

Declining Water Quality is Threatening the Health of Biscayne Bay and our Economy

Miami-Dade County is Florida's most populous county boasting 13.3% of Florida's population. Home to over 2.8 million people¹, Miami-Dade County is a dynamic and culturally diverse community known for its subtropical environments and iconic coastlines. Famous for its beaches and bordered by two national parks, Everglades National Park and Biscayne National Park, the County is a tourism hotspot. More than 23.3 million tourists ventured through the County in 2018, having an estimated economic impact of over \$18 billion², with beaches and local atmosphere ranking of high importance to visitors. Biscayne National Park ranked as one of the top 10 most popular attractions with 10% of tourists visiting the area³.



Biscayne Bay is about 420 square miles and is located on the Atlantic coast of South Florida. It is an important recreational waterway and natural ecosystem.

Biscayne Bay, an integral part of the Miami-Dade County economy, is in desperate need of action to bring it back to health (Figure 1). Recreation, visitation and use of Biscayne Bay accounts for a significant portion of Miami-Dade County's economic success. In addition, according to the National Park Service, Biscayne National Park reported almost 470,000 recreational visitors in 2018⁴ who contributed more than \$30 million to the surrounding communities and supported over 400 local jobs⁵.

In August of 2019, a grand jury convened by the Miami-Dade State Attorney's Office warned that Biscayne Bay was at a "tipping point" and that without corrective action, the Bay would surely suffer from irreversible damage. **The Grand Jury Report cautioned that aging wastewater infrastructure, increased plastic pollution and the ongoing issue of sea level rise were "slowly strangling" our cherished Bay⁶.** Water quality issues of concern for Biscayne Bay and Biscayne National Park are primarily caused by their proximity to Miami Metropolitan area and also to agricultural activities in the Homestead area (and even to agriculture south of Okeechobee Lake) whose nutrients, pesticides, and agro-chemicals may be transported along the canal network and brought south to the Biscayne Bay basin.

Water Quality Concerns in the Bay

The Bay plays a critical role in the County's economic prosperity. It is of utmost importance for the continued growth and success of the County that the health and protection

of Biscayne Bay be prioritized.

ECONOMIC IMPACT OF BISCAYNE BAY (2004)⁷

- \$12.7 billion in additional County productivity
- \$6.3 billion in income to County residents
- 137,600 jobs for the County
- \$627 million in tax revenue to the County

The water quality in Biscayne Bay has been significantly affected by past and continuing coastal and watershed development. The nutrient concentrations in the Bay have been dramatically changed by the conversion of natural creeks and sheet flow freshwater inputs to rapid and episodic canal inputs from the large and rapidly expanding Miami metropolitan area. Unfortunately, there are several water quality concerns plaguing the Bay:

Bacteria in the Bay and Sanitary Sewer Overflows (SSOs)

No-Swim Advisories warning about bacteria on our beaches have been hard to ignore over the last few years. In 2018 and 2019, high levels of bacteria led to beach closures and public health concerns. These higher-than-normal bacterial levels were associated with a number of sources including sewage and septic tank leaks, algae that washed up on beaches and animal feces. While measures have been taken to address these concerns, pollution from these sources is still occurring. In fact, **sanitary sewer overflows continue to threaten the Bay, from**

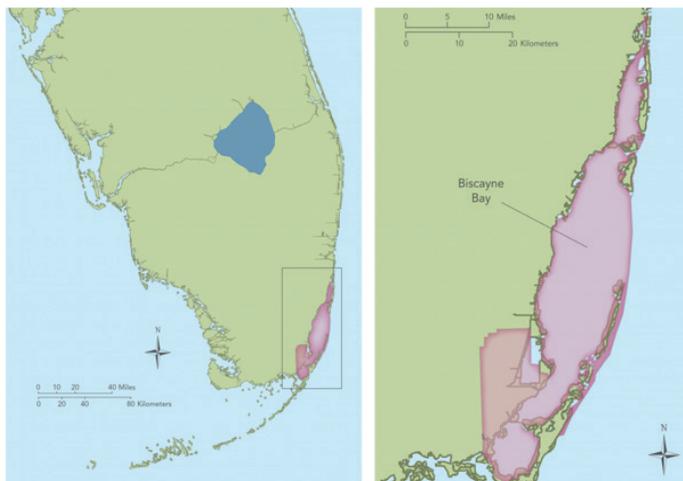


Figure 1. Map of the area of Biscayne Bay. Image by U.S. Army Corps of Engineers.



Figure 2. In August 2019 a break due to corrosion resulted in over 1 million gallons of sewage to flow into Oleta River, contaminating Biscayne Bay, that came with advisories urging swimmers and boaters not to enter the dirty water. Image by WSVN.

both failing and poorly maintained pipes, clogged pipes, and breaks due to construction projects. In August 2019 a break caused by corrosion resulted in over 1 million gallons of sewage to flow into Oleta River, contaminating Biscayne Bay, that came with advisories urging swimmers and boaters not to enter the dirty water (Figure 2). Contamination of the Bay as a result of sewer overflows is a known concern that prompted an EPA Consent Decree back in 2013.

In 2013, Miami-Dade County entered into a federally-mandated Consent Decree with the U.S. EPA and FDEP to improve the County's wastewater collection and treatment system. The decree ordered enhancements to the County's wastewater infrastructure and pledged to invest about \$1.6 billion over a fifteen-year period into 82 capital projects at 3 wastewater treatment plants⁸.

Addressing SSOs is a key part of restoring Biscayne Bay water quality and keeping our Bay healthy and accessible to the public, keeping our tourism economy thriving and improving the quality of life for our residents.

Sea Level Rise & Septic Tank Vulnerability

Another concern for the Bay is the vulnerability of our County's septic systems. According to a Miami-Dade County Department of Regulatory & Economic Resources (RER) report¹⁰, septic tanks are ill-equipped to handle the changing landscape due to sea level rise. The forthcoming Southeast Florida Regional Climate Compact Sea Level Rise workgroup reports that seas will continue to rise at an increased rate, adding another 5-12 inches of water by 2040 (e.g., projected rise of 10 to 17 inches above 2000 mean sea level)¹¹ (Figure 3).

The Miami-Dade RER report explains that, as groundwater levels rise and the area of unsaturated soil decreases, there is an increased risk of pollution or system failure¹⁰. Septic systems were not designed with the assumption that

groundwater levels would rise gradually over time and as a result many are not functioning as they were originally designed (Figure 4). **The County estimates that there are approximately 100,000 septic tanks within the urban development boundary, with about 58-67% of tanks subject to periodic compromise over the next 20 years¹⁰.** There are already about 1,000 properties with likely failing septic tanks under current conditions.

In fact, a January 2019 study by Barreras et al. showed that fecal indicator bacteria (FIB) levels can be improved with better beach management strategies and sanitary infrastructure improvements that include increasing connections to centralized wastewater management systems⁹. Poorly maintained or failing septic tanks pose a significant risk to Biscayne Bay water quality, as well as create a serious threat to the source of our local drinking water supply⁶.

Nutrient Concentration Shifts & Seagrass Die-Off

In 2019, a Miami-Dade study reported a precipitous decline in seagrass meadows over the last decade (Figure 5)¹⁰, primarily occurring in 3 main regions of the Bay: 1) Barnes Sound and Manatee Bay basins (93% die-off), 2) central portion of Biscayne Bay near Coral Gables (85% die-off), and 3) basins north of Rickenbacker Causeway (66%-89% die-off) (Figure 6). These die-offs were associated with excess nutrients in the water leading to a shift from a seagrass-dominated habitat with clear water, low turbidity and low levels of algae, to an al-

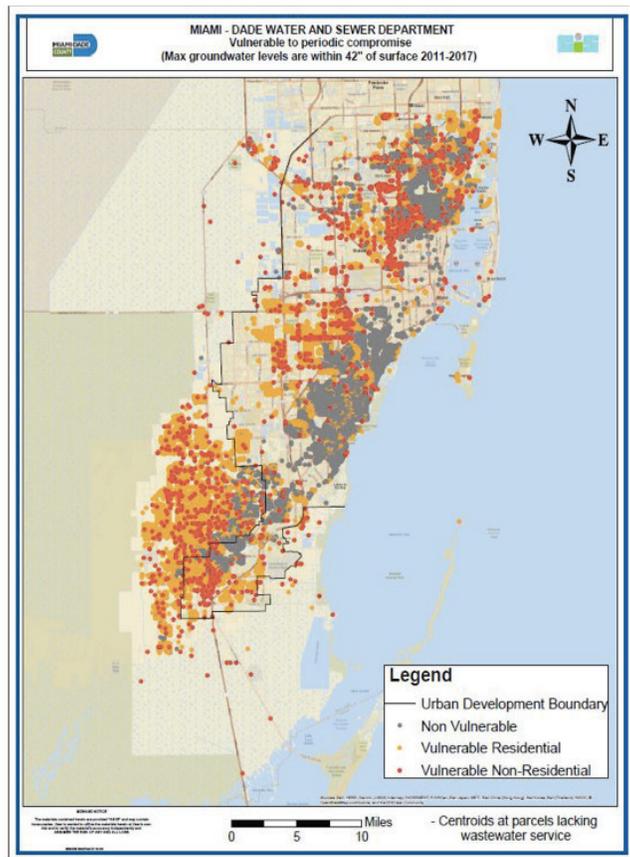


Figure 4. The County estimates that there are approximately 100,000 septic tanks within the urban development boundary, with about 58-67% of tanks subject to periodic compromise over the next 20 years.

gae-based ecosystem that is turbid and has reduced fisheries habitats (Figure 7)¹⁶.

A recent study by Millette et al (2019)¹ found that, **over a 20-year period, both chlorophyll a and phosphate concentrations have increased in the Bay, indicating eutrophication.** In all parts of the Bay, average chlorophyll concentrations nearly always exceed the FDEP numeric nutrient criteria in recent years. Nutrients and excessive algae growth (i.e. algal blooms) lead to low levels of oxygen when the algae die and are eaten by bacteria. Just like humans, aquatic species require oxygen, and low levels of oxygen can be harmful to aquatic species. Further, low water clarity can reduce the light available to seagrass meadows, impacting their health. In fact, **the National Oceanic and Atmospheric Administration (NOAA) recently designated Biscayne Bay as one of their new "Habitat Focus Areas", prompted by concerns of declining water quality in the Bay, including elevated levels of nutrients that can trigger algal blooms and contribute to seagrass die-offs¹⁵.**

Seagrass meadows are critically important ecosystems for a healthy Bay environment. They are a direct food source for manatees and sea turtles and provide important habitat for juvenile species of recreationally- and commercially-important fish. They also play a critical role in regulating water clarity by stabilizing sediments and reducing erosion, store significant atmospheric CO₂, oxygenate the water column for

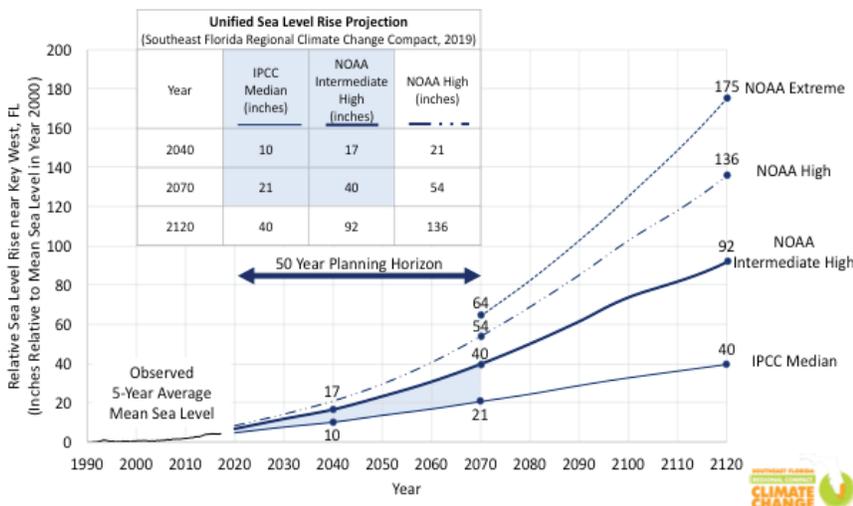


Figure 3. The forthcoming Southeast Florida Regional Climate Compact Sea Level Rise workgroup reports that seas will continue to rise at an increased rate, adding another 5-12 inches of water by 2040 (e.g., projected rise of 10 to 17 inches above 2000 mean sea level)

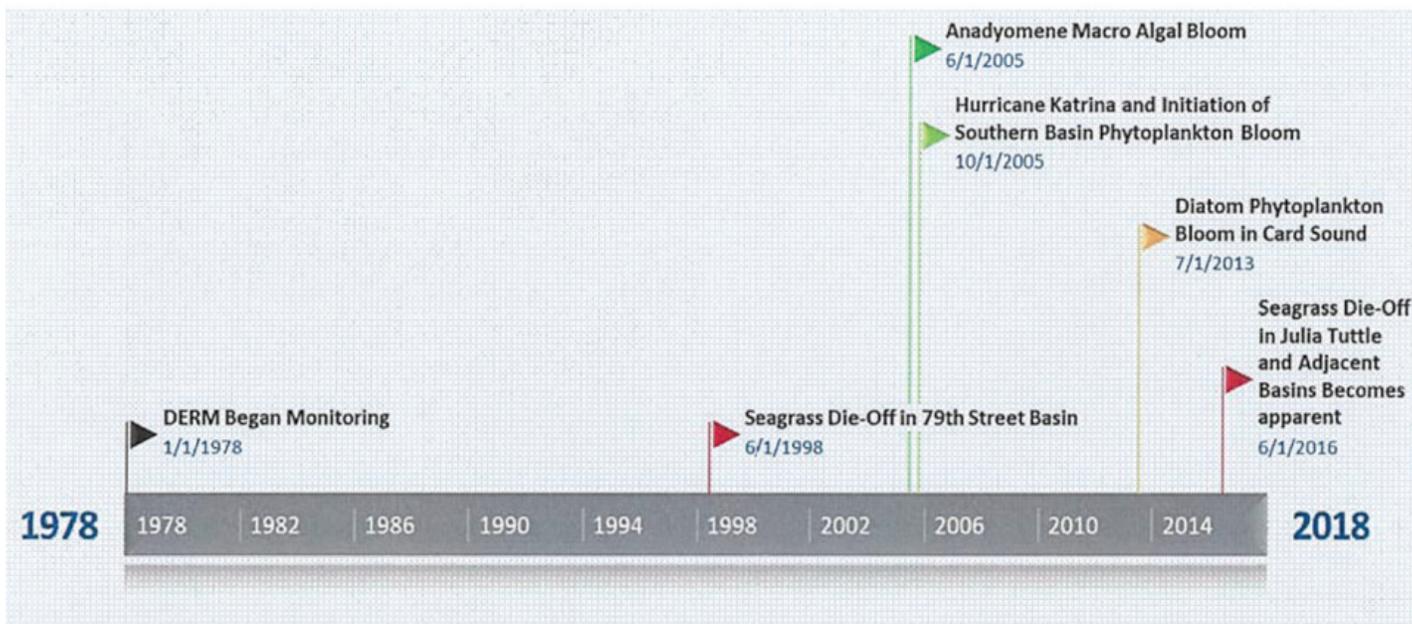


Figure 5. Timeline of seagrass loss events and total reduction in seagrass basin in Biscayne Bay.

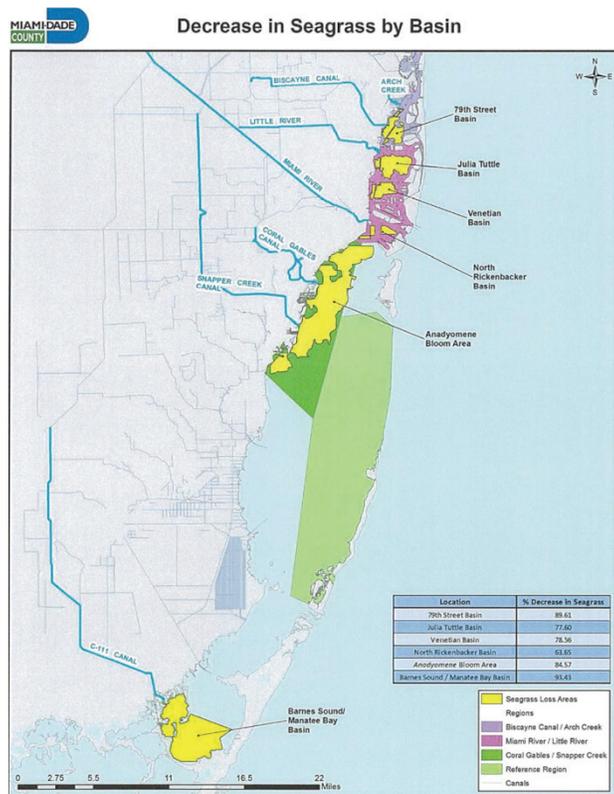


Figure 6. Seagrass loss areas for the study period 2005-2018 in Biscayne Bay.



Figure 7. In-situ photographs of seagrass die-off at fixed sampling location BH-14 from June 2016, September 2016 and June 2017, respectively. These photos show the devastating impact of the Bay's declining water quality on

aquatic species, and filter nutrients from the overlying water column. **Seagrass recovery is vitally important for a healthy and resilient Biscayne Bay.**

Moreover, eutrophication, which is an excess of nutrients, has been a persistent problem in Biscayne Bay, with nitrogen and phosphorus loadings influenced by their geographic locations relative to discharge amount, watershed land use, stormwater runoff, and proximity to landfills¹³. To add, a significant source of nutrient load is also caused by natural debris rotting in storm drain systems due to infrequent maintenance.

Extreme events like hurricanes also impact Bay water quality. Zhang et al (2009) showed that after Hurricane Katrina, nutrient concentrations increased in Biscayne Bay in response to runoff from agricultural sites¹⁷. While nutrient concentrations in the Bay returned to pre-hurricane levels a few months later,

this is a clear indication of how shoreline and watershed land-use influence the impact that natural disasters can have on our Bay water quality.

Plastic Trash and Marine Debris

Marine debris is a global problem caused by the overuse of single-use plastics, human carelessness, and ineffective waste streams. It is estimated that by 2050, there will be more plastic trash in the ocean by weight than fish. The negative impacts include harm to marine wildlife, toxic chemicals entering human food supplies, lower real estate values, damage to watercraft, and more expensive cleanup costs.

Each year, volunteers pull over 50,000 pounds of trash from Biscayne Bay waters and shorelines. While derelict fishing gear, boater activities, and illegal dumping are significant sources of marine debris, much of Biscayne Bay trash is street litter traveling through storm drain systems and canals. In fact, there is so much trash in Miami-Dade canals maintained by South Florida Water Management District (SFWMD), that it is visible from satellite imagery and Google maps (Figure 8).

The FDEP has issued a National Pollution Discharge Elimination System and Municipal Separate Storm Sewer System permit that covers all areas located within the political boundary of Miami-Dade County, but plastic trash is not considered a "pollutant" only a nuisance which impedes water flow. **A lack of centralized strategy, guidance, and oversight results in a wide range of pollution control designs and maintenance practices that are often insufficient.** It has been discovered that many entities operating under the FDEP permit (including Miami-Dade County) are cleaning their stormwater systems only once every 5+ years,

which renders the pollution controls ineffective and creates flooding due to clogged systems¹⁹.

With some focus, planning, coordination, and oversight, the amount of plastic entering Biscayne Bay can be significantly reduced.

If we don't take immediate action to restore degraded areas of the Bay and protect areas of the Bay that remain healthy, our economy and quality of life continue to be at great risk.

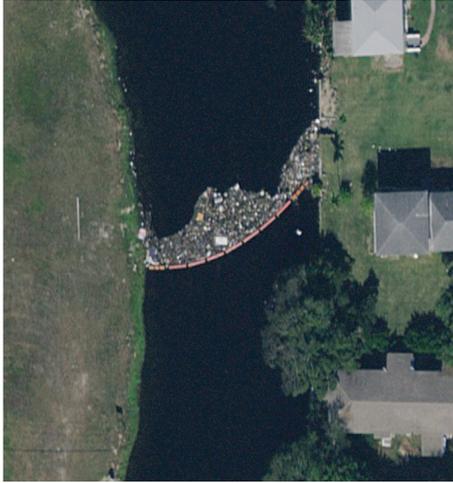


Figure 8. Trash in SFWMD canals.

What Can Be Done?

Participants of the second Biscayne Bay Marine Health Summit, which over 300 people attended, offered a number of crucial recommendations¹⁸ for saving our Bay, a few highlighted here:

1. Improve the County's wastewater and stormwater infrastructure by preventing nutrients and trash from entering and exiting stormwater systems, addressing canals as large conveyors of pollution, fixing sewer and septic systems, and prioritizing living shorelines and living seawalls, guided by science and monitoring to deliver the biggest impact for Biscayne Bay health.

2. Declare Biscayne Bay an environmental health emergency and increase public education and engagement by mandating sustainable best practices for all events in public places, enforcing a ban on plastics so that plastic pollution doesn't end up in the Bay, and calling for volunteer support to advocate for Bay health.

3. Focus research and monitoring toward quality of life outcomes by updating a

Biscayne Bay ecosystem services valuation, securing "bold" institutional support research coordination, implementation, and application, focus research efforts on public health, economics and recreational uses and create a living laboratory for Bay health to train the next generation of scientists and environmental stewards.

4. Call for a new, permanent Biscayne Bay Management Plan that will establish a report card for the Bay, create a reasonable assurance plan, Basin management action plan, and/or enforce total maximum daily loads (TMDL) for pollutant in the Bay (including implementing a plastics ban), and create a permanent Biscayne Bay Task Force to monitor Bay progress.

What is FIU Doing?

Research conducted at Florida International University's Institute of Environment is leading the way in identifying some of the factors degrading the marine health of our local Biscayne Bay. Our work includes:

- **Technology:** Twenty-five years of water quality data collected and classified into 42 groups of water quality types; three specially designed research buoys featuring an array of high-tech sensors used to analyze Bay water quality and provide early detection for dangerous contaminants and pollutants in our waterways, including harmful algal blooms.

- **Research:** Collaborating with the Biscayne Bay Aquatic Preserve (BBAP) for seagrass monitoring that can help us better understand seagrass die-off within the Bay; understanding the impact of mixed urban and natural influences on the overall health of the Bay, including the role of land-based sources of nutrients; studying the lives of the Bay's resident dolphin to gain a better understanding of how they respond to disturbances and environmental change.

- **Community:** Hosting the first and second Biscayne Bay Marine Health Summits to identify the sources of Biscayne Bay's declining marine health. The Summits brought together stakeholders and experts to act on improving Bay health and protecting Biscayne Bay. The last Summit led to the creation of the Biscayne Bay Task Force (BBTF) by Miami-Dade County. The BBTF prepares a written report with recommendations to the Mayor and the Board of County Commissioners identifying problem areas, prioritizing projects and providing recommendations regarding state and federal legislation, activities and appropriations.

Biscayne Bay needs all the help it can get to bring it back to a healthy state. The Bay's significant contributions to the Miami-Dade County

economy are at stake if the quality of its water and natural ecosystems aren't improved. Biscayne Bay's continued degradation will tragically impact the County's economic activities that rely on the iconic waterway. It's up to all of us to take immediate action in order to turn the tide for our irreplaceable Biscayne Bay.

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To find out more information about the Biscayne Bay Marine Health Summit, please visit: <http://biscaynebayfiu.com/>.

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