

## *Watershed Management Approach*

DEP's statewide method for water resource management, called the watershed management approach, is the framework for developing and implementing the provisions of Section 303(d) of the federal CWA as required by federal and state laws. This approach manages water resources on the basis of hydrologic units—natural boundaries such as river basins—rather than arbitrary political or regulatory boundaries. DEP assesses each basin as an entire functioning system and evaluates aquatic resources from a basinwide perspective that considers the cumulative effects of human activities. From that framework, DEP addresses the causes of pollution.

Rather than relying on single solutions to water resource issues, the watershed management approach is intended to improve the health of surface water and groundwater resources by strengthening coordination among such activities as monitoring, stormwater management, wastewater treatment, wetland restoration, agricultural BMPs, land acquisition, and public involvement. Stakeholder involvement (including federal, state, regional, tribal, and local governments and individual citizens) is an important feature to cooperatively define, prioritize, and resolve water quality problems. Coordination among the many existing water quality programs helps manage basin resources and reduce duplication of effort.

DEP implements the watershed management approach by using a 5-year basin rotation cycle. Under this approach, DEP groups Florida's 52 HUC basins (51 HUCs plus the Florida Keys) into 29 distinct basins distributed among each of DEP's 6 districts. Within each district, DEP assesses 1 basin group each year (except for the Northeast District) and assesses each basin every 5 years. **Table E.1** lists the basin groups included in each of the basin rotations by DEP district. **Table E.2** lists the specific assessment periods for the Planning, Study, and Verified Lists for each of the 5 basin groups for the 44 iterations of the basin rotation.

**Table E.1. Basin groups for the implementation of the watershed management approach, by DEP district**

\- = No basin assessed

| DEP District | Group 1 Basins | Group 2 Basins | Group 3 Basins | Group 4 Basins | Group 5 Basins |
|---|---|---|---|---|---|
| **Northwest** | Ochlockonee–St. Marks | Apalachicola–Chipola | Choctawhatchee–St. Andrew | Pensacola | Perdido |
| **Northeast** | Suwannee | Lower St. Johns | - | Nassau–St. Marys | Upper East Coast |
| **Central** | Ocklawaha | Middle St. Johns | Upper St. Johns | Kissimmee River | Indian River Lagoon |
| **Southwest** | Tampa Bay | Tampa Bay Tributaries | Sarasota Bay–Peace–Myakka | Withlacoochee | Springs Coast |
| **South** | Everglades West Coast | Charlotte Harbor | Caloosahatchee | Fisheating Creek | Florida Keys |
| **Southeast** | Lake Okeechobee | St. Lucie–Loxahatchee | Lake Worth Lagoon–Palm Beach Coast | Southeast Coast–Biscayne Bay | Everglades |

**Table E.2. Periods for the development of the Planning, Study, and Verified Lists by cycle and basin group**

| Cycle Rotation | Basin Group | Planning Period | Verified Period |
|---|---|---|---|
| **1** | 1 | 1989–1998 | 1/1/1995–6/30/2002 |
| **1** | 2 | 1991–2000 | 1/1/1996–6/30/2003 |
| **1** | 3 | 1992–2001 | 1/1/1997–6/30/2004 |
| **1** | 4 | 1993–2002 | 1/1/1998–6/30/2005 |
| **1** | 5 | 1994–2003 | 1/1/1999–6/30/2006 |
| **2** | 1 | 1995–2004 | 1/1/2000–6/30/2007 |
| **2** | 2 | 1996–2005 | 1/1/2001–6/30/2008 |
| **2** | 3 | 1997–2006 | 1/1/2002–6/30/2009 |
| **2** | 4 | 1998–2007 | 1/1/2003–6/30/2010 |
| **2** | 5 | 1999–2008 | 1/1/2004–6/30/2011 |
| **3** | 1 | 2000–2009 | 1/1/2005–6/30/2012 |
| **3** | 2 | 2002–2011 | 1/1/2007–6/30/2014 |
| **3** | 3 | 2003–2012 | 1/1/2008–6/30/2015 |
| **3** | 4 | 2004–2013 | 1/1/2009–6/30/2016 |
| **3** | 5 | 2005–2014 | 1/1/2010–6/30/2017 |
| **4** | 1 | 2006–2016 | 1/1/2011–6/30/2018 |
| **4** | 2 | 2007–2017 | 1/1/2012–6/30/2019 |
| **4** | 3 | 2008–2018 | 1/1/2013–6/30/2020 |
| **4** | 4 | 2009–2019 | 1/1/2014–6/30/2021 |
| **4** | 5 | 2010–2020 | 1/1/2015–6/30/2022 |

The watershed management approach also involves the coordination of multiple programs within DEP. First, DEP prepares a monitoring plan in collaboration with stakeholders to determine when and where additional monitoring is needed to assess potentially impaired waters. This effort culminates in the preparation of a strategic monitoring plan. DEP then executes the strategic monitoring plan primarily using DEP staff in the Regional Operations Centers (ROCs). Data from this effort are used to produce a Verified List of Impaired Waters, developed by applying the surface water quality standards in Chapter 62-302, F.A.C., and the IWR methodology in Chapter 62-303, F.A.C. Next, DEP provides draft lists to stakeholders for comment and finalizes the lists based on these comments and any additional information received throughout the process. Finally, as required by Subsection 403.067(4), F.S., DEP adopts the Verified List for each basin by Secretarial Order.

After Secretarial adoption, the TMDL Program uses the Verified List and additional considerations to set priorities for TMDL development. A TMDL assigns preliminary allocations to point and nonpoint pollution sources. DEP adopts all TMDLs by rule. Depending on the circumstances, a basin working group may be formed to develop a BMAP to guide TMDL implementation activities. DEP works closely with watershed stakeholders to ensure that they understand and support the approaches being undertaken to develop and implement the TMDLs.

The basin working group and other stakeholders—especially other state agencies, WMDs, and representatives of county and municipal governments—develop the BMAP. The BMAP may address some or all of the watersheds and basins that flow into the impaired waterbody. This process may take several months to years and culminates in the formal adoption of the BMAP by DEP's Secretary.

The most important BMAP component is the list of management strategies to reduce pollutant sources. Local entities (e.g., wastewater facilities, industrial sources, agricultural producers, county and city stormwater systems, military bases, water control districts, and individual property owners) usually implement these efforts. The management strategies may improve the treatment of pollution (e.g., wastewater treatment facility upgrades, or retrofits in an urban area to enhance stormwater treatment), or the activities may improve source control.

Watershed restoration plans that implement TMDLs can be through a BMAP or through other regulatory requirements such as National Pollutant Discharge Elimination System (NPDES) municipal separate storm sewer system (MS4) bacteria pollution control plans or TMDL implementation plans. In addition, there are opportunities for stakeholders to develop plans that address impairments and improve water quality prior to TMDL development and adoption. While these alternative plans are not BMAPs, they can promote improved water quality and begin the restoration process without waiting for a TMDL to be established. There are two alternative plan types: (1) Assessment Category 4b, reasonable assurance plans (RAPs), and (2) Assessment Category 4e, water quality restoration plans. Once a restoration plan—whether BMAP or stakeholder driven—is in place, activities and projects are completed on a schedule to ensure progress towards water quality restoration.

## *Tracking Improvements Through Time*

The iterative nature of the watershed management approach allows DEP to evaluate and track the effectiveness of management activities (i.e., BMAP and TMDL implementation, the extent to which water quality objectives are being met, and whether individual waters are no longer impaired) over time. For example, each adopted BMAP includes a monitoring component. These data can be compared across multiple basin rotation cycles to document water quality change.

## *Determination of Use Support*

Section 303(c) of the CWA requires that water quality standards established by the states and tribes include appropriate uses to be achieved and protected for jurisdictional waters. The CWA also establishes the national goal of "fishable and swimmable" for all waters wherever that goal is attainable. **Table E.3** lists the use support categories evaluated by assessments performed under the IWR. These categories correspond hierarchically to the surface water classifications provided in **Appendix C**.

**Table E.3. Designated use support categories for surface waters in Florida**

| Designated Use Category Evaluated by Assessments Performed under the IWR | Applies to Waters Having This Surface Water Classification |
|---|---|
| **Aquatic Life Use** | Class I, II, III, III-Limited |
| **Primary Contact and Recreation** | Class I, II, III, III-Limited |
| **Fish and Shellfish Consumption** | Class I, II, III, III-Limited |
| **Drinking Water** | Class I |
| **Protection of Human Health** | Class I, II, III, III-Limited |

Although the IWR establishes the assessment methodology for identifying impaired waters, DEP uses EPA's multicategory, integrated reporting guidance to report use support status. **Table E.4** lists the categories for waterbodies or waterbody segments used by DEP in the *2020 Integrated Report*, and **Table E.5** lists the categories anticipated to be used in the *2022 Integrated Report*.

**Table E.4. Categories for waterbodies or waterbody segments DEP used in the *2020 Integrated Report***

**Note:** The TMDLs are established only for impairments caused by pollutants (a TMDL quantifies how much of a given pollutant a waterbody can receive and still meet its designated uses). For purposes of the TMDL Program, pollutants are chemical and biological constituents, introduced by humans into a waterbody, that may result in pollution (water quality impairment). Other causes of pollution, such as the physical alteration of a waterbody (e.g., canals, dams, and ditches) are not linked to specific pollutants.

| Category | Description | Comments |
|---|---|---|
| **1** | Attains all designated uses. | Not currently used by DEP. |
| **2** | Attains some designated uses and insufficient or no information or data are available to determine if remaining uses are attained. | If attainment is verified for some designated uses of a waterbody or segment, DEP will propose partial delisting for those uses that are attained. Future monitoring will be recommended to acquire sufficient data and/or information to determine if the remaining designated uses are attained. |
| **3a** | No data and/or information are available to determine if any designated use is attained. | Future monitoring will be recommended to acquire sufficient data and/or information to determine if designated uses are attained. |
| **3b** | Some data and information are available but not enough to determine if any designated use is attained. | Future monitoring will be recommended to acquire sufficient data and/or information to determine if designated uses are attained. |
| **3c** | Enough data and information are available to determine that one or more designated uses may not be attained according to the Planning List in the IWR. | These waters are placed on the Planning List and will be prioritized for future monitoring to acquire sufficient data and/or information to determine if designated uses are attained. |
| **4a** | Impaired for one or more designated uses but does not require TMDL development because a TMDL has already been completed. | After EPA approves a TMDL for the impaired waterbody or segment, it will be included in a restoration plan or BMAP to reduce pollutant loading toward the attainment of designated use(s). |

| Category | Description | Comments |
|---|---|---|
| **4b** | Impaired for one or more designated uses but does not require TMDL development because the water will attain water quality standards based on existing or proposed measures. | Pollutant control mechanisms designed to attain applicable water quality standards within a reasonable time have either already been proposed or are already in place. |
| **4c** | Impaired for one or more criteria or designated uses but does not require TMDL development because the impairment is not caused by a pollutant. | This category includes segments that do not meet their water quality standards because of naturally occurring conditions or pollution; such circumstances more frequently appear linked to impairments for low DO or elevated iron concentrations. In these cases, the impairment observed is not caused by specific pollutants but is believed to represent a naturally occurring condition, or to be caused by pollution. |
| **4d** | Identified as not attaining one or more designated uses, but DEP does not have sufficient information to determine a causative pollutant; or current data show a potentially adverse trend in nutrients or nutrient response variables; or there are exceedances of stream nutrient thresholds, but DEP does not have enough information to fully assess nonattainment of the stream nutrient standard. | This category includes segments that do not meet their water quality standards, but no causative pollutant has been identified or where there are adverse trends in nutrients, nutrient response variables, or DO. Waters in this category are included on the basin-specific Study List and submitted to EPA as additions to Florida's 303(d) list of impaired waters. |
| **4e** | Does not attain water quality standards, and pollution control mechanisms or restoration activities are in progress or planned to address nonattainment of water quality standards. DEP does not have enough information to fully evaluate whether proposed pollution mechanisms will result in the attainment of water quality standards. | Restoration activities for waterbodies in this category have been completed, are planned, or are ongoing, such that once the activities are completed or the waterbody has had a chance to stabilize, in the opinion of DEP staff it will meet its designated uses. Waters in this category are included on the basin-specific Study List and submitted to EPA as additions to Florida's 303(d) list of impaired waters. |
| **5** | Water quality standards are not attained and a TMDL is required. | Waterbodies or segments in this category have been identified as impaired for one or more designated uses by a pollutant or pollutants. Waters in this category are included on the basin-specific Verified List adopted by Secretarial Order and submitted to EPA as additions to Florida's 303(d) list of impaired waters. |

### Table E.5. Categories for waterbodies or waterbody segments DEP plans to use in the *2022 Integrated Report*

WAS = Watershed Assessment Section
WQETP TMDL = Water Quality Evaluation and TMDL Program–Total Maximum Daily Load
WPCS BMAP = Watershed Planning and Coordination Section–Basin Management Action Plan
NPDES MS4 = National Pollutant Discharge Elimination System–Municipal Separate Storm Sewer System (MS4) Section
DWRA NPS = Division of Water Restoration Assistance–Nonpoint Source Section

| Category | Description | Comments |
|---|---|---|
| **2b** | Attains one or more designated uses and a RAP has already been completed. | Waterbody is not impaired for the parameter being assessed and has a RAP that addresses the parameter. A comprehensive and coordinated evaluation will be implemented that includes DEP staff (WAS, WQETP TMDL, WPCS BMAP, NPDES MS4, DWRA NPS, etc.) and/or stakeholders to determine whether the use of the assessment category is warranted (i.e., has attainment/success really been achieved) or whether the evaluation of the data used in the current assessment is considered preliminary. If additional data are needed to confirm attainment, the waterbody should be retained in Assessment Category 4b. |
| **2e** | Attains one or more designated uses and an alternative restoration plan has already been completed. | Waterbody is not impaired for the parameter being assessed and has an alternative restoration plan that addresses the parameter. A comprehensive and coordinated evaluation will be implemented that includes DEP staff (WAS, WQETP TMDL, WPCS BMAP, NPDES MS4, DWRA NPS, etc.) and/or stakeholders to determine whether the use of the assessment category is warranted (i.e., has attainment/success really been achieved) or whether the evaluation of the data used in the current assessment is considered preliminary. If additional data are needed to confirm attainment, the waterbody should be retained in Assessment Category 4e. |
| **2t** | Attains one or more designated uses and a TMDL has already been completed. | Waterbody is not impaired for the parameter being assessed and has a TMDL that addresses the parameter. A comprehensive and coordinated evaluation will be implemented that includes DEP staff (WAS, WQETP TMDL, WPCS BMAP, NPDES MS4, DWRA NPS, etc.) and/or stakeholders to determine whether the use of the assessment category is warranted (i.e., has attainment/success really been achieved) or whether the evaluation of the data used in the current assessment is considered preliminary. If additional data are needed to confirm attainment, the waterbody should be retained in Assessment Category 4a. |

Assessments and subsequent listing decisions performed using the IWR methodology relate only to the current assessment periods. For segments that cannot be fully assessed using only data from the current assessment periods, EPA has encouraged Florida to incorporate a complete review of all water quality data for the entire period of record. Consequently, DEP extended the assessment methodology to include period-of-record data when such additional data are available and these data meet DEP QA requirements (often the quality and/or the reliability of older data cannot be established).

For the second cycle of the basin rotation, DEP implemented a complete review of each basin group to evaluate the period-of-record data and determined which waterbodies needed further data collection. Waterbodies with historical data that met the Verified List methodology were placed on the Planning List if more recent data were not available to confirm use attainment.

## *Data Management*

### Sources

WIN, Florida STORET, and Statewide Biological Database (SBIO) are the primary sources for assessment data. While the vast majority of IWR assessments rely almost entirely on data from Florida STORET and WIN, these data are supplemented as required with data obtained from other sources. For assessments performed for the current assessment period, 87 % of the data used came from Florida STORET, 12 % came from WIN, and less than 1 % came from other sources. **Table E.6** lists the agencies and organizations that provided IWR assessment data.

## Table E.6. Agencies and organizations providing data used in the IWR assessments

- Alabama Department of Environmental Management
- Alachua County Environmental Protection Department
- Amec Foster Wheeler Environment and Infrastructure Inc. (AMEC)
- Avon Park Air Force Range
- Babcock Ranch
- Biological Research Associates (ENTRIX)
- Bream Fishermen Association
- Broward County Environmental Protection Department
- Charlotte County Department of Health
- Charlotte County Stormwater Division
- Charlotte Harbor National Estuary Program (CHNEP) – East Wall
- CHNEP – Lower Lemon Bay
- CHNEP – Matlacha Pass
- CHNEP – Peace River
- CHNEP – San Carlos Bay
- CHNEP – Tidal Myakka River
- CHNEP – Tidal Peace River
- CHNEP – West Wall
- Choctawhatchee Basin Alliance
- City of Altamonte Springs
- City of Atlantic Beach
- City of Bonita Springs
- City of Cape Coral
- City of Deltona
- City of Fort Myers
- City of Jacksonville
- City of Jacksonville Beach
- City of Kissimmee
- City of Lakeland
- City of Marco Island
- City of Naples
- City of Neptune Beach
- City of Orlando
- City of Port St. Lucie
- City of Punta Gorda
- City of Saint Petersburg
- City of Sanibel, Natural Resources Department
- City of Tallahassee Stormwater Management Division
- Collier County Coastal Zone Management Department
- Collier County Pollution Control
- Dade County Environmental Resource Management
- FDOH – Division of Environmental Health, Bureau of Water
- Environmental Services and Permitting, Inc.
- DEP – Groundwater Monitoring Section
- DEP – Charlotte Harbor Aquatic/Buffer Preserves
- DEP – Tallahassee Regional Operations Center
- DEP – Watershed Assessment Section
- DEP – Water Quality Standards and Special Projects
- DEP – WET Section
- DEP – Central District
- DEP – Northeast District
- DEP – Northwest District
- DEP – South District
- DEP – Southeast District
- DEP – Southwest District
- DEP – Okaloosa County Environmental Council
- Florida Department of Agriculture and Consumer Services
- Florida Department of Environmental Protection
- Florida Game and Freshwater Fish Commission
- Florida Keys National Marine Sanctuary – Water Quality Monitoring Program
- Florida LakeWatch
- Florida Marine Research Institute
- Frydenborg Ecologic LLC
- Guana Tolomato Matanzas Estuarine Research Reserve
- Hillsborough County, Florida Water Quality Data
- Howard T. Odum Florida Springs Institute
- Jacksonville Electric Authority
- Lake County Water Resource Management
- Lee County Environmental Lab
- Lehigh Acres Municipal Services Improvement District
- Leon County Public Works
- Loxahatchee River District
- Manatee County Environmental Management Department.
- Marine Resources Council of East Florida
- McGlynn Laboratories, Inc.
- Naval Station Mayport
- Northwest Florida Water Management District
- Orange County Environmental Protection
- Palm Beach County Environmental Resource Management
- Pasco County Stormwater Management Division
- Peace River Manasota Regional Water Authority
- Pelican Bay Services
- Pinellas County Department of Engineering and Environmental Services
- Polk County Natural Resources Division
- Reedy Creek Improvement District Environmental Services
- Sanibel Captiva Conservation Foundation
- Sarasota County Environmental Services
- Seminole County
- SMR Communities, Inc.
- South Florida Water Management District
- Southwest Florida Water Management District
- Southwest Florida Water Management District (Project Coast)
- St. Johns River Water Management District
- Suwannee River Water Management District
- Tampa Bay Water
- Turrell, Hall and Associates., Inc.
- U.S. Geological Survey
- Volusia County Environmental Health

### Quality Assurance/Quality Control (QA/QC) Criteria

The IWR addresses QA/QC by requiring all data providers to use established SOPs and National Environmental Laboratory Accreditation Conference (NELAC)–certified laboratories to generate results intended for use in IWR assessments. All data must meet DEP QA rule requirements (Chapter 62-160, F.A.C.). To further ensure that the QA/QC objectives of the program are being met, DEP's Aquatic Ecology and Quality Assurance (AEQA) Section, on request, audits data providers (or laboratories used by data providers) on behalf of the program.

### Rationales for Exclusion of Existing Data

In assessing surface water quality under the IWR, DEP attempts to assemble and use all readily available ambient surface water quality data. DEP excludes measurements or observations that are known not to be representative of ambient waters (e.g., results for samples collected from discharges or in approved mixing zones) from IWR assessments. In addition, data collected at locations or during periods that are not representative of the general condition of the waterbody (e.g., samples collected during or immediately after a hurricane or samples linked to a short-term event such as a sewage spill) are subject to additional review before inclusion in the IWR assessment process.

If QA/QC audits identify specific data deficiencies, corresponding data subsets may be excluded from the assessment process. In these situations, the AEQA Section will provide recommendations to the appropriate data providers. Similarly, if a review of water quality assessment data identifies specific discrepancies or anomalies, these data also may be precluded from an assessment. Typically, such discrepancies include systematic issues such as errors in the conversion of units, errors caused by using an incorrect fraction to characterize an analyte, or other data-handling errors that may have occurred in conjunction with the data-loading process. In these cases, DEP staff will work with the data provider to resolve the underlying issues. Upon resolution, corrected data are (re)loaded to Florida STORET and made available for subsequent IWR assessments.

**Table E.7** contains additional details about the specific types of data that have been excluded from assessments performed under the IWR.

## *Use and Interpretation of Biological Results*

The biological assessment tools used in conjunction with IWR assessments consist of the SCI, LVI, RPS, LVS, Habitat Assessment (HA), and Bioreconnaissance (BioRecon). Because BioRecon is primarily a screening tool, DEP does not use low BioRecon scores alone as the basis for impairment decisions. Instead, it requires follow-up sampling with the SCI to provide a more comprehensive measure of aquatic life use support. In addition, a single SCI with a score less than the acceptable value is not sufficient to support an impairment or delisting decision. When SCIs are used as the basis for impairment decisions, DEP requires a minimum of at least two temporally independent SCIs.

**Table E.7. Data excluded from IWR assessments**

| Data Excluded | Comment |
|---|---|
| **Results reported in Florida STORET that did not include units or included units that were inappropriate for the particular analyte.** | The result values could not accurately be quantified or relied on for assessment purposes under the IWR. |
| **Results reported as negative values.** | It was concluded that, except in cases where documentation was presented that indicated otherwise, any results reporting a negative value for the substance analyzed represent reporting errors. Credible data could not have any values less than the detection limit (in all cases a positive value) reported, and therefore results reported as negative values could not be relied on for assessment purposes under the IWR. |
| **Results reported as "888" "8888" "88888" "888888" "8888888" and "999" "9999" "99999" "999999" "9999999".** | Upon investigation, all data reported using these values were found to be provided by a particular WMD. The district intentionally coded the values in this manner to flag the fact that they should not be used, as the values reported from the lab were suspect. The data coded in this manner were generally older. |
| **Extremely old USGS data (from the beginning of the previous century).** | These results did not have complete date information available, and accurate date information is required to assess results under the IWR. The USGS data using USGS parameter codes 32230 or 32231 also were excluded from assessments performed under the IWR, based on information in a memo sent from USGS. |
| **Results for iron that were confirmed to be entered into Database Hydrologic (dbHydro) (South Florida WMD's environmental database) using an incorrect Legacy STORET parameter code.** | These results were limited to a subset of the results reported by a particular WMD. |
| **Results reported associated with "K," "U," and "W," qualifier codes (all of which suggest that the result was below the method detection limit [MDL]) when the reported value of the MDL was greater than the criterion, or the MDL was not provided.** | To be able to compare a nondetect result with a criterion value, it is necessary to know that it was possible to measure as low as the numeric value of the criterion. |
| **Results reported using an "I" qualifier code (meaning that the result value was between the MDL and the practical quantitation limit [PQL]) if the MDL was not provided, or where the MDL and PQL were inconsistent with the rest of the data record.** | Because of the uncertainty with results that had an MDL above a criterion, it is not possible to determine the precision of the data. |

| Data Excluded | Comment |
| --- | --- |
| **Results reported for metals using an "I" qualifier code if the applicable criterion was expressed as a function of hardness, and the numeric value of the metal criteria corresponding to the reported hardness value was between the MDL and PQL.** | Because of the uncertainty with results that had an MDL above a criterion, it is not possible to determine the precision of the data and the applicable water quality criterion. |
| **Results reported using an "L" qualifier code (meaning that the actual value was known to be greater than the reported value) where the reported value for the upper quantification limit was less than the criterion.** | The reasoning for excluding these data follows a similar logic as the cases discussed above for results reported as below the MDL. |
| **Results reported with a "Z" qualifier code (indicating that the results were too numerous to count).** | These results were excluded because there was no consistency among data providers in how data using this qualifier code were reported. Some data providers entered numeric estimates of bacteria counts, while others entered the dilution factor. As a result, the meaningful interpretation of data reported using this qualifier was not uniformly possible. |
| **Results reported with an "F" qualifier code (indicating female species).** | Since the IWR does not assess any analytes for which this qualifier code would be appropriate, the intended meaning of the use of this code is unknown. The reported result is therefore rendered uninterpretable (although there are very few instances of the use of this qualifier code in the IWR dataset, and some agencies may use this to indicate a field measurement). |
| **Results reported with a "G" qualifier code (analyte detected in blank).** | Data are excluded when the blank value was greater than 10 % of the associated sample value. |
| **Results reported with an "O" qualifier code (indicating that the sample was collected but that the analysis was lost or not performed).** | The exclusion of results reported using this qualifier code is self-explanatory. |
| **Results reported with an "N" qualifier code (indicating a presumption of evidence of the presence of the analyte).** | Comparing concentrations of analytes with water quality criteria requires a numeric result value. Presence or absence, for the purposes of assessments performed under the IWR, is not sufficient information on which to base an impairment decision. |
| **Results reported with a "V" or "Y" qualifier code (indicating the presence of an analyte in both the environmental sample and the blank, or a laboratory analysis from an unpreserved or improperly preserved sample).** | Such data may not be accurate. The use of these codes indicates that the reported result was not reliable enough to be used in IWR assessments. |
| **Results reported in WIN with a "?" qualifier (data are rejected).** | These results are excluded because some or all of the QC data for the analyte were outside criteria, and the presence or absence of the analyte cannot be determined from the data |

| Data Excluded | Comment |
|---|---|
| **Results reported with a "Q" qualifier code (indicating that the holding time was exceeded).** | The data were reviewed to validate whether the appropriate holding times were used, and if so, whether they were exceeded. All parameters reported with a "Q" qualifier code were excluded from IWR assessments, except bacteria. |
| **Results reported for mercury not collected and analyzed using clean techniques, as required by the IWR.** | The use of clean techniques removes the chance for contamination of samples collected and analyzed for mercury. Mercury concentrations obtained from contaminated samples would not be representative of the true mercury concentrations in the target waterbody segments. |
| **Results recommended for exclusion from DEP's QA Section as a result of lab or field audits.** | The data excluded based on lab audits were generally analyte specific and referred to a specific period. While the data issues encountered were variable, the lack of acceptable, or verifiable, records was a common issue. |
| **Certain DO measurements collected using a field kit (as opposed to a sonde).** | The results are excluded because of the lack of data quality based on field kits. |

# Appendix F: IWR Methodology for Evaluating Impairment

DEP evaluates the quality of waters of the state by using the science-based assessment methodology described in Chapter 62-303, F.A.C. The methodology provides a detailed process for determining the attainment of applicable water quality standards. Two distinct steps aim at identifying impaired waters: (1) using a statistical methodology to identify waterbody segments that exceed water quality criteria ("potentially impaired waters"), and (2) subjecting these segments to further review. If an exceedance for a potentially impaired segment caused by a pollutant later is verified, the segment is placed on the Verified List of Impaired Waters. The methodology described in the IWR provides a prespecified level of confidence that assessment results accurately reflect the actual water quality conditions of waters of the state.

In addition to providing assessment and listing thresholds, the IWR also (1) describes data sufficiency requirements, (2) addresses data quality objectives, and (3) describes the requirements for delisting segments that were previously included on the Verified List. The results in this report, including those assessments performed through 2019, are based on water quality criteria that were recently revised to incorporate DO (as percent saturation, replacing DO as concentration), NNC (DEP 2013a), recreational bacteria, and total ammonia nitrogen (replacing un-ionized ammonia).

The particular type of data and/or information required to determine use support varies by designated use (see **Appendix C**) and, in addition to physical and chemical analytical results characterizing the water column, includes biological data, fish consumption advisories, and beach closure and advisory information, as well as changes in the classification of shellfish-harvesting areas. At times, DEP also uses field survey and reconnaissance information to help identify impairments.

## *Evaluation of Aquatic Life–Based Use Support*

Aquatic life–based use support refers to the propagation and maintenance of a healthy, well-balanced population of fish and wildlife. To determine aquatic life–based use support, the IWR methodology uses three distinct types of data (Rule 62-303.310, F.A.C.):

1. Comparisons of discrete water quality measurements with specific class-specific numeric criteria from the Florida Standards (and other, similarly worded numeric threshold values, as described in Rule 62-303.320, F.A.C.).

2. Comparisons of results calculated for multimetric biological indices with waterbody type–specific biological assessment thresholds (as described in Rule 62-303.330, F.A.C).

3. Comparisons of annual summary statistics with numeric values based on an interpretation of narrative nutrient criteria from the Florida Standards (as described in Rule 62-303.350, F.A.C.).

Evaluations performed under the IWR rely primarily on discrete sample data obtained primarily from STORET and WIN. Subject to data sufficiency and data quality requirements, exceedances of applicable criteria and/or threshold values indicate that aquatic life–based use support is not achieved. However, the IWR allows waterbodies with values not meeting the DO criterion that have healthy biological assessments not to be included on the Verified List

### *Evaluation of Primary Contact and Recreation Use Support*

The IWR methodology determines primary contact and recreation use attainment by evaluating the following (Rule 62-303.360, F.A.C.):

1. Comparisons of discrete water quality measurements with specific numeric criteria values for bacteria, consisting of comparisons with the relevant class-specific numeric criteria from the Florida Standards (and other, similarly worded numeric threshold values, as described in Rule 62-303.360, F.A.C.).

2. Evaluation of beach closure, or beach advisories, or warning information; this information must be based on bacteriological data, issued by the appropriate governmental agency, as described in Rule 62-303.360, F.A.C.

3. Comparison of summary measures of bacteriological data with threshold values described in Rule 62-303.360, F.A.C.

For the purpose of assessments using bacteria counts, FDOH reports the bacteriological results used as the basis for beach advisories, warnings, and closures to WIN. DEP combines these data with bacteriological results from other data providers statewide. Subject to data sufficiency and data quality requirements, exceedances of applicable criteria and/or threshold values indicate that primary contact and recreational use support are not achieved.

### *Evaluation of Fish and Shellfish Consumption Use Support*

The evaluation of fish and shellfish consumption use support relies on the evaluation of both quantitative and qualitative information, as follows (as described in Rule 62-303.370, F.A.C.):

1. Comparisons of discrete water quality measurements with specific numeric criteria values for bacteria, consisting of comparisons with the relevant class-specific numeric criteria from the Florida Standards (and other, similarly worded numeric threshold values, as outlined in Rule 62-303.320, F.A.C.).

2. Evaluation of fish advisory information issued by FDOH or other authorized governmental entity.

3. Evaluation of shellfish-harvesting actions taken by FDACS, provided those actions were based on bacteriological contamination or water quality data.

When a Class I, II, or III waterbody fails to meet its applicable water quality criteria for bacteriological quality, the waterbody is assessed as impaired under the IWR. Subject to data sufficiency and data quality requirements, exceedances of applicable thresholds indicate that aquatic life–based use attainment is not met.

In addition, if FDOH has issued a fish consumption advisory, or if FDACS has classified a Class II waterbody segment as anything other than approved for shellfish harvesting or propagation, that segment is verified as impaired, and determined not to meet its designated use.

## *Evaluation of Drinking Water Use Attainment*

The evaluation of drinking water use attainment is based on the following type of information (Rule 62-303.380, F.A.C.):

1. Comparisons of discrete water quality measurements to class-specific threshold values or numeric criteria from the Florida Standards, as outlined in Rule 62-303.320, F.A.C.

## *Evaluation and Determination of Use Attainment*

### Exceedances of Numeric Criteria from the Florida Standards

**Table F.1** lists analytes for which numeric criteria exist in the Florida Standards and counts of sample results available for assessments performed under the IWR.

## Table F.1. Sample counts for analytes having numeric criteria in the Florida Standards

| Analyte | Number of Observations |
|---|---|
| **2,4-D** | 4,545 |
| **Anthracene** | 246 |
| **Silver** | 48,058 |
| **Aluminum** | 42,964 |
| **Aldrin** | 1,820 |
| **Alkalinity** | 151,490 |
| **Acenaphthene** | 236 |
| **Arsenic** | 59,990 |
| **Boron** | 9,668 |
| **Barium** | 39,038 |
| **Beta BHC** | 1,831 |
| **Beryllium** | 24,075 |
| **Benzene** | 293 |
| **Cadmium** | 60,477 |
| **Chlordane** | 1,608 |
| **Chloride** | 150,868 |
| **Chlorine** | 49 |
| **Cyanide** | 8 |
| **Specific Conductance** | 606,531 |
| **Chlorophenol** | 229 |
| **Chromium III** | 55,054 |
| **Carbon Tetrachloride** | 292 |
| **Copper** | 64,501 |
| **Dichloroethylene** | 159 |
| **2,4-Dichlorophenol** | 186 |
| **DDT** | 1,816 |
| **Demeton** | 1,565 |
| **Detergents** | 25 |
| **Dieldrin** | 1,917 |
| **Dissolved Solids** | 97,259 |
| **2,4-Dinitrophenol** | 224 |
| **Escherichia coli** | 28,654 |
| **Enterococci** | 183,788 |
| **Endosulfan** | 1,835 |
| **Endrin** | 1,737 |
| **Fluoride** | 64,086 |
| **Fecal Coliform** | 296,583 |
| **Iron** | 71,123 |
| **Fluoranthene** | 246 |

| Analyte | Number of Observations |
|---|---|
| **Fluorene** | 236 |
| **Guthion** | 1,806 |
| **Heptachlor** | 1,828 |
| **Mercury** | 2,078 |
| **Lindane** | 1,755 |
| **Malathion** | 2,211 |
| **Mirex** | 1,712 |
| **Manganese** | 42,384 |
| **Methoxychlor** | 1,655 |
| **Nickel** | 50,645 |
| **Nitrate** | 49,087 |
| **Oil/Grease** | 269 |
| **Lead** | 61,580 |
| **Pentachlorophenol** | 196 |
| **pH** | 695,880 |
| **Phenol** | 1,115 |
| **Pyrene** | 246 |
| **Antimony** | 23,432 |
| **Selenium** | 40,867 |
| **Sevin** | 304 |
| **Tetrachloroethylene** | 238 |
| **Thallium** | 23,223 |
| **Toxaphene** | 1,615 |
| **Trichloroethylene** | 293 |
| **Turbidity** | 337,734 |
| **Un-Ionized Ammonia** | 154,817 |
| **Zinc** | 58,382 |

Since the numeric water quality criteria from Chapter 62-302, F.A.C., are class and waterbody-type specific, DEP classifies segments first by their appropriate waterbody class and as one of four waterbody types—stream (including springs), lake, estuary, or coastal. For each analyte having a criterion in the Florida Standards, DEP calculates four-day station median concentrations (or, in some instances, daily values) and compares these values with the applicable class-specific criterion values in the Florida Standards, rather than the four-day station median.

For waters assessed under Subsection 62-303.320(1), F.A.C., for each segment and analyte combination, DEP counts the number of samples and exceedances of the applicable criterion and compares the exceedance count with the listing threshold value for the corresponding sample size. The listing thresholds represent the minimum number of samples not meeting the applicable water quality criterion necessary to obtain the required confidence levels. Comparisons performed for acute toxicity–based exceedances, or exceedances of synthetic organics and pesticides, have a lower listing threshold of more than a single exceedance in any consecutive three-year period.

Subject to data sufficiency requirements, DEP places a waterbody segment assessed under Subsection 62-303.320(1), F.A.C., on the Planning List if there are a sufficient number of samples to attain at least 80 % confidence that the actual criterion exceedance rate was greater than or equal to 10 %. Waters placed on the Planning List are subject to additional data collection and review.

To place a waterbody segment assessed under Subsection 62-303.420(2), F.A.C., on the Verified List, the number of samples must be sufficient to attain at least 90 % confidence that the actual criterion exceedance rate was greater than or equal to 10 %.

### Interpretation of Narrative Nutrient Criterion

The Florida Standards include a narrative nutrient criterion, which states, "In 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." In Rule 62-303.350, F.A.C., the IWR provides a working interpretation of this criterion. Under this interpretation, the AGMs for chlorophyll *a*, TN, and TP concentrations (for streams, lakes, and estuaries) and nitrate-nitrite (for spring vents) were used to assess whether a waterbody should be further assessed for nutrient impairment under the rule in effect in 2019.

#### *Exceedances of Biological Thresholds*

Biota inhabiting a waterbody function as continual natural monitors of environmental quality, capable of detecting the effects of both episodic, as well as cumulative, alterations in water quality, hydrology, and habitat. A biological assessment uses the response of resident aquatic biological communities to various stressors as a method of evaluating ecosystem health. Because these communities can manifest long-term water quality conditions, they can provide a direct measure of whether the designated use of a "well-balanced population of fish and wildlife" is being attained (Rule 62-302.400, F.A.C.) better than characterization by discrete chemical or physical measurements alone. In addition, bioassessment often can provide insights into appropriate restoration strategies.

### Metrics Used

Bioassessment tools used with the IWR assessments incorporate multimetric methods to quantify biological community structure or function. When multimetric methods are used, the results of individual metrics (e.g., number of long-lived taxa, number of sensitive taxa, percent filter feeders, percent clingers) are combined into a single dimensionless, multimetric index. Such indices offer potential advantages over the use of individual metrics by integrating multiple nonredundant measures into a single score reflecting a wider range of biological information. The SCI and BioRecon are two examples of multimetric indices used to quantify the health of rivers and streams based on the biological health of macroinvertebrates.

Recalibrations of the SCI and the BioRecon methods completed in 2007 involved the use of the Human Disturbance Gradient (HDG), which ranks sites based on independent assessments of habitat quality, degree of hydrologic disturbance, water quality, and human land use intensity. The SCI and BioRecon scores calculated before August 2007 used a smaller, similar set of input metrics.

Since both sets of scores represent valid biological assessments performed during discrete periods, both are used in assessments of biological health performed under the IWR. The BioRecon is used to place waterbodies on the Planning List only, but the SCI is used in conjuction with the floral metrics (chlorophyll *a*, RPS, and LVS, as described in Rules 62-302.531 and 62-302.532, F.A.C.). This implementation is consistent with the document *Implementation of Florida's Numeric Nutrient Standards* (DEP 2013a).

Additional efforts to develop multimetric indices for periphyton (attached algae) and phytoplankton (drifting algae) that incorporate the HDG also have been attempted, but significant relationships between human disturbance and biological response in these communities have not been established. DEP has since developed and implemented an RPS method to evaluate periphyton communities and continues to use chlorophyll *a* concentrations to quantify imbalances in phytoplankton communities.

**Bioassessment Data Used**

IWR bioassessments used macroinvertebrate data only from ambient sites located in surface waters of the state. DEP excluded data from effluent outfall sites and monitoring sites not clearly established to collect ambient water quality data.

Site-specific habitat and physicochemical assessment (e.g., percent suitable macroinvertebrate habitat, water velocities, extent of sand or silt smothering, and width of riparian buffer zones) provides information important for identifying stressors responsible for a failed SCI score.

This information also can be extremely useful in determining biological impairment, since biological communities sometimes respond to factors other than water quality, such as habitat disruption and hydrologic disturbances. Waterbody segments adversely affected only by pollution (e.g., a lack of habitat or hydrologic disruption) but not by a pollutant (a water quality exceedance) are not placed on the Verified List.

DEP's SOPs provide definitions and specific methods for the generation and analysis of bioassessment data. Because these bioassessment procedures require specific training and expertise, the IWR also requires that persons conducting bioassessments must comply with the

QA requirements of Chapter 62-160, F.A.C., attend at least eight hours of DEP-sanctioned field training, and pass a DEP-sanctioned field audit. Meeting these requirements helps ensure samplers will follow the applicable SOPs in Chapter 62-160, F.A.C., before collecting bioassessment data used in IWR assessments.

### SCI

The total SCI score is the average of 10 metric scores: total number of taxa, total number of taxa belonging to the order Ephemeroptera, total taxa of the order Trichoptera, percent filter feeders, total number of long-lived taxa, total number of clinger taxa, percent dominant taxa, percent taxa in the tribe Tanytarsini, total number of sensitive taxa, and percent very tolerant taxa (see **Table F.2** for calculations).

**Table F.2. SCI metrics for the Northeast, Big Bend, Panhandle, and Peninsula regions of Florida**

X = Raw metric value, ln = Natural log

| SCI Metric | Northeast | Big Bend | Panhandle West | Peninsula |
|---|---|---|---|---|
| **Total taxa** | 10 * (X–15)/27 | 10 * (X–17)/23 | 10 * (X–19)/28 | 10* (X-15)/24 |
| **Ephemeroptera taxa** | 10 * X /5 | 10 * X /5 | 10 * X /8 | 10 * X /5 |
| **Trichoptera taxa** | 10 * X /8 | 10 * X /7 | 10 * (X-1) /9 | 10 * X /7 |
| **% filterer** | 10 * (X-0.7)/40.5 | 10 * (X-1)/53 | 10 * (X-2.7)/47 | 10 * (X-0.7)/43 |
| **Long-lived taxa** | 10 * X /4 | 10 * X /3 | 10 * X /5 | 10 * X /3 |
| **Clinger taxa** | 10 * X /10 | 10 * X /8 | 10 * (X-2) /10 | 10 * X /7 |
| **% dominant** | 10 - (10 * [ (X-11)/48]) | 10 - (10 * [ (X-12.5)/54]) | 10 - (10 * [ (X-10.5)/36]) | 10 - (10 * [ (X-14)/50]) |
| **% Tanytarsini** | 10 * [ ln (X + 1) /3.2] | 10 * [ ln (X + 1) /3.1] | 10 * [ ln (X + 1) /3.2] | 10 * [ ln (X + 1) /3.4] |
| **Sensitive taxa** | 10 * X /13 | 10 * X /10 | 10 * (X-2) /15 | 10 * X /7 |
| **% Very tolerant** | 10 - (10 * [ ln (X + 1)/4.1]) | 10 - (10 * [ (ln (X + 1)-0.6)/3.6]) | 10 - (10 * [ ln (X + 1)/3.3]) | 10 - (10 * [(ln (X + 1)-0.7)/4.0]) |

### BioRecon

A BioRecon data impairment rating uses the six metrics as calculated in **Table F.3** and the index thresholds in **Table F.4**.

**Table F.3. BioRecon metrics for the Northeast, Panhandle, and Peninsula regions of Florida**

X = Raw metric value

| BioRecon Metric | Northeast | Panhandle | Peninsula |
|---|---|---|---|
| **Total taxa** | (X–14) /23 | (X–16) /33 | (X–11) /25 |
| **Ephemeroptera taxa** | X /3.5 | X /12 | X /5 |
| **Trichoptera taxa** | X /6.5 | X /7 | X /7 |
| **Long-lived taxa** | X /6 | X /10 | X /7 |
| **Clinger taxa** | X /7 | X /15.5 | X /8 |
| **Sensitive taxa** | X /11 | X /19 | X /9 |

**Table F.4. BioRecon sample size and index range**

| BioRecon | Index Range |
|---|---|
| **1 sample: Pass** | (6–10) |
| **1 sample: Fail** | (0–6) |
| **2 samples: Good** | (7–10) |
| **2 samples: Fair** | (4–7) |
| **2 samples: Poor** | (0–4) |

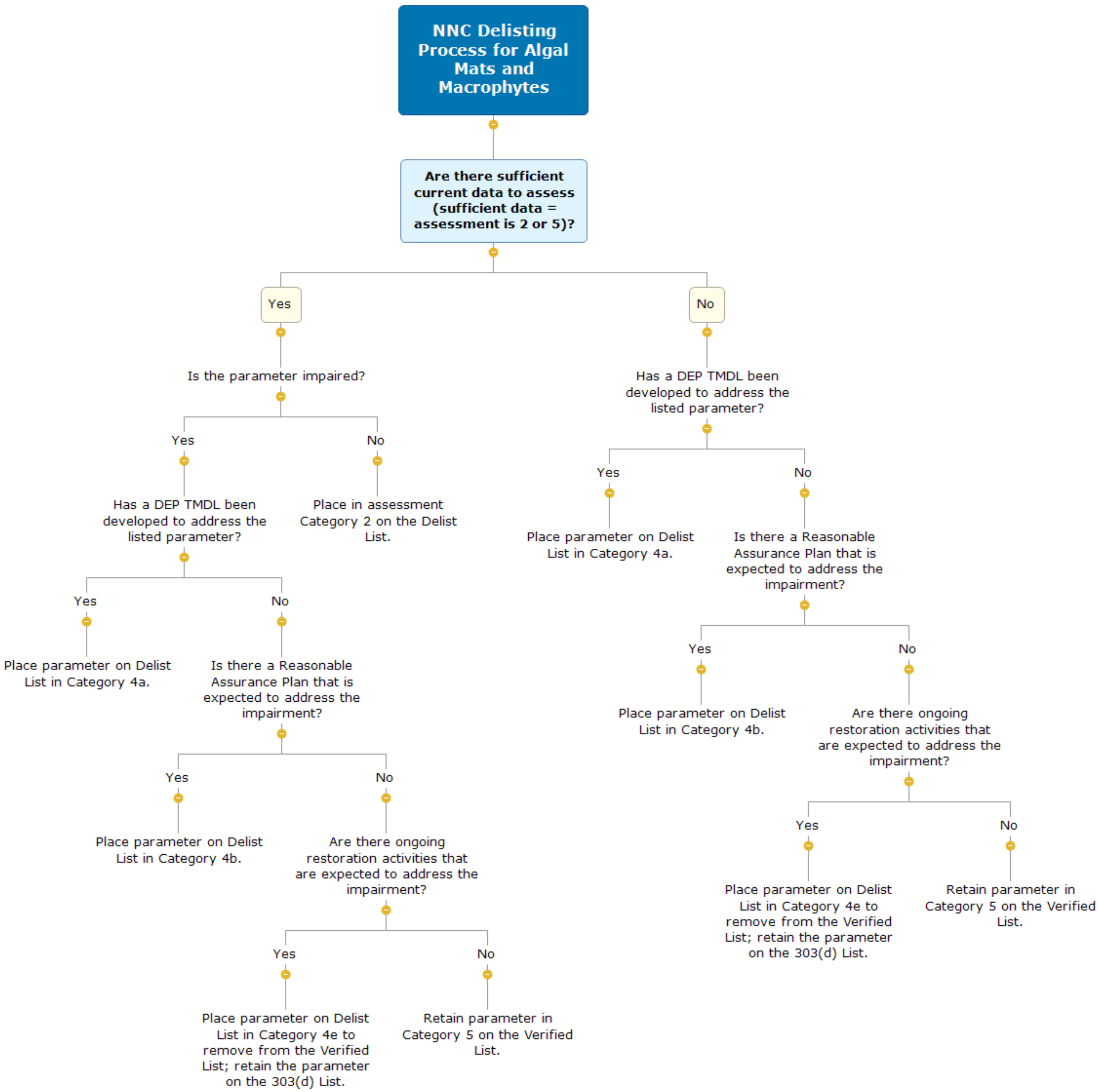
## *Delisting*

A waterbody segment on the 303(d) list or the Verified List may be proposed for delisting when it is demonstrated that water quality criteria are currently being met. Waterbody segments also may be proposed for delisting for other reasons, including if the original listing is in error, or if a water quality exceedance is from natural causes or not caused by a pollutant.

Although the IWR has specific requirements for delisting decisions, determining the ultimate assessment category (or subcategory) (see **Appendix G**) for delisted segments is not necessarily straightforward. For example, EPA has provided guidance that a waterbody previously identified as impaired for nutrients based on chlorophyll *a* or TSI assessments can be delisted if the waterbody does not exceed the IWR threshold values or NNC (DEP 2013a). However, until sufficient site-specific information is available to demonstrate use attainment, these waterbody segments cannot be placed in Assessment Category 2 and instead are assigned to Assessment Category 3b. The required site-specific information to place the waterbody segment in Assessment Category 2 can include, but is not limited to, measures of biological response such as the SCI and macrophyte or algal surveys.

# Appendix G: IWR Guidance for Delisting WBIDs for Nutrients

## Chart G.1. NNC delisting process for algal mats and macrophytes



## Chart G.2. NNC delisting process for chlorophyll *a*, TN, TP, and nitrate-nitrite

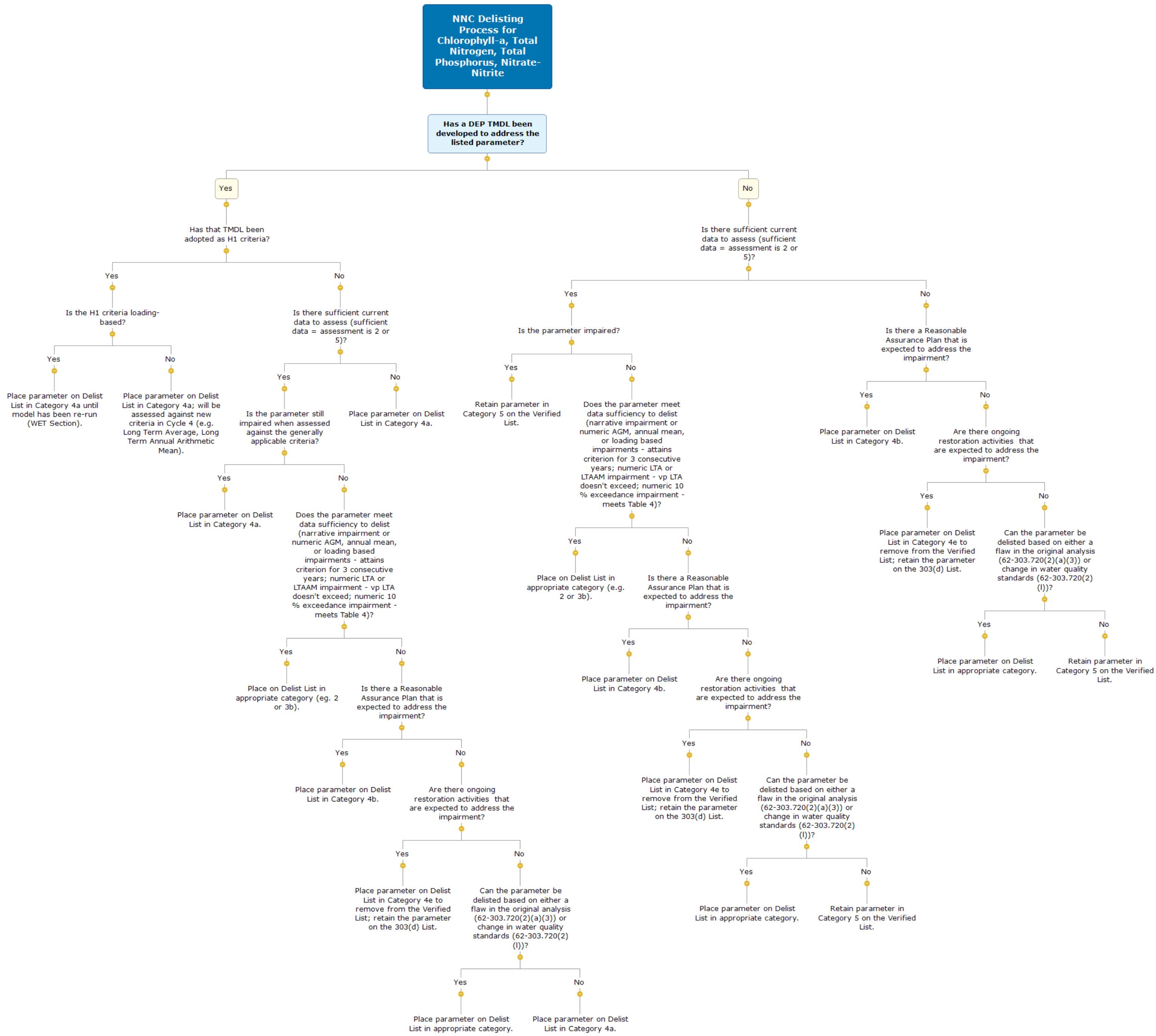
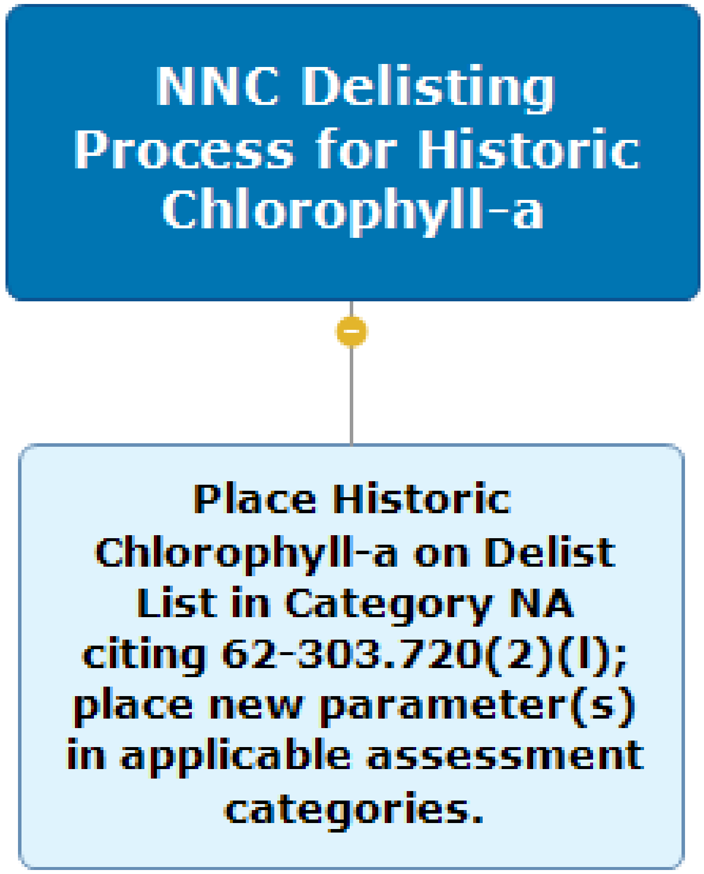
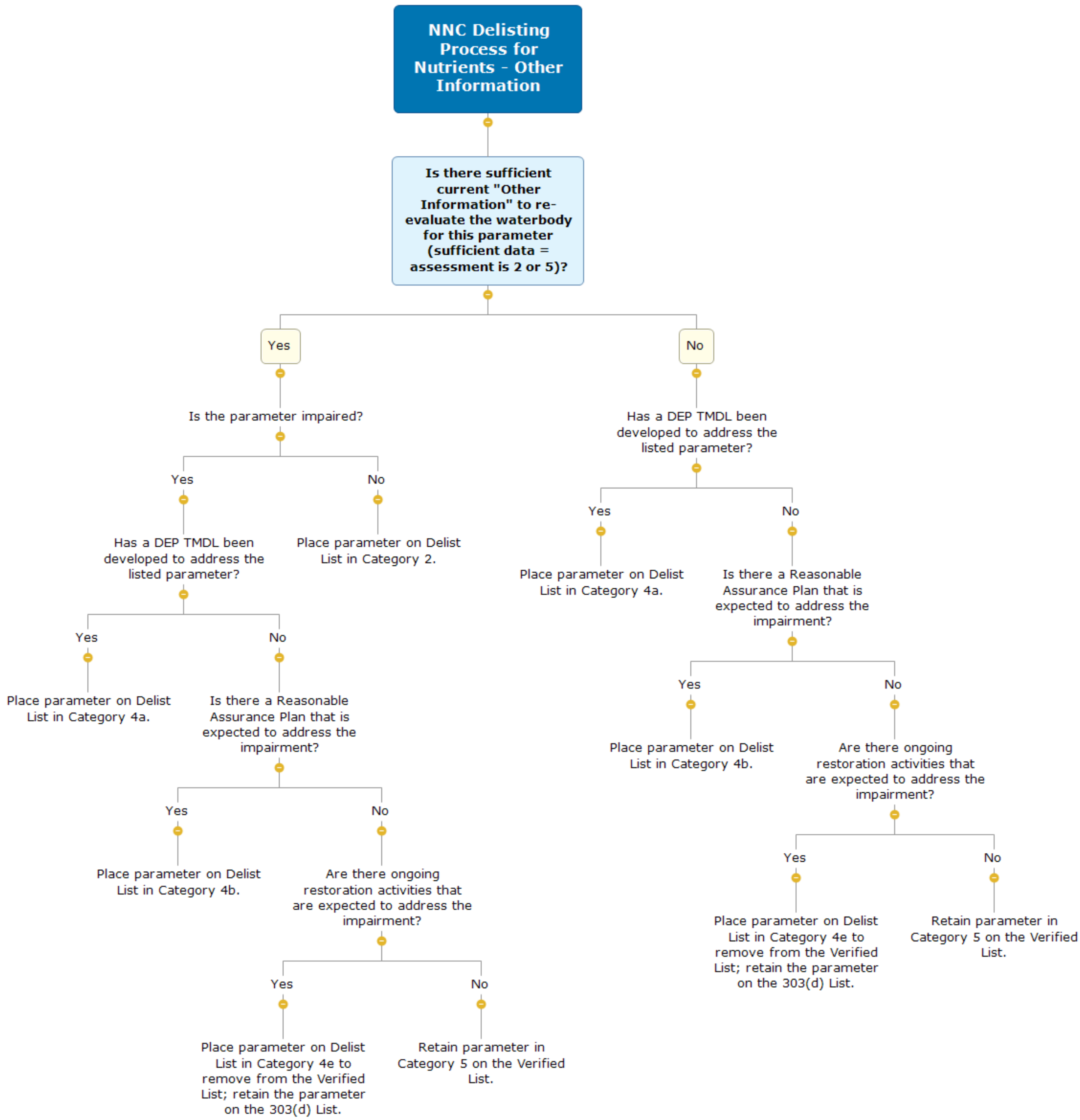


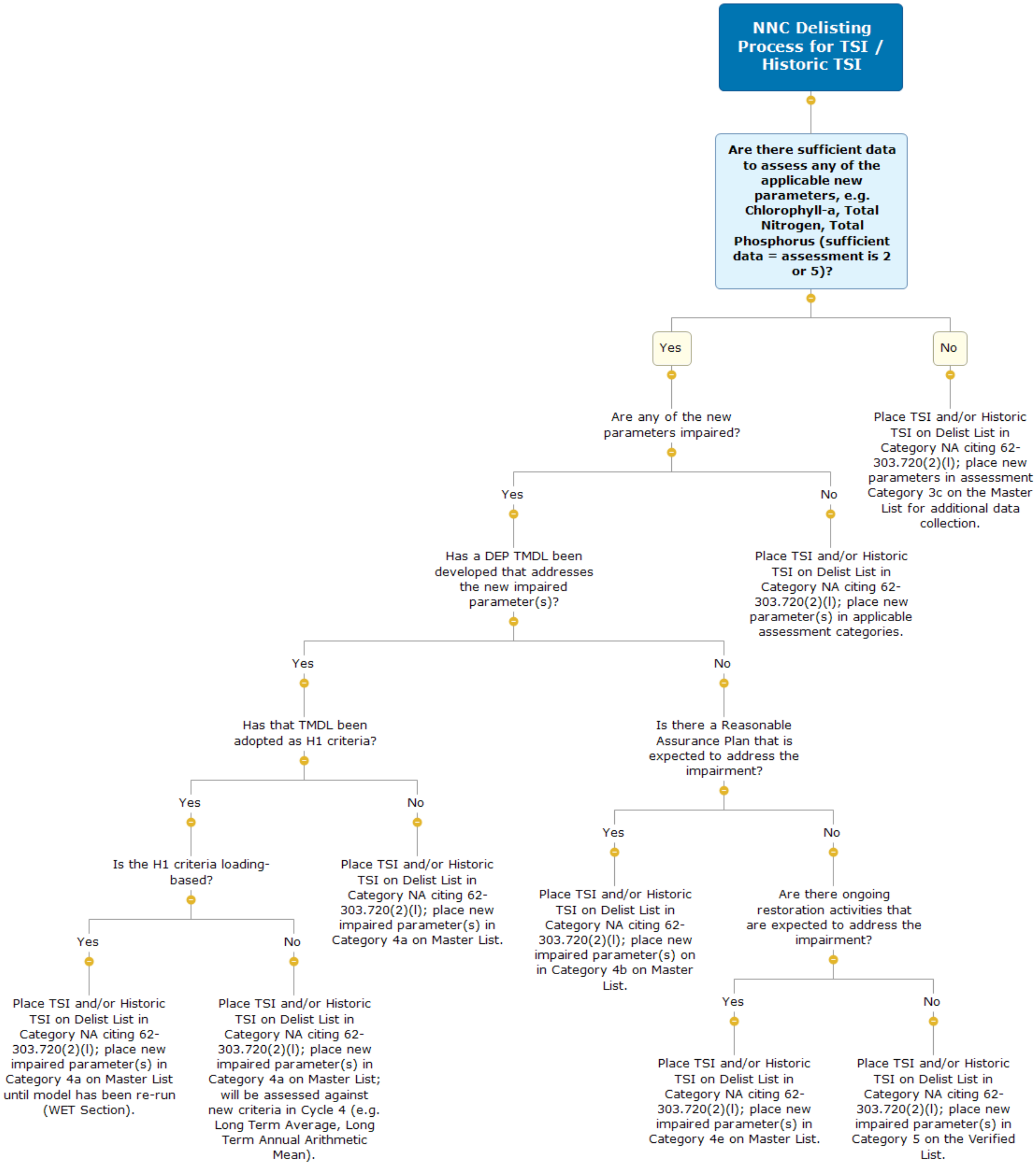
**Chart G.3. NNC delisting process for historic chlorophyll *a***



## Chart G.4. NNC delisting process for nutrients–other information



## Chart G.5. NNC delisting process for TSI/historic TSI



## Chart G.6. Study List (303[d] list) removals for Assessment Category 4d DO assessments