

City of Miami Beach
Water Quality Report
January 8, 2020

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Introduction

Stormwater Management in the Biscayne Bay Watershed

Clean waterways are critical to our local ecosystem, our residents' quality of life, and our economy. As a utility, the city has the responsibility of protecting public health and safety by operating the wastewater and stormwater systems appropriately. Each year, the city reviews its stormwater management program to determine what strategies worked and which require refinement to keep up with changes in our community. A critical part of this review process is to monitor the health of the waterways to understand how our aquatic habitats function and set measurable goals to improve their health.

The health of Biscayne Bay is a regional concern. Contributing factors such as underground septic tanks, nutrient loading from agriculture, and inputs from heavy industry, are examples of inputs that cause other areas of the bay and contributing waterways to have higher nutrient loads and have lower percentages of dissolved oxygen. Through the development of the Greater Miami & the Beach Resiliency Strategy, the region developed recommendations and goals for improving regional water quality.

To augment the efforts occurring across the region, the city implements a multi-faceted strategy to keep pollution from entering our waterways that meets and, where possible, exceeds regulatory requirements. The city's strategy is founded on the requirements of the National Pollution Discharge Elimination System (NPDES) permit program, which was created in 1972 by the Clean Water Act. The NPDES permit program addresses water pollution by regulating point sources that discharge pollutants to waters of the United States.

Miami Beach is one of 32 municipal co-permittees with Miami-Dade County for NPDES Permit No. FLS000003, that own and operate Municipal Separate Storm Sewer Systems (MS4s) throughout Miami-Dade County. The Miami Beach MS4 is comprised of over 90 miles of pipes that carry rainwater collected from inlets on city streets and discharges it via more than 300 outfalls into our waterways and Biscayne Bay. 31 other municipalities and Miami-Dade County also operate MS4s for a combined total of more than 8,000 outfalls discharging into Biscayne Bay and its tributaries. The city's outfalls constitute approximately 4% of the region's outfalls.

The city reduces potential pollution through a combination of education and outreach, good housekeeping, as well as the use of cutting-edge technology and industry-vetted operational practices. The city's stormwater management program focuses heavily on preventing pollution at its source: people. It is easier and less expensive for each person to do their part by picking up after their pets, tossing trash into designated bins, and properly applying landscape maintenance chemicals than to capture and remove pollutants in larger concentrations from within the stormwater system. Nevertheless, the city plays an important role in protecting water quality and has a well-rounded strategy to remove pollutants outside and inside the stormwater system before they reach Biscayne Bay.

Over the last seven years, the city has made great strides to improve water quality:

- In science, such as the voluntary launch of a municipal water quality sampling program.

- In engineering, such as installing water quality treatment structures within the stormwater system that trap pollutants, including litter, sediment, and oils, through a four-step process at new stormwater pump stations.
- In operations, such as increasing stormwater system maintenance from once every three years to once every year.
- In education, such as the launch of the Plastic Free MB initiative.
- In policy, such as the citywide bans on polystyrene and plastic straws; and,
- In compliance, such as the creation of environmental inspection programs to reduce sanitary sewer overflows and construction run-off.

Water quality is a key factor of waterway and ecological health. The city has pollution prevention programs beyond those required by the NPDES permit, such as a waterway cleanliness contract that removes litter from the Bay and its surrounding waterways. For example, a total of 84,825 lbs. of debris were removed from waterways during this report year. The city continues to improve its stormwater management program and exceed NPDES permit program expectations.

Miami Beach Water Quality Sampling Program

Protecting water quality is a continuous and team effort. As part of the NPDES permit requirements, the Miami-Dade County permit holders are required to regularly monitor the water quality in Biscayne Bay and its tributaries. In 1994, interlocal agreements between Miami-Dade County and its NPDES co-permittees provided funding and enabled DERM to collect samples on behalf of its co-permittees to meet the requirements of the NPDES permit. The samples are tested for physical (i.e., temperature), chemical (i.e., nutrients) and biological (i.e., enterococcus) parameters. The results are analyzed annually and provided in a surface water quality monitoring report to the NPDES co-permittees so they can evaluate the effectiveness of their stormwater management programs.

Due to the geographical distribution of the county's sampling stations, there is limited water quality information for the areas of Biscayne Bay surrounding the barrier islands, like Miami Beach. We cannot protect our beaches, our waterways, or our urban forest unless we understand how each habitat functions and we set measurable goals to improve their health. To fill this data gap, in 2016, the city voluntarily launched its own water quality sampling program to expand upon the county's existing sampling network of nearly 90 stations countywide.

The program added more than 60 stations to cover areas of Biscayne Bay closer to our shoreline and within our waterways for which data has historically not been collected. The stations are sampled in accordance with the county's methodology so the data collected can be used toward the larger management of the bay. The data from this program generates a more robust snapshot of local water quality and allow city staff to make data-driven stormwater management decisions. The results inform where staff time, resources and funding will provide the greatest environmental benefit.

City staff annually reviews data from our municipal water quality sampling program, as well as data collected and reported by Miami-Dade County's Division of Environmental Resources Management (DERM) to determine where enhancements in pollution prevention are necessary. Certain enhancements can be implemented at the local level, such as increased cleaning frequency

of city pump stations to ensure their water quality treatment structures operate as designed. Other enhancements require regional collaboration, such as enacting countywide policies that reduce pollution into Biscayne Bay.

It is important to note that the first five years of data were expected to serve as a baseline or control, providing an initial picture of the health of our waterways through which we can begin to understand natural patterns of fluctuation in local water quality, such as tidal or seasonal variations. The baseline serves as a control to which we can compare the data collected in future years. The longer we collect data, the larger our sample size and the more statistical confidence we will be able to have in the analysis of the results. Therefore, each year we will have a better understanding of the health of our waterways than the previous year.

To ensure the integrity of the analysis and the program, staff retained an outside water quality expert, Dr. Charles Rowney, in February 2018 upon completion of the first full year of sampling. Dr. Rowney had over 35 years of experience in assessing, implementing, and interpreting water quality programs and was tasked with reviewing the city's data, drawing initial conclusions about the health of our waterways, and identifying observable trends that will be monitored in subsequent years. He completed his review, released a report, and shared his findings with the Sustainability and Resiliency Committee (currently named Land Use and Sustainability Community), as well as a technical roundtable of representatives from the Florida Department of Environmental Protection, Miami-Dade County, the City of Miami and other regional community stakeholders on September 26, 2018.

Based on his analysis of the Miami Beach water quality sampling program and the data collected during the monitoring period, there is no indication of gross or persistent sanitary system contamination into Biscayne Bay from Miami Beach. Furthermore, the samples taken through his review did not show a significant difference between the samples taken near the gravity outfalls the city has operated for over 100 years and the samples taken near the pumped outfalls. Therefore, there was no evidence that the City's activities, including the installation of the pumps, have had a measurable change in the bay. Dr. Rowney also made recommendations for improving the sampling program design that allowed the city to fine-tune its sampling and stormwater management efforts.

In February 27, 2019, following the recommendations provided by Dr. Rowney, city staff made six changes to the water quality monitoring program:

- Enhancement 1 – Train in-house staff to execute and oversee sample collection.
- Enhancement 2 – Remove all "outfall" sampling stations.
- Enhancement 3 – Add stations in areas where data is not currently collected.
- Enhancement 4 – Sampling for more parameters at existing and new stations.
- Enhancement 5 – Sampling during rain events.
- Enhancement 6 – Install constant monitoring probes in areas requiring in-depth investigation.

These six enhancements were approved by the Sustainability and Resiliency Committee (currently named Land Use and Sustainability Community). Training will allow staff to respond more

quickly to water quality violations, improving enforcement, and it will allow greater oversight and control of monthly sample collections. Removing outfall and unnecessary sampling stations with redundant information will reduce monthly costs where funds can be used to finance other enhancements. For example, we reduced the total stations from 64 to 35 because the data showed that having an “outfall” versus an “ambient” station was redundant, and we could use these funds to add other improvements.

Additional sampling stations will increase coverage, particularly in North Beach. New stations will sample in the stormwater system that has less influence from Biscayne Bay. Sampling for more parameters will allow us to identify early warning signs of ecosystem health regarding excess nutrient loading, such as Chlorophyll A. Also, it will provide a more holistic picture of bay health. Quarterly sampling during storm events in select locations will occur to account for seasonality. It is an NPDES permit requirement to estimate pollutant loading during rain events.

Constant monitoring probes will help staff understand how the stormwater system functions over time. Data will be collected as frequently as every minute. However, we have not installed constant monitoring probes yet because our Environmental Specialist, who was purchasing probes from In-Situ, at the time resigned in June 2019. The new Environmental Specialist started in September 2019 and began to fill in the three-month gap left by the lapse in position fulfillment. This has caused us to delay the purchase of constant monitoring probes for several months. The city is still working on purchasing constant monitoring probes.

As the Miami Beach water quality monitoring program nears the completion of its fourth year, it will continue to serve as a useful screening level program for early detection of major or potentially chronic water quality concerns that could impact Biscayne Bay so the City can address them swiftly. The city is constantly evaluating its stormwater management program and making improvements that further improve the quality of our stormwater discharges

Methodology

Sample Locations

Miami-Dade County has been collecting water quality data for nearly 40 years throughout Biscayne Bay. The County’s sampling program collects forty-five (45) of its samples from freshwater canals and the remaining eighty-nine (89) samples come from estuarine stations within Biscayne Bay. The county collects water quality data from within the 9 Nutrient Regions as defined by the Florida Department of Environmental Protection (FDEP) established Water Body Identification (WIBIDs) in 1999. One of the county’s sampling locations includes five (5) stations (BBMB01, BBMB02, BBMB03, BBMB04 and BB14) part of the Southern North Bay (SNB) within the waters surrounding the City of Miami Beach (**Figure 1**).

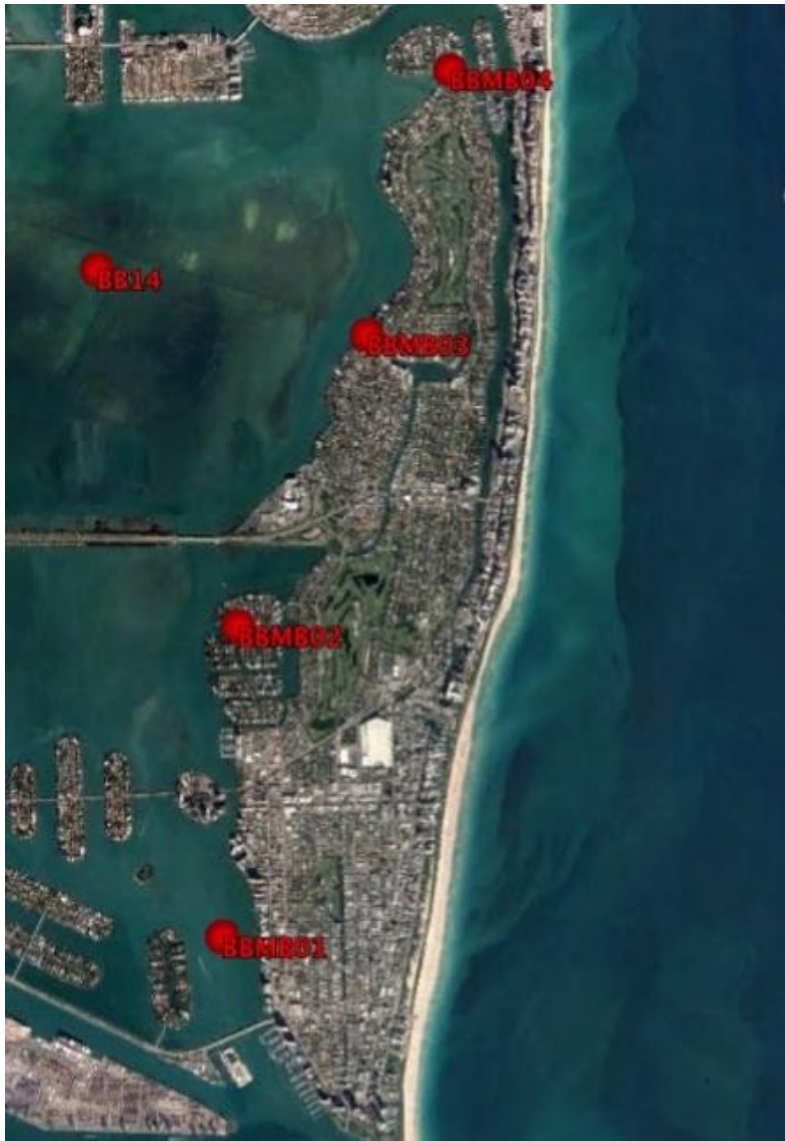


Figure 1-SNB monitoring stations within Miami Beach

The City of Miami Beach's program is modeled after the Miami Dade County's water quality sampling program, following their approach and methodology. The sample locations were selected to fill gaps in the County's monitoring network. From its launch in 2016 through 2018, the city's monitoring network grew to 64 stations (**Figure 2**).



Figure 2- City of Miami Beach water quality sampling program stations

In 2019, after reviewing input from Dr. Rowney, the city's water quality program was enhanced by removing duplicative sample points and adding sample locations within the stormwater sewer system, such as pump station wet wells and manholes upland from the outfalls. The current network collects data from 35 sample locations in Biscayne Bay and the waterways surrounding the city (**Figure 3A & 3B**). The locations of the sample points were selected to reflect land uses in various zoning areas including single family residential (SR1-4), multifamily residential (RM1-3), commercial (CD1-3), government use (GU), and the Convention Center District (CCC), at stormwater outfalls and ambient locations approximately 50 feet from the corresponding outfall as well as within the wet well at pump stations.



Figure 3A- North Beach sampling stations

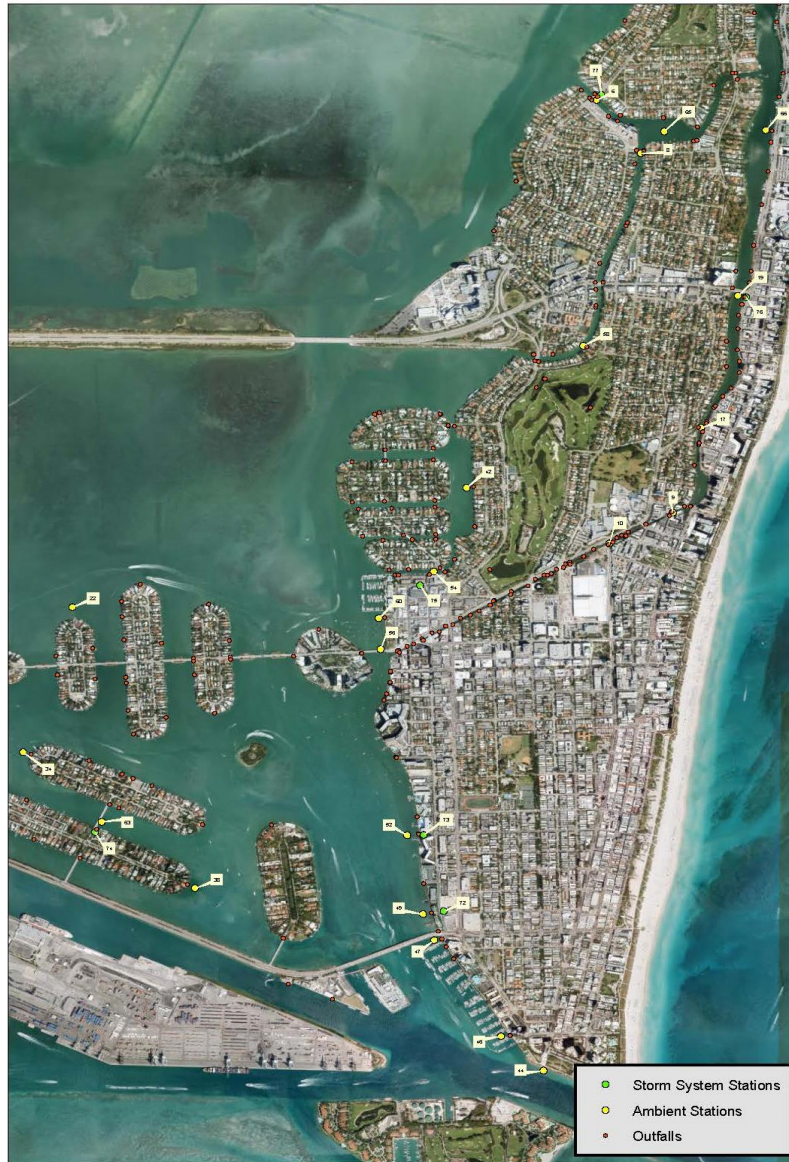


Figure 3B- South Beach sampling stations

Sampling Methodology and Equipment used

The city has used Miami-Dade County's contract with PACE Analytical Services (PACE) to perform the sampling and laboratory testing portion of the program. Samples are collected once a month. Given the large sample size and distance between sample locations, the sampling event spans the course of two days each month. Consideration is given to ambient conditions. Before each sampling event weather patterns are studied for the coming weeks to determine rain patterns, wave conditions, wind conditions and tide conditions.

While in the field PACE staff uses equipment in line with the DEP-SOP-001/01 FS 2100 Surface Water Sampling SOP. PACE staff performs sample recovery by lowering a high-density

polyethylene (HDPE) bottle attached to an extendable pole into the water, allowing the water to flow from the top 2 feet of the water into the sample container. Prior to the collection of the sample the container is triple rinsed. The source water is collected and transferred to pre-labeled bottles. Additionally, before the sample is taken a YSI 556 multimeter probe is lowered into the water to record field readings, including temperature, pH, specific conductance and dissolved oxygen. A portion of the source water is also collected into a glass quevet to record field turbidity with the use of a Hach 2100Q Turbidimeter.

To access the sample points a boat is used and operated by city staff. When approaching the outfall, the boat is slowed down and placed in a neutral state. When obtaining samples in shallow areas the outboard motor on the boat is propped up to avoid sediment resuspension.

Field Observation

During sampling events staff records observations that are relevant to the future interpretation of the results, such as wind speed, wind direction, temperature, tide and current conditions. Observations are also made in relations to boat traffic and construction near outfall locations and anthropogenic influences. The sampling network includes outfalls, locations within the wet well at pump stations and manholes along the trunk lines upstream of outfalls. Observations are made in relation to the conditions surrounding the outfall. For example, during sampling events observations are made to determine if the outfall is fully submerged or above water, condition of water directly below the outfall. For the wet wells, the efficiency of the trash capturing structures is inspected to observe how much trash has been introduced into the system and how much of the trash has been captured for removal. Within the manholes along the trunk line, observations are made to determine if debris from designated land use may be entering the storm sewer system. Additional observations are made regarding boat traffic, recreational activities and construction near or at outfall locations that may interfere with the sampling events.

Analysis

The parameters of the water quality monitoring program established by the city were selected to mirror the NPDES recommended parameters that have been selected by Miami-Dade County for their water quality monitoring program with exceptions based on the unique conditions of the city (**see Table 1**). In addition, as with the Miami-Dade County water quality program for those nutrients with numeric interpretations of narrative criteria listed in 62-302.532 Florida Administrative Code (F.A.C.), the evaluation will follow the protocol as noted in that section of the F.A.C.

Table 1: List of NPDES recommended parameters, and other parameters samples for in the city's water quality monitoring program.

Parameters	
Dissolved Oxygen	Enterococcus
Total Kjeldahl Nitrogen	Fecal Coliform
pH	Specific Conductance
Salinity	Nitrogen, Ammonia
Nitrogen, NO ₂ Plus NO ₃	Turbidity
Field Temperature	

The results of the samples tested for parameters mentioned in **Table 1** are provided by PACE to the city within two weeks prior to the sampling event. City staff reviews the results to determine if any lab errors have been made. Once a year, city staff performs a comprehensive review of the results in conjunction with the results of the data in the previous year to identify potential trends and the success of the city's stormwater management program improvements. Currently the only water bodies with designated numeric nutrient criteria (NNC) are estuarine and coastal waters and to evaluate the compliance of the appropriate estuarine regions with the listed nutrient criteria the calendar Annual Geometric Mean (AGM) values for each parameter in the SNB will be calculated. The AGM will be compared to its respective criterion to determine whether the criterion was exceeded (please refer to **Table 2** for the respective criterion). Additionally, the data will be used to identify portions of the city's Municipal Separate Storm Sewer System (MS4) which can be targeted for loading reduction and/or corrective action with additional pollutant reduction measures.

Table 2: Numeric interpretation of the State of Florida's narrative nutrient criteria expressed in mg/L or µg/L, as AGM (62-302.532 F.A.C.) per Estuarine Region.

Estuary	Total Phosphorus	Total Nitrogen	Chlorophyll-A
Biscayne Bay	Annual geometric means that shall not be exceeded more than once in a three-year period.		
Southern North Bay (SNB)	1.010 mg/L	0.29 mg/L	1.1 µg/L

Results

A review of the Miami-Dade County Surface Water Quality Monitoring Report for 2018 revealed that the City had exceedances in Enterococci and Escherichia Coli (E.Coli) following their assessment of Biscayne Bay. Following the review of the report, a preliminary review was conducted to analyze the water quality data gathered for 2019. During the review of the 2019 water quality data, it was revealed that the city had exceedances in seven of the 35 sample locations each spread throughout the city's 12 land use areas (see Table 3). In addition, the data analysis revealed that there were Total Nitrogen exceedances in five of the 35 sample locations. The data analysis revealed exceedances in Total Phosphorus above the numeric nutrient criteria (NNC) for the SNB but within the allowable limit under state standards.

Table 3: City of Miami Beach Water Quality Sample Location Data

Land Use	Sample Location
Single Family Residential (RS-1, RS-2, RS-3, RS-4)	4,6,8,17,22,34,38,42,58,63,65,67,68,70,77,78
Residential Multifamily, Low Intensity (RM-1)	69,71
Residential Multifamily, Medium Intensity (RM-2)	19,76
Residential Multifamily, High Intensity (RM-3)	52,66,73,75
Commercial, Medium Intensity (CD-2)	54,72
Commercial, High Intensity (CD-3)	9
Commercial Performance Standard, Intense Phased Bayside (CPS-4)	46,47,49
Convention Center District (CCC)	10
Civic and Government Use (GU)	44,56,60,74

Conclusion

After reviewing the 2019 water quality data, it was apparent that the main area of concern for the city was total phosphorus. The city had exceedances for phosphorus in all sample locations above the NNC for SNB. The results of the 2019 water quality data revealed that the concentrations of total phosphorus was between 0.031mg/L and 0.04 mg/L, which is between 0.021 and 0.037 times greater than the NNC for SNB of 0.010 mg/L. Storm water runoff in urban watersheds has become a leading cause of nonpoint phosphorus pollution. When rain falls, the runoff washes pollutants off our streets, parking lots, construction sites, storage yards and lawns. Urban runoff carries a mixture of pollutants from our cars and trucks, outdoor storage piles, muddy construction sites and pesticide spills. Often efficient systems of ditches, gutters and storm sewers carry the polluted runoff to nearby water bodies, bypassing wastewater treatment systems.

The city's stormwater management system may be linked to heavy fertilizer use, desorbed pools of eroded soil, decomposing plant materials, such as leaves and grass clippings. Another source of phosphorus can come from land use changes. The construction of new buildings can create unfavorable conditions, particularly the impervious surfaces, which can aid in the transport of nutrient laden materials.

The city takes every precaution to protect our waterways and makes a concerted effort to introduce preventative measures to protect water quality. The city has developed a multi-faceted stormwater management program to minimize stormwater pollution above and beyond our NPDES permit requirements. The first component of this multi-faceted program focuses on preventing pollutants from entering our stormwater systems through various approaches including public education, daily street sweeping and other good housekeeping practices.

The second component of our stormwater management program focuses on trapping debris within the system and removing it from the stormwater via Vortex structures and other pollution control structures. Sediment and debris trapped in these structures can create a breeding ground for bacteria. The third component of the stormwater management program is preventing the growth of bacteria within the system. The city has introduced into its stormwater management program is regular cleaning and maintenance of the system to remove trapped pollutants. The city cleans the entire system at least once a year and cleans the Vortex structures on a quarterly basis to remove pollutants and reduce the potential for bacteria within the system.

The fourth and final component of the city's stormwater management program is the water quality monitoring of Biscayne Bay, which has historically been done monthly by Miami-Dade County on our behalf and reported annually to the Florida Department of Environmental Protection (FDEP). As previously mentioned, within this report the city has developed its own monthly sampling program to monitor the health of Biscayne Bay and the city's waterways to mirror the county's sampling program.

Recommendations

The city continues to make enhancements to its water quality program and after receiving insight from an outside water quality expert, the city removed duplicative sample locations and introduced sample points within our pump stations. The next step will be for the city to analyze the data and compare the results of the water quality for samples collected from the outfall and samples collected from within the wet well at the pump station. Another recommendation for the program moving forward is to compare the results of samples collected in areas with pump stations versus areas using gravity. The results should be analyzed to make comparisons between land use areas to determine the effectiveness of the pump stations in those areas. The discovery of exceedances in phosphorus (TP) has caused the city to put into action a fertilizer ordinance to reduce the levels of TP. The ordinance was designed to implement the following requirements;

- All commercial and institutional applicators of fertilizer (landscapers) within the City to abide by and successfully complete the six-hour training program in the

"Florida-friendly Best Management Practices for Protection of Water Resources by the Green Industries" offered by the Florida Department of Environmental Protection through the University of Florida Extension "Florida-Friendly Landscapes" program, or an approved equivalent. All managers and employees must be certified.

- A 10 ft. setback from waterways and storm drains where no fertilizer may be applied
- No fertilizer applied during the rainy season (June-Sept)
- Nitrogen content in fertilizer must be 50% 'slow release'
- In no case shall grass clippings, vegetative material, and/or vegetative debris be washed, swept, or blown off into stormwater drains, ditches, conveyances, water bodies, wetlands, or sidewalks or roadways.

Additional measure included in the ordinance included the consideration of banning the retail sale of fertilizers with either phosphorus or less than 50% 'slow release' nitrogen. During the ordinance process it was revealed that city would have issues with enforcement mechanisms for contractors performing landscaping services on private property. This concern has led the city to approve a resolution urging the County to introduce a fertilizer ordinance. The fertilizer ordinance would work to reduce the use of fertilizers and its runoff, which can be harmful to the health of waterways in Biscayne Bay.

As the city continues to enhance its water quality program we will look to implement a water quality campaign to will include educational materials and trainings that will provide city staff and residence with information on steps that can be taken to prevent pollution from entering into Biscayne Bay. Additional steps will be taken to collaborate with other Counties and state agencies to share information on water quality protection programs.

Miami Beach draws approximately 6 million overnight tourists on an annual basis and appeals to the 90,000 residents who choose to call the urban island home. Protecting our waterways is key to providing our visitors with the world-class experience they have come to expect from Miami Beach and protecting the high quality of life residents enjoy. While at this time no major issues have been identified, the City is consistently evaluating its stormwater management program to go above and beyond in protecting this regional resource.