Biscayne Bay-Southeast Coast Basin
Lakes, Rivers, Streams, and Aquifers

Florida Department of Environmental Protection

Division of Environmental Assessment and Restoration

Bureau of Assessment and Restoration Support, Watershed Monitoring Section

Good science is the foundation of the Florida Department of Environmental Protection's (FDEP) programs to assess and protect water quality. FDEP is committed to characterizing the environmental conditions of Florida's freshwater resources through several monitoring programs. The Watershed Monitoring Section administers the Status Monitoring Network, which oversees the statewide sampling of surface and ground water. This report summarizes the 2007 Status Monitoring Network results for the Biscayne Bay-Southeast Coast Basin.

Biscayne Bay-Southeast Coast Basin

The Biscayne Bay-Southeast Coast Basins encompass 1,200 square miles of the lower east coast region of the state, extending from the Everglades Water Conservation Areas 2 and 3 and Everglades National Park on the western side, to the Atlantic Ocean on the eastern side. The basins include Biscayne Bay, the Intracoastal Waterway, and nearshore coastal waters of the Atlantic Ocean. It is situated in Broward and Miami-Dade Counties and a small portion of Monroe County.

The coastal areas of Broward and Miami-Dade Counties were the first to be inhabited because of the natural coastal ridge, which historically existed as well-drained land, with flatwood and lowland areas to the west. These areas remain the most densely populated in the Biscayne Bay-Southeast Coast Basins. As the coastal areas were urbanized, drainage canals were constructed which made the land to the west of the coastal ridge suitable for development. Excluding coastal areas, urban development in Broward County and the northern part of Miami-Dade County constitutes approximately 50 percent of the total land area, and has a significant impact on surface water quality. Stormwater runoff from intensively developed properties and roadways, hydrologic modifications, and pollution from septic systems pose the greatest threats to water quality in the Intracoastal Waterway and Biscayne Bay.

Although the basin is highly urbanized, it is home to five state parks, two national parks and an aquatic preserve. These natural areas support a variety of plants and wildlife. Biscayne Bay, the largest estuary in southeast Florida, is home to many threatened and endangered species. The Bay also plays an important part in this basin's economy. One of the largest commercial and passenger ports in the world, the Port of Miami, is located within Biscayne Bay. Tourism is the largest industry in the area with agriculture still a significant land use, in the southern portion of Miami-Dade County.

The following table summarizes land use statistics calculated for the Biscayne Bay-Southeast Coast Basin from 2004 Statewide Land Use imagery.

Land Use	Agriculture	Forest	Urban	Wetlands	Other
Percentage	10.7	1.7	53.2	20.6	13.8

The percentage reported as "Other" consists of water, rangeland, barren land, transportation, communication, and utilities.

Monitoring Design of the Status Monitoring Network

FDEP has worked with the water management districts, local governments, and other entities to establish an Integrated Water Resource Monitoring (IWRM) Program. This program combines surface and ground water monitoring efforts, consisting of water chemistry, biology, and sediment analyses. It is fiscally and logistically prohibitive to sample every river, stream, lake, or individual well in the state on a regular basis. A probabilistic monitoring design is a cost-effective approach to produce a statistically valid estimate of the condition of water resources. The IWRM Program is made up of three levels of monitoring designs: (1) the Status Monitoring Network designed to allow statistical inferences about all state waters; (2) more intensive basin monitoring used to identify and confirm impaired waterbodies that do not meet Florida's water quality standards; and (3) site-specific regulatory compliance monitoring.

The Status Monitoring Network uses a random site monitoring design to assess the state's surface and ground water quality. The objective of this design is to broadly characterize aquatic resources with a known statistical confidence. Samples are collected from randomly selected points, which is a cost-effective way to provide a geographic snapshot of the condition of all waters in a basin. This monitoring program is not designed to answer site-specific questions about individual lakes, rivers, streams, or wells.

The Status Monitoring Network categorizes Florida's fresh waters into 6 different resource types. Four of these are surface water: small lakes, large lakes, rivers, and streams. The other 2 resources are ground water: unconfined and confined aquifers. The 2004–09 Status Monitoring Network design divides the state into 29 basins, with 5 or 6 basins sampled each year. Approximately 30 samples are collected annually from each resource in the selected basins. Thus, in each basin, approximately 120 samples are collected for surface water resources, and 60 samples for ground water resources, in addition to quality assurance samples.

Lakes

The Biscayne Bay-Southeast Coast Basin has few natural lakes and many artificially constructed lakes. Artificial lakes are not part of the target population and therefore were not sampled. FDEP has divided lakes by size into 2 categories: small lakes of 2.5 to 25 acres and large lakes over 25 acres. This division allows a better characterization of the status of the basin's lake resources. Large lakes were not sampled in this basin and there was insufficient data to analyze small lakes.

Rivers and Streams

The North Fork New River, North New River Canal, Tamiami Canal, C-1, C-2, C-3, C-6, C-7, C-8, C-9, C-11, C-100, C-102, C-103, L-30, L-31N and L-38A, totaling 179 miles, represent the river resource. The remaining streams and tributaries are designated as the stream resource. These total about 662 miles, although some may be dry during periods of drought. The 2 resources can have different habitats and uses.

Aquifers

Aquifers are permeable layers of sand, gravel, or rock that contain water. Unconfined aquifers are near the land surface and are easily affected by human activities. Confined aquifers lie below a layer of material, such as fine-grained clay, that limits the downward flow of water. Water in confined aquifers usually filters slowly through sediment and rock layers, and is older and less affected by human activities. FDEP's Watershed Monitoring Section samples ground water in the Biscayne Bay-Southeast Coast Basin through wells in unconfined aquifers. There are few confined aquifer wells in this basin and they were inaccessible for sampling.

There are two major aquifer systems in the Biscayne Bay-Southeast Coast Basin: the Biscayne aquifer and the Floridan aquifer system (FAS). The Biscayne aquifer is a shallow, unconfined surficial aquifer consisting of highly permeable limestone and less permeable sandstone and sand. The Biscayne aquifer is designated as a sole source aquifer by EPA which means it is the principal

source for water supply for the area. Nearly 90 percent of all water withdrawals in the basin are from the Biscayne aquifer. In this basin, the Floridan aquifer is a very deep, confined system. The water is highly mineralized and not useful for water supply. Use of the deep FAS is limited to aquifer storage and recovery, reverse osmosis, and wastewater injection within the deeply buried Boulder Zone.

Summary and Results

The tables below show the sampling carried out for each resource in the Biscayne Bay-Southeast Coast Basin, in terms of acres of large lakes, number of small lakes, miles of rivers and streams, and number of wells for confined and unconfined aquifers. Not all randomly selected stations can be sampled for various reasons. Those that can be sampled are termed accessible. Those stations that cannot be sampled are considered either dry or inaccessible. Reduced rainfall or periods of drought occur on a cyclical basis in many areas of Florida. Prolonged or intense periods of drought can adversely affect water chemistry. During the sampling period, precipitation increased by 11% compared with the 30-year annual average.

Surface Water Resource	Large Lakes (≥ 25 acres)	Small Lakes (2.5–25 acres)	Rivers (17 rivers/canals)	Streams (all other streams/ canals)
Resource Size (area, number, length)	0 acres	16 lakes	179 miles	662 miles
Accessible	0%	88%	100%	86%
Dry	0%	0%	0%	0%
Inaccessible	0%	12%	0%	14%
Number of Samples	0	7	30	30

Ground Water Resource	Unconfined Aquifers	Confined Aquifers
Number of Wells	590	2
Accessible	29%	0%
Inaccessible	71%	100%
Samples	30	0

Basin Precipitation	Average Annual (1971–2000)	Annual (2007)
Biscayne Bay-Southeast Coast Basin	57.7 inches	64.2 inches

Rainfall data were obtained from the National Climatic Data Center database for the Ft. Lauderdale, Miami Beach, Miami International Airport, and Perrine 4 W Stations.

The discussion and figures below provide results for the basin's surface and ground water resources for a number of important indicators (see the *Definitions and Criteria* pages for explanations of the indicators used). As discussed in *Definitions and Criteria*, natural conditions such as higher water temperatures, freshwater and stormwater inflows, and different soils can affect the results shown below. The exceedance of a standard or threshold is not necessarily caused by a pollutant.

Lakes: There were no large lakes assessed and there was insufficient data to analyze small lakes in this basin.

Rivers and Streams: DO is below the standard in 41% of the rivers and 43% of the streams sampled. Canal/ditch construction and ground water inflows can contribute to low DO concentrations. Low DO can be harmful to aquatic life. Fecal coliform bacteria are above the

standard in 29% of the streams and 37% the rivers sampled. pH is within the standard range for all streams and rivers. Un-ionized ammonia values are within the standards for rivers and and above the standard for 3% of the streams. Chlorophyll values are above the standard in 4% of the rivers and 18% of the streams.

Aquifers: The confined aquifer wells in this basin were inaccessible. Exceedances of lead (5%) and sodium (8%) are found in a small percentage of the unconfined wells. Total coliform bacteria exceed the standard in 36% of the unconfined wells. These bacteria are indicators of possible human health effects if the water is used for drinking. All other analytes are within standards.

Surface Water Resource	Dissolved Oxygen	Fecal Coliform	pH	Un-ionized Ammonia	Trophic State Index
Large Lakes	na	na	na	na	na
Small Lakes	ISD	ISD	ISD	ISD	ISD

Surface Water Resource	Dissolved Oxygen	Fecal Coliform	pH	Un-ionized Ammonia	Chlorophyll
Rivers					
Streams					

Ground Water Resource	Arsenic	Cadmium	Chromium	Lead	Nitrate–Nitrite	Sodium	Fluoride	Total Coliform
Unconfined Wells								
Confined Wells	na	na	na	na	na	na	na	na

Note: The gray segments of the pie charts represent the percentage of water resources that meets water quality standards. Blue segments represent the percentage that does not meet the standards. See the *Definitions and Criteria* pages for more information.

na – Not applicable.
ISD: Insufficient data for analysis.

This survey does not represent a comprehensive analysis of any individual waterbody.

The Watershed Monitoring Section would like to thank the South Florida Water Management District for its contributions to this report.

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Surface Water Definitions and Criteria

Each indicator listed below was chosen because it has an applicable state criterion, found in *Criteria for Surface Water Quality Classifications, Rules 62-302 and 62-303, Florida Administrative Code.*

Indicators	Criterion/Threshold[1]	Designated Use
Fecal Coliform Bacteria	< 400 counts/100mL	Recreation
Dissolved Oxygen	≥ 5 mg/L	Aquatic Life
pH	≥ 6 and ≤ 8.5 SU	Aquatic Life
Un-ionized Ammonia	≤ 0.02 mg/L	Aquatic Life
Chlorophyll *a*	≤ 20 µg/L	Aquatic Life
Trophic State Index (TSI)	Color ≤ 40 PCUs, then TSI ≤ 40 Color > 40 PCUs, then TSI ≤ 60	Aquatic Life

[1] mL – milliliters; mg/L – milligrams per liter; SU – standard units; µg/L – micrograms per liter; PCUs – platinum cobalt units

Fecal coliform bacteria: The single-sample threshold for fecal coliform is 400 counts per 100 milliliters of water. These bacteria can enter water through the discharge of waste from mammals and birds, agricultural and stormwater runoff, and untreated human sewage. The presence of fecal coliform bacteria may indicate that the water is contaminated by other disease-causing organisms.

Dissolved oxygen (DO): The state criterion for DO is a minimum of 5 milligrams per liter to maintain healthy conditions for aquatic life. Lower levels do not affect human recreation. Algae and plants produce oxygen through photosynthesis. Oxygen is also dissolved in water by wind and wave action. Respiration by aquatic animals, decomposition, wastewater, stormwater runoff from urban streets or farmland, and failing septic tanks consume oxygen. Natural conditions—such as ground water from springs, water from swamps/wetlands, higher water temperatures, and calm and cloudy weather—can also decrease DO levels in waterbodies.

pH: The surface water criterion for pH is between 6 and 8.5 standard units. The pH scale, which ranges from 0 to 14, is a measure of the degree of acidity or alkalinity of a solution. Numbers below 7.0 indicate acidity; numbers above 7.0 indicate alkalinity. The midpoint of 7.0 on the pH scale represents neutrality—that is, a neutral solution is neither acidic nor alkaline. pH affects many chemical and biological processes in water, and aquatic organisms are adapted to a certain range of pH. When pH levels are outside this range, it stresses these organisms' physiological systems and can reduce reproduction. Atmospheric deposition (acid rain), geology, vegetation, and pollution can cause changes in pH.

Un-ionized ammonia: The threshold for un-ionized ammonia is less than or equal to 0.02 milligrams per liter. This is calculated from total ammonia and adjusted for temperature, salinity, and pH. Ammonia occurs in different forms; water temperature and pH affect which form predominates at any given time in an aquatic system. Un-ionized ammonia can be toxic to fish and invertebrates.

Chlorophyll a*: The threshold for chlorophyll is less than or equal to 20 micrograms per liter. Chlorophyll is the pigment that allows algae and plants to convert sunlight into organic compounds during the process of photosynthesis. Excess nutrients, such as nitrogen and phosphorus, can stimulate algal blooms. Excess algae sink to the bottom and decay, using up the oxygen that other plants and organisms require to survive. High concentrations of chlorophyll reduce water clarity and limit the light available to shallow-water ecosystems.

Trophic State Index (TSI)*: TSI and chlorophyll are the primary measures used to assess nutrient impairment in a waterbody. There are two thresholds for TSI, based on the color of a lake. Dark-water lakes with a mean color greater than 40 platinum cobalt units (PCUs) are impaired when their annual mean TSI exceeds 60. Clear and low-color lakes with a mean color less than or equal to 40 PCUs are impaired when their annual mean TSI exceeds 40. TSI is measured using chlorophyll, nitrogen, and phosphorus concentrations. A 10-unit increase or decrease in the index represents a doubling or halving, respectively, of the number of algal cells present.

***** Both TSI and chlorophyll *a* are not standards, but thresholds used to estimate the impairment of state waters. These thresholds are used in the analysis of Status Network data, based on single samples in a basin at a predetermined time of year. The analysis and representation of these data are not intended to infer the verification of impairment, as defined in Rule 62-303, Florida Administrative Code, in these waters.

Aquifer Definitions and Criteria

The table below shows the thresholds for eight indicators regulated under drinking water standards.

Indicators	Criterion/Threshold[1]	Designated Use
Arsenic	≤ 10 µg/L	Potable Water(drinking water)
Cadmium	≤ 5 µg/L	Potable Water(drinking water)
Chromium	≤ 100 µg/L	Potable Water(drinking water)
Lead	≤ 15 µg/L	Potable Water(drinking water)
Nitrate–Nitrite	≤ 10 mg/L	Potable Water(drinking water)
Sodium	≤ 160 mg/L	Potable Water(drinking water)
Fluoride	≤ 4 mg/L	Potable Water(drinking water)
Total Coliform Bacteria (counts per 100 milliliters)	≤ 4 (sample maximum)	Potable Water(drinking water)

[1] µg/L – micrograms per liter; mg/L – milligrams per liter

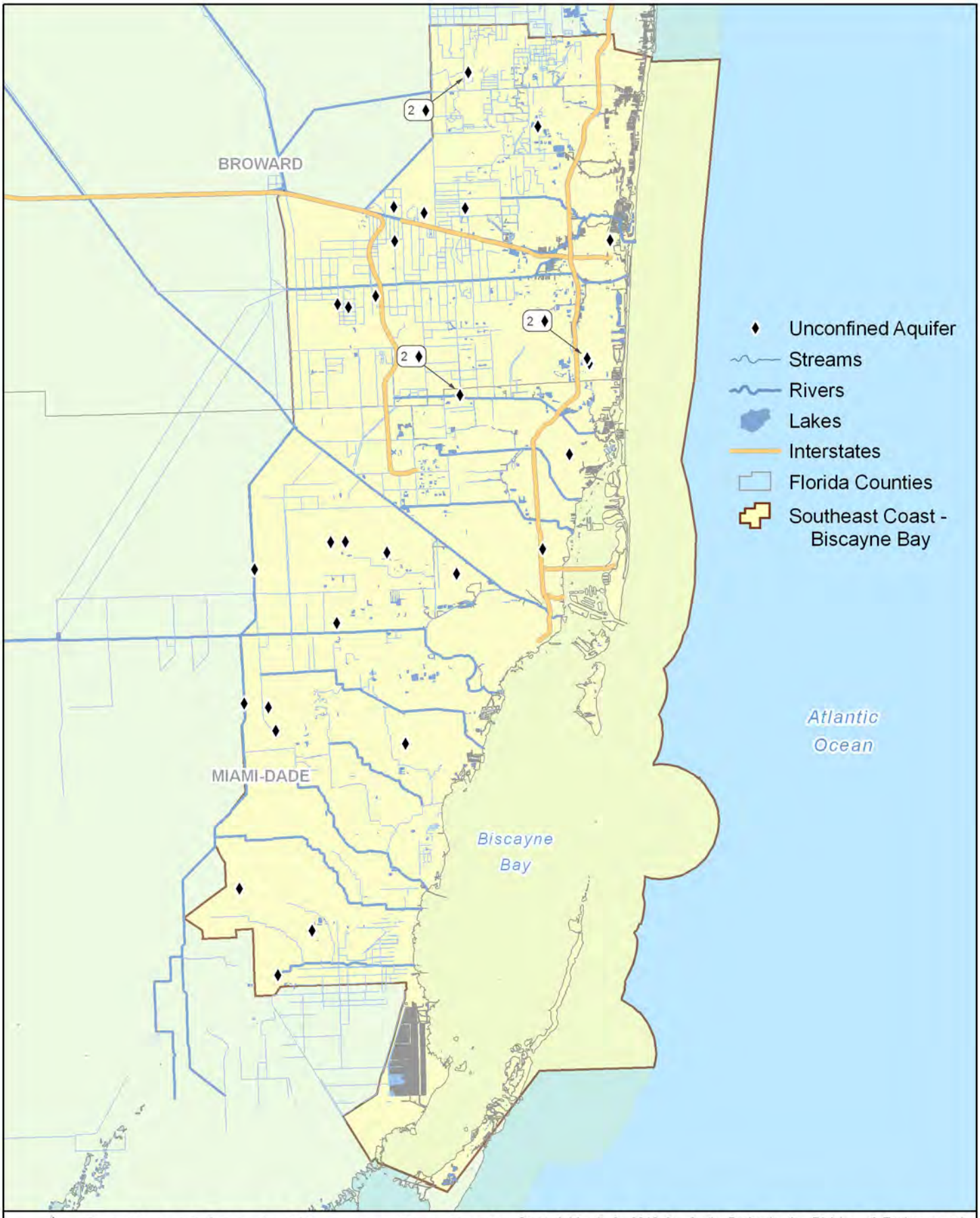
Arsenic, cadmium, chromium, and lead are all naturally occurring metals in the earth's crust. These and other metals are used in manufacturing and can be produced and used in pesticides, preservatives, and industrial operations. They may enter water as a pollutant. Florida has primary standards (criteria) for these metals to protect human health. Excess levels in drinking water can cause adverse health effects.

Nitrate–nitrite is used in fertilizer and is found in sewage and wastes from human and/or farm animals. Florida's drinking water standard is 10 milligrams per liter (mg/L) for nitrate and 1 mg/L for nitrite. In addition, to allow for the fact that the toxicity of nitrate and nitrite is additive, the standard for the sum of nitrate and nitrite is 10 mg/L. In the long term, nitrates and nitrites have the potential to cause serious adverse effects in humans.

Sodium (salt) has a drinking water standard to protect individuals who are susceptible to sodium-sensitive hypertension or diseases that cause difficulty in regulating body fluid volume. Sodium is monitored so that individuals on sodium-restricted diets may take the sodium in their water into account. Drinking water contributes only a small fraction (less than 10%) of an individual's overall sodium intake.

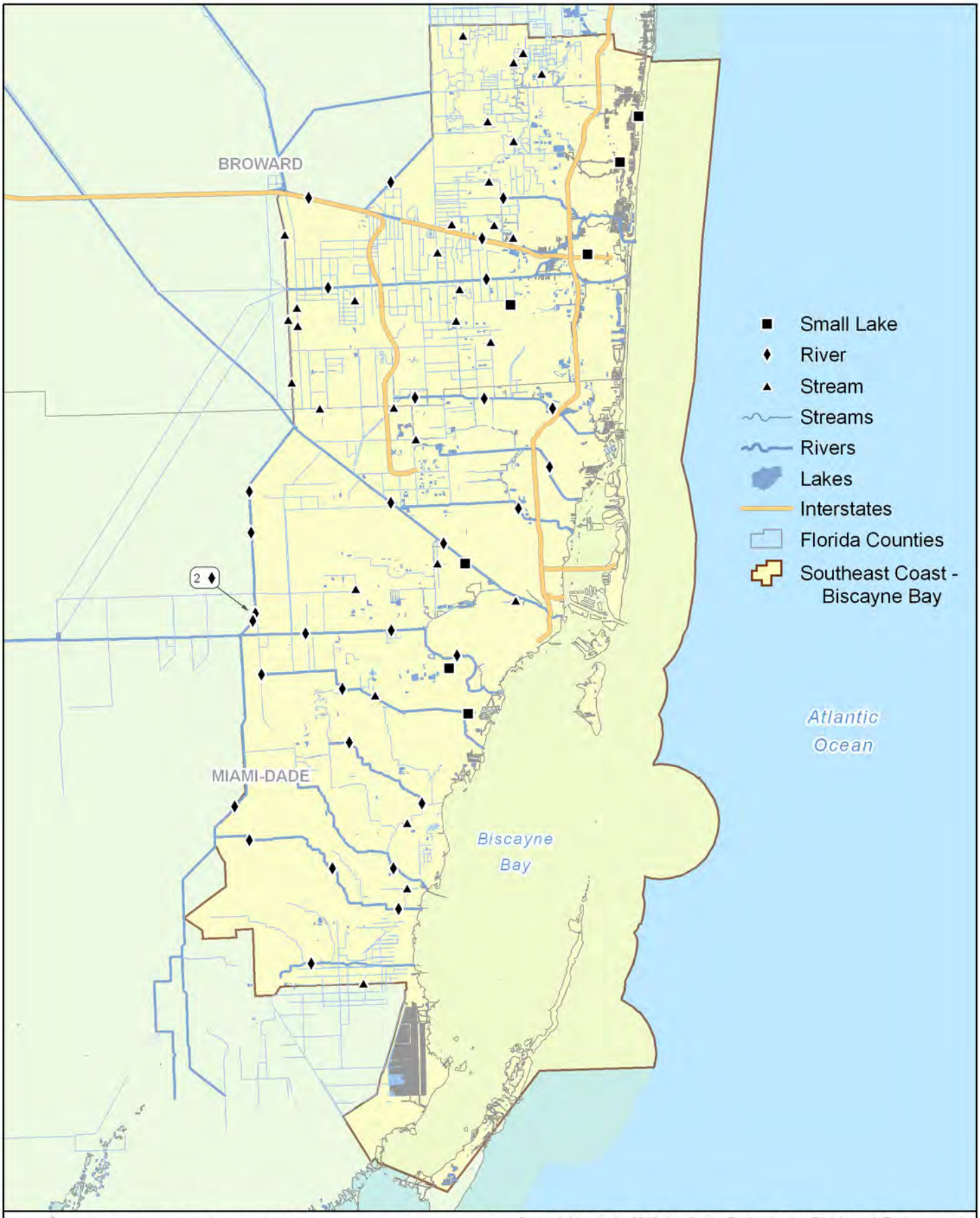
Fluoride, a natural element, is added to drinking water systems to reduce dental cavities. Prolonged exposure to levels above 4 milligrams per liter may result in crippling skeletal fluorosis, a serious bone disorder. Lower levels may cause dental fluorosis when children are developing teeth. In its moderate and severe forms, dental fluorosis is a brown staining and/or pitting of the permanent teeth.

Total coliform bacteria are common in the environment and are generally not harmful. The presence of these bacteria in drinking water, however, is an indicator that disease-causing organisms may be present. The U.S. Environmental Protection Agency and Florida have set an enforceable drinking water standard for total coliform of 4 counts per 100 milliliters to reduce the risk of adverse health effects. Drinking water that meets this standard is usually not associated with a health risk from disease-causing bacteria and is considered safe.



Southeast Coast - Biscayne Bay Basin 2007 Ground Water Sample Sites

Created March 8, 2010 by Justin Berke in the Division of Environmental Assessment and Restoration, Watershed Monitoring Section. This map is a representation of ground conditions and is not intended for further analysis. For more information contact Justin.Berke@dep.state.fl.us (850) 245-8551. Basin reports available at http://www.dep.state.fl.us/water/monitoring/basins.htm



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