## MIAMIBEACH

Sustainability Resiliency Committee Meeting City Hall Commission Chambers, 3rd Floor June 26, 2019 - 1:00 PM Commissioner Mark Samuelian, Chair Commissioner John Elizabeth Aleman, Vice-Chair Commissioner Joy Malakoff, Member Commissioner Ricky Arriola, Alternate Elizabeth Wheaton, Liaison

### <u>REPORTS</u>

1. REVIEW OF RESILIENCE STRATEGY WORKPLAN - PLANNED AND IN PROGRESS RESILIENCY PROJECTS

City Manager's Office | Public Works | CIP

2. SUSTAINABILITY COMMITTEE

Dave Doebler, Committee Chair

#### **DISCUSSION ITEMS**

3. DISCUSSION ON CITY OF MIAMI BEACH STORMWATER, SANITARY SEWER, AND WATER INFRASTRUCTURE BEST MANAGEMENT PRACTICES Commissioner Micky Steinberg Environment and Sustainability

#### Item C4U - May 11, 2016 Commission Meeting

 DISCUSS UPDATES TO THE CITY CODE REFERENCING TURTLE NESTING Commissioner John Elizabeth Aleman I Co-Sponsor Commissioner Joy Malakoff Environment and Sustainability

Item C4F - September 25, 2017 Commission Meeting

5. DISCUSSION ON ARTIFICIAL REEFS Commissioner Ricky Arriola Environment and Sustainability

#### Item C4 AI - May 16, 2018 Commission Meeting

- DISCUSSION REGARDING PRIVATE SEAWALLS City Commission City Manager's Office | Public Works Item R7F - December 12, 2018 Commission Meeting
- DISCUSSION ON EXPANDING THE PLASTIC BAG ORDINANCE IN MIAMI BEACH. Commissioner Micky Steinberg I Co-sponsored by Commissioner Michael Gongora City Attorney's Office

Item C4 T - February 13, 2019 Commission Meeting

8. AN ORDINANCE OF THE MAYOR AND THE CITY COMMISSION OF THE CITY OF MIAMI BEACH, FLORIDA, AMENDING CHAPTER 46 OF THE CODE OF THE CITY OF MIAMI BEACH, ENTITLED "ENVIRONMENT," BY CREATING ARTICLE VIII THEREOF, TO BE ENTITLED "SALE OF SUNSCREEN PRODUCTS," TO PROHIBIT THE SALE OF SUNSCREEN PRODUCTS CONTAINING OXYBENZONE OR OCTINOXATE, OR BOTH; AND, PROVIDING FOR REPEALER, SEVERABILITY, CODIFICATION, AND AN EFFECTIVE DATE.

Commissioner Michael Gongora

Environment and Sustainability

Item R5 N - March 13, 2019 Commission Meeting

9. DISCUSS THE CITY'S PLAN TO ADDRESS FLOODING AS A RESULT OF EXTREME RAIN EVENTS AS WELL AS ANY LESSONS LEARNED.

Commissioner Mark Samuelian

City Manager's Office | Public Works

Item C4 K - June 5, 2019 Commission Meeting

 DISCUSS A BIOSWALE PILOT PROJECT FOR 59TH STREET WEST OF ALTON ROAD. Commissioner John Elizabeth Aleman Public Works

ITEM C4 J - JUNE 5, 2019 Commission Meeting

#### DEFERRED ITEMS

11. UPDATE ON THE PUMP STATION PLUMES ON WEST AVENUE

Public Works

#### Item C4 U - February 13, 2019 Commission Meeting

12. DISCUSS THE USE OF PESTICIDES, HERBICIDES, AND FERTILIZERS ON BOTH PUBLIC AND PRIVATE PROPERTIES

Commissioner John Aleman

Environment and Sustainability

#### Item C4 V - March 13, 2019 Commission Meeting

13. DISCUSSION REGARDING HOW GREEN INFRASTRUCTURE INCLUDING LIVING OR HYBRID SHORELINES CAN COMPLEMENT GREY INFRASTRUCTURE IN OUR CLIMATE ADAPTATION ON-GOING WORK

Commissioner Micky Steinberg

Environment and Sustainability

#### Item C4N - April 13, 2016 Commission Meeting

14. DISCUSSION REFERRING A TASK TO THE CITY MANAGER'S READY TEAM IN ORDER TO BOTH OPTIMIZE PUBLIC ENGAGEMENT AND FACILITATE TIMELY COMPLETION OF PROJECTS

Commissioner John Elizabeth Aleman

CIP I Marketing & Communications

#### Item C4V - July 25, 2017 Commission Meeting

15. DISCUSSION REGARDING EXPLORING THE CITY OF MIAMI BEACH JOINING THE AMERICAN FLOOD COALITION

Commissioner Mark Samuelian I Co-Sponsor Commissioner Joy Malakoff

City Manager's Office | Environment & Sustainability

#### Item C4W - December 12, 2018 Commission Meeting

 DISCUSSION ON REPURPOSING OUR GOLF COURSES FOR THE FUTURE Commissioner Ricky Arriola Parks and Recreation | Public Works | Environment and Sustainability Item C4 AB - May 16, 2018 Commission Meeting

## MIAMIBEACH

### <u>Item 1.</u> COMMITTEE MEMORANDUM

TO: Sustainability Resiliency Committee Meeting

FROM: Jimmy L. Morales, City Manager

DATE: June 26, 2019

### SUBJECT: REVIEW OF RESILIENCE STRATEGY WORKPLAN - PLANNED AND IN PROGRESS RESILIENCY PROJECTS

#### **RESPONSIBLE DEPARTMENT:**

City Manager's Office | Public Works | CIP

## <u>Analysis</u> VERBAL UPDATE AT COMMITTEE MEETING.

#### **UPDATE:**

#### Supplemental Information 06.24.19: Item Memorandum Attached.

## ATTACHMENTS:

	Description	Туре
D	SRC Report June 2019	Other
D	Resilient 305 Strategy	Other
D	Miami Beach Strategic Plan	Other
D	MEMO_ Resilience Strategy	Memo

#### SUSTAINABILITY AND RESILIENCY COMMITTEE PROJECTS PROGRESS REPORT

Project Name	District	Scope of Work	Project Budget	Current Status	Anticipated Completion
First Street Imp Alton & Washington	South Beach	Improvements on First Street to include complete roadway reconstruction, elevation of the roadway to a minimum 3.7 NAVD elevation, utility removal/replacement, new storm drainage line installation, new storm pump station (120,000 gpm), force main installation, landscaping and lighting. Drainage improvements on Alton Road from South Point Drive to 5th Street and Washington Avenue from South Point Drive to 5th Street.			Fall 2021
Indian Creek -Street Drainage Imp Phase III	Middle Beach	Storm water drainage improvements on Indian Creek Drive and side streets from 25 Street to 41 Street, including completing the stormwater pump station at 32nd Street. Final pavement restoration of the roadway and sidewalk on Collins Avenue between 25 Street and 26 Street; Rebuilding and raising the roadway and sidewalk on Indian Creek Drive between 26 Street and 41 Street and new street lighting, signage and pavement markings.			Fall 2021
Maurice Gibb Park Redesign (GOB)	Middle Beach	Renovation of the park to include soil remediation, a new playground with shade canopy, pavilion(s), a dog park, walkways, minor restroom renovations, landscaping with open sodded areas, irrigation, signage and park furnishings.	\$7,020,681	Project was approved by the DRB on May 7, 2019. The 60 % Design Documents are due June 28, 2019. Anticipated completion of Design in late August 2019.	Summer 2021
Mid Beach Community Park (Par 3) (GOB)	Middle Beach	lake; open meadows and informal open play field areas; site grading; pavilion; 6 tennis courts with restroom facilities; children's playground; dog park; boardwalk and pathways; security lighting; vita course and fitness cluster; butterfly garden; linear water feature and parking lot. Resilient strategies	\$21,160,190	and the stormwater resiliency concept was held on 5/31/2019. RER will assign an independent modeler to perform a more traditional ground water modeling and reconvene by early July to compare	Spring 2021
Middle Beach Recreational Corridor Ph 3 (GOB)	Middle Beach	Construction of approximately 3,500 linear feet of an on-grade pedestrian walkway and the demolition of the existing wooden boardwalk from 24th to 45th street. Dune enhancements such as native dune vegetation species and beach compatible dune fill and irrigation systems will be provided for the landscaping. Path lighting will meet Florida Fish and Wildlife Commission's marine turtle nesting requirements.	\$13,215,000	FDEP permit and FDOT Approval have been received. City has issued an ITB and bids are due July 8.	Fall 2021
North Beach Oceanside Park Renovation	North Beach	Renovation of the park to include pedestrian entrances with new gates, pedestrian beach access, walkways with lighting, refurbished restrooms and picnic shelters, site furnishings, open sodded areas, landscape and irrigation.	\$12,700,000	addressed. FDEP is reviewing the application.	Spring 2021
Sunset Harbor Pump Station #3 Screen	Middle Beach	Sunset Harbour Pump Station #3. The height of the screen will vary from 9'-0" above the traffic barricade adjacent to the generator, to 3'-0" at the	\$400,000	The 90 % Design Documents, incorporating the replacement of the traffic barricades, are anticipated July 8, 2019.	Spring 2020
struction					
Brittany Bay Park	North Beach	This project includes the creation of a living shoreline between the existing remaining seawall and the concrete retaining / seawall. ADA-Accessible overlook that will allow park patrons to walk from the Park to the existing seawall's edge. The project is intended to enhance the surrounding riparian and intertidal environment by creating a new habitat for aquatic and terrestrial species and improving water quality via filtration of upland runoff. The Park renovations also include new concrete walkways, milling and resurfacing the existing parking lot, new trees, new exercise equipment, furniture, lighting and new landscaping.	\$1,243,000	various agencies, during the Permitting phase.The Procurement phase will begin in June. Project	Spring 2020
	First Street Imp Alton & Washington Indian Creek -Street Drainage Imp Phase III Maurice Gibb Park Redesign (GOB) Mid Beach Community Park (Par 3) (GOB) Middle Beach Recreational Corridor Ph 3 (GOB) North Beach Oceanside Park Renovation Sunset Harbor Pump	First Street Imp Alton &       South Beach         Indian Creek -Street       Middle Beach         Drainage Imp Phase III       Middle Beach         Maurice Gibb Park       Middle Beach         Redesign (GOB)       Middle Beach         Middle Beach Community Park       Middle Beach         (Par 3) (GOB)       Middle Beach         North Beach Oceanside       Middle Beach         Park Renovation       North Beach         Sunset Harbor Pump       Middle Beach         struction       Indiale Beach	First Street Imp Alton & South Beach         Improvements on First Street to include complete roadway reconstruction, elevation of the roadway to a minimum 3.7 NAVD elevation, utility removal/replacement, new storm drainage line installation, new storm pump station (120.000 gm), force main installation, landscaping and lighting. Drainage improvements on Alton Road from South Point Drive to Sth Street and Washington Avenue between 126 Street for South Drive to Sth Street.           Indian Creek -Street         Storm water drainage improvements on Indian Creek Drive and sidewalk on Collins Avenue between 25 Street and 26 Street, Beduling and raising the roadway and sidewalk on Indian Creek Drive between 26 Street and 26 Street, Evaluating and raising the roadway and sidewalk on Indian Creek Drive between 26 Street and 15 Street and 26 Street, Beduling and raising the roadway indices and sidewalk on Indian Creek Drive between 26 Street and 15 Street and 26 Street, Beduling and raising the roadway and sidewalk on Indian Creek Drive between 26 Street and 15 Street and 26 Street, Beduling and raising the roadway indices and a street sighting, signage and pavement markings.           Maurice Gibb Park Redesign (GOB)         Middle Beach         Renovation of the park to include soil remediation, signage and pavement markings.           Middle Beach         Middle Beach         A new passive community park to include environmental remediation, a certain lake, open meadows and informal open pay field areas; lite grading, souther; butterfly grader, linear water feature and parking tot. Residing strategies proposed at the park include stormwater retention system, pervicus pavement; solar panels for pedestrian lighting, energy efficient lighting and rool mounde solar panels. Construction of approximately 3,500 linear feet of an on-grade pedestrian walkway and the demolit	First Street Imp Alton &         South Beach         Improvements on First Street to include complete roadway reconstruction, elevation of the roadway to a minimum 3.7 NAVD elevation, utility removal/replacement, new storm drainage line installation, new storm pump station (12,000,000)         \$24,000,000           First Street Imp Alton &         South Beach         Improvements on Alton Road from South Point Dive to Stin Street and Washington Avenue from South Point Dive to Stin Street and Washington Avenue from South Point Dive to Stin Street and Washington Avenue from South Point Dive to Stin Street and Washington Avenue from South Point Dive to Stin Street and Washington Avenue from South Point Dive to Stin Street and Washington Avenue from South Point Dive to Stin Street and Washington Avenue from South Point Dive to Stin Street and Washington Avenue from South Point Dive to Stin Street and Washington Avenue from South Point Dive to Street and 41 Street including completing the stormwater pump station at 32nd Street, Final pavement restoration of the roadway and sidewalk on Indian Creek Drive between 25 Street and 41 Street and new storm diverse pump station and new store storem removations, and new statem storing pays, walkways, minor restorom removations, Bade cancey, walkways, and indiverse pays makington, signage and park furnishings.         \$7,020,681           Maurice Gibb Park Redesign (GOB)         Middle Beach         A new passive community park to include environmental remediation, a certal streeting paysound (So garx, badways) and payson payson and finas streeting payson.         \$7,120,681           Middle Beach (Par 3) (GOB)         Middle Beach         A new passive community park to include environmental remediation, a certal stredison, a certal streetis and streage payson.         \$	Improvements on First Street to include complete reachery reconstruction, elevation of the randows to a minimum 37 NAVD elevation, and the resultation, new storm pump station (120,000 gom), force main installation, landscaping and lighting, Dariange improvements on Alten Road torons of the Street.         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#### SUSTAINABILITY AND RESILIENCY COMMITTEE PROJECTS PROGRESS REPORT

	Project Name	District	Scope of Work	Project Budget	Current Status	Anticipated Completion
9	Middle Beach Recreational Corridor Ph 2 - Section 2	Middle Beach	Construction of approximately 3,350 linear feet of an on-grade, paver pedestrian walkway of varying widths ranging from 15-feet to 25 feet, extending from 46 to 53 Street. Non-native vegetation will be removed and replaced with native vegetation. Sea turtle-friendly pedestrian lighting will also be installed.	\$14,799,058	Ribbon Cutting ceremony was held on June 13. This project is now in close-out phase.	Substantially Complete
10	Palm & Hibiscus Island Neighborhood Improvements	South Beach	This project includes a variety of aboveground and underground improvement such as new water main and service, new storm water drainage system including 3 pump stations, lining of the sanitary sewer system and replacing all the sewer laterals, raising the elevation and reconstruction of the roadways including installation of Geo Textile, new decorative street lights, speed tables, landscape, hardscape improvements, harmonization with private properties and undergrounding the franchise utilities on Hibiscus Island. Additional scope of services was added to the project to install 3 bi-fuel generators as well as, implementation of the new drainage criteria to install and harmonize a yard drain in each private property with the finished floor elevation (FFE) lower than the crown of road.	\$48,938,882	This project is 89% complete. FPL is working to energize the pump station on Hibiscus Island. Both pump stations in Palm Islands are in operation. Design/Builder is designing the three (3) generators for the pump stations. Design and permitting of the private drains per the new drainage policy has commenced.	September 2019
11	Stormwater Pump Station at 19th Street East of Meridian	Middle Beach	Installation of a stormwater pump station, including an emergency generator and seawall reconstruction along Collins Canal near 19th Street and Meridian Avenue. A change order was approved for the extension of the Botanical Garden along the Dade Canal and a seawall at the Carl Fisher Clubhouse.	\$8,400,000	Pump Station Completed. A field inspection and start-up with DERM was held on June 13, 2019. Waiting for DERM to issue a partial certification to the permit, as the Park is still under construction. Carl-Fisher Seawall: DERM is still reviewing and analysing the seawall aligment and plans. SFWMD performed a site visit, and the final application is being submitted this month. It is anticipated it will take 3 months to get the final permit. Botanical Gardens: FPL continues to work on rerouting the aerial lines and the removal of the existing poles. FPL has had to interrupt progress to accomodate Convention Center shows, affecting completion date.	April 2019 September 2019 August 2019
12	Venetian Islands Neighborhood Improvements	South Beach	Work includes site preparation, earthwork, demolition, storm drainage, roadway, concrete valley gutters, paving and grading, water main, lighting, and planting. Additional scope added included installation of six (6) stormwater pump stations, two per island, and automated meter reading technology.	\$37,382,720	FPL to energize the South Rivo Alto transformer on June 19. FPL has scheduled North Rivo Alto transformer installation for 2nd week of July 2019. City continues to evaluate the construction deficiencies in the asphalt roadway to determine the best resolution and service life.	TBD
13	Venetian Islands Seawalls	South Beach	This project entails seawall replacement, at two (2) locations consisting of precast concrete bulkhead panels, king piles, batter piles and concrete cap; and seawall cap raising at five (5) locations consisting in new concrete cap, batter piles and retaining walls, all locations within the Venetian Islands.	\$650,000	Modifications to the DERM permit are required as per field conditions and direction from DERM. Plans are currently being revised for submission to the agency. NTP2 is on hold.	TBD

#### SUSTAINABILITY AND RESILIENCY COMMITTEE PROJECTS PROGRESS REPORT

	Project Name	District	Scope of Work	Project Budget	Current Status	Anticipated Completion
	West Avenue - Phase II Improvements - North of 14 Street	South Beach	West Avenue - Phase II Improvements North of 14th St - Scope includes Water, Sewer, Storm and above ground improvements from 14th Street north to the Collins Canal and include a new Pump Station and Baywalk at the end of Lincoln Road. Project is being re-designed to include the following resiliency items: Road elevation 3.7 NAVD; 10 year storm event; Mobility – 2 lanes with center continuous turn lane; Protected bike path; Street ends enhanced design; Permanent generators and 120,000 gpm pump station.	\$79,158,564	Final Drainage report is due by the end of July 2019. Team is still evaluating other locations for the Pump Generator, as there is heavy opposition from the residents at Lincoln Court street end. The segmented construction approach have been widely supported by the community. Harmonization plans for segment 1 are being finalized and meetings with properties will commence by early July 2019	TBD
15	West Avenue - Phase II Improvements - South of 14th Street	South Beach	West Avenue - Phase II Improvements South of 14th St. The scope includes Water, Sewer, Storm and above ground improvements from 14th Street south to 5th Street. Project is being re-designed to include the following resiliency items: Road elevation 3.7 NAVD; 10 year storm event; Mobility – 2 lanes with center continuous turn lane; Protected bike path; Street ends enhanced design; Elimination of street paving to allow for wider pedestrian sidewalks and more green areas; Permanent generators for existing pump stations.		Final Drainage report is due by the end of July 2019. The segmented construction approach have been widely supported by the community. Harmonization plans for segment 1 are being finalized and meetings with properties will commence by early July 2019	TBD
TOTAL				\$302,068,095		



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## Welcome.

Where are you from? We hear this question every day, all over South Florida. Some of us are from up north and came to thaw out. Some of us are from countries to the south and came to escape turmoil. Wherever we came from and for whatever reason, we now call South Florida home. We savor the unique culture our diversity has created as well as its opportunities. And together, we face Florida's multitude of natural disasters—hurricanes, tropical storms and tropical depressions, tornadoes, wildfires, and floods.

Our resilience strategy—that is, planning for and dealing with such adversity—begins with and ends with our people, with you. We are surrounded by family and friends. We are part of neighborhoods, community organizations, businesses, and churches. The intricate systems and processes that support us—transportation, water, the environment, food, and energy—also connect us. However, we are a large, complex, and diverse region and sometimes individuals and communities fall through the cracks. This document is intended to address this and other resilience challenges through intergovernmental and community collaboration. This resilience strategy will build on our existing networks and endeavor to safeguard our people, our homes, and our livelihoods, so that no person, neighborhood, or business is left behind.

Resilience, for us, means providing the opportunity for every person and every community to bounce back after large-scale flooding events, hurricanes, or economic hardships, and to not only survive, but thrive in the face of sea level rise, expensive housing, challenging traffic, and uncertain labor markets. By connecting, engaging, and empowering every voice in our community, we will stand strong and share our unique South Florida story. Join us in this journey.



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## LETTER FROM THE MAYORS

Dear Residents, Businesses, and Partners in the 305:

As we launch this Resilient305 Strategy in the spring of 2019, cities around the world are also issuing their plans to tackle the many challenges to come in the decades ahead as ocean waters rise and average global temperatures increase.

Our shared community of Miami-Dade County, the City of Miami, and the City of Miami Beach has had both the honor and the responsibility of being the first regional partnership that was invited to join the 100 Resilient Cities initiative. First created in 2013 for the Rockefeller Foundation's centennial year, that important worldwide collaboration has enabled us to share our best practices, built across party lines and governing boundaries, with other local and international leaders.

In the following pages you will find 59 specific actions already in the works to ensure that our region of Greater Miami & the Beaches thrives for generations to come. Our Resilient305 Strategy also offers 28 case studies showcasing clearly defined steps that local groups are currently taking to ensure that we reach our goals.

We are grateful to the many exceptional leaders and partners who have helped us thus far in our journey. That includes former City of Miami Mayor Tomas Regalado and former Miami Beach Mayor Philip Levine, who opened the doors to our inclusion in the 100RC initiative in 2016; scores of collaborators who have since joined us in this Resilient305 mission at the numerous city, county, business, philanthropic and educational organizations that you will read about in this report; and countless others who have also played vital roles beyond the scope of this report.

The 305 Community has never known a challenge like this, and the task ahead is as daunting as the one we faced in the space race of the 1960s. Like those successful Moonshots, this will require new ingenuity, collaboration, and a sense of urgency. Together, we can and will rise to the occasion and create a more resilient future for our planet. Thank you for joining us in this transformative work.

Mayor Gelber, Mayor Gimenez, Mayor Suarez



## **LETTER FROM 100 RESILIENT CITIES**

On behalf of 100 Resilient Cities (100RC). I want to congratulate Mayor Gelber, Mayor Gimenez, Mayor Suarez, and the entire Greater Miami & the Beaches (GM&B) team on the release of the Resilient305 Strategy, a major milestone in our partnership and the result of a tremendous collective effort.

The unique collaboration between Miami-Dade County, the City of Miami, and the City of Miami Beach (collectively, the GM&B region) stands out in the 100RC network as the only regional partnership between a county and two cities working together to create a shared resilience strategy. Located in a dynamic and growing coastal region, GM&B is acutely aware of the environmental, social, and economic challenges it faces—from severe storms and sea level rise to mobility and housing affordability—and the need to work together on solutions that promise a strong future for all. The 59 actions detailed in the Resilient305 Strategy will help the region thrive in the face of these challenges, while the partnerships that were formed and strengthened through this process will ensure that the GM&B region can address future shocks and stresses, both known and unknown.



Framed through the lens of Places. People, and Pathways, this strategy presents a roadmap for safeguarding the region's beautiful natural environment while connecting, enhancing, and adapting its vibrant communities; for bolstering the health, educational, and economic resources that enable individual residents to survive and thrive in both good times and bad; and for strengthening the connections, partnerships, and systems that facilitate collective action in tackling GM&B's shared resilience challenges.

This innovative strategy would not be possible without the leadership of GM&B's Chief Resilience Officers, Jane Gilbert, Jim Murley, and Susanne Torriente, and the numerous municipal staff and community partners who have contributed their time, energy, expertise, and willingness to experiment on a new approach. Through information gathered from over 150 public meetings involving over 1.100 participants, and an additional 2.400 survey responses, the strategy development process was truly a collaborative and participatory endeavor, yielding a clear set of intergovernmental and community priorities on which to build resilience.

While the release of the Resilient305 Strategy represents a remarkable achievement, the work is far from over. As Greater Miami & the Beaches continues its resilience journey through implementation of this strategy, we are confident this unique partnership will strengthen and grow. Through collective and individual action, Miami-Dade County, the City of Miami, and the City of Miami Beach - along with the many partner organizations who make up Greater Miami & the Beaches - will lead the region toward a vibrant future while serving as a global model for regional resilience.

Michael Berkowitz, President 100 Resilient Cities

## MEET YOUR CHIEF RESILIENCE OFFICERS

Dear friends:

In the spring of 2016 this rather unique partnership, Greater Miami & the Beaches, became the first two cities and a county to join the 100RC network as one. We were chosen because we are urban inventors willing to partner. And in a sense, we were already pioneers among pioneers. We were chosen because we could give to the network and we would receive from the network. And we have.

As CRO's we have convened, listened and connected our beautiful and vulnerable PLACES, our diverse and already resilient PEOPLE and we found PATHWAYS to a stronger future. During this planning process we also put many ideas into action through our individual government investments and through the unique opportunities our partnership presented. Resilient305 is our collective resilience Strategy. It builds upon the challenges and strengths of the past to address the shocks and stresses of today and tomorrow. We hope that you will find your role in this plan and PIVOT with us into the future.

We want to thank and recognize so many important individuals without whom this plan could not have been written. To start, thank you to the thousands of individuals and organizations that have contributed ideas, context and feedback throughout this journey. We are fortunate to have hard working and talented staff; supportive and visionary bosses; 100 Resilient Cities current and former relationship managers Eric Wilson and Peter Jenkins providing network resources and, at times, therapy; The Miami Foundation for believing in the original intergovernmental experiment in collaboration; and finally our strategic partner AECOM - Claire Bonham-Carter for her insight and patience, especially Lauren Swan, our local AECOM task master extraordinaire and a good friend of the Greater Miami & the Beaches partnership.

Susy, Jim, and Jane

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SUSANNE TORRIENTE **CITY OF MIAMI BEACH JAMES MURLEY MIAMI-DADE COUNTY** JANE GILBERT **CITY OF MIAMI** 

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## **EXECUTIVE SUMMARY**

## What is Greater Miami and the Beaches?

Greater Miami & the Beaches (GM&B) is a unique partnership of Miami-Dade County, the City of Miami, and the City of Miami Beach. We came together to lead development of our community's resilience under the 100 Resilient Cities Network – Pioneered by the Rockefeller Foundation. Because the GM&B community is often referred to by our area code, "the 305" we thought it fitting that this document, GM&B's collaborative resilience building strategy, be titled Resilient305. To ensure Resilient305 has broad impact, GM&B will continue to expand to include the remaining 32 municipalities, other community organizations and anchor institutions in implementation.

## What is the Resilient305 Strategy?

This Resilient305 Strategy is a living document created to address resilience challenges we prioritized through intergovernmental and community collaboration. Throughout the process – in public meetings, surveys and focus groups - GM&B engaged thousands of stakeholders to help shape the Strategy and make sure it reflected the input from a wide range of expertise, ages, ethnicities, cultures, income levels and geographic areas. This continued interaction will be key to the successful implementation of the Strategy.

As our community continues to grow and evolve, the Resilient305 Strategy will encourage us to work together to better prepare for an increasing occurrence of shocks, such as hurricanes, and infrastructure failures, as well as better mitigate stresses, such as sea level rise and sunny day flooding, crippling traffic and severe economic inequities. Even during the planning process, our resilience was tested by the Zika outbreak and Hurricane Irma. We are stronger because of our experiences and have incorporated many of the lessons learned into this document.

We recognize that even our passion and dedication doesn't prevent some of our most vulnerable from falling through the cracks. We hope that the Resilient305 Strategy will serve as a foundation in building a strong network focused on addressing equity gaps and elevating our vulnerable populations. We believe that together we have an opportunity to work differently and more effectively by promoting stronger leadership, closer collaboration, and better use of our resources.

## What challenges will the Resilient305 Strategy tackle?

Over 50 actions have been identified, developed and organized for the Resilient305 Strategy into three overarching goal areas: Places. People, and Pathways. To better define the actions that would be included in the strategy, we focused on opportunities where we were best positioned to move the needle and separated them from those where we were better suited to complement the exceptional work that is already being done throughout various communities in the region.





## GOALS

## Places - Lugares -Kote

Many of us came to this part of Southeast Florida because we were drawn by the beautiful natural environment, balmy climate and the surrounding clear waters of this sub-tropical paradise. Those same features today simultaneously pose threats and offer opportunities. Through our "Places" actions, we aim to address location-based challenges and improve our climate resilience through research, design and planning; create, connect, and improve mobility and housing options; and enhance and safeguard our ecosystems.

## People - Gente - Moun

Individual people are the heart and soul of resilient cities. If individuals do not have access to certain basic needs, their resilience is diminished and so too is the resilience of their neighborhoods and communities. Through our "People" actions, we aim to improve the lives of our citizens every day, whether sunny or stormy, by supporting job and wealth creation; addressing specific health needs for the most vulnerable among us; and preparing and empowering neighborhoods and networks to anticipate and respond to disruptions, both large and small.

## Pathways - Caminos - Wout

"Pathways" is the strategic course we take to accomplish our goals by expanding our networks and sharing resources and tools. It is our "how to" guide. Through our "Pathways" actions, we aim to build the connections, collaborations, and committed leadership needed to change the status quo, enabling GM&B to become a global leader in resilience. We can achieve this by setting realistic and common goals, and committing to actions that bring together governments, businesses, community organizations and educational institutions.

## PIVOT - Making it happen

GM&B recognizes that implementing each of the actions within the Resilient305 strategy will require dedicated effort from ourselves and our partners, guided by a team that we call PIVOT or "Progress, Innovation, and Vision for Our Tomorrow". The initial PIVOT team will be comprised of leadership from Miami-Dade County, City of Miami, City of Miami Beach and The Miami Foundation, and will expand over time to include representatives from community partners. This team will look at resources, timeframes and priorities to develop a work plan and will oversee the implementation and progress of the Strategy.

## Join us in the Resilient305 Movement!





## WHO IS GREATER MIAMI & THE BEACHES?

OUR STORY

Greater Miami & the Beaches (GM&B) is a collaboration of Miami-Dade County, the City of Miami, and the City of Miami Beach, created to respond to the region's major challenges. As GM&B matures, the partners hope that GM&B will expand to include the remaining 32 GM&B municipalities within Miami-Dade County.

In 2016, after a very competitive process, GM&B was selected from among 400 applicants to join the 100 Resilient Cities network as the only inter-governmental partnership working to develop a shared resilience strategy.

## WHAT IS 100 RESILIENT CITIES?

100 Resilient Cities - Pioneered by The Rockefeller Foundation (100RC) was launched in 2013 to help cities around the world become more resilient to the physical, social, and economic challenges that are a growing part of the 21st century.

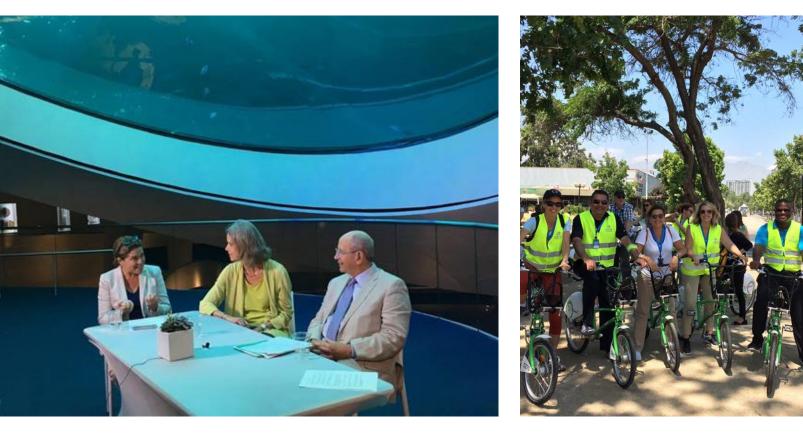
100RC supports the adoption and incorporation of a view of resilience that addresses not just the shocks—hurricanes, economic crash, floods, etc.—but also the stresses that weaken the fabric of a city or a region on a day-to-day or cyclical basis. Resilience is what allows cities to adapt and transform in the face of these challenges, helping them to prepare for and respond in the face of both the expected and the unexpected.

In GM&B, stresses include aging infrastructure, an inadequate public transportation system, sea level rise, pronounced poverty, and health disparities. By addressing both the shocks and the stresses in a holistic manner, we become more prepared to respond to adverse events and better able to deliver basic functions in both good times and bad, to all populations.

## WHAT IS RESILIENT305?

GM&B's Resilience Strategy—the Resilient305 Strategy—has been created as a living document to address prioritized resilience challenges through intergovernmental and community collaboration. Often referred to by our area code, the "305" has become a common nickname for local efforts. Not all our challenges will be addressed through actions in this resilience Strategy. Some of the issues are already being tackled by other plans or entities, such as decreasing congestion and improving transit through the Strategic Miami Area Rapid Transit (SMART) Plan, mental health through the new Miami Center for Mental Health and Recovery and the work of many social service providers and initiatives, and affordable housing through in-development Affordable Housing Master Plans. The resilience challenges tackled in Resilient305 were identified through a rigorous process that included extensive stakeholder engagement.









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OUR STORY

## GM&B IN CONTEXT

As the southeast tip of the Florida peninsula and most southern land mass on the United States mainland. GM&B is a low-lying coastal community that totals 2,431 square miles, including 1,898 square miles of land. GM&B also comprises 533 square miles of water and is adjacent to three water bodies, including Biscayne Bay and the Atlantic Ocean on its eastern boundary, and the Florida Strait on the southern boundary.

The northern, central, and eastern portions of GM&B are heavily developed with numerous high-rise buildings along the eastern coastline and Miami River. South Florida's central business district is in downtown Miami and its primary tourist destination is Miami Beach.

According to the U.S. Census Bureau, Miami-Dade County is the most populated county within the State of Florida and the seventh most populated county in the United States. It has an average density of 1.464 persons per square mile with an approximate population of 2.7 million residents across 34 GM&B municipalities and unincorporated areas.

Of the population 25 years and older. 26 percent has a bachelor's degree or equivalent, slightly below the national average of 32 percent. The census identifies 16.7 percent of the population living in poverty, which is 4 percent higher than the national average. Some 68 percent of the resident population is Hispanic or Latino with a 53 percent foreign-born population. The multicultural composition of GM&B has continued to grow since 1961 with a 10.2 percent population increase between 2010 and 2017. This overall growth is expected to continue.

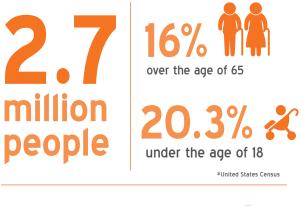
Every year, GM&B sees an influx of approximately 16 million visitors, predominantly for business purposes, or to visit the National Parks, sandy beaches, and turquoise waters. Cruise vacations and major events lure additional visitors. According to Miami-Dade County, GM&B's economy has continued to strengthen since the end of the Great Recession in 2010 with an increasing number of corporate headquarters for both the United States and Latin America located here. As the "Gateway to the Americas," GM&B hosts more than 700 multinational companies.

#### **GEOGRAPHIC AREA**\*



2/3 protected land, local/national parks, waterways, urban development boundary

**POPULATION** -



36 340

average age expected to increase to 40 by 2030

\*United States Census

\*United States Census



**DIVERSITY**\*

**TOURISM**\*

3 Primary languages spanish english creole

\*United States Census

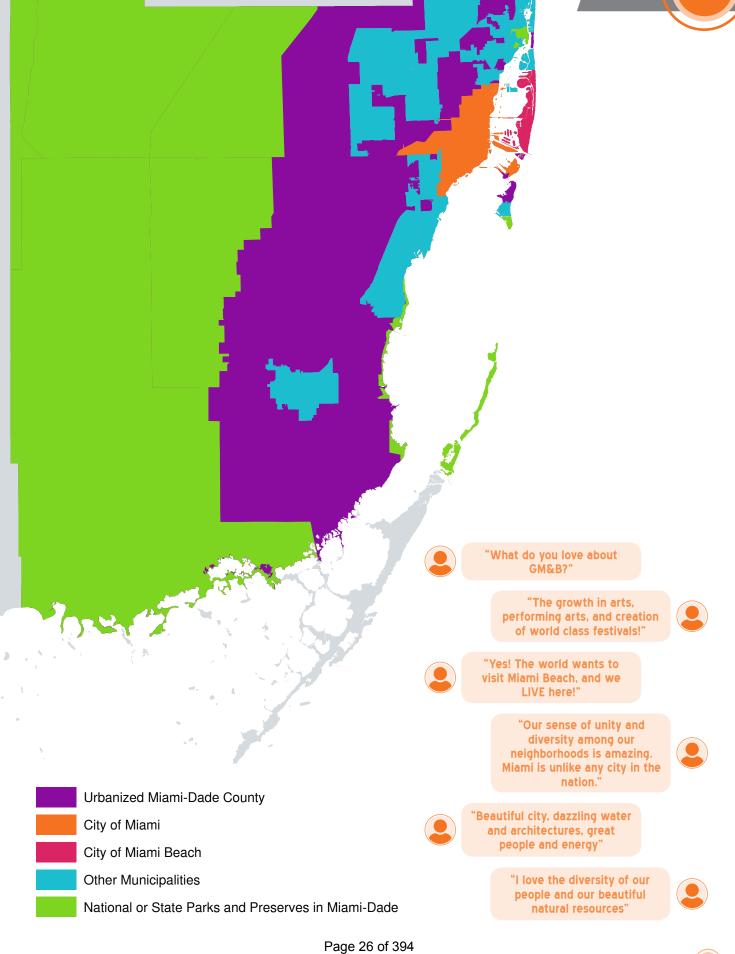


33% from Latin America 85% visit for leisure \$26 billion in expenditures in 2017

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\*Greater Miami Convention & Visitors Bureau

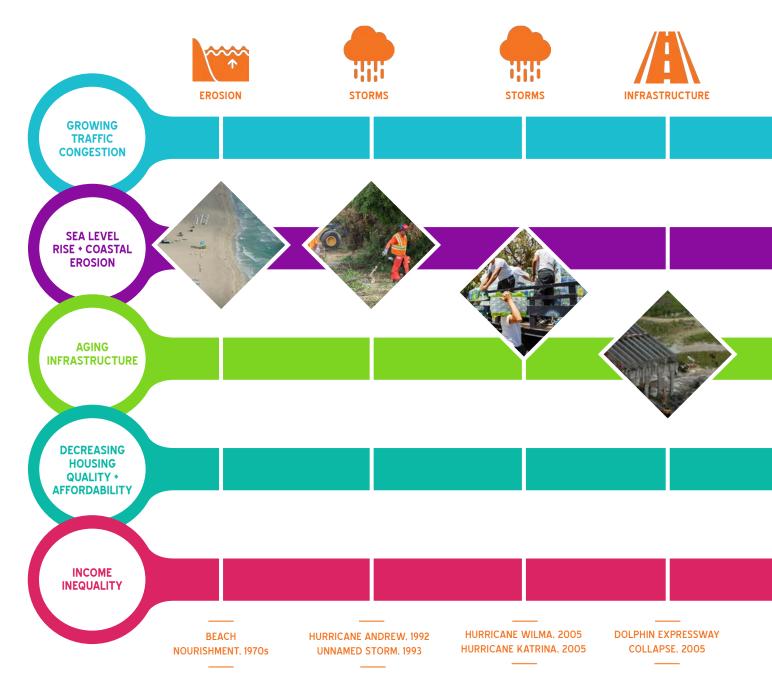






## **OUR CURRENT STRESSES AND PAST SHOCKS**

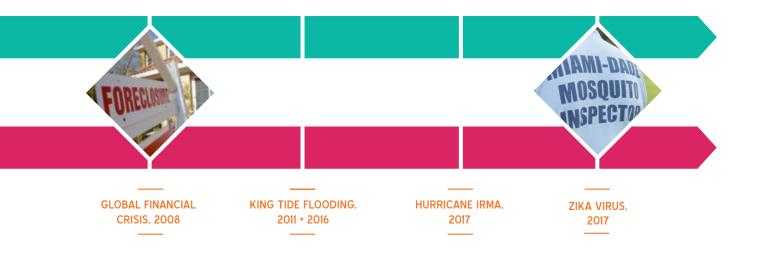
As with many communities, GM&B's challenges have brought additional underlying issues to surface. Unforeseeable circumstances and their consequences create opportunities for GM&B to strengthen its communities and better prepare for the next occurrence. As we grow, we learn.













In 2009, officials in South Florida lobbied for a federal climate policy in Washington, D.C., and quickly discovered they didn't have enough clout as a single entity for their requests to be prioritized. Officials needed to speak as a region to have more impact. Leaders from Palm Beach, Broward, Miami-Dade, and Monroe Counties formed a voluntary and collaborative partnership called the Southeast Florida Regional Climate Change Compact to work on issues such as rising temperatures, increased storm activity, and sea level rise that clearly cross municipal boundaries. The Compact's initial work was to develop and agree to consistent sea level rise projections, a regional vulnerability assessment, and the region's first greenhouse gas inventory. As the efforts of the Compact expanded, this innovative form of collaboration has become a model for regions around the nation and internationally. As a result, GM&B is leveraging the Compact and seeking to replicate the approach to engage GM&B municipalities in the GM&B region to address shared problems, advance shared priorities, and provide technical assistance. In 2018, Miami-Dade County hosted the Southeast Florida Regional Climate Leadership Summit with a record attendance of more than 700 participants.

Sunny day or nuisance flooding during high tides is now a regular occurrence in parts of GM&B due to the elevation and the geology of the region, disrupting daily life and causing economic impacts to residents and businesses alike. This is only going to get worse as sea levels continue to rise. GM&B is seen as an early actor in adapting to sea level rise, such as through raising roads in Miami Beach.

## OUR HISTORY OF HURRICANES HAS TAUGHT US TO PREPARE BETTER, RESPOND QUICKER, AND RECOVER SMARTER.

In 1992, Hurricane Andrew hit Miami-Dade County with devastating impact, destroying homes and businesses. This Category 5 hurricane left Miami-Dade County with 175,000 people homeless and 1.4 million people without power in a very hot and humid climate. As a result, Miami-Dade County and its municipal partners developed a unified emergency response network and collaborated to develop one of the strongest building codes in the nation. After Hurricane Andrew, Miami-Dade County also founded the Homeless Trust, which today is one of the nation's most successful systems for ending homelessness. In 2018, Miami-Dade County saw an 8 percent reduction in homelessness.

In 2005, two hurricanes hit our region within a 2-month span, causing \$2.9 billion in damages. The Federal Emergency Management Agency (FEMA) issued disaster declarations and response teams were deployed from all over the country to support our emergency operations and disaster clean-up after Hurricane Katrina. Meanwhile, we were simultaneously preparing for our next storm. Hurricane Wilma, which produced a 6-foot storm surge in some areas of Miami-Dade County and caused over 98 percent of our residents to lose power for weeks. As a result, gas stations and larger grocery stores are now required to have back up power and fuel on site. In 2017, Hurricane Irma forced evacuations for the first time in over a decade. The debris from the hurricane's aftermath took months to clean-up. As a result of our experience in coping with the aftermath of hurricanes, GM&B municipalities in the GM&B region have begun working with local organizations to have clean-up crews in place prior to an anticipated severe weather event. In addition, local nonprofits have a renewed interest in building disaster awareness and preparedness at the community level.

OUR STORY



GM&B municipalities have signed the Mayor's Climate Action Pledge 53,000 number of homes located less than 3 feet above high tide



Amount sea level has risen since 1992



**5 inches** additional amount sea level is expected to rise in Southeast Florida by 2030



\$2.9 billion in damages in 2005 **31,246** Citizen Corps Volunteers in



FEMA damage estimates Miami-Dade County Operated 43 evacuation centers; (2) 20

medical management facilities during Hurricane Irma

\$467,371,000 in 2017 (Hurricane Irma)

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## OUR GROWING POPULATION HAS TAUGHT US THE IMPORTANCE OF BETTER MOBILITY OPTIONS.

Over the last 50 years, we have continued to experience development growth and population influx, leading to increasingly congested roadways. According to the Florida Department of Transportation (FDOT), in 2018, commuters averaged 60-minute daily commute times. In an effort to reduce travel costs and congestion, the Transportation Planning Organization (TPO) prioritized rapid transit and transit supportive projects for GM&B. Ongoing efforts include the SMART Plan's six major transit corridors, a drive to support Transit-Oriented Development as well as making grid-based route adjustments, and implementation of an Advanced Traffic Management System to increase reliability and reduce travel time for 80 percent of bus riders. In addition to TPO initiatives, several GM&B municipalities within the GM&B region, including the City of Miami and City of Miami Beach, operate trolley systems without fares to encourage ridership. In partnership with the South Florida Regional Planning Council (SFRPC) and South Florida Regional Transportation Authority (RTA). GM&B is aiming to reduce dependence on privately owned vehicles from its current 97 percent to 65 percent over the next 50 years.

## OUR EXPERIENCE WITH HIGH RATES OF PROPERTY FORECLOSURES HAS TAUGHT US TO BETTER DIVERSIFY OUR ECONOMY AND REVENUE SOURCES.

Miami-Dade County was severely affected in 2007 by the mortgage crisis with more than 79.000 residential foreclosures, resulting in aggregate residential loss of value from \$258 billion in 2008 to \$157 billion in 2012. The largest source of revenue for GM&B municipalities is property taxes, which declined by 27 percent. This decline resulted in the elimination of discretionary reserves and a loss of funding for many community-based organizations. In 2012, the Miami-Dade Beacon Council, the economic development agency for Miami-Dade County, updated its long-term economic development strategy, One Community One Goal. This effort involved public, private and nonprofit organizations in developing and implementing a strategy to diversify our industry base and retain local talent. In 2018, the County welcomed more than \$402 million in new capital investments.







average commute time 30 mins quicker than by car

of transit riders use buses



peak ridership over 9.5 million

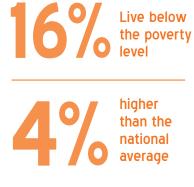
**Public buses** peak ridership over 7 million everv

Metrorail

month

people ride

"The County has implemented Employ Miami-Dade a program that reaches out to unemployed residents to train and prepare them for job placement in GM&B." MAYOR GIMENEZ. MIAMI-DADE COUNTY





lower than the national average

267.544 people earn \$25,000

59% s

Live above the poverty level but struggle to meet basic needs

## OUR DIVERSE, FOREIGN-BORN POPULATION HAS TAUGHT US TO EXPAND OUR COMMUNITY ACTION AND SOCIAL JUSTICE EFFORTS.

Approximately 500.000 Cubans. most of them business people and professionals, arrived in Miami during a 15-year period after the Cuban Revolution in 1959. In 1980, the Mariel boatlift allowed as many as 125,000 Cubans to emigrate to Florida in search of both political freedom and economic opportunities. Much of the population settled in the GM&B region, forever changing the cultural and demographic flavor of the area. Since then, both our federal and local governments have continued to enact Temporary Protected Status (TPS) to welcome persons from places who leave their countries due to extreme environmental, political, and/or economic impacts that compromise their livelihoods. An example includes Haitians impacted by the 3.2 magnitude earthquake of 2010, which severely crippled their country. Climate change may increase that flow.

As new residents assimilate, make the GM&B their home, and participate in our communities as tax paying residents, the needs of an influx of new people can also stress our social services networks. These networks have been assisted by community-based organizations that have historically been reliant on local, state, and federal government funding. However, in recent years funding sources have broadened to include more private partnerships. Community-based organizations have also begun collaborating to avoid duplication of services and to develop more creative, solution-based approaches for our diverse and culturally significant populations, which today generate an estimated \$1.43 billion in annual economic activity.

## OUR OVERWHELMED CRIMINAL JUSTICE SYSTEM HAS TAUGHT US THE VALUE OF SOCIAL SERVICES AS PUBLIC HEALTH INTERVENTIONS.

The Miami-Dade County jail currently serves as the largest psychiatric institution in Florida and contains nearly as many beds serving inmates with mental illnesses as all state civil and forensic mental health facilities combined. GM&B's high percentage of people with serious mental illnesses combined with its relatively low level of funding for treatment programs has led to arrest and incarceration of mentally ill individuals for criminal offenses that are directly related to psychiatric symptoms or life circumstances (e.g. homelessness, addiction, poverty). On any given day, the jail houses approximately 2,400 individuals receiving psychotherapeutic medications, and costs taxpayers roughly \$180 million annually or \$500,000 per day.

The response to this challenge has been multisectoral and multijurisdictional. 35 different police departments have Crisis Intervention Teams (CIT) which are comprised of police officers trained to recognize and respond to individuals experiencing psychiatric emergencies, and to assist them in accessing services, in lieu of arrest, when appropriate. If individuals are arrested, there are post-booking mental health jail diversion programs that seek to divert nonviolent offenders with serious mental illnesses away from the criminal justice system into comprehensive community-based treatment and support services. A new mental health diversion facility is currently being built to serve and house these mentally ill individuals who need psychiatric services but are currently homeless and/or being handled by the criminal justice system. There are also interventions beyond the criminal justice system like the Lazarus Project, launched in 2014, which brings direct outreach to chronically homeless individuals living on the streets, with the goal of eventually moving individuals into permanent housing. Social services and programming are also being used as interventions for other public health threats, like youth violence via the Together for Children initiative.

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OUR STORY

OUR STORY



VENEZUELAN, HONDURAN, HAITIAN, RUSSIAN RESIDENT POPULATION IS ON THE RISE

# in annual local revenue

"The vibrancy of our extraordinary cultural life is why we are considered to be an international hub for a creative workforce and the place to be for economic innovation and cultural diversity."

ADOLFO HENRIQUES, FORMER CHAIRMAN OF MIAMI-DADE CULTURAL AFFAIRS COUNCIL





**16 million** annual attendees (a) cultural events

**27%** attendees from GM&B

15,0000 people in need of mental health treatment are arrested each year in Miami-Dade County, primarily for misdemeanors and low-level felonies Florida is 9th

in the nation for prevalence of mental illness

There are roughly 5,950 CIT trained officers who respond to 16,000 crisis calls per year





prisoners receiving psychotherapeutic medication which costs taxpayers

**\$180** 

Roughly 9.1% of Miami-Dade residents experience serious mental illness



## PARTNERSHIP ACHIEVEMENTS

When Miami-Dade County, the City of Miami, and the City of Miami Beach came together to form the Resilient GM&B partnership, Miami-Dade County and Miami Beach already had established Chief Resilience Officer positions and resilience priorities. With the support of 100RC, the City of Miami Beach created the CRO position and an Office of Resilience, and the three entities initiated a joint strategic planning process for long-term resilience. Through the Resilient305 Strategy development process this unique partnership has allowed for GM&B partners to collaborate and leverage their existing resources resulting in valuable achievements. Some examples include:

METROLAB AGREEMENT: Together GM&B partners and three local universities signed a City + University Collaborative called the Metrolab Network. This collaborative is a mutually beneficial relationship that drives urban innovation partnerships between these universities and GM&B municipalities to research, develop, and deploy technology-enabled solutions that can help address the community's most pressing challenges.

BUSINESS CASE ANALYSIS PARTNER ACCESS: The City of Miami Beach's Business Case Analysis contract allows GM&B partners to develop task orders and hire selected consultants to perform work outlined in the Business Case Analysis contract without having to perform traditional procurement procedures allowing for expedited workflow.

#### **URBAN LAND INSTITUTE STORMWATER RECOMMENDATIONS:**

100RC funded an Urban Land Institute (ULI) panel that resulted in a series of recommendations specific for the City of Miami Beach's stormwater program which are applicable to many of GM&B's coastal communities and in many cases, are in the early stages of application amongst GM&B partners.

**RECOVERY RESOURCES:** To evaluate post disaster response and recovery, GM&B developed three resources for use by additional governments and organizations:

The Rapid Response Essentials toolkit strengthens intergovernmental coordination for post-disaster operations by providing guidance that supports improved analysis and evaluation of capabilities to recover and bounce forward after a disaster. The toolkit aligns with Miami-Dade County's Post Disaster Redevelopment Plan (PDRP) and Comprehensive Emergency Management Plan.

- The 5-Step Guide to Innovative Disaster Recovery Finance incorporates lessons learned from past storms with traditional insurance and FEMA funding into a financial preparedness resource for GM&B municipalities.
- The Resilient Land Use Essentials Guide is a resource for GM&B municipalities and land owners that facilitates planning for recovery from disasters caused by climate-induced flooding and sea level rise.

ZIKA ERADICATION: The Zika virus was successfully eradicated in 2017 when GM&B worked together with the state, federal, and community partners to proactively address the zika virus.

AIDS DRUG ASSISTANCE PROGRAM: Due to an introduction by GM&B, the Aids Drug Assistance Program partnered with the Infectious Disease Elimination Act (IDEA) Exchange to improve access to medication for mutual, low income patients.

ADVANCING CITIES: Leveraging GM&B's 100RC work. JPMorgan Chase awarded a \$3 million dollar AdvancingCities Grant to The Miami Foundation in partnership with the City of Miami to address workforce development and small business expansion needs and opportunities.

A STORY MAP TO UNDERSTAND MOBILITY: A Story Map of current transit, transportation and land use types was developed as a communication tool to understand mobility and development prioritization. As a result of the story map, an ArcGIS Hub was purchased by Miami-Dade County during strategy development to enhance intergovernmental data sharing and transparency.

CITY WATER RESILIENCE APPROACH: A "one water" approach to tackling water specific issues was developed and adopted as a more resilient and holistic approach to managing water resources. This process allowed Miami-Dade County's Water and Sewer Department to work more closely with Miami-Dade County's Office of Resilience, GM&B municipalities, and regional organizations.

ACCELERATOR PROJECTS: Four projects were put through an intensive three-day development ('accelerator') process led by Colombia University and 100RC. The process was so successful that GM&B is committing to undertake future accelerator projects.









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## **100RC Network in Action**

When cities join the 100RC network they are given access to many resources, including its Cities Network. The 100RC network has allowed GM&B to connect with Chief Resilience Officers (CROs) in other 100RC cities throughout the world who share similar challenges, offering both inspiration and support. This snapshot of collaboration and shared priorities from across the 100RC Network shows some of the many collaborative achievements throughout this process.

#### SAN FRANCISCO, CA

In 2016, San Francisco developed a sea level rise action plan which defined a set of goals and principles for sea level rise planning and established a framework for further assessment. adaptation planning, and implementation of identified initiatives.

#### LOS ANGELES, CA

To support the implementation of its resilience strategy, Los Angeles is appointing and training **Departmental Chief Resilience** Officers across the municipal organization who are tasked with integrating resilience priorities across City operations, programs, and policies.

#### NORFOLK, VA

GM&B turned to the CRO of Norfolk, VA for her experience working with the U.S. Army Corps of Engineers on a Coastal Storm **Risk Management Feasibility Study,** which helped inform a similar USACE partnership now underway in GM&B to identify coastal flood protections along Biscayne Bay.

#### ATLANTA, GA

Through the Atlanta Beltline Equitable Development Plan, Atlanta is working to advance housing affordability, sustainable design, community health, and equitable access to greenspace through the development of the Atlanta Beltline, a 22-mile transit loop and trail network.

SAN FRANCISCO

LOS ANGELES



BOULDER

DALLAS

MEXICO CITY

NEW ORLEANS

PITTSBURGH



**GLASGOW, UNITED KINGDOM** 

In its resilience strategy, Glasgow

identified an opportunity to work

with businesses - ranging in size

companies - to ensure that they

have the necessary resources to be

resilient and adaptable to changing

from start-ups to mature

economic conditions.

SANTIAGO DE LOS CABALLEROS

MEDELLÍN . CALI QUITO •

SANTIAGO

#### CALI, COLOMBIA

In Cali, the Territories of Inclusion and Opportunities program (TIO, which also means "uncle" in Spanish) is bringing together the entities involved in violence prevention to design and pilot effective government initiatives to reduce violence.

HONOLULU

#### **QUITO, ECUADOR**

Through neighborhood risk management committees, Quito is developing networks of young volunteers who are ready to respond to a variety of natural hazards to ensure the most vulnerable residents in their communities are kept safe

#### prevention and response, training builders in seismic retrofits, and installing early-warning communication networks.

MEDELLÍN, COLOMBIA

Medellín is taking a multi-pronged

approach to mitigating natural hazard risks in its neighborhoods,

including training local risk

management committees on

#### **RIO DE JANEIRO, BRAZIL**

During the summer of 2016, GM&B and Rio de Janeiro shared best practices for tackling the public health threat of the Zika virus. Having both experienced the shock of Zika, they exchanged approaches for limiting its spread, such as neighborhood inspections for mosquito breeding grounds. Page 37 of 394 BUENOS AIRES

OUR STORY

# Contraction of the second

GLASGOW

HULL

BARCELONA

BELLAGIO

GREATER MANCHESTER

#### BOULDER

Realizing the Resilience Dividend Workshop GM&B CROs and Budget Directors participated in the October 2017 "Realizing the Resilience Dividend" workshop where they exchanged best practices on advancing resilience through public finance, municipal budgeting, and capital improvement planning with other US cities

CITIES: BOULDER, DALLAS, HONOLULU, MINNEAPOLIS, NEW ORLEANS, NORFOLK, PITTSBURGH, SAN FRANCISCO



#### LONDON/BELLAGIO

**City Water Resilience Approach** 

Through the 100RC Network, GM&B joined Amman, Jordan; Cape Town, South Africa; Hull, United Kingdom; and Mexico City, Mexico in developing and piloting a City Water Resilience Approach to enhance water security and protect against water-related shocks and stresses through a holistic evaluation of water resources and management practices

CITIES: AMMAN, CAPE TOWN, HULL, MEXICO CITY



JAKARTA

#### SANTIAGO DE CHILE

Building Resilience at the Metropolitan Scale In December 2017, the GM&B team joined other 100RC member cities in Santiago de Chile to share experiences, tools and, tactics that build resilience at a metropolitan scale through regional, inter-governmental partnerships and collaboration

CITIES: BARCELONA, BUENOS AIRES, GREATER MANCHESTER, JAKARTA, PARIS, SANTIAGO DE CHILE, SANTIAGO DE LOS CABALLEROS, SYDNEY

SYDNEY
 MELBOURNE

CAPE TOWN

#### MELBOURNE, AUSTRALIA

Metropolitan Melbourne is developing a resilience training program for local government employees across the region to equip them with the knowledge and resources to incorporate resilience into their day-to-day responsibilities, which include implementing policies intended to address shocks and stresses, often with limeage.38e.0f 394



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Agenda Setting Workshop





Preliminary Resilience Assessment



## SUMMER 2017—SUMMER 2018 We Discovered

- 175 Participant Phase II Kick-Off
- 6 Discovery (Focus) Areas
- 34 Discovery Area Meetings
- 245 Participant Subject Matter Input
- 9 GM&B Collaboration Events

## FALL 2016 We Listened + We Learned

- 70% of 34 GM&B municipalities and the County Interviewed
- 200 Participant Agenda Setting Workshop
- 2,031 Resilience Priority Survey Responses
- 118 Participant Subject Specific Meeting
- 491 Participant Interactive Focus Group
- 403 Focus Area Survey Responses

32

• 5 100RC Network Collaboration Events

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OUR STORY

## RESILIENT305 PROCESS

GM&B's Resilient305 Strategy development process has been an extensive multi-year effort. GM&B has worked closely with 100RC through two phases, with a third— implementation—still to come. Through the first phase GM&B reviewed and analyzed its resilience challenges alongside multiple partners, culminating in a preliminary resilience assessment. The second phase gave GM&B the opportunity to review priority resilience areas in more detail in order to establish realistic actions.

Throughout this process GM&B has engaged thousands of stakeholders that reflect a wide range of expertise, ages, ethnicities, cultures, income levels and geographic areas to help shape the Resilient305 Strategy. This inclusive process allowed GM&B to work with residents and subject matter experts through community meetings, surveys and focus groups. As a result of this dialogue, GM&B has developed a communications plan and engagement toolkit for the implementation phase of the Resilient305 Strategy.

As phase three begins, GM&B recognizes that implementing each of the actions within the Resilient305 Strategy will require a dedicated effort from a team that we call Progress, Innovation, and Vision for Our Tomorrow (PIVOT). The PIVOT team will oversee the prioritizing, implementation, and monitoring of progress on the Strategy. More information on PIVOT and how we are putting the plans to work can be found in the section called "Implementation."



GM&B Resilient305 Strategy



## SPRING 2019 We Implement

 Work with our municipal partners, community organizations, universities and residents to implement the Resilient305 Strategy and build on the Resilient305 movement.



## **RESILIENT305 VISION**

GM&B has organized the Resilient305 Strategy into three goal areas.

PLACES aims to address place-based challenges by:

- Enhancing climate resilience through design and planning;
- Creating, connecting, and improving mobility and housing options; and
- Safeguarding ecosystems.

PEOPLE aims to improve the lives of our residents everyday by:

- Supporting job and wealth creation;
- Addressing specific health needs for the most vulnerable; and
- Preparing and empowering neighborhoods to anticipate and respond to disruptions.

PATHWAYS aims to enhance collaboration and committed leadership by:

- Setting common and equitable goals;
- Developing shared resources; and
- Working with our neighbors to succeed across boundaries.

Each of the three goals of People, Places, and Pathways, has objectives that help organize actions within the goals. Many of the actions have case studies and spotlights that accompany a specific action to spotlight project examples and action leaders separate of the GM&B partnership.

The actions build on existing efforts or address program and policy gaps to further resilience in the GM&B region.

# **PLACE**

## **OBJECTIVES**

- Enhance Natural Systems
- Safeguard Urban Systems
- Create Mobility Options
- Increase Energy Efficiencies
- Enhance Housing Options



# **PEOPLE**

## **OBJECTIVES**

- Cultivate Financial Stability
- Advance Public Health Priorities
- Strengthen Community Response
- Communicate the Concept of Resilience

## **OBJECTIVES**

- Pre-plan for Post Recovery
- Cultivate Resilience Expertise

OUR STORY

PATHWAY

- Leverage our Experience
- Develop Shared Resources
- Leverage our Dollars





## HOW TO READ THE ACTIONS

OUR STORY

## **OBJECTIVE** —

Steps that GM&B plans to take to tackle each goal.

## ACTION —

Specific policies or programs that GM&B and its partners will deploy to help achieve resilience goals.

## **PERFORMANCE METRICS** -

How we will track performance over time.

## **COLLABORATORS** –

Key public, private, nonprofit, and civic collaborators that will implement Resilient305 actions in the years ahead. Partnership is not exclusive and is meant to be a starting point.

## **FUNDING** –

Identifies whether the action is funded, partially funded or unfunded, identifying sources where possible.

# $\bigcirc$

#### OBJECTIVE: CREATE MOBILITY OPTIONS

## **HOW THIS WILL HELP US**

- Improves air quality
- Reduces greenhouse gas emissions
- Streamlines government processes
- Improves financial planning

## **OPERFORMANCE METRICS**

- Number of GM&B municipalities requiring EV infrastructure in building code
- Number of EVs in municipal fleets
- Number of EV chargers countywide
- Tons of greenhouse gas emissions from private cars
- Number of registered EVs

## **DKEY COLLABORATORS**

LEAD: Miami-Dade County

- Miami-Dade County
- GM&B municipalities

## FUNDING

36

Partially funded by Electrify America.



ACTION:

**IT'S ELECTRIC** 

### DESCRIPTION

Since 2013, electric vehicle (EV) ownership in Miami-Dade County has 450percent. After California, Florida leads the country in number of revehicles; by 2030, Florida is expected to reach 30 percent market pen prepare for and catalyze the growth of the EV market, GM&B will ena that support development of EV infrastructure (like chargers), seek op introduce EVs into municipal fleets, and engage in knowledge sharing practices and a unified network.

One perceived barrier to greater deployment and use of EVs is an inac of publicly available chargers. GM&B partners will pass legislation to r capability in newly built parking structures to set the foundation for E growth. Additionally, GM&B municipalities with existing EV policies an their experiences and best practices with other GM&B municipalities concerns and issues. Collective commitment and investment is neede an EV transition that will not only significantly reduce vehicle emissio governments and residents operations costs.









increased by egistered electric etration. To ct policies portunities to to create best

dequate network equire EV charger V infrastructure d fleets will share to reduce potential d to facilitate ns but also save

## CASE STUDY ELECTRIFYING THE FLEET

In 2015, the City of Coral Gables began drafting its 10-year Sustainability Management Plan to provide a framework on creating a more sustainable and resilient community. One of the goals established in the plan was to reduce gasoline and diesel fuel use 20 percent below 2013 levels by 2025. One way the City has focused on achieving this goal is integrating EVs into its City fleet. The City established an FY 2021 goal of 78 EVs, which represents 60 percent of their administrative fleet. The City purchases these EVs via a statewide procurement contract and has supported the fleet by installing dedicated EV support equipment at its maintenance facility, City Hall parking lot, and municipal parking garages. In 2015, the City began purchasing EVs and currently has a total of 43 EVs in its fleet, making it one of the largest government EV fleets in Florida. The City has been able to fund this through its annual vehicle replacement budget. The installation of 22 charging stations, with a goal of expanding to 43 by 2021, has enabled and inspired the community to start transitioning away from traditional gasoline powered vehicles.



Photo Credit: City of Coral Gables

AMI AND THE BEACHES

RESILIENT GREATER MIAMI AND THE BEACHES

37

A strength of the Greater Miami & the Beaches (GM&B) region is the diversity of our urban areas set next to uniquely beautiful and ecologically valuable natural areas, from the Everglades to Biscayne Bay to the ocean reefs beyond. Although our urban centers are booming, many of our residents' struggle: the high cost of housing takes its toll as does transportation. Our burgeoning population, with its associated car ownership, can make journeys to work long and tiresome. Today those same features are vulnerable to tropical hurricanes and rising seas. While our natural environment is one of our greatest assets, it is at risk and changing, requiring our collective efforts to protect and adapt along with it.

Through our "Places" actions, we aim to address these place-based challenges, enhancing our climate resilience through design and planning for the future; creating, connecting, and improving mobility and housing options; and safeguarding our ecosystems.

## WHO IS WHO?

THE PARTNERSHIP Greater Miami & the Beaches (GM&B)

THE SUPPORTING ORGANIZATION 100 Resilient Cities (100RC)

THE STRATEGY Resilient305

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THE IMPLEMENTING TEAM PIVOT (Progress Innovation Vision for Our Tomorrow)





## **Objective 1**

## **Enhance Natural Systems**



on 1	Preserve and Restore Biscayne Bay
n 2	Build Reef Biodiversity and Defenses
on 3	Bolster Our Beaches
n 4	Expand Nature-Based Infrastructure
n 5	Integrate Resilience into Parks and Open
	Spaces

## **Objective 2**

## Safeguard Urban Systems



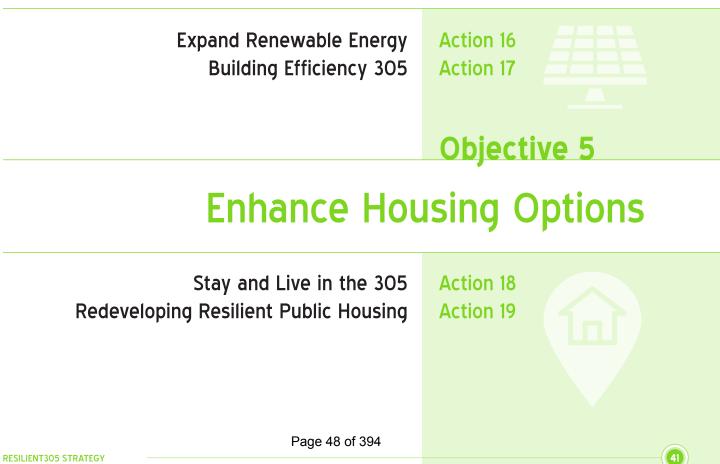
## **Objective 3**

## **Create Mobility Options**

Develop Mobility Hubs in the 305 Design a Better Bus Network Drive into the Future It's Electric Action 12 Action 13 Action 14 Action 15

## **Objective 4**

## **Increase Energy Efficiencies**





## OBJECTIVE 1: ENHANCE NATURAL SYSTEMS

## ACTION 1: PRESERVE AND RESTORE BISCAYNE BAY

## HOW THIS WILL HELP US

- Improves water quality
- Restores coastal ecology
- Attracts state and federal funding
- Creates natural habitat

## PERFORMANCE METRICS

- Number of Biscayne Bay Restoration Action Plan recommendations implemented
- Number of agencies with active representation in the peer-to-peer network
- Water quality (as measured by Miami Dade County)

## **KEY COLLABORATORS**

LEAD: Miami-Dade County

- GM&B municipalities
- Local universities
- Biscayne Bay interest groups (nongovernmental organizations, clubs, and business and professional organizations)

## FUNDING

42

Funded within resources existing in participating entities



## TIMEFRAME: IMMEDIATE (0-1 YEAR)

## **DESCRIPTION**

Miami-Dade County is internationally recognized for its waters, being home to Biscayne Bay, a National Marine Sanctuary, numerous State of Florida aquatic preserves, and several water conservation areas. The Biscayne Bay wetlands project is a key coastal feature in the Comprehensive Everglades Restoration Plan (CERP). To establish a framework for coordinating and collaborating among Biscayne Bay stakeholders—county, municipal and state agencies; academia; interest groups; and the general public—two parallel partnerships will be formed: (1) the Biscayne Bay Task Force, and (2) a peer-topeer network of natural resources managers.

The Biscayne Bay Task Force will be composed of interdisciplinary and interagency members residing in GM&B, who are nominated and chosen by the Miami-Dade Board of County Commissioners. Its overall purpose will be to advise the Board of County Commissioners on issues related to the long-term preservation and restoration of Biscayne Bay water quality and habitat. The Task Force will prepare a Biscayne Bay Restoration Action Plan for the Commissioners that will identify problem areas, prioritize projects for Biscayne Bay, and provide recommendations for state and federal legislation, activities, and appropriations.

The peer-to-peer network of natural resource managers will be created from local GM&B municipalities, Miami-Dade County, and other governmental agencies across GM&B responsible for environmental initiatives throughout the Biscayne Bay watershed. The purpose of the network is to strengthen relationships and improve communication among natural resource practitioners, build capacity across the region, and coordinate efforts related to Biscayne Bay management that accelerate action and maximize impact. The network will share best practices and align multi-jurisdictional projects related to Biscayne Bay restoration at quarterly round table meetings. Additionally, the network will create a database that includes governmental natural resource managers from the area.

## ACTION 2: BUILD REEF BIODIVERSITY AND DEFENSES

OBJECTIVE 1: ENHANCE NATURAL SYSTEMS





## TIMEFRAME: IMMEDIATE (0-1 YEAR)

## DESCRIPTION

The only barrier reef in the continental United States, the Florida Reef tract is the thirdlongest coral barrier reef in the world, stretching 200 miles along the Atlantic Coast of South Florida. Its coral reefs are biodiversity hotspots. While these reefs cover only a small fraction of the ocean floor, they provide habitat for 25 percent of the world's fish species. These coral reefs adjacent to GM&B warrant further protection and enhanced restoration as part of Resilient305. Miami-Dade County, which is responsible for managing its Artificial Reef Program, will collaborate with the Southeast Florida Coral Reef Initiative, local academic institutions, and coastal GM&B municipalities on continued implementation and in identifying opportunities for expanding this important program. Using leading science and proven intervention strategies, the Artificial Reef Program will seek to further enhance nearshore recreational benefits, provide additional habitat structure, and look for opportunities to further reduce storm-related coastal impacts. In conjunction with its ongoing beach nourishment program, Miami-Dade County will perform coastal modeling to determine the feasibility of using structures, such as submerged artificial reef material, to promote greater coastal habitat and shoreline resilience.

Reefs are a \$6.3 billion Florida economic driver supporting more than 70,000 local jobs. The health of the Florida Reef tract, which serves as a coastal buffer from wave energy and storm surge (Florida Department of Environmental Protection), has been declining sharply. In some areas, the state's coral species have declined by more than 90 percent and some species have lost more than 97 percent of their populations (Mote Marine Lab). Currently, coral reef disease across the southeast coastal counties has impacted 20 of the 45 species found in Miami-Dade County.

## HOW THIS WILL HELP US

- Protects against storm-related impacts
- Creates natural habitat
- Stimulates economic growth
- Restores coastal ecology
- Provides recreational opportunities

## PERFORMANCE METRICS

- Updated reef master plan
- Artificial reef structure area (square feet or number)
- Reef health (e.g., fish diversity, coral diversity)

## **KEY COLLABORATORS**

LEAD: Miami-Dade County

- U.S. Army Corps of Engineers
- National Oceanic and Atmospheric Administration
- Florida Department of Environmental Protection
- Florida Fish and Wildlife Conservation Commission
- Coastal GM&B municipalities

## FUNDING

Partially funded with existing program resources of collaborators



## OBJECTIVE 1: ENHANCE NATURAL SYSTEMS

## ACTION 3: BOLSTER OUR BEACHES

## HOW THIS WILL HELP US

- Protects against storm-related impacts
- Creates natural habitat
- Improves recreational opportunities
- Stimulates economic growth
- Restores coastal ecology

## **PERFORMANCE METRICS**

- Completed comprehensive beach management plan
- Number of regulatory permits for nourishment
- Dollar value of funding sources identified
- Platform for intergovernmental coordination created

## **KEY COLLABORATORS**

LEAD: Miami-Dade County

- U.S. Army Corps of Engineers
- Florida Department of Environmental Protection
- Municipal coastal partners: City of Miami Beach, Surfside, Bal Harbour, Sunny Isles, Key Biscayne
- Other municipal, state, and federal agency partners; private-sector partners

## **FUNDING**

Partially funded by U.S. Army Corps of Engineers



## TIMEFRAME: SHORT-TERM (1-5 YEARS)

## **DESCRIPTION**

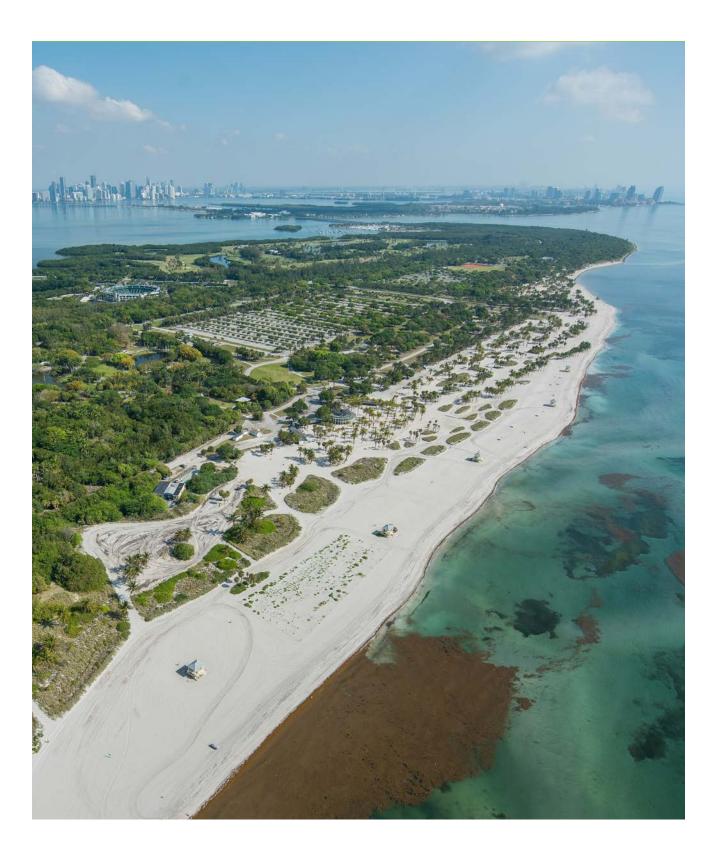
Beach nourishment provides essential economic, environmental, and recreational benefits to coastal communities. As the local sponsor for state and federal beach nourishment projects. Miami-Dade County manages its beaches, which are a vital buffer between coastal infrastructure and the impacts of wave action and surge during storm events. Miami-Dade County's beaches are the very foundation of its tourism economy. In 2016, visitors to the GM&B region identified the beaches as the area's best feature, and 77.5 percent of those tourists went to the beach (Greater Miami Convention & Visitor's Bureau, 2017). For every \$1 that the federal government spends on beach nourishment, it receives \$810 in tax revenue from tourists. Miami-Dade County will partner with U.S. Army Corps of Engineers and collaborate with coastal cities to develop a comprehensive beach management plan that supports coastal sustainability and protection.

The current 50-year federal authorizations for the Dade County Beach Erosion & Hurricane Protection Project (the Project) are set to expire in 2025 and 2038, respectively. Over the course of the next 2 years. Miami-Dade County, the City of Miami Beach, and other coastal barrier island GM&B municipalities will work with U.S. Army Corps of Engineers on a \$3 million feasibility study to prepare for reauthorization of the Project and the next 50 years of beach management. The feasibility study and future beach master plans by Miami-Dade County will provide further analysis and insight on domestic and non-domestic sand sources, and structural and non-structural solutions. The study will focus on identifying proactive strategies that help stabilize coastal beaches and minimize erosion to maximize investment. Miami-Dade County will seek to identify a dedicated funding source, a top priority for coastal municipal mayors, and blanket permits for GM&B municipalities to be more nimble as erosional hotspots arise.

U.S. Army Corps of Engineers has allocated \$158 million for beach nourishment for Project construction over the next 5 years, but Miami-Dade County will need to collaborate with coastal GM&B municipalities on identifying funding to continue implementing the beach management program over the next 50 years.

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## OBJECTIVE 1: ENHANCE NATURAL SYSTEMS

## ACTION 4: EXPAND NATURE-BASED INFRASTRUCTURE

## HOW THIS WILL HELP US

- Reduces sea level rise and coastal flooding impacts
- Restores coastal ecology
- Restores natural habitat
- Increases understanding of resilience

## **PERFORMANCE METRICS**

- Number of prioritized projects completed
- Ecosystem services benefits identified and tracked per project

## **KEY COLLABORATORS**

LEAD: Miami-Dade County

- Coastal GM&B municipalities
- The Nature Conservancy
- Florida Department of Transportation

## **FUNDING**

Partially funded by managing organizations

## TIMEFRAME: SHORT-TERM (1-5 YEARS)

## DESCRIPTION

GM&B partners will collaborate with local and regional partners to implement four green. blue, and hybrid infrastructure projects identified and prioritized during the Resilient305 Strategy development phase for implementation. These projects were chosen because of the different habitat types they represent, and for their various resilience benefits, pioneering designs, regional significance, educational opportunity, and potential replicability. GM&B, with The Nature Conservancy of Florida, has prioritized these four projects to highlight primary environmental typologies in the region: 1) The South Dade Wetlands Project, supporting Everglades restoration: 2) the Indian Creek Living Shoreline Project, representing urban area wetlands habitat; 3) the Arch Creek Drainage Basin Project, representing urban area uplands habitat; and 4) the Julia Tuttle Causeway Shoreline Enhancement Project, representing Biscayne Bay habitat. Demonstrating the resilience benefits and lessons learned from these four projects will be important outcomes that will be used to inform similar future projects within GM&B and in other coastal communities.

----- SPOTLIGHT

## COLLABORATION WITH THE NATURE CONSERVANCY

The Nature Conservancy (TNC) is an important local and regional partner, providing expertise on nature-based resilience efforts, and attracting funding and additional resources to the southeast Florida region. The Florida Chapter of TNC has been engaged with the Southeast Florida Regional Climate Change Compact (Compact) since 2010, providing critical technical expertise and support for its nature-based policies and efforts, including leadership of the Compact's Regional Shoreline Resilience Workgroup. The Workgroup's products describe multiple community-engaged projects that are in development along urbanized waterways and coastal shorelines. These products provided important baseline information for GM&B's Resilient305 Strategy development phase. This inclusive engagement process will further activate the community, and to advocate for the advancement of green infrastructure across South Florida. It is anticipated that the TNC nature-based coastal resilience project funded by the Chubb Charitable Foundation, which started in late 2018, will also help inform the design and implementation of some of the four prioritized projects.



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## **CASE STUDIES**

# USING SCIENCE-BASED BENEFIT-COST ANALYSES TO OPTIMIZE FLOOD PROTECTION INFRASTRUCTURE

TNC works around the world, helping communities adapt to climate change through nature-based solutions such as restored reefs, mangroves, and wetlands that reduce the impact of storms and flooding. Starting in late 2018, with the support of the Chubb Charitable Foundation, TNC identified over a dozen potential locations in Miami-Dade County where natural and hybrid infrastructure could increase resilience to storms and rising sea levels. Science-based flood modeling and cost-benefit analyses were used to identify the optimal location where people and property could benefit most from a shoreline resilience project. The project is designed to increase flood protection and serve as a model for other parts of Miami-Dade County, other cities in the United States, and globally.

Using a science-based approach that includes cost-benefit analyses allows restoration projects to be optimized for risk reduction potential. Working with institutional investors and other private-sector partners can promote investments in natural solutions; such entities can be an important complement to local governments. Identifying key steps, including performance data on natural assets, will make investing in nature as easy as it is to invest in traditional infrastructure.



## FROST SCIENCE'S MUVE INITIATIVE ENGAGES COMMUNITY VOLUNTEERS IN RESTORING NATIVE COASTAL HABITATS

In October 2017, the Frost Museum of Science partnered with the City of Miami and Miami-Dade County, and received a \$287,000 National Fish and Wildlife Foundation Resilient Communities program grant, funded by Wells Fargo, to restore living shorelines on Virginia Key and in East Greynolds Park. This is the first of 100 coastal resilience demonstration sites within the GM&B region planned for the next 10 years. Coastal habitats are called living shorelines because native vegetation allays the impacts of sea level rise and climate change. For example, mangroves are adapted to salt water and their floating seeds can colonize new coastal areas, creating new habitat. Their stilt-like roots stabilize sand and slow down waves while keeping the plant above the water.

As part of the project, the museum will be creating an original exhibition about sea level rise with the help of its Museum Volunteers for the Environment (MUVE). MUVE's mission is to educate people about the environment while also empowering them to be proactive in protecting it. By acting together to help restore native habitats. MUVE volunteers are helping to create a more resilient metropolitan area. Since its inception in 2007, over 8,000 volunteers have restored 25 acres of living shorelines.

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## OBJECTIVE 1: ENHANCE NATURAL SYSTEMS

## ACTION 5: INTEGRATE RESILIENCE INTO PARKS AND OPEN SPACES

## HOW THIS WILL HELP US

- Creates natural habitat
- Provides recreational opportunities
- Restores coastal ecology
- Improves air quality
- Improves community cohesion

## **PERFORMANCE METRICS**

- Number of pilot projects completed
- Number of parks including flood resilience measures
- Number of parks planting new native trees and vegetation
- Number of cities adopting similar guidelines
- Number of parks seeing reduced flooding

## **KEY COLLABORATORS**

LEAD: Miami-Dade County

- South Florida Parks Coalition/GM&B municipalities
- Miami-Dade Parks Foundation
- Trust for Public Land
- The Nature Conservancy

## **FUNDING**

Partially funded through departmental budgets; grant funds and other external funds are necessary to fully implement the action



## TIMEFRAME: SHORT-TERM (1-5 YEARS)

## **DESCRIPTION**

Public parks and open spaces offer a large-scale opportunity to implement resilient design and innovative resilience measures at multiple scales simultaneously. GM&B will lead by example by using its own publicly owned park lands and open spaces to implement resilience best practices in three pilot projects over the next 5 years. Examples of resilience best practices that will be implemented include restoring living shorelines, increasing the number of park acres and open spaces, planting trees to mitigate increasing temperatures, using green infrastructure to manage stormwater, and restoring native habitat. Resilient park design simultaneously reduces physical vulnerabilities to environmental stressors such as flooding and the urban heat island effect while enhancing community health and resilience.

Using parks and open spaces as living classrooms and examples of resilient design provides a dynamic educational opportunity to the millions of visitors who use the parks each year. Innovative resilient design offers the thousands of school children who attend parks after school, summer, spring, and winter programs the chance to participate in living classrooms to learn about water resources, green infrastructure, and living shorelines, among other concepts. The parks can also serve as living laboratories for innovative resilience design and measures that lead the way for best practices such as Leadership in Energy & Environmental Design (LEED) site planning guidelines.

At a larger scale, the Miami-Dade County Parks and Open Space Master Plan, implemented through the South Florida Parks Coalition, provides community and ecosystem resilience by creating an integrated network of parks, open spaces, trails, civic spaces, and streets that are pedestrian- and bike-friendly. The parks departments of the GM&B are proactively improving this network by strategically targeting land acquisition programs to support transit corridors; transition redfields to greenfields; reduce social, economic, and health disparities; improve east-west and north-south connectivity to provide a seamless park system; and enhance ecosystem and watershed connectivity.

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## **CASE STUDIES**

# USING SCIENCE-BASED BENEFIT-COST ANALYSES TO OPTIMIZE FLOOD PROTECTION INFRASTRUCTURE

Miami-Dade County's Matheson Hammock Park is a mostly low-lying 630-acre park owned by Miami-Dade County located along the western shoreline of Biscayne Bay in the City of Coral Gables. It is one of the few publicly accessible waterfront areas in the southern portion of the County and the only one with beach access. The park floods during high tide events, which affects its normal operations and accessibility to the park; it is expected to be increasingly impacted by sea level rise.

In 2018. Miami-Dade County funded a sea level rise flood mitigation study to help determine appropriate flood mitigation measures for different areas of the park. The study used the 2015 Southeast Florida Unified Sea Level Rise Projection, prepared by the Sea Level Rise Workgroup of the Southeast Florida Regional Climate Change Compact. The study developed flood mitigation concepts for major infrastructure components within the park out to 2100. It provided a summary of existing conditions, conceptual solutions, a suggested implementation schedule for mitigation, estimated construction costs, and guidance for the planning and design phases of the mitigation concepts. Based on preliminary cost estimates, the proposed improvements are estimated to be \$50 million to \$55 million between now and 2040. The mitigation concepts developed as a part of the study will be used in Miami-Dade County's capital programming considerations for other parks.

## **RESILIENCE IN PARKS—JOSE MARTI PARK**

The City of Miami is working with the Van Alen Institute, a nonprofit organization that works to catalyze positive change in cities. on a climate adaptive design of Jose Marti Park in Little Havana. The park is located on the Miami River and is susceptible to flooding during high tides and heavy rain events due to its current layout, which limits drainage. The goal of this project is to redesign Jose Marti Park to be an adaptive waterfront park that enhances restorative recreation, preserves cultural heritage, improves access to green space and the water, provides solutions to flooding in the short term, and will adapt to sea level rise in the future. The Van Alen Institute will lead a participatory design process and is paying local members from the community to help define and support outreach for engagement activities. The park design will be enhanced by interdisciplinary expertise that incorporates green and gray infrastructure, holistic measures of success, and inclusivity. The design will also seek solutions to increase storm surge protection and rain storm drainage for the surrounding residential community. Final design solutions will be used to inform and inspire future projects at sites with similar conditions (at or near sea level, near a body of water, and subject to flooding).

## **RESILIENCE IN PARKS—500-700 ALTON ROAD PARK**

The City of Miami Beach is a geographically small and dense barrier island, with very few open spaces left for conservation or adaptation. In a rather unique move, the City Commission entered into a development agreement in 2018 with a local developer who will be creating the City's first eco-park in exchange for development incentives that include increased building height allowances. The proposed 3-acre public park, funded by the developer, will include significant and measurable resilience and sustainability components, including:

- Open green space
- Florida-friendly native and naturalized plant materials that reduce water consumption and the need for fertilizer and pesticides
- Stormwater retention capabilities
- Infrastructure for treating water going to the 6th Street outfall
- Dedicated pedestrian paths

- Proposed integration and width of the perimeter sidewalks along West Avenue and Alton
- Surface lot composed of pervious pavers (no asphalt or concrete), including all parking spaces, drive aisles, and access points from the street



## OBJECTIVE 2: SAFEGUARD URBAN SYSTEMS

## ACTION 6: REDUCE "BACK BAY" FLOODING

## HOW THIS WILL HELP US

- Protects against storm-related impacts
- Reduces sea level rise and coastal flooding impacts
- Improves natural disaster preparedness
- Improves water quality

## **PERFORMANCE METRICS**

Dollars secured for adaptation measures

## **KEY COLLABORATORS**

LEAD: U.S. Army Corps of Engineers

- Miami-Dade County
- South Florida Water Management District
- GM&B municipalities
- Southeast Florida Regional Climate Change Compact

## **FUNDING**

50

Study fully funded via a Congressional appropriation to U.S. Army Corps of Engineers



## TIMEFRAME: SHORT-TERM (1-5 YEARS)

## DESCRIPTION

Protecting the areas along Biscayne Bay—known also as the "Back Bay" —from storm surge is much more difficult than protecting the ocean facing portions of the GM&B region because the essential tools of beach nourishment and dunes do not apply to Biscayne Bay. U.S. Army Corps of Engineers is working with GM&B to identify appropriate protective measures that can reduce coastal flooding in those areas. To achieve this goal, U.S. Army Corps of Engineers has launched a 3-year, \$3 million Coastal Storm Risk Management Feasibility Study (CSRM) to explore measures such as upgrading the salinity control structures along the major canals to serve as storm surge barriers, acquisition of land in the floodplain, and/or restoration of mangroves and reefs. Ultimately, designing and constructing these measures could be eligible for partial federal funding if they are deemed technically feasible and cost effective. Reducing the risk of devastating coastal floods in the Biscayne area would benefit the entire GM&B region.

The Miami-Dade Back Bay CSRM will be coordinated with a multi-state coastal management strategy and the South Atlantic Coastal Study, also conducted by U.S. Army Corps of Engineers. The study will conduct regional analyses of coastal risk and identify initial measures/costs that can address vulnerabilities with emphasis on maintaining or enhancing current levels of coastal storm risk reduction. This study will be coordinated with the Southeast Florida Regional Climate Change Compact.







## TIMEFRAME: SHORT-TERM (1-5 YEARS)

## **DESCRIPTION**

GM&B's sea level rise strategy will identify implementable, financially feasible adaptation actions that its GM&B municipalities can use to better prepare for sea level rise and coastal storms. The Strategy will include an analysis of multiple adaptation pathways that will result in improved guidance on how to implement a flexible and adaptable path forward in the face of changing sea level conditions and the associated risks faced by communities across the GM&B region. Recommendations arising from this analysis are expected to be especially useful to local governments tackling these issues.

GM&B's sea level rise strategy will evaluate the economic cost of inaction and the cost of several alternative pathways, including a heavy reliance on gray or green infrastructure. GM&B will also identify short-term capital projects to be implemented by 2022 that will increase the area's resilience to anticipated coastal flooding. GM&B's Strategy will complement other on-going initiatives such as Miami-Dade County's development of a sea level rise checklist for all County capital projects and other larger resilience efforts as highlighted in the County's budget. The GM&B municipalities will be involved during the outreach phase of implementing the sea level rise strategy.

## HOW THIS WILL HELP US

- Reduces sea level rise and coastal flooding impacts
- Reduction in sunny day flooding
- Reduces stormwater flooding
- Replaces aging infrastructure
- Protects against storm-related impacts

## **PERFORMANCE METRICS**

- Percent of projects with funding identified
- Percent of projects implemented

## **KEY COLLABORATORS**

- LEAD: Miami-Dade County
- GM&B Municipalities

## **FUNDING**

Fully funded from Miami-Dade County's budget





# CASE STUDY

## STAKEHOLDER RESILIENCE TRAINING

Miami-Dade County provides detailed and cutting-edge skills to public and private stakeholders through training sessions that include demonstrations of online tools to help identify at-risk assets. The training focuses on how to integrate sea level rise into planning and project design as well as on broader water and energy efficiency. These popular training sessions have included:

- Geographic information systems (GIS) training cosponsored with the National Oceanic and Atmospheric Administration (NOAA) to provide technical inundation mapping skills to local government staff, students, and private consultants (attended by over 170 individuals).
- Sea level rise projections and application of those projections to existing projects (attended by 30 transportation professionals).
- Benchmarking Training workshops to develop skills in analyzing County buildings' energy and water use over time, including comparison to other facilities.

Miami-Dade County will continue to bring national and international resilience experts to the GM&B region and will work to expand outreach efforts, particularly to underresourced communities. Training offerings are expected to expand to meet demand, both in terms of attendance requests and topics that may arise in GM&B.





## OBJECTIVE 2: SAFEGUARD URBAN SYSTEMS

## ACTION 8: DEVELOP SEA LEVEL RISE CHECKLIST FOR CAPITAL PROJECTS

## HOW THIS WILL HELP US

- Reduces sea level rise and coastal flooding impacts
- Streamlines government processes
- Improves natural disaster preparedness
- Reduces stormwater flooding
- Reduction in sunny day flooding

## **PERFORMANCE METRICS**

- Number of capital projects utilizing checklist
- Number of GM&B municipalities adopting checklist

## **KEY COLLABORATORS**

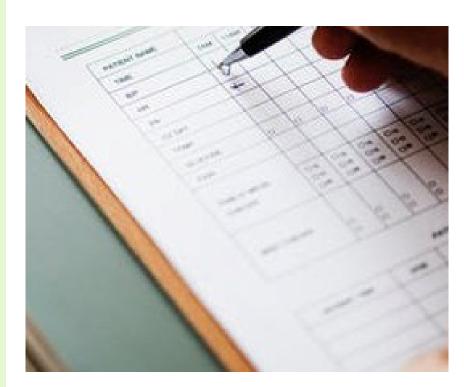
LEAD: Miami-Dade County

- City of Miami
- City of Miami Beach

## **FUNDING**

54

Fully funded via staff time



## TIMEFRAME: SHORT-TERM (1-5 YEARS)

## DESCRIPTION

The most cost-effective way to systematically protect infrastructure in the GM&B region is to integrate resilience considerations into the design of all new capital improvement projects as early as possible. In support of this concern. Miami-Dade County will develop a sea level rise checklist that compliments existing resilience training programs for capital planning. A previous study by engineering consultants found that an additional \$6 million investment in protective measures would prevent approximately \$24 million in losses and protect Miami-Dade County assets worth more than \$150 million. Additionally, if climate considerations are not integrated into design, key infrastructure may not last its entire design life and additional funds would be required to rebuild or modify the asset.

Miami-Dade County's checklist will help ensure that new infrastructure is built to withstand future floods and storms and that there is a consistent approach across departments to integrate climate change considerations into project designs. A checklist and a clear process will help various departments adopt consistent standards, information, and the best practices for capital projects. Miami-Dade County will convene a working group with key departments responsible for the most critical infrastructure projects to test and refine the checklist format. Miami-Dade County is currently working to create an easy-to-use online tool that provides the data necessary to complete the requested information in the checklist, such as parcel-level information about elevations and flood risk. After developing the checklist, Miami-Dade County will share it with GM&B municipalities, along with best practices, so municipal partners can adapt it to meet their unique needs.

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## ACTION 9: CREATE DEVELOPMENT REVIEW CHECKLIST





## TIMEFRAME: SHORT-TERM (1-5 YEARS)

## **DESCRIPTION**

To minimize costs associated with disruption, factoring risk from natural hazards (such as floods) into project designs is a must in a resilient coastal community. With high development pressures, especially in the urban core, affordability and displacement must also be addressed to stabilize the economy and citizen's quality of life. Identifying concerns during the development review process and then modifying projects in the early design phase is typically the most cost-effective stage to adjust a project to improve risk reduction. GM&B will complete a Development Review Checklist and guidance document for GM&B municipalities to use in support of integrating resilience and equity into their development review processes. For instance, the City of Miami Beach has incorporated flood risk considerations into their land use board review processes as a decision-making tool for land use changes. The City of Miami has used the draft GM&B Development Review Checklist to review Special Area Plans and will integrate this resilience and equity review into their standard review processes to ensure that resilience is a consideration at the early stage of large development projects.

GM&B's resource guide, with sample checklists and application questions for development reviews, will help other communities, especially those that are resourcelimited, incorporate resilience considerations into their design, planning, and development processes. This resource document will be a valuable aid in developing consistent standards, use of consistent information, and best practices for projects, and its use will facilitate decision making. Once completed, the guidance document will be shared through the Miami-Dade Planners Technical Committee.

## HOW THIS WILL HELP US

- Improves natural disaster preparedness
- Streamlines government processes
- Reduces sea level rise and coastal flooding impacts

## **PERFORMANCE METRICS**

- Number of cities who report utilizing checklist
- Number of buildings constructed using checklist

## **KEY COLLABORATORS**

LEAD: Miami-Dade County

- City of Miami
- City of Miami Beach

## **FUNDING**

Funded through existing staff resources

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## CASE STUDY

## RESILIENCE PRINCIPLES IN LAND USE DECISIONS

On July 26. 2017, the Miami Beach City Commission adopted an ordinance establishing criteria that the City's four land use boards would incorporate principles to address and plan for the effects of sea level rise and climate change. Since its adoption, over 282 items have been considered by the land use boards. The ordinance also includes separate criteria for the Planning Board when making recommendations on proposed amendments to the Land Development Regulations to the City Commission.

For new developments, applying the criteria means that climate adaptation and mitigation is considered during the review process, and subsequently at the land use board review. This process has encouraged robust dialogue between applicants and staff, informed the review process, and resulted in stronger designs. As part of an application for new development, applicants must address the criteria as part of their letter of intent to develop; as a result, new buildings in the City of Miami Beach are more resilient to extreme weather, more energy efficient, and increasingly adaptable to rising seas.

Historic structures present a unique set of challenges since many were built below current elevation standards. The criteria encourages raising these structures. If that is not feasible, floodproofing must be applied.







## OBJECTIVE 2: SAFEGUARD URBAN SYSTEMS

## ACTION 10: STRENGTHEN RESILIENCE PLANNING

## HOW THIS WILL HELP US

- Streamlines government processes
- Improves public realm
- Reduces duplication of services

## **PERFORMANCE METRICS**

 Number of GM&B municipalities that incorporate resilience principles in their CDMP

## **KEY COLLABORATORS**

LEAD: Miami-Dade County

- GM&B municipalities
- Southeast Florida Regional Climate Change Compact
- South Florida Regional Planning Council

## **FUNDING**

58

Fully funded through staff time



## TIMEFRAME: SHORT-TERM (1-5 YEARS)

## **DESCRIPTION**

Potential shocks and stressors confronting the GM&B region need to be considered in all aspects of long-range planning. Therefore, resilience initiatives are addressed throughout each element of the Miami-Dade County's Comprehensive Development Master Plan (CDMP). Mandated by state law, Miami-Dade County and its cities must regularly update their CDMPs and document progress in implementing CDMP's goals, objectives, and policies. Updates to the CDMP's maps and text are performed using the Evaluation & Appraisal Report (EAR) process. In 2019, via the EAR update, Miami-Dade County will include resilience as a central principle of the update. Updates will include promoting moderate- to high-density development along transit corridors in areas less susceptible to flooding, and strong protection of the natural systems that attenuate coastal hazards. The update will also address economic resilience, including provision of housing for all income levels. As GM&B municipalities update their CDMPs, templates for resilience components—such as those related to Florida's Peril of Flood legislation—will be made available (via a new, online easy-to-use portal) to GM&B municipalities to adopt as relevant in their communities.

The City of Miami and City of Miami Beach are actively incorporating policies into their CDMPs to increase their resilience. The 2016 CDMP for the City of Miami Beach's EAR update improved policies related to stormwater management and designated the City as an Adaptation Action Area. The revised CDMP employs several strategies to ensure the City can adapt to sea level rise impacts by ensuring that the City provides protective infrastructure, accommodates anticipated future water levels, and manages and avoids development in high risk areas. Specific policies and strategies being considered include ensuring that new development adapts to the impacts of sea level rise; ensuring that greenhouse gas emissions are minimized: providing guidance for future infrastructure improvements to improve resilience; requiring additional study of the needs of historic structures; and addressing the needs of the City's most vulnerable residents.

## ACTION 11: MAXIMIZE OPPORTUNITY ZONES

## TIMEFRAME: IMMEDIATE (0-1 YEAR)

## DESCRIPTION

Sixty-seven federally designated Opportunity Zones have been mapped in Miami-Dade County to revitalize economically distressed communities using private investments. Governments, not-for-profit organizations, and civic and private groups throughout the GM&B region need to collaborate to develop more holistic strategies to guide investments in Opportunity Zones, ensure achievement of resilient outcomes, maximize the outcome of anticipated investments, and avoid creating unintentionally negative consequences in communities. To accomplish these goals, Miami-Dade County, working with the Miami-Dade Beacon Council, has prepared an Atlas of Opportunity Zones throughout the County. The Atlas includes population and economic data for each zone and will be updated based on additional collaboration with GM&B municipalities and other stakeholders. The Miami-Dade Beacon Council and Miami-Dade County will perform outreach activities, in person and online, to inform elected officials, business owners, developers, investors, and others about the Opportunity Zones. In addition, Miami-Dade Beacon Council, assisted by Miami-Dade County, will create an investment prospectus providing potential Opportunity Fund investors with information on zoning, existing and planned infrastructure, and community goals.

The Atlas of Opportunity Zones was created in response to the Federal Opportunity Zone legislation, which creates favorable tax benefits for offering Opportunity Funds in designated zones. Federal regulations guiding investment in these zones by Opportunity Funds are being finalized. To yield maximum financial benefits, the private sector will be looking to make quick decisions on where to invest. The Opportunity Zone program presents an opening for community leaders to focus on resilient strategies and work with Opportunity Funds to achieve and accelerate broad-based outcomes. The Atlas of Opportunity Zones will facilitate use of the Opportunity Funds.

## OBJECTIVE 2: SAFEGUARD URBAN SYSTEMS

## HOW THIS WILL HELP US

- Improves housing quality
- Improves housing affordability
- Creates community wealth
- Streamlines government processes
- Stimulates economic growth

#### PERFORMANCE METRICS

 Number of resilient investments made within opportunity zones

## **KEY COLLABORATORS**

LEAD: Miami-Dade Beacon Council

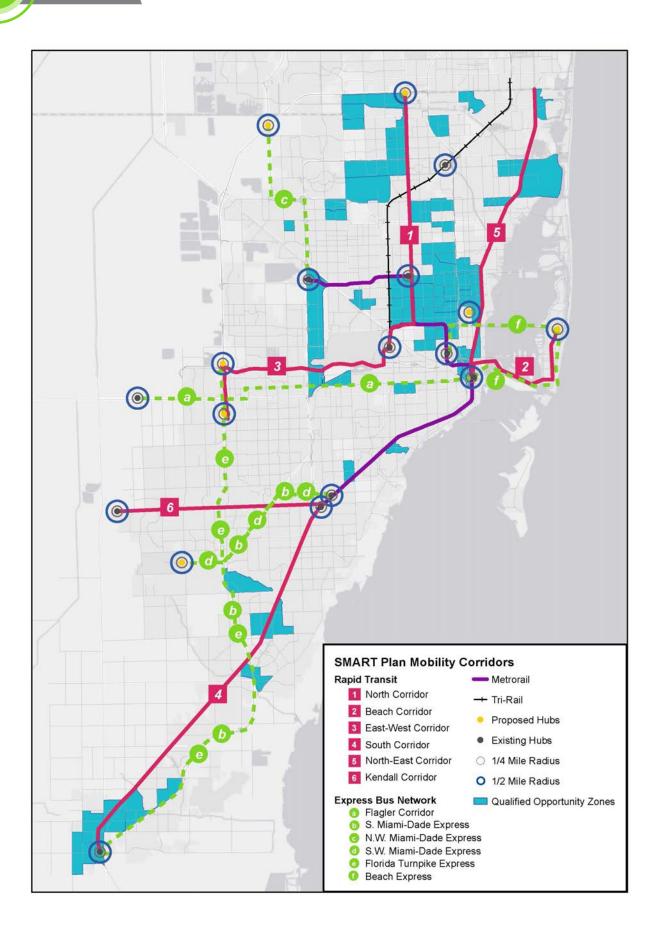
- Miami-Dade County
- City of Miami and GM&B municipalities
- South Florida Regional Planning Council

#### FUNDING

Fully funded; coordination to be funded by participating entities

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60



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## STRATEGIC MIAMI AREA RAPID TRANSIT PLAN

As Miami-Dade County continues to experience rapid growth, GM&B recognizes the need to mitigate the costs of congestion. The Strategic Miami Area Rapid Transit (SMART) Plan is a bold infrastructure program of projects that will significantly improve transportation mobility in Miami-Dade County and the South Florida Region. Once implemented, the SMART Plan will lower Miami-Dade County greenhouse gas emissions, reduce travel times, and refocus GM&B away from single occupancy vehicles.

The SMART Plan when combined with newly established Opportunity Zones will further promote economic growth and job creation, as well as increase the region's international competitiveness. The SMART Plan represents a vision for the region that is both strategic and far reaching, creating a system of multiple transportation options by leveraging existing infrastructure, and integrating technology at the highest levels. The plan is comprehensive, proactive, and supports the future population and employment growth anticipated in our region.

The SMART Plan will expand transit options in Miami-Dade County along six (6) critical corridors that are linked to regional, state, national, and global economic markets, as highlighted below. Another critical component of the SMART Plan is a network of Express Buses, known as Bus Express Rapid Transit (BERT), which will connect the SMART rapid transit corridors on limited access facilities, promoting the active expansion of South Florida's Express Lanes network. The SMART Plan will be complimented by a SMART Trails Plan to expand accessnon-vehicular opportunities.





## **ACTION 12: DEVELOP MOBILITY HUBS IN THE 305**

## HOW THIS WILL HELP US

- Enhances mobility options
- ٠ Decreases traffic congestion
- Reduces greenhouse gas emissions
- Improves air quality
- Improves cyclist and pedestrian safety

## PERFORMANCE METRICS

- Transit mode share
- Number of last mile alternative options available

## **KEY COLLABORATORS**

LEAD: Miami-Dade County

- Miami-Dade Transportation Planning Organization
- Rail & Bus Transportation Providers

## FUNDING

62

Partially funded by multiple transportation entities



## TIMEFRAME: MID-TERM (5+ YEARS)

## DESCRIPTION

Miami-Dade County will develop Mobility Hubs around current Metrorail, Metromover, and Strategic Miami Area Rapid Transit (SMART) Plan Corridor stations. Mobility Hubs consist of physical improvements that seamlessly integrate different modes of transportation together. The Mobility Hubs will enhance the reach of the current and future transportation corridors including rail and Bus Rapid Transit (BRT) stations. The program will include a design competition for current Metromover and Metrorail stations by the end of 2020 and will develop solutions for mobility providers to enhance service to and from mobility hubs.

Mobility Hubs are a crucial component of expanding access to surrounding neighborhoods that are serviced by rail and bus rapid transit (BRT). Traditionally, transit stations provide non-vehicle access within a 1/2 mile radius surrounding the station. Mobility hubs provide the opportunity to expand the reach of transit beyond this  $\frac{1}{2}$  mile and expand multimodal benefits to additional neighborhoods. Mobility Hubs will also provide opportunities to connect shared-use paths and other non-motorized facilities to the transportation stations and associated transit-oriented developments. The Mobility Hubs action is in alignment with the goal of the SMART Trails Program to identify and address First/Last Mile (FLM) connections. Improvements include:

- Technology to match trips from rail and BRT to bus, microtransit, transportation network companies, carshare, and other modes through connected real-time navigation through enhanced broadband
- Dedicated space to serve "last-mile" options, including bus, microtransit, transportation network companies, and carshare
- Human-centered design to increase safe walking and biking trips
- Supportive infrastructure to encourage electric, non-polluting transportation options ٠
- Permeable surfaces to reduce stormwater runoff

Mobility Hubs have great potential to help transform the region and reinforce the policies developed with the current shared mobility work and will promote transit-oriented development. Page 69 of 394

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## **CASE STUDIES**

# THE UNDERLINE, A 10-MILE LINEAR PARK AND LIVING ART DESTINATION

The Underline is transforming the underutilized land below Miami-Dade County's Metrorail, from the Miami River to Dadeland South Station, into a 10-mile linear park, world-class urban trail, and living art destination. This linear park will connect communities; improve pedestrian and bicyclist safety; create over 120 acres of open space with restored natural habitats; encourage a healthy lifestyle; provide an easily accessible place to exercise; create a mobility corridor that integrates transit, car, biking, and walking; provide a 10mile canvas for artistic expression; attract development along U.S. Highway 1; and generate significant economic benefit. Much like the High Line in New York City, the Underline will be open to all and provide amenities and art connecting people to place and each other.

Construction of the Underline will be done in nine phases. The first phase began in November 2018. The total construction and design budget for the first phase is \$120 million, with over \$90 million in public funds already committed. The Underline is led by Friends of The Underline, a 501c3, in partnership with Miami-Dade County, with additional support from the Cities of Miami, Coral Gables, South Miami, the State of Florida, and Florida Department of Transportation. Phased completion will be done as funding becomes available.



## **GROWING GREEN BUS STOPS PILOT PROJECT**

Growing Green Bus Stops began as pilot project created by Neat Streets Miami in partnership with O. Miami Poetry Festival. The project targeted unshaded bus stops along transit corridors throughout Miami-Dade County to mitigate the urban heat island effect and enhance the transit experience for riders. The project planted two canopy trees at 10 unshaded bus stops (20 trees total) located in different areas across Miami-Dade County. An additional component of the project was stenciling a haiku poem about trees, written by a local resident, onto the surrounding sidewalk. The resulting benefits were threefold: shade creation, beautification of roadways, and public engagement. The project demonstrated how communities can enhance the transit experience while cultivating more awareness about the benefits of trees through relatively small aesthetic and environmental investments.

The pilot project was funded from The Miami Foundation Public Space Challenge grant. Neat Streets Miami, housed in Miami-Dade County, is a multi-jurisdictional County board dedicated to the maintenance and beautification of transportation corridors, gateways, and connections.

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## OBJECTIVE 3: CREATE MOBILITY OPTIONS

## ACTION 13: DESIGN A BETTER BUS NETWORK

## HOW THIS WILL HELP US

- Decreases traffic congestion
- Enhances mobility options
- Reduces duplication of services
- Reduces greenhouse gas emissions
- Improves community cohesion

## **PERFORMANCE METRICS**

 Number of monthly/annual bus riders (after new routes launched)

## **KEY COLLABORATORS**

LEAD: Miami-Dade County

- Transit Alliance
- GM&B municipalities with public transit programs

## **FUNDING**

64

Fully funded by a \$250.000 commitment from Miami-Dade County and matching funds raised by the Transit Alliance

## TIMEFRAME: SHORT-TERM (1-5 YEARS)

## DESCRIPTION

When it comes to public transit, Metrobus is the most heavily used mode of transportation in Miami-Dade. In 2018, roughly 50 million trips were taken on Metrobus alone. However, ridership has been declining. Transit Alliance (a local public transit advocacy nonprofit) will spend the next 2 years redesigning the Metrobus route network to create a more efficient and more cohesive public transit system. GM&B will support this effort through open collaboration, data, and staff resources.

The bus system is flexible and is the best candidate for short-term improvements that could have a major, positive impact on the use of mass public transit. Ridership has been in steady decline due to increased car ownership, trolley services without fares, longer bus wait times, unreliable service, and a poorly designed route network. This reconfiguration aims to improve service on highly frequented routes; create better connections to other bus lines, trolleys, and other modes of transit; and, design more logical and intuitive route paths. These improvements will work together to enhance user experience and bring riders back to Metrobus. Transit Alliance plans to recommend a new bus route system in late 2020.

#### SPOTLIGHT

## TRANSIT ALLIANCE

Transit Alliance is a nonprofit organization advocating for walkable streets, bikeable neighborhoods, and better public transit. Its campaigns combine data-driven research, community engagement, and policy advocacy to get residents in the GM&B region moving safer, faster, and happier.



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## ACTION 14: DRIVE INTO THE FUTURE

## OBJECTIVE 3: CREATE MOBILITY OPTIONS



## TIMEFRAME: SHORT-TERM (1-5 YEARS)

## DESCRIPTION

Driverless cars have much to offer, including the potential of reducing greenhouse gas emissions. Reducing greenhouse gas emissions could be achieved using shared mobility services, vehicle electrification, and smart pricing while not undermining other emissionreduction strategies. As part of the (Re)Defined Mobility project, Miami-Dade County will conduct numerous public workshops to determine which new technology tools and mobility options public and private transportation system customers are comfortable using. At the same time, demonstration projects will be conducted using autonomous vehicles (AVs) and on-demand transit circulators (hail on demand) to evaluate whether these technologies can be successfully integrated into the existing transportation system.

The (Re)Defined Mobility project will bring residents of Miami-Dade County into the decision-making process and explore mobility solutions that match their needs. The project will work to: 1) develop citizen-centric solutions informed by participation in planning, design, and delivery of new mobility solutions: 2) experiment with new mobility solutions and technology with the deployment of AVs; and 3) create a digital interface to manage locations for AV drop-offs and pick-ups.

Ultimately, the project will redefine the transportation planning process by helping to better understand the public's sentiments toward mobility solutions and new technologies in Miami-Dade County. Additional benefits include reduction of greenhouse gas emissions through vehicle electrification and increased occupancy of private and public vehicles, as well as improved walkability and equal access to all residents in the GM&B region.

## HOW THIS WILL HELP US

- Improves communication with residents
- Decreases traffic congestion
- Enhances mobility options
- Reduces greenhouse gas emissions

## **PERFORMANCE METRICS**

- Number of workshops
- Number of transportation system users engaged
- Number of new mobility solutions introduced following workshops
- Metric tons of greenhouse gas emissions reduced from private cars

## **KEY COLLABORATORS**

LEAD: Miami-Dade County

- Miami-Dade Transportation Planning Organization
- GM&B municipalities

## FUNDING

Fully funded. The pilot project is funded by the Knight Foundation and federal grants



# ACTION 15: IT'S ELECTRIC

#### HOW THIS WILL HELP US

- Improves air quality
- Reduces greenhouse gas emissions
- Streamlines government processes
- Improves financial planning

#### PERFORMANCE METRICS

- Percentage of GM&B municipalities requiring EV infrastructure in building code
- Percentage of EVs in municipal fleets
- Percentage of EV chargers countywide
- Tons of greenhouse gas emissions from private cars reduced
- Percentage of registered EVs

#### **KEY COLLABORATORS**

LEAD: Miami-Dade County

- Miami-Dade County
- GM&B municipalities

#### **FUNDING**

66

Partially funded by Electrify America



TIMEFRAME: SHORT TERM (1-5 YEARS)

#### DESCRIPTION

Since 2013, electric vehicle (EV) ownership in Miami-Dade County has increased by 450 percent. After California, Florida leads the country in number of registered electric vehicles; by 2030, Florida is expected to reach 30 percent market penetration. To prepare for and catalyze the growth of the EV market, GM&B will enact policies that support development of EV infrastructure (like chargers), seek opportunities to introduce EVs into municipal fleets, and engage in knowledge sharing to create best practices and a unified network.

One perceived barrier to greater deployment and use of EVs is an inadequate network of publicly available chargers. GM&B partners will pass legislation to require EV charger capability in newly built parking structures to set the foundation for EV infrastructure growth. Additionally, GM&B municipalities with existing EV policies and fleets will share their experiences and best practices with other GM&B municipalities to reduce potential concerns and issues. Collective commitment and investment is needed to facilitate an EV transition that will not only significantly reduce vehicle emissions but also save governments and residents operations costs.

GOAL 1: PLACES

# CASE STUDY ELECTRIFYING THE FLEET

In 2015, the City of Coral Gables began drafting its 10-year Sustainability Management Plan to provide a framework for creating a more sustainable and resilient community. One of the goals established in the plan was to reduce gasoline and diesel fuel use 20 percent below 2013 levels by 2025. One way the City has focused on achieving this goal is integrating EVs into its City fleet. The City established a FY 2021 goal of 78 EVs, which represents 60 percent of their administrative fleet. The City purchases these EVs via a statewide procurement contract and has supported the fleet by installing dedicated EV support equipment at its maintenance facility, City Hall parking lot, and municipal parking garages. In 2015, the City began purchasing EVs and currently has a total of 43 EVs in its fleet, making it one of the largest government EV fleets in Florida. The City has been able to fund this through its annual vehicle replacement budget. The installation of 22 charging stations, with a goal of expanding to 43 by 2021, has enabled and inspired the community to start transitioning away from traditional gasoline powered vehicles.

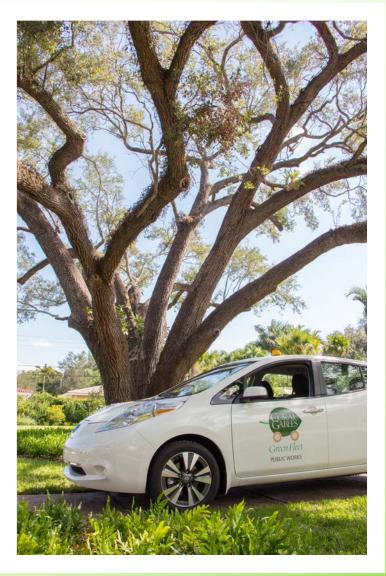


Photo credit: City of Coral Gables



# ACTION 16: EXPAND RENEWABLE ENERGY

#### HOW THIS WILL HELP US

- Improves natural disaster preparedness
- Improves air quality
- Creates community wealth
- Creates job opportunities
- Reduces greenhouse gas emissions

#### **PERFORMANCE METRICS**

- kW renewable energy installed on County buildings
- Number of PV systems installed on County building
- kWh solar electricity generated
- kW renewable energy systems County-wide

## **KEY COLLABORATORS**

LEAD: Miami-Dade County

- Local Utilities such as Florida Power and Light and Others
- Solar Cooperatives
- SolSmart
- Private Industry

#### FUNDING

Partially funded



#### TIMEFRAME: SHORT-TERM (1-5 YEARS)

#### DESCRIPTION

Miami-Dade County will work with local electric utilities and other stakeholders to reduce greenhouse gas emissions within the GM&B region by implementing energy efficiency and conservation strategies, and by increasing production of renewable energy, battery storage, and similar energy storage systems and microgrids. GM&B will collaboratively implement strategies promoting solar cooperatives and national programs such as SolSmart that foster mature local solar markets. The City of Miami Beach has achieved Gold SolSmart status and Miami-Dade County has achieved Bronze SolSmart status. Miami-Dade County is working towards Gold status.

Uninterrupted access to reliable energy is critical to the GM&B region. Sustaining the region's lifestyle requires a deliberate effort to increase efficiency, use alternative sources, and improve the resilience of energy systems. Implementing these strategies focuses on reducing carbon pollution and consequent heat waves, the leading cause of weather-related deaths in the United States.

#### **SPOTLIGHT**

# SOLSMART

SolSmart is a national technical assistance and designation program that guides communities in lowering the costs and barriers for community members to go solar and encourages solar energy development. The South Florida Regional Planning Council (SFRPC) recently received a technical assistance grant that provided for a SolSmart

Advisor to work full-time since November 2018. The SolSmart Advisor provides expertise and dedicated support to communities within and outside of the GM&B region to encourage local solar energy growth with the goal of achieving the SolSmart designa@@age 75 of 394



**GREATER MIAMI & THE BEACHES** 

# BUILDING EFFICIENCY 305

#### TIMEFRAME: SHORT-TERM (1-5 YEARS)

#### DESCRIPTION

In Miami-Dade County, energy use in buildings accounts for 37 percent of the County's energy use and climate pollution; these buildings waste an average of about 30 percent of their energy and water use due to building inefficiencies. To help mitigate these issues, Miami-Dade County, in collaboration with GM&B municipalities, will implement the Building Efficiency 305 (BE 305) program. The BE 305 program will promote more efficient buildings through initiatives that improve energy and water use in large, existing buildings, both private and public. The BE 305 program includes a variety of strategies including:

- Local governments leading by example through benchmarking and improving municipal building performance
- Promoting financing mechanisms, such as PACE, to assist building owners and managers make efficiency improvements
- Enhancing building performance through code compliance education and assessments
- Establishing building performance policies to include annual benchmarking requirements for residential and non-residential buildings
- Facilitating community training and other educational opportunities focused on improving building performance

The BE 305 program is an innovative approach that uses the deployment of building performance data to drive decision making and transform the marketplace. It aligns with Miami-Dade County's vision to create jobs, enhance economic productivity, improve grid resilience, reduce the residential utility burden on low-income residents, bolster healthy and resilient communities, and initiate progress toward its resilience goals. The program's focus is county-wide implementation in collaboration with GM&B municipalities.



#### THE CITY ENERGY PROJECT

SPOTLIGHT

The City Energy Project (CEP) is a national initiative that provides technical and strategic assistance to local governments developing programs such as BE 305. The goal of CEP is to create healthier and more prosperous American cities by improving the efficiency of buildings. It is a joint project of the Natural Resources Defense Council (NRDC) and the Institute for Market Transformation (IMT) funded by a partnership of Bloomberg Philanthropies, the Doris Duke Charitable Foundation, and The Kresge Foundation.



# OBJECTIVE 4: INCREASE ENERGY EFFICIENCIES

#### HOW THIS WILL HELP US

- Improves air quality
- Improves housing affordability
- Creates community wealth
- Creates job opportunities
- Reduces water usage

#### PERFORMANCE METRICS

- Tons of greenhouse gas emissions reduced from buildings sector
- Dollars saved in energy/water bills
- Gallons potable water saved
- Number of buildings above 20,000 sq. ft. benchmarked

#### **KEY COLLABORATORS**

LEAD: Miami-Dade County

- GM&B municipalities
- Florida Power and Light
- Building industry stakeholders
- University of Miami

#### FUNDING

Miami-Dade County and partially funded via grant from City Energy Project that ended in December 2018

69



### OBJECTIVE 5: ENHANCE HOUSING OPTIONS

# ACTION 18: STAY AND LIVE IN THE 305

#### HOW THIS WILL HELP US

- Improves housing quality
- Improves community cohesion
- Creates community wealth
- Streamlines government processes

#### **PERFORMANCE METRICS**

- Number of affordable housing units preserved/year in City of Miami and Miami-Dade County
- Number of housing units created annually in City of Miami and Miami-Dade County
- Percent rent burdened households in City of Miami and Miami-Dade County

#### **KEY COLLABORATORS**

LEAD: City of Miami

- Miami Homes for All
- FIU Metropolitan Center
- Greater Miami Chamber of Commerce Housing Committee
- University of Miami Housing and Community Development Initiative

#### **FUNDING**

Partially funded by the Center for Community Investment

#### TIMEFRAME: SHORT-TERM (1-5 YEARS)

#### DESCRIPTION

Working towards regional replication and expanded collaboration, the City of Miami will work with Miami Homes for All to launch initiatives that leverage municipal financing to increase production of affordable housing units. As a final product, Miami Homes for All and City of Miami will prepare and release a guidance document for improved regional collaboration on affordable housing.

This work is being completed as part of the City's participation in the Connect Capital program, a 2-year initiative of the Center for Community Investment that assists communities in attracting capital at a scale to improve residents' health and access to opportunity. The Connect Capital process has helped the City establish a shared set of priorities among diverse stakeholders with strengthened the policies and practices required to achieve the outcomes. The City is working with its private-sector, university, and nonprofit partners to meet an ambitious goal of creating or preserving 12,000 housing units by 2024. In effort to meet this goal the City has identified key policies or regulations that needed to be created or modified (such as an inclusionary zoning policy being piloted in the Omni/Overtown area) and prioritizing the use of publicly owned land for new housing. Some non-policy priorities were also identified, such as improved coordination among regulatory bodies for permitting and collaboration with other governments, institutions, and nonprofits to leverage funding, financing, and/ or land. By July 2020, the City of Miami hopes to have adopted a new housing master plan. It is anticipated that the guidance document will be used to develop a coordinated interagency strategy and approach related to housing needs across Miami-Dade County.

#### SPOTLIGHT

#### MIAMI HOMES FOR ALL

Since its conception, Miami Homes For All has sought to create formal alliances to break down silos within the homelessness sector and support all individuals who experience homelessness at any point in their lives. Their work concentrates on advocacy, prevention, and informational services to enhance already existing community efforts and fill identifiable gaps.



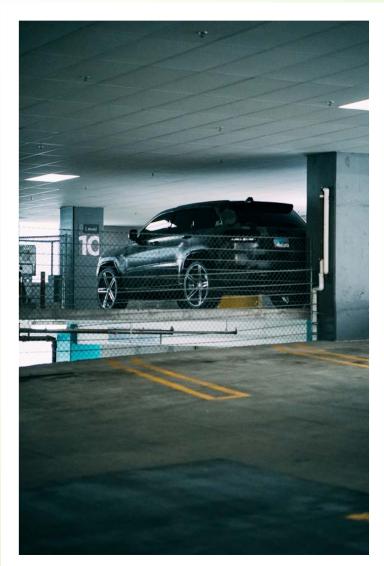
# **CASE STUDY**

# DO YOU WANT TO LIVE IN A GARAGE?

With the future of driving and parking your own car in question, the City of Miami Beach City Commission adopted a parking garage convertibility criterion in 2016. Originally conceived to address workforce housing needs, it is an excellent model for adaptive re-use advanced planning. The City of Miami Beach is already seeing a decline in garage utilization and revenue, in part due to the car share disruption created by Uber and Lyft. The criteria for designing a parking garage that could be converted to future housing units include:

- Increased floor-to-floor heights (10 feet clear floor heights to accommodate future heating, ventilation, and air conditioning (HVAC); plumbing; and electrical systems)
- Maximized flat area floor plates (keep circulation ramps outside main areas)
- Reduced vehicular ramp footprints to minimize future non-convertible areas
- Structural design to accommodate change of use (increased loading)
- Inclusion of vertical plumbing/waste chases or core for future use
- Potentially include larger elevator shafts to accommodate future cargo elevators
- Provide utility connection points for future use

Many variables apply when comparing costs of a traditional garage to convertible one - lot sizes. Zoning requirements and project scope can significantly affect estimates. The differential is in the 15 percent to 25 percent range. The City of Miami Beach is planning for two convertible garages in North Beach to meet today's need and tomorrow's reality.





# OBJECTIVE 5: ENHANCE HOUSING OPTIONS

# ACTION 19: REDEVELOPING RESILIENT PUBLIC HOUSING

#### HOW THIS WILL HELP US

- Improves housing quality
- Improves housing affordability
- Improves tenant rights
- Decreases homelessness
- Improves community cohesion

#### **PERFORMANCE METRICS**

 Number of public housing units redeveloped or constructed via RAD

#### **KEY COLLABORATORS**

LEAD: Miami-Dade County

 U.S. Department of Housing and Urban Development

#### **FUNDING**

72

Redevelopment of the first 2,400 units is funded and the approximate additional 6500 units will be funded via the RAD program



#### TIMEFRAME: SHORT TERM (1-5 YEARS)

#### **DESCRIPTION**

Miami-Dade County currently oversees 9.000 public housing units. The cost of renovating or replacing all units is \$2.6 billion. To date, 2.400 units have been redeveloped, are under construction, or closing soon with a total development cost of \$730 million. If the approximately 6.500 remaining units are redeveloped through demolition or new construction, the total cost would be approximately \$1.9 billion. To help complete renovation or replacement of these units. Miami-Dade County was approved to redevelop these under the U.S. Department of Housing and Urban Development (HUD) Rental Assistance Demonstration (RAD) plan.

Miami-Dade County plans to issue nine requests for proposals for the 1:1 redevelopment of site-specific public housing contracts by December 2019. Developers will be required to follow the County's Sustainable Buildings ordinance. Priority will be given to hardened buildings; elevated back-up generators to power common areas; use of solar power and hot water systems, when feasible; and those that ensure water and utility cost-burdens for residents are minimized. Ultimately, this redevelopment will help to fill the gap of pending renovated and updated public housing stock. Miami-Dade County has committed to maintaining the same rent for tenants returning to the redeveloped units. When stacked with additional financing incentives such as Opportunity Zones and opportunities for mixed-use development, redevelopment may even increase the number of public housing units available. Under the RAD plan, strict resident rights (such as resident notices and consultation, right-to-return after temporary relocation, and prohibition of rescreening of resident), relocation assistance, and other benefits allow for greater transparency. Implementation of the RAD planning process will be integrated into the Resilient305 when specific public housing sites are ready for redevelopment.



A strength of Greater Miami & the Beaches (GM&B) is its diversity of people and neighborhoods, which are shaped by a myriad of cultures and characters. Although our economy is strong, many of our residents struggle because of the scarcity of living wage jobs, lack of opportunities for youth, and insufficient support for growing local businesses. The most vulnerable of our population are challenged by public health concerns, from mental health issues to opioid abuse to the threat of pandemics from climate change. Our neighborhoods and communities are not as connected as they could be, leaving some areas isolated when small day-to-day crises occur or big events such as hurricanes strike.

Through our "People" actions, we aim to improve the lives of our residents every day, whether sunny or stormy, by supporting job and wealth creation: addressing specific health needs for the most vulnerable among us: and preparing and empowering neighborhoods and networks to anticipate and respond to disruptions, both large and small.

# WHO IS WHO?

THE PARTNERSHIP Greater Miami & the Beaches (GM&B)

THE SUPPORTING ORGANIZATION 100Resilient Cities (100RC)

THE STRATEGY Resilient305

THE IMPLEMENTING TEAM PIVOT (Progress Innovation Vision for Our Tomorrow)





# **Objective 6**

# **Cultivate Financial Stability**

	Action 20 Action 21	Build an Inclusive Economy Train for Construction
	Action 22	Promote Fair Chance Hiring
	Action 23	Buy Local
	Action 24	Be Counted
Action 25		Re-establish the Financial Capability
		Collaborative
	Action 26	Teach Kids to Save
	Action 27	Expand Youth Career Opportunities

# **Objective 7**

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# **Advance Public Health Priorities**

Action 28	Break the Cycle of Youth Violence
Action 29	Respect Our Elders
Action 30	Update the Social Services Master Plan
Action 31	Advocate for Mental Health
Action 32	Pilot an Arrest Diversion for Opioid Users
Action 33	Accelerate Progress of HIV/AIDS Strategy
Action 34	Advance Pandemics Communication



# **Objective 8**

# **Strengthen Community Response**

Action 35

Action 36

Action 37

Action 38

Increase Neighborhood Response		
Time to Volunteer		
Prepare Your Property		
Support Resilience Hubs		

**Objective** 9

77

# Communicate the Concept of Resilience

Get the 311 on Resilience for the 305	Action 39	
Create a K-12 Plan for Resilience Literacy	Action 40	
See It To Believe It	Action 41	

# OBJECTIVE 6: CULTIVATE FINANCIAL STABILITY

# ACTION 20: BUILD AN INCLUSIVE ECONOMY

## HOW THIS WILL HELP US

- Stimulates economic growth
- Creates job opportunities
- Provides youth employment
- Lifts residents out of poverty
- Improves industry/job diversification

#### PERFORMANCE METRICS AND TARGETS

- Number of organizations committed to local sourcing
- Number of training partnerships established
- Number of individuals placed in living wage career tracks
- Number of small- to medium-sized businesses securing new business

#### **KEY COLLABORATORS**

LEAD: Miami-Dade Beacon Council

GM&B

78

- Health Foundation of South Florida
- CareerSource

#### FUNDING

Partially funded by The Miami Foundation



# TIMEFRAME: SHORT-TERM (1-5 YEARS) DESCRIPTION

One Community One Goal (OCOG), overseen by the Miami-Dade Beacon Council Economic Development Foundation (a not-for-profit affiliate of the Miami-Dade Beacon Council), is a long-term strategic plan for GM&B's future economic, entrepreneurial, and educational success. The OCOG strategic plan brings together a broad spectrum of organizations that work to advance the goal of creating a thriving, inclusive, and diverse community. Since 2012, this community-wide initiative has assisted our community by contributing to the creation of 60,000 target industry jobs over a 5-year period, enhancing our educational ecosystem through new initiatives such as the Academic Leaders Council, and helping build a vibrant population of young professionals. GM&B will work with OCOG co-chairs to advance four specific priorities related to building a resilient and inclusive economy outlined in the Miami-Dade Beacon Council's updated action plan:

- Support small business growth using technology, outreach opportunities, and connecting small- to medium-sized local businesses with local, national, and global companies and anchor institutions for goods and services.
- Identify clear pathways for low-skilled youth and adults seeking to advance their careers (including rapid retraining) and build a sustainable model to support and scale middle-skill training programs in the industries targeted by OCOG and construction industries (see Action 21, Let's Build).
- Facilitate the formation of public-private partnerships in resilient infrastructure, especially in the areas of mass transit, flood risk management, and communications.
- Continue and expand outreach to businesses related to disaster preparedness, response, and recovery.

# CASE STUDY MIAMI COMMUNITY VENTURES INVESTS IN INDIVIDUAL SUCCESS

With the goal of building long-term economic benefits in communities. Miami-Dade Beacon Council launched the Miami Community Ventures (MCV) initiative to connect low-income, structurally unemployed individuals to living wage jobs. The program specifically aims to aid individuals who are public assistance recipients, returning citizens, at-risk youth (19-29 years), or disabled, with female head-of-households and veterans as sub-groups. Additionally, the program helps struggling residents overcome factors that may keep them from maintaining gainful employment by matching them with wrap-around support services in the areas of job training, child care, success coaching, education (with an emphasis on financial literacy), transportation assistance, and social services for up to 2 years. The MCV program is a model replicated from Michigan's Community Ventures program. Miami-Dade Beacon Council launched the MCV pilot in partnership with Transitions, Inc., Goodwill Industries, and Lotus House in the neighborhoods of Liberty City, Overtown, and Goulds in the Fall of 2018.



SPOTLIGHT

#### Miami-Dade Beacon Council's ONE COMMUNITY ONE GOAL

In 2012, the Miami-Dade Beacon Council Foundation re-launched its OCOG strategic plan to provide Miami-Dade County with a roadmap for future economic development success. The plan is based on the results of focus groups, surveys, and thousands of hours of community engagement conducted throughout Miami-Dade County. Using this information, a professional research firm developed strategic recommendations to support significant job creation focused on increasing the number of higher-paying jobs. Industry leaders work closely with the education community to develop the proper curriculum for training required to support the growth of the targeted industries.



GOAL 2: PEOPLE

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# OBJECTIVE 6: CULTIVATE FINANCIAL STABILITY

# ACTION 21: TRAIN FOR CONSTRUCTION

#### HOW THIS WILL HELP US

- Lifts residents out of poverty
- Improves industry/job diversification
- Improves individual well-being

#### PERFORMANCE METRICS

- Number of training programs and partnerships formed
- Number of local residents securing construction jobs

# **KEY COLLABORATORS**

LEAD: City of Miami

- Miami-Dade Beacon Council
- Builders and Construction Associations
- Trade Unions
- Miami-Dade College

#### FUNDING

Unfunded

80



# TIMEFRAME: SHORT-TERM (1-5 YEARS) DESCRIPTION

GM&B is projected to have \$320 billion in construction work in the next 10 years. To fully realize the economic benefits and ensure an adequate supply of qualified workers within the construction industry, GM&B will engage with Miami-Dade Beacon Council, Miami-Dade College, and other entities to convene stakeholders to address identified industry challenges for these low-barrier, high-demand occupations. GM&B will examine opportunities to leverage their local hiring requirements for construction-related contracts and encourage partner anchor institutions to do the same.

As part of the Resilient305 Strategy development phase. GM&B engaged Fourth Economy to produce a research brief on the region's workforce availability and training capacity in the construction industry. The research brief showed that the industry faces an impending labor shortage as experienced workers begin to retire, and the skills required for new construction evolve. Over 5,000 workers are needed to fill low-barrier, high-demand occupations in construction, i.e., those that require limited training or education and are therefore a solid entry level path for workers to engage in the sector. Challenges include restoring the perception of construction and trade occupations as rewarding and lucrative career paths: developing local partnerships to create a trainee and job placement pipeline with high retention: and improving relevance of and participation in training programs, especially in the areas of new and adaptive construction materials and methods that focus on climate resilience and sustainability. The goal is to create and implement an action plan to better meet the labor force gap, and proactively engage with new populations by training and recruiting workers, particularly in under represented demographics. Page 87 OT 394





#### **MIAMI DADE COLLEGE**

Miami-Dade College has the largest undergraduate enrollment of any college or university in the country and offers multiple programs relevant to the construction industry. The College embraces its responsibility to serve as an economic, cultural, and civic leader for the advancement of our diverse global community.



SPOTLIGHT

SPOTLIGHT

# FOURTH ECONOMY

Fourth Economy is a national community and economic development consulting firm that focuses on fostering action to create great communities, impactful organizations, and strong economies. The organization aims to effectively blend both quantitative and qualitative inputs to develop realistic recommendations that can be easily understood and readily implemented.





# ACTION 22: PROMOTE FAIR CHANCE HIRING

#### HOW THIS WILL HELP US

- Reduces neighborhood violence
- Lifts residents out of poverty
- Creates job opportunities
- Improves individual well-being

#### **PERFORMANCE METRICS**

- Number of GM&B municipalities with fair chance hiring ordinances
- Number of businesses/anchor institutions with fair chance hiring policies
- Reduced recidivism

#### **KEY COLLABORATORS**

LEAD: City of Miami

- Transitions, Inc.
- Participating GM&B municipalities
- CareerSource South Florida
- Greater Miami Chamber of Commerce

#### FUNDING

82

Funded by existing commitments.



# TIMEFRAME: MID-TERM (5+ YEARS) DESCRIPTION

Currently, Miami-Dade County and the City of Miami Beach exercise fair chance hiring policies, commonly referred to as "Ban-the-Box," which removes one barrier to employment for qualified workers with criminal records. GM&B, in partnership with community organizations focused on serving and/or advocating on behalf of returning residents, will promote the expansion of this policy to municipal hires across Miami-Dade County, starting with City of Miami. The City of Miami will write a draft ordinance that can be used as a roadmap for other GM&B municipalities to use.

The "Ban-the-Box" initiative aligns with the statewide "Voting Rights Restoration for Felons Initiative" approved in the 2018 election that aims to reintegrate residents with a criminal history. Fair chance policies promote a qualifications first approach to hiring by moving inquiries about arrest records to the final stages of employment, allowing candidates to be considered without stigma. Over the long term, GM&B, together with community partners, will advocate for anchor institutions and other private businesses to adopt fair chance hiring policies and inform them of benefits they can receive like the Work Opportunity Tax Credit. Implementing these practices at the municipal level will create local best practices that can be adopted by others.

# ACTION 23: BUY LOCAL

# OBJECTIVE 6: CULTIVATE FINANCIAL STABILITY

# TIMEFRAME: SHORT-TERM (1-5 YEARS) DESCRIPTION

GM&B partners have established policies and programs that provide preference and support for buying and hiring from local businesses. GM&B's strategy to expand opportunities for local businesses relies on anchor institutions as key partners in implementing the Resilient305 Strategy. Using information from past studies and forthcoming action items to be developed in the summer of 2019 by South Florida Anchor Alliance (SFAA) working groups. GM&B will provide participating institutions with a list of proposed high-impact actions to help catalyze "buy and hire local" actions in the region. GM&B will collaborate with the SFAA in developing a resource directory of minorityowned, woman-owned, and local businesses and a resource guide for local businesses interested in pursuing contracts with local governments or other anchor institutions.

SFAA is an initiative of the Health Foundation of South Florida, which requires addressing several associated factors, including economic well-being. This "Buy Local" action builds on the results of a study that examined barriers and opportunities for local institutions to engage in "buy and hire local" actions. The study was conducted in partnership with The Democracy Collaborative, a national leader in the field of community wealth building. Further, the action will be supported and supplemented with SFAA activities in the summer of 2019. SFAA will sponsor participation by procurement and human resource decision makers in working groups that will establish inclusive economy standards/ norms, procurement, and workforce strategies with clear activities and benchmarks.



SPOTLIGHT

#### HEALTH FOUNDATION OF SOUTH FLORIDA

Health Foundation of South Florida (HFSF) is a public foundation working to invest in and be a catalyst for collaborations, policies, and system changes to improve the health of South Florida communities. HFSF focuses on vulnerable, low- to moderate-income populations. According to the HFSF, in 2017 HFSF established a Community Building and Economic Prosperity Initiative to support the scalability of strategies that engage anchor institutions in practices to elevate the economic well-being of communities and its residents. The creation of this initiative is based on the recognition that improvement in health requires addressing issues such as income, education, housing, transportation, and other neighborhood characteristics.



#### HOW THIS WILL HELP US

- Stimulates economic growth
- Creates job opportunities
- Improves industry/job diversification

#### **PERFORMANCE METRICS**

- Creation of online portal with resources for participating anchors and small businesses
- Number of local businesses reporting expansion of business

#### **KEY COLLABORATORS**

LEAD: Health Foundation of South Florida

- Local Hospitals
- Universities
- Governmental Entities
- Miami-Dade Beacon Council
- Private-Sector/Corporate Partners

#### FUNDING

Partially funded by Health Foundation of South Florida. Citi Foundation, and the Annie E. Casey Foundation.

83

# OBJECTIVE 6: CULTIVATE FINANCIAL STABILITY

# ACTION 24: BE COUNTED

#### HOW THIS WILL HELP US

- Creates community wealth
- Improves communication with residents
- Attracts state and federal funding

#### **PERFORMANCE METRICS**

• Participation rates in the census

#### **KEY COLLABORATORS**

LEAD: The Miami Foundation

- Miami-Dade County 2020 Census Task Force
- Participating GM&B municipalities
- Health Foundation of South Florida

#### **FUNDING**

Unfunded.

84



# TIMEFRAME: SHORT-TERM (1-5 YEARS) DESCRIPTION

In preparation for the 2020 decennial census, GM&B will take a leadership role to ensure an accurate Census 2020 count by supporting outreach to hard-to-count populations, participating in Complete Count Committees, and identifying key messages and providing public education about the census and the importance of participating. A complete and accurate census is essential for proper federal representation and funding, as well as the creation of a data set that truly depicts our community. An undercount could lose GM&B millions of dollars of federal support for over 50 programs that support our most vulnerable residents, such as the Community Development Block Grant Program; roads, school programs, and lunches; Medicaid; and foster care. Outreach and efforts to ensure a complete count will be bolstered by Miami-Dade County's Census 2020 Task Force's action plan and the information gathered by the task force.

Based on the latest census estimates, approximately 430,025 people (16 percent) in the GM&B region live in hard-to-count neighborhoods, meaning that there was a lower-thannormal return rate for census forms in 2010. The 2020 census, for the first time ever, will offer online response as the primary option to all respondents. The online option may increase response in some areas of the region but may provide a challenge for the roughly 23 percent of Miami-Dade County households that have either no internet access or dial up-only. Through outreach campaigns to build awareness and trust, GM&B and collaborators will make sure everyone has the opportunity to be counted.

# ACTION 25: RE-ESTABLISH THE FINANCIAL CAPABILITY COLLABORATIVE

# CULTIVATE FINANCIAL STABILITY



# TIMEFRAME: SHORT-TERM (1-5 YEARS) DESCRIPTION

Approximately 59 percent of residents in the GM&B region and 70 percent of City of Miami residents live in "liquid asset" poverty, meaning they have insufficient funds to survive 3 months after a personal or natural disaster. These individuals and households are one emergency (such as a hurricane or flood) away from falling into debt or losing a home. Hurricane Irma, revealed the financial vulnerability of many residents in the GM&B region. To strengthen collective efforts to support financial health and stability, the United Way Center for Financial Stability will reconvene the Miami-Dade Financial Capability Collaborative quarterly meetings to seek innovative solutions for scaling and strengthening the Collaborative's capacity and reach.

The Collaborative, including the United Way Center for Financial Stability, Catalyst Miami, Inc., and the City of Miami, aims to expand and improve service delivery and integration among dozens of local agencies that help low- to moderate-income individuals and families improve their long-term financial stability. Previously the Collaborative established standards of quality for financial coaching, tax preparation, and other financial stability services; set common metrics and data sharing through regular crossreporting: drove coordinated services to maximize access and utilization among Miami-Dade County residents; and enhanced staff trainings to provide high-quality financial capability services. Building on these successes, the Collaborative will seek ways to strengthen their programs and identify new opportunities to support residents in the GM&B region.

#### HOW THIS WILL HELP US

- Enhances financial stability
- Lifts residents out of poverty
- Improves financial planning

#### PERFORMANCE METRICS

- Number of innovative strategies implemented by partners
- Number of individuals served by network services

### **KEY COLLABORATORS**

#### LEAD: United Way

- City of Miami
- Catalyst Miami, Inc.
- Branches

FUNDING

Partially funded.

RESILIENT305 STRATEGY

# OBJECTIVE 6: CULTIVATE FINANCIAL STABILITY

# ACTION 26: TEACH KIDS TO SAVE

#### HOW THIS WILL HELP US

- Creates community wealth
- Enhances financial stability
- Improves youth graduation rates
- Improves individual well-being

#### **PERFORMANCE METRICS**

- Number of kindergarteners in first co-hort
- Percent of families receiving free and reduced lunch that participate

#### **KEY COLLABORATORS**

LEAD: Catalyst Miami, Inc.

- The Children's Trust
- United Way
- City of Miami + City of Miami Beach
- Miami-Dade County Public Schools

#### FUNDING

86

Partially funded by The Children's Trust and participating GM&B municipalities.

### TIMEFRAME: SHORT-TERM (1-5 YEARS) DESCRIPTION

Children's Savings Accounts (CSAs) are long-term savings accounts that provide incentives to help children and their families build savings for the future. Research indicates that low- to moderate-income children with savings of just \$1-499 when completing high school are three times more likely to enroll in college and four times more likely to graduate. Funds saved in CSAs will be accessible upon high school graduation, which can then help pay for postsecondary education. GM&B will support the expansion of this program by encouraging other GM&B municipalities, anchor institutions, and private partners to support its expansion.

The CSA action is the result of a comprehensive planning process funded by The Children's Trust. United Way. and Citi Community Development, and facilitated by Catalyst Miami, Inc.. From this planning process with key community stakeholders, the Future Bound Miami Consortium emerged with a vision of launching a universal CSA program, with a focus on building financial assets and post-secondary readiness among children from low-wealth families. The program will operate with financial support from both public and private funders. In addition to the initial seed deposit and program incentives, participating children and parents will also have access to free financial education provided by or through Catalyst Miami, Inc. and partners to build financial capability, including information on creating emergency family savings accounts. This program is scheduled to launch in Fall of 2019 in all elementary schools within the City of Miami (reaching a targeted 2.300 kindergarteners). In the second and third years, the program will expand to all elementary schools in Title 1 feeder patterns throughout Miami-Dade County, followed by all remaining elementary schools in years 4 and 5.

#### SPOTLIGHT

#### CATALYST MIAMI, INC.

Since 1996, Catalyst Miami, Inc. has helped thousands of residents to become financially secure and civically engaged. Catalyst Miami, Inc.'s mission is to identify and collectively solve issues adversely affecting low-wealth communities throughout the County, based on these principles:

- PROSPER: We foster prosperity by connecting residents to preventative healthcare options and financial services.
- LEAD: We teach individuals how to make a difference in their communities through trainings for youth and adults in advocacy and public policy.
- CATALYZE: Our entire community must work together, across sectors, to create change that improves the quality of life for residents.



# ACTION 27: EXPAND YOUTH CAREER OPPORTUNITIES

# CULTIVATE FINANCIAL STABILITY

# TIMEFRAME: SHORT-TERM (1-5 YEARS) DESCRIPTION

High school students often encounter barriers when trying to enter job markets that can inform their long-term career decisions. GM&B proposes expanding three existing programs that support Miami-Dade County youth as they leave high school: Big Brothers Big Sisters School-to-Work program; the City of Miami's Summer Jobs Connect Program; and the Summer Youth Internship Program, a collaboration between The Children's Trust and Miami-Dade County. These three programs currently serve approximately 3.225 youth of the more than 75.000 eligible youth in Miami-Dade County. Two of these programs are only active during the summer season; a year-round expansion would allow more youth to be gainfully employed while attending school.

These programs provide benefits to youth by giving them a greater understanding of financial management, real-world work experience, improved interpersonal communication skills, career choice advice and educational guidance, positive adult role models, connections for future career opportunities, resume building for future jobs or college applications, and interview practice.

The Children's Trust will lead this effort with support from Miami-Dade Beacon Council, Greater Miami Chamber of Commerce, and governments involved with GM&B by encouraging and celebrating companies, anchor institutions, and GM&B municipalities that contribute to the programs financially, participate in career-based mentoring programs, and offer paid high school internships.

### HOW THIS WILL HELP US

- Reduces neighborhood violence
- Lifts residents out of poverty
- Provides youth employment
- Improves youth graduation rates
- Improves industry/job diversification

#### PERFORMANCE METRICS

- Number of youths hired during summer and year-round programs
- Number of career mentoring matches

#### **KEY COLLABORATORS**

LEAD: The Children's Trust

- Big Brothers Big Sisters Miami
- Miami-Dade Beacon Council
- Greater Miami Chamber of Commerce
- Miami-Dade County Public Schools
- GM&B Municipalities

#### FUNDING

Partially funded by The Children's Trust, Citi Foundation, Cities for Financial Empowerment Fund, and other corporate sponsors.

#### SPOTLIGHT

## THE CHILDREN'S TRUST

The Children's Trust is supported by a dedicated source of revenue derived from property taxes, established by voter referendum in 2002. Its mission is to partner with the community to plan, advocate for, and fund strategic investments that improve the lives of all children and families in Miami-Dade County. The Trust envisions a community that works together to provide the essential foundations to enable every child to achieve their full potential... Because all children are our children.





# ACTION 28: BREAK THE CYCLE OF YOUTH VIOLENCE

#### HOW THIS WILL HELP US

- Reduces neighborhood violence
- Improves community cohesion
- Reduces duplication of services
- Improves individual well-being

#### **PERFORMANCE METRICS**

- Number of youth arrests reduced in each zip code
- Number of community and primary caregiver engagements
- School attendance rates

#### **KEY COLLABORATORS**

LEAD: Together for Children leaders

- Miami-Dade County Public Schools
- Miami-Dade County
- The Children's Trust

#### **FUNDING**

88

Partially funded by The Children's Trust, Miami-Dade County, and the Jorge Perez Family Foundation.



# TIMEFRAME: SHORT-TERM (1-5 YEARS) DESCRIPTION

Together for Children, launched in April 2016, aims to address known risk factors that lead to youth violence by effectively connecting youth and their families to neighborhood support, services, and other resources. Through collective engagement, this coalition has leveraged resources, experiences, and ideas to create data-driven, neighborhood action plans to address, reduce, and prevent youth violence. Over the next 5 years, Together for Children is committed to programs in targeted neighborhoods that will strengthen families, empower youth through access to opportunities, and protect the most vulnerable youth. The targeted neighborhoods are Homestead, Florida City, Naranja, Perrine, Richmond Heights, Overtown, Liberty City, Miami Gardens, Opa-locka, Little Haiti, North Miami, and North Miami Beach. GM&B commits to supporting the priorities outlined in the neighborhood action plans developed by Together for Children by connecting with program staff and resources, assisting with progress, and by improving communications along the social services spectrum.

Together for Children's collective impact model ensures that funded initiatives serve both youth and their families and maximize resources by eliminating duplication of referrals and programming offerings. Together for Children and its partners will develop a specialized data system that will lead to refined metrics and data collection processes that will work to correlate the relationship of collective engagement of community with community safety. The data system developed for this action will build on best practices related to data sharing and big data decision making.

# ACTION 29: RESPECT OUR ELDERS

# OBJECTIVE 7: ADVANCE PUBLIC HEALTH PRIORITIES



# TIMEFRAME: SHORT-TERM (1-5 YEARS) DESCRIPTION

To ensure long-term resilience is relevant to long-term population shifts, GM&B will facilitate a review of Miami-Dade County's Age Friendly Initiative (AFI) to identify opportunities for raising awareness about aging population and population shifts, understand implications related to long-term planning, and expand opportunities to engage with AFI. Examples of possible engagement opportunities may be assigning an AFI liaison (for updates and opportunities) to support governments, signing the Age-Friendly Pledge/Mayor's Challenge, or adopting "older adults in all policies" practices. Expanding age-friendly efforts is uniquely important in the GM&B region because of its culture of multigenerational living.

In 2017. Miami-Dade County received official designation as a member of the global Network of Age Friendly Communities by Association of American Retired Persons (AARP) and World Health Organization (WHO). The application for this designation was submitted by Miami-Dade County and facilitated by Miami-Dade's County AFI. This designation reflects a collaboration that supports making our community age friendly. per the World Health Organization framework. The Network of Age Friendly Communities designation means that the GM&B region has committed to addressing age-inclusion in the following domains: 1) housing. 2) transportation, 3) outdoor spaces and buildings. 4) civic participation and employment, 5) community support and health services, 6) communication and information, 7) social participation, and 8) respect and inclusion.

#### HOW THIS WILL HELP US

- Improves community cohesion
- Attracts state and federal funding
- Lifts residents out of poverty
- Improves individual well-being

#### PERFORMANCE METRICS

- Priority list of resilience-related planning groups established
- Percent of prioritized groups receiving agefriendly orientation
- Number of cities participating in the AFI

#### **KEY COLLABORATORS**

LEAD: United Way of Miami-Dade

- Miami-Dade Age Friendly Initiative
- Florida Department of Health Miami Dade
- Health Foundation of South Florida
- Association of American Retired Persons
- Urban Health Partnerships

#### FUNDING

Partially funded.

# OBJECTIVE 7: ADVANCE PUBLIC HEALTH PRIORITIES

# ACTION 30: UPDATE THE SOCIAL SERVICES MASTER PLAN

#### HOW THIS WILL HELP US

- Creates community wealth
- Improves public realm
- Improves community cohesion
- Streamlines government processes
- Expands access to health services

#### **PERFORMANCE METRICS**

Dollars secured to complete update

## **KEY COLLABORATORS**

LEAD: Miami-Dade County

GM&B

90

Community-Based Organizations

#### FUNDING

Partially funded by Miami-Dade County; requires matching funds.

## TIMEFRAME: SHORT-TERM (1-5 YEARS) DESCRIPTION

Miami-Dade County's Social Services Master Plan (SSMP) creatively and comprehensively helps leverage and link Miami-Dade's considerable investments in the areas of economic development, social welfare, housing affordability, education, and other health and human services systems. The SSMP was last updated in 2001. GM&B has identified updating the SSMP as a key action item as the strategies and issues in the plan are outdated. Miami-Dade County allocated \$200,000 in its FY 2018-2019 budget towards updating the SSMP and will work with GM&B and other social service stakeholders to attract the funding needed to complete a comprehensive review and update of the SSMP.

The SSMP addresses social services challenges to give Miami-Dade County citizenry an overall snapshot of the issues and challenges, goals, suggested steps for strategic action, and targeted results and outcomes. As part of updating the SSMP, Miami-Dade County will look closely at the evolving challenges that GM&B communities face, including the HIV/AIDS epidemic, opioid use, and youth violence. The updated SSMP will consider Miami-Dade County's community make-up, will assess how to best provide services, and will identify possible alignments with other community assessments, such as the Mobilizing for Action through Planning and Partnerships (MAPP) process. As part of creating a holistic approach in the updated SSMP, Miami-Dade County will review what services can be integrated to avoid duplication and to best meet citizen's needs in a comprehensive manner. An important consideration will be identifying linkages between people's needs, facilitating access to needed services, and providing those services comprehensively based on individual and neighborhood-level needs.

#### SPOTLIGHT

#### **CONSORTIUM FOR A HEALTHIER MIAMI-DADE**

The Consortium for a Healthier Miami-Dade (Consortium) was formed in 2003 by the Florida Department of Health in Miami-Dade County to address the rising rates of chronic disease in the county. With over 350 partners from various sectors—government, health, academic, nonprofit, and private—the Consortium works collaboratively to tackle the various health issues afflicting Miami-Dade County residents to ensure they live longer, happier, and healthier. Through its various committees,

members work on the built environment, nutrition, physical activity, worksite wellness, and tobacco- and smoke-free environments.



# CASE STUDY INVESTING IN HEALTHY COMMUNITIES

Live Healthy Community Partnerships (LHCPs) are collective impact initiatives funded by the Health Foundation of South Florida to strengthen a community's capacity to collaboratively plan and carry out health strategies. LHCP launched in 2014, beginning with each community creating a community action plan that defined its health challenges and goals. This 6-year commitment is a strategic and systemic effort to reduce poor health outcomes by engaging community residents to improve public health indicators unique to each community. Two communities currently have funding: Little Havana and Miami Gardens. Each operates through its City government and is eligible for up to \$3.75 million in funding to implement projects.

Live Healthy Little Havana (Viva Saludable Pequeña Habana) aims to improve the health of this historic neighborhood by addressing social determinants of health with priorities in the public realm, education and employment, and housing. Past projects have focused on connecting community members with resources and services, increasing walkability and bikability, improving the public transit experience, and activating spaces for community recreation. Through the initiative, the City of Miami has developed a deeper understanding of and improved engagement with the Little Havana community and plans to use the lessons learned to scale the model to more neighborhoods throughout the City in 2020 and beyond.

Live Healthy Miami Gardens' goal is to improve conditions in the City of Miami Gardens to make it a healthier place to live, focusing on the following Health Impact Areas: alcohol, tobacco, and other drugs; healthy eating and improved nutrition; mental health; physical activity; and primary health care. Past projects have focused on strengthening organizational-level practices and policies around physical activity and nutrition, reducing the stigma of mental illness and connecting community members to behavioral health resources, and encouraging the community to practice healthy behaviors. In 2018, the City of Miami Gardens was awarded an additional \$3.4 million over 5 years from the Centers for Disease Control (CDC) and Prevention to continue this work.

# CASE STUDY MOBILIZING FOR ACTION THROUGH PLANNING AND PARTNERSHIPS

The Mobilizing for Action through Planning and Partnerships (MAPP) process is a community-driven framework for improving community health. The process allows the examination of issues such as risk factors for disease, illness and mortality, socioeconomic and environmental conditions, inequities in health, and quality of life. MAPP is not an agency-focused assessment process: rather, it is an interactive process that can improve the efficiency, effectiveness, and ultimately the performance of public health systems. The MAPP process includes four community health assessments: local public health system, community themes and strengths, forces of change, and the community health status. These four assessments can help identify and prioritize health problems and facilitate planning and actions to address those problems. Facilitated by public health leaders, this framework helps communities apply strategic thinking to prioritize public health issues and identify resources to address them.

In 2018, the Consortium for a Healthier Miami-Dade began the assessment portion of the MAPP process, resulting in a list of challenges and opportunities that will be used by stakeholders to identify strategic health issues. By using MAPP, communities seeking to achieve optimal health can identify and use their resources wisely, considering their unique circumstances and needs, and form effective partnerships for strategic action.

# OBJECTIVE 7: ADVANCE PUBLIC HEALTH PRIORITIES

# ACTION 31: ADVOCATE FOR MENTAL HEALTH

### HOW THIS WILL HELP US

- Reduces duplication of services
- Improves communication with residents
- Decreases chronic homelessness
- Reduces neighborhood violence
- Streamlines government processes

#### PERFORMANCE METRICS

- Number of individuals accessing community based treatment services
- Number of individuals diverted from the justice system
- Rates of recidivism to the justice system and acute care treatment settings
- Rates of housing admission and retention among chronically homeless individuals
- Number and outcome of mental health calls responded to by Crisis Intervention Team trained police officers
- Number of school faculty and staff trained to recognize signs and symptoms of mental health needs

## **KEY COLLABORATORS**

LEAD: South Florida Behavioral Health Network, Inc.

- 11th Judicial Circuit Criminal Mental Health Project (Judge Leifman)
- Jackson Behavioral Health Hospital
- Miami-Dade County Homeless Trust
- Miami-Dade County Public Schools

#### FUNDING

Partially funded.

92

# TIMEFRAME: SHORT-TERM (1-5 YEARS) DESCRIPTION

To enhance existing programs and fill much needed gaps. GM&B will advocate, at the state and federal level, for more proportional per capita funding for evidencedbased mental health and substance abuse treatment services that will reduce costs to individuals and society. Greater Miami & the Beaches is home to the largest percentage of people with serious mental illnesses of any urban community in the United States. Yet, the State of Florida ranks near the lowest (48th out of 50) in per capita spending for publicly-funded treatment. Roughly 9.1 percent of Miami-Dade residents experience serious mental illnesses, however fewer than 13 percent of these individuals receive care in the public health system.

To better inform funding requests. South Florida Behavioral Health Network, Inc. will lead on developing approaches to determine both the societal cost of our current inadequate mental health and/or substance use treatment options, as well as the economic benefits of increased investments in evidence-based treatment programs. System performance measures will be identified to measure return on investment and ensure accountability for resources allocated because of GM&B's advocacy. In addition, advances in information technology and data analytics will be used to facilitate collaboration among providers of care and to ensure appropriate services are available when and where they are needed.

This work will also help GM&B secure the resources needed to fully operate the Miami Center for Mental Health and Recovery, a first-of-its-kind mental health diversion facility designed to serve individuals who are frequent and costly reoffenders to the criminal justice system, homeless continuum of care, and acute care medical and mental health treatment systems. The facility, to be operated by the South Florida Behavioral Health Network, Inc., will offer a comprehensive continuum of mental health, substance use, and serve as a focal point in the community for the development and dissemination of best practice standards in clinical care, education, research, and community outreach and advocacy.

SPOTLIGHT

# SOUTH FLORIDA BEHAVIORAL HEALTH NETWORK

South Florida Behavioral Health Network is committed to improving the lives of people with mental disorders and addiction problems. The goal is to develop, implement, and refine a coordinated system of behavioral health care



within the community that enhances prevention, treatment, and recovery. The vision of the South Florida Behavioral Health Network is to be a nationally recognized system of care for those at risk and affected by substance use and mental health illnesses.

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# ACTION 32: PILOT ARREST DIVERSION FOR OPIOD USERS





# TIMEFRAME: IMMEDIATE (0-1 YEAR)

#### DESCRIPTION

While opioid addiction is a growing epidemic throughout GM&B, the City of Miami, as the urban core and host of many social services, is a natural magnet for illicit drug users and transactions. Of the 5,404 drug-related arrests in Miami-Dade County during the first 6 months of 2018, 2,351 of them occurred within the City of Miami. In addition, it is estimated that 40 percent of Miami's addict community is homeless. Through grant supported funds, Miami-Dade County, the City of Miami, and Jackson Behavioral Health Hospital (JBHH) recently launched a first-of-its kind arrest diversion program for individuals identified by police officers as having felony possession of opioids for personal use. This program is a major step forward, serving about 100 individuals a year over 3 years, but it will not produce enough new treatment capacity to help everyone in the throes of opioid addiction. Miami-Dade County, the City of Miami, and JBHH will seek additional support to provide more treatment capacity at JBHH and more dedicated long-term housing.

This arrest diversion program is based on the Law Enforcement Assisted Diversion program in the Seattle area, but is unique in its ability to legally bind participants, via voluntary opt-in, to direct substance abuse and mental health treatment services without having them enter the criminal justice system. Individuals who choose to participate in the 12-month treatment program sign a binding treatment agreement that admits them to JBHH for medically supervised withdrawal and medication assisted treatment, as well as mandated therapy and individual case management. If expanded, this arrest diversion program could be made available to other GM&B municipalities.

#### HOW THIS WILL HELP US

- Decreases homelessness
- Expands access to health services
- Improves individual well-being
- Streamlines government processes

#### **PERFORMANCE METRICS**

- Recidivism rate in target population
- Number of individuals served/year

### **KEY COLLABORATORS**

LEAD: City of Miami Police

- City of Miami Human Services (Veterans and Homeless Affairs)
- Jackson Behavioral Health Hospital
- Behavioral Science Research Institute
- Miami-Dade County Opioid Addiction Task Force

## FUNDING

Partially funded by the U.S. Department of Justice.

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# OBJECTIVE 7: ADVANCE PUBLIC HEALTH PRIORITIES

# ACTION 33: ACCELERATE PROGRESS OF HIV/AIDS STRATEGY

### HOW THIS WILL HELP US

- Expands access to health services
- Streamlines government processes
- Attracts state and federal funding
- Improves individual well-being

#### **PERFORMANCE METRICS**

 Percent decrease in HIV transmission rate within Miami-Dade County

# **KEY COLLABORATORS**

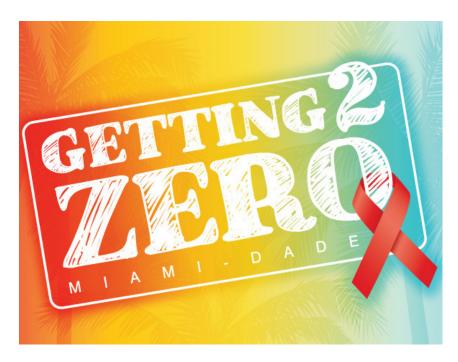
LEAD: Florida Department of Health in Miami-Dade County

- Office of AIDS Central Office
- Ryan White Part A / Minority AIDS Initiative Program
- Care Resource Center
- University of Miami

#### **FUNDING**

Unfunded.

94



### TIMEFRAME: SHORT-TERM (1-5 YEARS) DESCRIPTION

Miami-Dade County has the highest rate of new HIV/AIDS infections of any city in the United States, with one in 85 adults living with HIV/AIDS. In September 2016, the Office of the Miami-Dade County Mayor, the Miami-Dade HIV/AIDS Partnership, and the Florida Department of Health established the Miami-Dade HIV/AIDS "Getting to Zero" Task Force as a means of mobilizing resources and expertise throughout the Miami-Dade community in a concerted effort to address the HIV/AIDS epidemic. The Task Force established a set of 16 strategic action recommendations aimed at addressing this major public health issue in a culturally competent manner, given Miami-Dade County's large immigrant population, and the entire spectrum of HIV/AIDS issues. GM&B will help advance progress of this Strategy by engaging the entities and individuals championing broader, regional recommendations and creating connections with governments and key institutions to expand impact. Partnerships and actions will be informed by determining where, geospatially, HIV/AIDS is being transmitted and where those living with HIV/AIDS reside to make response as place-based as possible. In addition, the Florida Department of Health and stakeholders will align tactics with the National HIV strategy, "Ending the HIV Epidemic: A Plan for America."



# CASE STUDY EXPANSION OF AIDS DRUG ASSISTANCE PROGRAM

The Resilient305 action development process included obtaining ideas from the Founder and Medical Director of Infectious Disease Elimination Act (IDEA Exchange), Florida's first authorized syringe exchange program, as to how to reduce HIV incidences among people who inject drugs.

Resilient305 was able to connect the IDEA Exchange, whose focus is HIV prevention and linkage to care and treatment, to the Florida Department of Health to discuss how IDEA Exchange patients can reduce their viral load. One method is improving medical compliance by referring clients to and streamlining enrollment in the AIDS Drug Assistance Program (ADAP), which serves those with incomes below the federal poverty level and who are unable to afford antiretroviral medications. In addition, IDEA Exchange was informed about third-party prescription pickup and was authorized to pick up medication for seven of their clients, removing a barrier to medical compliance. In fact, IDEA Exchange stated that they "feel certain that this process is essential for keeping these clients compliant with their treatment." Through closer cooperation and communication, ADAP and IDEA Exchange have been able to better serve their common clients, taking advantage of the services already in place.

#### SPOTLIGHT

#### FLORIDA DEPARTMENT OF HEALTH IN MIAMI-DADE COUNTY

Florida Department of Health in Miami-Dade County is the local branch of the Florida Department of Health and has served the Greater Miami-Dade County community since the 1940s. The responsibilities of the DOH-Miami-Dade are to prevent epidemics and the spread of disease, protect against environmental hazards, prevent injuries, promote and encourage healthy behaviors, respond to disasters and assist communities in recovery efforts, and ensure the quality and accessibility of health services.





# ACTION 34: ADVANCE PANDEMICS COMMUNICATION

#### HOW THIS WILL HELP US

- Enhances access to community-based interventions
- Improves natural disaster preparedness
- Streamlines government processes

#### **PERFORMANCE METRICS**

 Number of cases of locally transmitted mosquito-borne diseases

# **KEY COLLABORATORS**

LEAD: Florida Department of Health

- Centers for Disease Control and Prevention
- Miami-Dade County
- City of Miami
- City of Miami Beach

#### **FUNDING**

Unfunded.

96



# TIMEFRAME: SHORT-TERM (1-5 YEARS) DESCRIPTION

The Zika Virus detected in Miami in 2016 was most likely brought to the region by unknowing travelers. GM&B was the first community experiencing the Zika virus known to successfully eradicate it and break the chain of Zika transmission, but the outbreak did reveal gaps in collective action and preparedness to deal with new pandemic threats. GM&B will work with the state and local Departments of Health, the Centers for Disease Control and Prevention, and other necessary stakeholders to reevaluate pandemic risks and determine how to continue to improve collective response in the case of a disease outbreak.

Going forward, climate change, urban densification, and globalization will all increase the GM&B region's vulnerability to disease pandemics. Miami's biodiversity and climate make it a hotspot for species that can carry and transmit viruses to humans (e.g., mosquitoes, bats, birds). In addition, high volumes of travelers, both domestic and international, put Miami at risk for disease interception. Pandemic threats can have broad, intersectional impacts, such as the economic impacts that came because of Zika. Other areas of potential impact could be tourism interruption, stress to existing healthcare systems due to patient surges, worker absenteeism, and mistrust of public infrastructure such as public transit. Assessing the current readiness status of GM&B will assist communities in determining resources and planning needs during a pandemic. Determining ways to improve community-wide immunity as well as identifying trigger points to activate pandemic response are crucial for preventing and addressing disease outbreaks. As a global community. GM&B must be ready to fight pandemics not only to protect residents but also to improve global immunity. Page 103 of 394

GREATER MIAMI & THE BEACHES

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# CASE STUDY ZIKA—FROM SHOCK TO STRESS

In August 2016, the Florida Department of Health (FL-DOH) confirmed two local Zika transmission zones: one in the Wynwood neighborhood of the City of Miami and the other in Miami Beach. This type of shock was new for the region and the two municipalities, along with Miami-Dade County, mobilized quickly with the assistance of state and federal partners. Internally, each entity pulled expertise and directed action across multiple departments: this was not an issue one department could take on its own. Daily calls with the FL-DOH, County, and surrounding jurisdictions took place to discuss mosquito trap counts, health-related information, and deployment strategies.

Staff canvassed the designated Zika Transmission Zones to identify mosquito breeding conditions, remediate concerns, and educate residents and businesses on ways to "Drain & Cover" and "Fight the Bite." Resident outreach was key during this event as residents needed to feel informed and confident in the government response to maintain trust and ensure cooperation in cleanup and mitigation efforts. Standardized messaging, written in pamphlets and other materials, was sent and handed out Countywide to ensure the same information was provided to the public.

This collaborative approach was highlighted by the Centers for Disease Control and Prevention as a "best practices" model to build on for other municipal and county entities. Moving forward, the potential for mosquito-borne illnesses is a stressor that will be monitored.

# OBJECTIVE 8: STRENGTHEN COMMUNITY RESPONSE

# ACTION 35: INCREASE NEIGHBORHOOD RESPONSE

#### HOW THIS WILL HELP US

- Improves natural disaster preparedness
- Improves community cohesion
- Enhances community-based interventions
- Reduces duplication of services
- Expedites disaster recovery

#### **PERFORMANCE METRICS**

- Number of individuals CERT trained
- Number of trainings held
- Number of CERT trainings
- Number of CERT trained individuals residing in low-income neighborhoods

### **KEY COLLABORATORS**

LEAD: Miami-Dade County

- City of Miami Beach
- City of Miami
- City of Miami Gardens Police Department
- City of North Miami Police Department

#### **FUNDING**

98

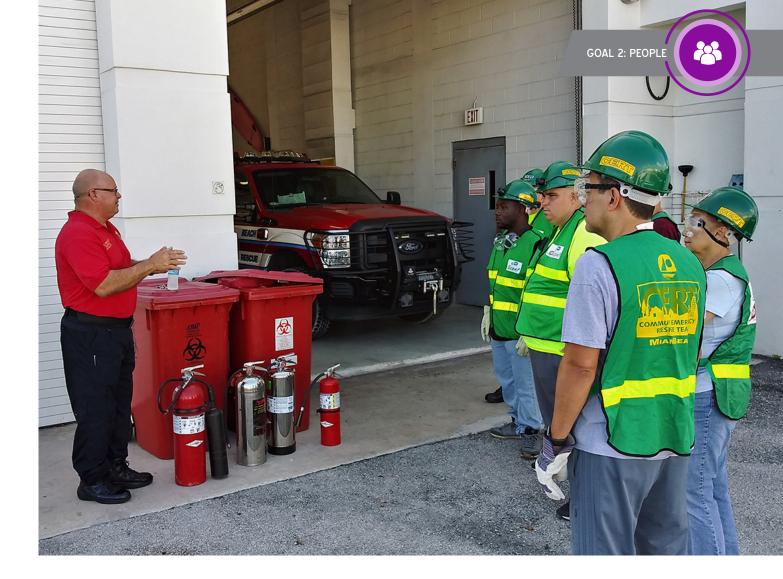
Partially funded by various grants.



# TIMEFRAME: SHORT-TERM (1-5 YEARS) DESCRIPTION

The Community Emergency Response Team (CERT) Program empowers communities and educates residents about disaster preparedness for hazards that may impact their area and trains them in basic disaster response skills, such as fire safety, light search and rescue, team organization, and disaster medical operations. There are near 5,000 trained CERT volunteers in Miami-Dade County. Miami-Dade County will work together with GM&B municipalities to GIS map and identify CERT gaps within GM&B to facilitate CERT programs, coordinate CERT teams, and provide training to CERT team leaders. Municipal CERT coordinators will identify high-need communities to place trainings and recruit where most needed. Miami-Dade County will maintain a master list of CERT-trained volunteers. In addition, Miami-Dade County will offer more diverse training opportunities (CERT+) for CERT trainees to allow them to expand their skillset.

Using the training learned in the classroom and during exercises. CERT members can assist others in their neighborhood or workplace following an event when professional responders are not immediately available to help. CERT members also are encouraged to support emergency response agencies by taking a more active role in emergency preparedness projects in their community. Increasing the number of CERT volunteers in the County and helping them organize into teams will increase neighborhood resilience and help build a culture of preparedness.



# CASE STUDY WEST COCONUT GROVE CERT PROGRAM

The West Coconut Grove CERT team plays a critical role in the resilience of its neighborhood and serves as a model for future CERT teams. Led by a former City of Miami firefighter, the team is the County's largest and most active CERT team; it doubled its size between 2017 and 2018. The team meets once a month to maintain readiness. Its organizational structure, combined with its integral community connections, led to its highly successful first major deployment, responding to Hurricane Irma.

The week before the storm, members of the team met to divide their neighborhood into walkable areas so they could hand out storm preparation information and identify residents who were not evacuating. In conjunction with the Thelma Gibson Health Initiative, the team created a list of individuals who might need electricity for medical purposes as well as food and water to check on after the storm.

After the storm, the team got right to work. A designated central dispatcher coordinated communications and fed information from team members on the ground to support entities, as needed. In addition to door-to-door activity, the team also worked with local supermarkets and restaurants to fill the five local food banks and activate volunteers to help cook for hungry residents.

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# OBJECTIVE 8: STRENGTHEN COMMUNITY RESPONSE

# ACTION 36: TIME TO VOLUNTEER

#### HOW THIS WILL HELP US

- Improves natural disaster preparedness
- Enhances community-based interventions
- Improves community cohesion
- Expedites disaster recovery

#### **PERFORMANCE METRICS**

- Number of volunteers registered on portal
- Number of organizations using the site to share opportunities
- Number of active volunteers

#### **KEY COLLABORATORS**

LEAD: United Way

- Participating GM&B Municipalities
- Community-Based Organizations in GM&B that assist with disaster relief

#### FUNDING

100

Funded by United Way.



# TIMEFRAME: IMMEDIATE (0-1 YEAR) DESCRIPTION

United Way recently expanded its online portal for recruiting and connecting with volunteers before, during, and after a disaster. The expanded function of the portal allows United Way to identify volunteers by special trainings and skills (e.g., medical, childcare, language, CERT). It also promotes training offered by Miami-Dade County, American Red Cross, and other partners. As of March 2019, there were over 1.200 volunteers registered to serve in the GM&B region. By June 2019, United Way will launch an additional upgrade to the portal that will allow GM&B municipalities and community organizations to post and promote volunteer opportunities in the GM&B region for disaster-related volunteer activities. The expanded capability will also streamline the processing of background checks.

Before hurricane season each year, United Way will kick off the season with a volunteer opportunity to help residents get prepared for the upcoming hurricane season. GM&B partners will support this action by promoting the volunteermiami.org portal to their residents and community-based organizations and by using the portal as a resource for their own volunteer needs.



#### UNITED WAY

United Way of Miami-Dade is the County Office of Emergency Management's official volunteer and donations arm before, during, and after a disaster. Before, during, and after Hurricane



SPOTLIGHT

Irma. United Way supported the GM&B region by recruiting volunteers; raising money through Operations Helping Hands; collaborating with local restaurants to provide hot meals to first responders and people in need; coordinating efforts with Feeding South Florida, Salvation Army, the Fire Department, and Miami-Dade County to deliver food, water, and ice to numerous shelters across Miami-Dade County; and providing volunteers to distribute ice and support cleanup efforts at various locations throughout the GM&B region.

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## ACTION 37: PREPARE YOUR PROPERTY





# TIMEFRAME: SHORT-TERM (1-5 YEARS) DESCRIPTION

The City of Miami will partner with public and private organizations to develop outreach content and events to assist property owners to understand their vulnerability to flooding and their options for reducing that risk. Information will be prepared and delivered in a manner that is easily digestible using the best available data. Given the unpredictability of future conditions, the City of Miami intends to communicate known uncertainties while still providing actionable solutions. Information on a variety of flood protection methods appropriate for different time horizons and budgets, along with options for financing, will be created and made available. Not only will this information be available online, it will be disseminated through workshops and outreach events throughout the City.

The goals of this action are to improve residents' preparedness for flood-related incidents, increase citizen's confidence in their ability to adapt to changing environmental conditions, and strengthen the lines of communication between local governments and residents. These outreach efforts also provide the opportunity for local governments to communicate local actions taken to address flooding (e.g., raising roads, installing pump stations, enhancing green infrastructure).

The City of Miami will determine the best mechanisms for keeping the distributed information up to date and will document the results of these tools and events to share best practices with GM&B municipalities.

#### HOW THIS WILL HELP US

- Reduces sea level rise and coastal flooding impacts
- Improves natural disaster preparedness
- Protects against storm-related impacts
- Improves communication with residents

#### PERFORMANCE METRICS

- Number of property owners attending events
- Number of unique visits to resources site
- Number of property owners who report acting based on resources provided

#### **KEY COLLABORATORS**

LEAD: City of Miami

- Miami-Dade County
- City of Miami Beach
- Mix of University, Private, and Nonprofit Partners

#### FUNDING

Partially funded by the City of Miami.

GOAL 2: PEOPLE

## OBJECTIVE 8: STRENGTHEN COMMUNITY RESPONSE

## ACTION 38: SUPPORT RESILIENCE HUBS

### HOW THIS WILL HELP US

- Improves natural disaster preparedness
- Enhances community-based interventions
- Improves community cohesion
- Improves communication with residents
- Expedites disaster recovery

#### PERFORMANCE METRICS

- Number of resilience hub sites launched by end of 2020
- Number of residents visiting resilience hub month
- Number of residents served after a natural disaster

#### **KEY COLLABORATORS**

LEAD: Catalyst Miami, Inc.

- The Miami Foundation
- Miami-Dade County
- Participating GM&B municipalities

#### FUNDING

102

Partially funded by The Miami Foundation, Citi Foundation, Robert Wood Johnson Foundation, and CRUO Fund at Movement Strategy Center.



## TIMEFRAME: SHORT-TERM (1-5 YEARS) DESCRIPTION

Throughout Miami-Dade County, local governments and non-profits alike have been working towards improving connection and access to information and services that are vital to community building and personal resilience. To achieve this, a local community advocacy and empowerment organization, Catalyst Miami, Inc., has started to work with governments and community members to develop "resilience hubs" in five target communities: Hialeah, Homestead-Naranja, Little Haiti, Miami Gardens, and Overtown. GM&B will support and embrace the establishment of resilience hubs and will determine how to integrate operations across the region to best serve communities. An important aspect of the resilience hubs will be to establish clear communication pathways during disaster events to ensure community needs are met.

Resilience hubs will serve a crucial role in disaster preparation and response, but they will also operate year-round. They will offer connections to government initiatives, as well as their own programming and supplemental social services. Catalyst staff will serve as supplemental community liaisons and help entities connect with the individuals they serve. The model built by these resilience hubs can be replicated widely and used to address every neighborhood's unique resilience challenges.



#### SPOTLIGHT

#### THE MIAMI FOUNDATION

Since 1967, The Miami Foundation has served as the primary community foundation dedicated to improving the quality of life in Miami-Dade County. The Miami Foundation has invested more than \$300 million in grants and scholarships. Following Hurricanes

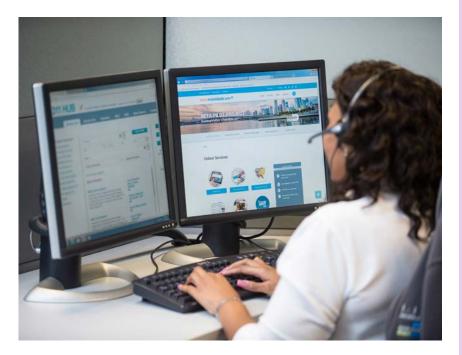
Irma and Maria in 2017, The Miami Foundation awarded more than \$5.4 million to support organizations addressing key recovery needs in the GM&B region, enhancing longterm capacity of communities to be better prepared, supporting resilience hubs, and coordinating key multisector

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GOAL 2: PEOPLE

## GET THE 311 ON RESILIENCE FOR THE 305 COMMUNICATE THE CONCEPT OF RESILIENCE



## TIMEFRAME: IMMEDIATE (0-1 YEAR)

#### DESCRIPTION

Miami-Dade County has a robust and well-developed 311 Contact Center that addresses questions and places service requests from callers; this center is an excellent resource that can be used by GM&B. GM&B will leverage the 311 Contact Center to distribute resilience-related information about relevant direct services and projects, as pertinent. To accomplish this, GM&B will provide the 311 Contact Center an informational script and FAQs designed to provide information about our shocks, stressors, actions, and services. This information will be made available to callers. GM&B will provide the initial information and provide an annual review and update of the information. The 311 Contact Center will also be a resource for launching new campaigns related to resilience actions; the information will be disseminated as messages that callers hear while waiting for an operator. The 311 Contact Center, in turn, will share important resilience data, such as information or service requests, that will be useful to GM&B for its resilience Strategy actions.

#### HOW THIS WILL HELP US

- Improves communication with residents
- Increases understanding of resilience
- Streamlines government processes

#### PERFORMANCE METRICS

- Number of 311 calls related to key resilience issues
- Number of knowledge bases created about resilience

## **KEY COLLABORATORS**

LEAD: Miami-Dade County

GM&B

#### **FUNDING**

Funded through the existing Miami-Dade County budget.



## ACTION 40: CREATE A K-12 PLAN FOR RESILIENCE LITERACY

#### HOW THIS WILL HELP US

Increases understanding of resilience

#### **PERFORMANCE METRICS**

 Number of K-12 curriculum modules/courses per grade integrating climate change

### **KEY COLLABORATORS**

LEAD: Miami-Dade County Public Schools

- Miami-Dade County
- South Florida Water Management District
- FIU School of Education and Sea Level Solutions Center
- The CLEO Institute
- Dream in Green

#### **FUNDING**

Unfunded.

104



## TIMEFRAME: SHORT-TERM (1-5 YEARS) DESCRIPTION

GM&B is committed to fostering a future workforce and citizenry that understands the causes and impacts of climate change on our natural and man-made systems and is prepared to lead in a new resilient economy. Miami-Dade County Public Schools, together with its multiple community partners, already has extensive climate change and environmental education built into its general and magnet school program curriculum. However, in recognition of South Florida's increasing development pressures, climate change impacts, and sea level rise. Miami-Dade County Public Schools will work with partners to augment its K-12 curriculum with lessons, projects, and experiential learning experiences that increase understanding of the region's complex water systems and challenges. The K-12 curriculum will encourage students to imagine how we might adapt our built systems and alter the way we design cities and buildings in the future. Climate resilience and sustainability literacy will be an increasingly critical 21st century career skill not just in the GM&B region, but globally. GM&B wants to inspire the next generation to begin building the cities of tomorrow.



## **CASE STUDY** NONPROFITS TACKLING **ENVIRONMENTAL EDUCATION**

There are several nonprofit organizations in GM&B dedicated to building literacy and grassroots engagement on climate change, water impacts, and resilience. A more informed and civically engaged public will help advocate for and generate policies that strengthen communities and support residents.

Active in South Florida for over a decade, Dream in Green (DIG) educates individuals about environmental challenges and eco-friendly behaviors. The DIG Academy focuses on building environmental literacy and stewardship in K-12 schools through STEM curriculum alignment, developing classroom activities for teachers, and funding student-led sustainability initiatives.

Since 2010. The CLEO Institute has been working to educate and empower all sectors of society on climate change basics. Its signature "Climate 101" trainings have been offered in the community since 2012. Past offerings have included training tailored for municipal staff members, elected officials, and homeowners associations.

Catalyst Miami, Inc. launched its CLEAR (Community Leadership on the Environment, Advocacy, and Resilience) Miami program in the fall of 2016. CLEAR Miami increases participants' understanding of climate resilience, ways to get involved in their communities, and the intersectionality of climate, environmental, and social issues.



SPOTLIGHT

#### MIAMI-DADE COUNTY PUBLIC SCHOOLS

Miami-Dade County Public Schools is the fourth largest school district in the United States, composed of 392 schools, 345,000 students, and over 40,000 employees. The school district stretches over 2,000 square miles to include diverse and vibrant communities ranging from rural and suburban to urban cities and municipalities. A truly global school district, its students speak 56 different languages and represent 160 countries. Superintendent Alberto M. Carvalho has led the school district since the fall of 2008. During his tenure, the district has received state and national recognition for unprecedented increases in student achievement and graduation rates.



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## OBJECTIVE 9: COMMUNICATE THE CONCEPT OF RESILIENCE

## ACTION 41: SEE IT TO BELIEVE IT

#### HOW THIS WILL HELP US

- Improves communication with residents
- Increases understanding of resilience
- Enhances community-based interventions
- Improves natural disaster preparedness

#### **PERFORMANCE METRICS**

 Number of organizations using the graphic visuals

### **KEY COLLABORATORS**

LEAD: Miami-Dade County Cultural Affairs

- Knight Foundation
- City of Miami Beach

#### FUNDING

106

Public arts contest is unfunded.

### TIMEFRAME: IMMEDIATE (0-1 YEAR) DESCRIPTION

In the GM&B region, we want resilience to be more than a word. We seek to create a culture, behavior, and a way of being that incorporates resilience. The concept of resilience is complex— the term is wide-reaching and means different things to different people. The GM&B seeks to create an emotional understanding and connection to resilience through the arts. The region is home to a vibrant and strong artistic world, with more than 16 million people attending cultural events each year. The GM&B can build on the presence of this artistic world to increase resilience by visually and emotionally connecting with people of all ages across our diverse cultures and neighborhoods.

GM&B will support several organizations in creating visuals—infographics, photos, and short video vignettes—to explain resilience in all its facets. These visuals will be created in a form that can be easily shared through multiple channels, from social media to church programs. The content of the visual will be appropriate for multiple audiences, including governments, community organizations, schools, and other venues. The visuals will be created by local artists and will rise organically in response to local resilience challenges and solutions.

GM&B will support the work of the Miami-Dade Cultural Affairs Department to host a public art contest to provide a non-predictable, perhaps controversial view of Resilient305. The winning materials from this contest will be added to the suite of "resilience visuals" available for use throughout the GM&B region. If successful, this contest could become an annual contest. Possible funding sources may include integrating with existing funding streams for arts and culture, cultural affairs grants, tourist development grants, and local grants for placemaking.

SPOTLIGHT

### THE MIAMI-DADE COUNTY DEPARTMENT OF CULTURAL AFFAIRS

The Miami-Dade County Department of Cultural Affairs and its volunteer advisory board, the Cultural Affairs Council, support cultural excellence, diversity, and participation throughout Miami-Dade County by strategically creating and promoting opportunities for our community's thousands of artists and not-for-profit cultural organizations and their audiences. The Department and Council provide grants and technical assistance to cultural organizations and individual artists; develop and improve cultural facilities;

create and advance arts education, public information, and outreach programs; advocate for effective cultural policies and for more public and private resources to invest in cultural development; and promote and market our cultural





## CASE STUDY MIAMI BEACH ART IN PUBLIC LIFE RESIDENCY

The Arts South Florida has partnered with the City of Miami Beach to offer an Art in Public Life residency focused on the challenges of climate change, sea level rise, and broader resilience. Community engagement is a central element in the work of visual artist Misael Soto, who has been selected as the first artist in residence. This year-long residency has been funded by the Knight Foundation and has the potential to extend an additional year.

Through this residency, Misael has been focusing on sea level rise, its economic and social consequences, and other challenges faced by many cities in the 21st century. Misael's first installation was entitled "Sand Amphitheater, Theater, Arena." This project was located at Collins Park (2100 Collins Avenue). From October 28 through November 17, Misael brought together City staff and community volunteers to fill and build in three sections an amphitheater using over 11.000 sandbags. The installation hosted diverse programming at each stage of its construction. Programming included panel discussions on Miami Beach's history and environment, films, poetry, and music. All programming used the theme of sand as a jumping off point and lens to better understand the past and future of the city.

Misael's creative practice is engaging the community in new and innovative ways and is creating new avenues for dialogue and exchange around the challenges faced by the City of Miami Beach. Projects such as "Sand Amphitheater. Theater. Arena" bring together a diverse group of stakeholders that are engaged through active participation in the actual installation's construction and the programing.







5. Terrafish by Felice Grodin. Photo: Christian Bonet 6. Anhinga in Calvary Cabin by Deborah Mitchell.

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2. Holoscenes by Lars Jan. Photos by Eli Abasi



4. Diatomaceous Earth by Lee Pivnik





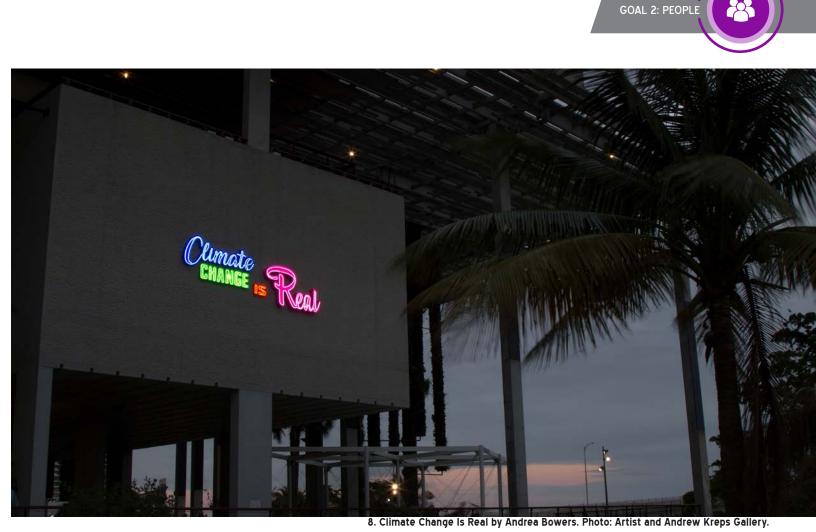
3. inverse condo bend by AST Collective



7. Holoscenes by Lars Jan. Photo: Eli Abasi

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**CLIMATE CHANGE INSPIRED ART** 





9. Holoscenes by Lars Jan. Photo: Eli Abasi



10. Sinking Everglades by Lucinda Linderman



11. The Bubble Pops Project by Laurencia Strauss

The GM&B region is booming with arts, culture, and creative people. Many local and international artists have been inspired to create works that confront the challenges of a changing climate on our community. GM&B recognizes a few here as encouragement to artists to reach diverse audiences, advance our public discourse, and strengthen our communities. of 394









13. National Water Dance 2018 by Dale Andree. Photo: Mitchell Zachs.

# CLIMATE CHANGE INSPIRED ART



14. Underwater HOA by Xavier Cortada. Photo: Village of Pinecrest.

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16. Water Pollution by Isabella Senatore



18. Anthropocene Extinction by Reinier Gamboa, Linda Cheung. Image courtesy of Before It's Too Late.



19. Oracle by Alexander Zastera. Photo: Roberto LaTorre.



15. National Water Dance 2018 by Dale Andree. Photo: Mitchell Zachs.

17. Self Portrait, Big Cyprus Everglades by Simon Faithfull.



20. Reenactment For A Future Scenario #2: Cape Romano by Simon Faithfull. Photo: Artsail

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A strength of the Greater Miami & the Beaches (GM&B) region is our understanding of the power of collaboration. We have seen its success in the Southeast Florida Climate Change Compact and our joint participation in the 100RC Resilience Accelerator initiative. The actions described in the Resilient305 Strategy pave the way for increasing efficiencies among all 34 cities and county as we unite in tackling the shocks and stressors we share, from flooding to major hurricanes. The challenge is to make sure that staff and leaders across the GM&B municipalities have both an understanding of the breadth and depth of our challenges and the tools needed to address them. Through our "Pathways" actions, we aim to build the connections, collaborations, and committed leadership needed to change the status quo, enabling GM&B to become a global leader in resilience. We can achieve this by setting common goals, and committing to actions that bring together governments, businesses, and academic and community organizations.

## WHO IS WHO?

#### THE PARTNERSHIP Greater Miami & the Beaches (GM&B)

THE SUPPORTING ORGANIZATION 100 Resilient Cities (100RC)

THE STRATEGY Resilient305

THE IMPLEMENTING TEAM PIVOT (Progress Innovation Vision for Our Tomorrow)





## **Objective 10**

# **Pre-plan for Post-recovery**

Action 42	Pre-Planning for Post-Disaster Toolkit		
Action 43	Roll-out 5-Step Guide to Innovative		
	Recovery Financing		
Action 44	Bounce Forward 305 - Distribute Resilient		
	Urban Land Use Essentials Guide		
<b>Objective 11</b>			
Cultivate Resilience Expertise			

Action 45	Send your Boss to Bootcamp
Action 46	Resilient 35 in the 305 Network
Action 47	Train Employees to be Resilient
Action 48	RISE to the Rescue

## **Objective 12**

# Leverage our Experience

Action 49	Collaborate with Universities	
Action 50	Create an Actionable Science Advisory	
	Panel (ASAP)	
Action 51	Resilience Accelerator Workshops	
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115

## **Objective 13**

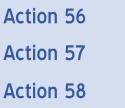
# **Develop Shared Resources**

Create a Resilient305 ArcGIS Hub		
Share Bold Integrated Water Models		
Employ a One Water Approach		
Planning Efficiently & Effectively Together		

Action 52	
Action 53	
Action 54	
Action 55	

## **Objective 14**

# Leverage our Dollars



Action 59

Finance a Resilient Future Leverage the Power of Purchasing Pilot Resilience Financing Decisions Toolkit Demonstrate Cost Benefits of Resilience GOAL 3: PATHWAYS



## ACTION 42: PRE-PLANNING FOR POST-DISASTER TOOLKIT

#### HOW THIS WILL HELP US

- Streamlines government processes
- Increases understanding of resilience
- Improves natural disaster preparedness
- Attracts state and federal funding
- Expedites disaster recovery

#### **PERFORMANCE METRICS**

- Number of cities trained in the Miami-Dade County Intergovernmental Annex on Post-Disaster Recovery
- Number of cities that use the toolkit to develop Post-Disaster Plans
- Number of cities reporting faster recovery after a shock

#### **KEY COLLABORATORS**

LEAD: Miami-Dade County

- City of Miami Beach
- City of Miami
- All Miami-Dade County municipalities

#### FUNDING

116

Funded by in-kind support



#### TIMEFRAME: SHORT-TERM (1-5 YEARS)

#### **DESCRIPTION**

Disaster recovery can be a long process with the success and timeliness of the efforts being partially dependent on quality pre-planning. Recovery efforts begin immediately after the disaster/shock, with actions and programs being set in motion, setting the stage for a long-term recovery for which the entire community is already prepared.

In 2018, GM&B developed the "Rapid Response Essentials" toolkit to foster better intergovernmental coordination for response and recovery actions. The toolkit is aligned with the County's recently updated Post Disaster Redevelopment Plan (PDRP) and is an appendix to the County's Comprehensive Emergency Management Plan. GM&B encourages cities to use the plan's guidance to analyze their capability to recover or bounce forward after a shock and, if appropriate, create their own tailored version of the toolkit.

The toolkit:

- Provides awareness of what government response is and helps to clarify responsibilities
- Spells out steps to set up for a recovery process that supports a rapid bounce forward
- Creates a network of trained and prepared recovery staff
- Builds bridges to other segments of the community, including businesses and the most vulnerable
- Provides a roadmap of critical path to recovery for whole community

### ACTION 43: ROLL-OUT 5-STEP GUIDE TO INNOVATIVE RECOVERY FINANCING

#### TIMEFRAME: IMMEDIATE (0-1 YEAR)

#### DESCRIPTION

Disaster preparedness is a strength of the GM&B region. The region has learned from history, having experienced disasters, but these risks have strengthened our emergency management preparation and response systems. To advance financial recovery, lessons learned from past storm events have been transformed into a simple and short 5-Steps to Innovative Disaster Financing guide to complement traditional insurance and FEMA funding for recovery in GM&B municipalities. This guide focuses on financial preparedness to recover faster after an event. Cities conventionally rely on traditional indemnity insurance and FEMA reimbursements, but this is often not enough to cover all the damages and service needs. It is also cumbersome and often takes too long. The guide describes a cohesive interdisciplinary team approach to examine current insurance coverage, financial risk, bond ratings, and economic drivers. The guide includes a list of financing options for recovery, and their benefits and drawbacks. The guide also provides information about parametric insurance, prepared by SwissRe, a 100RC Platform Partner. The Government Finance Officers Association of the United States and Canada (GFOA) will expand the use of the 5-Steps Guide with its member cities, highlighting it as a resource and topic for conferences.

#### SPOTLIGHT

#### **Government Finance Officers Association**

The GFOA, founded in 1906, represents public finance officials throughout the United States and Canada. The association's more than 20,000 members are federal, state/ provincial, and local finance officials deeply involved in planning, financing, and implementing thousands of governmental operations in each of their jurisdictions. GFOA's mission is to advance excellence in state and local government financial management and it has accepted the leadership challenge of public finance. To meet the many needs of its members, the organization provides best practice guidance: consulting; networking opportunities; publications, including books, e-books, and periodicals; recognition programs; research; and training opportunities for those in the profession.



## OBJECTIVE 10: PRE-PLAN FOR POST-RECOVERY

#### HOW THIS WILL HELP US

- Streamlines government processes
- Improves financial planning
- Attracts state and federal funding
- Expedites disaster recovery

#### **PERFORMANCE METRICS**

- Number of cities reporting using resource
- Change in municipality financial coverage

#### **KEY COLLABORATORS**

LEAD: Government Finance Officers Association of the United States and Canada

#### **FUNDING**

Unfunded

117



## ACTION 44: BOUNCE FORWARD 305 - DISTRIBUTE RESILIENT URBAN LAND USE ESSENTIALS GUIDE

#### HOW THIS WILL HELP US

- Improves public realm
- Increases understanding of resilience
- Streamlines government processes
- Improves natural disaster preparedness

#### **PERFORMANCE METRICS**

- Number of GM&B municipalities reporting using the guide
- Number of GM&B municipalities updating planning documents/ordinances

## **KEY COLLABORATORS**

LEAD: GM&B

- Gold Coast Chapter of American Planning Association
- Miami-Dade County Planners Technical Committee
- Miami-Dade County School Board Staff Working Group
- Local municipal planning and land use boards

#### **FUNDING**

None needed

118



#### TIMEFRAME: IMMEDIATE (0-1 YEAR)

#### **DESCRIPTION**

The Resilient Land Use Essentials Guide was developed during Resilient305 Strategy development phase. It is a guide for governments and other urban stakeholders in the GM&B region that contains recommendations for land use actions that local governments can implement before a disaster to facilitate post-disaster recovery and potentially minimize negative impacts, particularly in the face of climate-induced flooding and sea level rise. In this context, land use planning refers to rules and guidelines governing the disposal of public and private land to promote the physical security of urban communities. The guide is intended for every city planner, with notice to the city manager and emergency manager. GM&B lead planners will share, present, and facilitate dialogue at local collaborating venues.

## ACTION 45: SEND YOUR BOSS TO BOOTCAMP

## OBJECTIVE 11: CULTIVATE RESILIENCE EXPERTISE



#### TIMEFRAME: IMMEDIATE (0-1 YEAR)

#### **DESCRIPTION**

Plans and strategies tend to sit on the shelves unless they are operationalized and actively put into use. It is critical for all 34 GM&B cities and the county to be motivated to adopt resilience policies at the governance level, and take action at the staff operational level. To accomplish this, Miami-Dade County will collaborate with GM&B partners to host an intensive 1-day workshop every January for the next 3 years. The boot camp is geared to newly elected and re-elected local municipal elected officials and is intended to grow our leadership commitments beyond mayors. Participants will be introduced to theory and practice of the Resilience Accelerator approach. They will be coached by experts and inspired by 100RC network mayors experienced in implementing strategies. Local and regional resources will also be shared. Participants will leave with the tools, tips, tricks, and relationships to operationalize the Resilient305 Strategy and support their CROs in action and implementation. Participating cities that commit to creating or identifying a CRO in their city would be able to participate in Action 46: Resilient 35 in the 305.

#### HOW THIS WILL HELP US

- Increases understanding of resilience
- Streamlines government processes

#### **PERFORMANCE METRICS**

- Number of elected officials participating in Bootcamp annually
- Percent GM&B municipalities participating in Bootcamp annually
- Number of GM&B municipalities with CRO

### **KEY COLLABORATORS**

LEAD: Miami-Dade County

GM&B

#### FUNDING

Initial in kind support from GM&B and The Miami Foundation with participating cities providing in-kind support after participation



## ACTION 46: RESILIENT 35 IN THE 305 NETWORK

#### HOW THIS WILL HELP US

- Reduces sea level rise and coastal flooding impacts
- Improves water quality
- Improves natural disaster preparedness
- Improves community cohesion
- Increases understanding of resilience
- Streamlines government processes

#### **PERFORMANCE METRICS**

- Number of cities active in the network/year
- Number of multi-city resilience projects established
- Number of cities with CRO
- Number of peer learning exchanges by end of 2020

### **KEY COLLABORATORS**

LEAD: Miami-Dade County

- All municipalities within Miami-Dade County
- Urban Sustainability Directors Network
- Southeast Sustainability Directors Network
- Florida Sustainability Directors Network

#### FUNDING

120

Within existing GM&B municipalities' budgets

#### TIMEFRAME: SHORT-TERM (1-5 YEARS)

#### DESCRIPTION

Miami-Dade County will catalyze the resilience work across Miami-Dade County by providing peer exchange and connecting local government practitioners through the planned Resilient 35 in the 305 Network. The 305 Network will facilitate intergovernmental collaborative work among practitioners by enhancing and supporting the sharing of communication and resources between cities in Miami-Dade County to advance resilience work. The 305 Network will support its member cities in their resilience work, develop multi-city collaboration projects, influence the development of policies at the local and regional level, and build a network of trusting relationship between peers. To participate in the 305 Network, cities commit to creating a CRO position or identifying a person responsible for CRO duties.

305 Network members will be able to transfer knowledge learned from their peers to their own work and thereby synergistically advance resilience within their municipality. Through the 305 Network, GM&B municipalities will be able to leverage resources to become better prepared to overcome the shocks and stressors the region faces. For example, the City of Miami Beach has made significant strides in stormwater management, land use changes, and creative procurements. The City's lessons learned and resulting products will be made available to 305 Network member cities to modify and inspire their own work. By participating in this local network, including the elected official bootcamp (Action 45, Send your boss to bootcamp) and the online training, GM&B municipalities in the GM&B region are truly making strides towards resilience.



#### SPOTLIGHT

#### LOCAL MITIGATION STRATEGY

Miami-Dade County's Local Mitigation Strategy (LMS) is a

LMS Miami-Dade

whole-community initiative designed to reduce or eliminate the long-term risk to human life and property from hazards. Established over two decades ago, the LMS is a comprehensive approach to effectively reduce the impact of current

and future hazards and risk faced by communities within Miami-Dade County. The LMS is a compendium of efforts of the whole community, integrating governmental and nongovernmental agencies such as non-profit, private sector, educational and faith-based organizations as well as communities, families and individuals.

In addition to preparing residents for the potential impacts of various types of natural hazards, the LMS is critically important because it satisfies Miami-Dade County's mitigation plan requirement under Section 322 of the Stafford Act as enacted under the Disaster Mitigation Act of 2000 and enables all jurisdictions that participate in the LMS to be eligible for federal hazard mitigation grants in the event of a declared disaster. To remain current and vital, the LMS is updated annually and the LMS Committee holds four meetings yearly. Additionally, the LMS plan undergoes a complete state and federal review and approval every 5 years by Florida's Department of Emergency Management and FEMA, and is ultimately adopted by local elected officials.

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## ACTION 47: TRAIN EMPLOYEES TO BE RESILIENT

## OBJECTIVE 11: CULTIVATE RESILIENCE EXPERTISE



#### TIMEFRAME: IMMEDIATE (0-1 YEAR)

#### DESCRIPTION

For some occupations, such as a CRO or an Emergency Manager, resilience is the essence of the job. For many others, resilience adds a new way of thinking, a new lens to examine existing work and service delivery. The City of Miami Beach will pilot online resilience training for all employees and make the material available to the GM&B municipalities to enable them to adapt it to their own training programs.

By using eLearning platforms, cities can create custom learning experiences that engage learners through interactivity and collaboration. These systems are available 24 hours a day. 7 days a week, 365 days a year for any department and any shift. Effective rollout will include determining which courses are appropriate for learners. The City of Miami Beach will work with experts to develop content and build courses that may include a PowerPoint presentation, video vignettes, and/or a mastery component. Each government entity can further customize the resilience training with city-specific information and can work with their internal training coordinators to determine who will be required to take the courses, assign them through the eLearning platform, and determine the frequency of the refreshers.

#### HOW THIS WILL HELP US

- Increases understanding of resilience
- Streamlines government processes

#### **PERFORMANCE METRICS**

- Number of employees trained annually
- Number of entities implementing the training

#### **KEY COLLABORATORS**

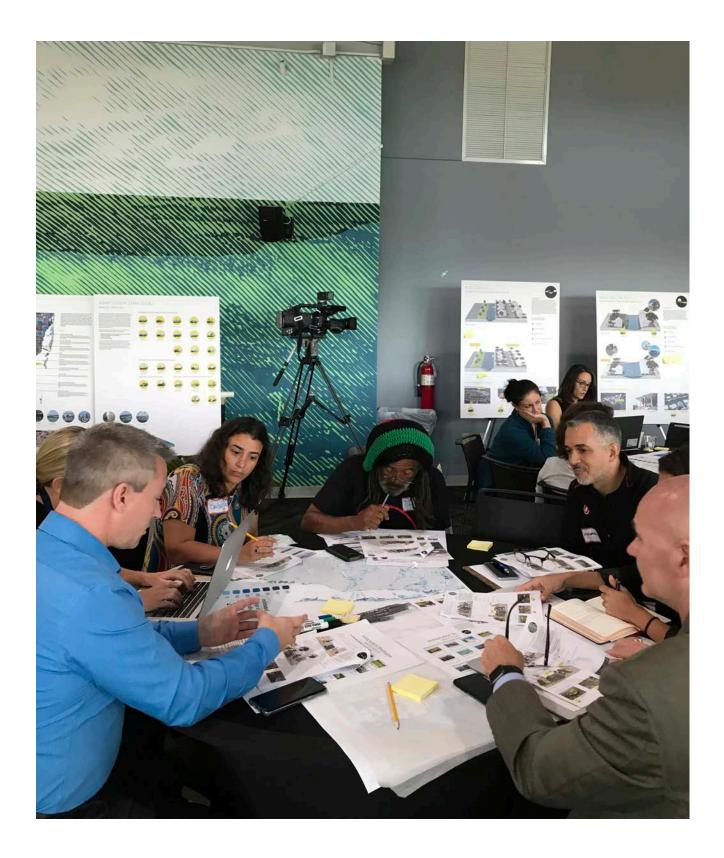
LEAD: City of Miami Beach

Miami-Dade County

#### **FUNDING**

Partially funded by in-kind services and participating cities

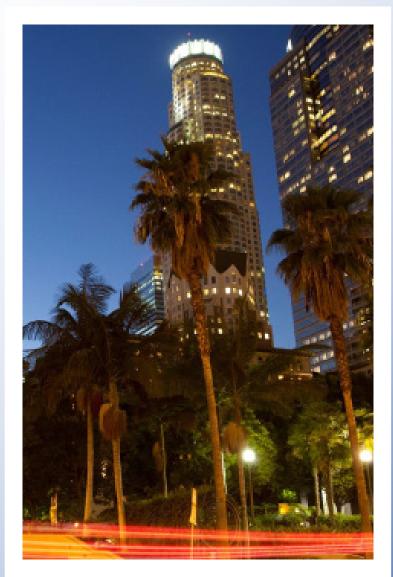
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## CASE STUDY 100RC TRAINING FOR LOS ANGELES

As part of the effort to spread the impact of Resilient Los Angeles and to implement its priority initiatives, Los Angeles Mayor Eric Garcetti signed an executive directive instructing many City departments to designate Departmental Chief Resilience Officers (DCROs) who are tasked with integrating resilience priorities across each arm of City operations, programs, and policy. With its diversity in expertise and thematic interest, this group is a critical resource for mainstreaming resilience thinking in Los Angeles. By significantly expanding the number of resilience champions in Los Angeles and paving the way for new kinds of cross-departmental partnerships on resilience initiatives, the group also sits at the forefront of Resilient Los Angeles implementation.

To support these efforts, 100RC partnered with the City of Los Angeles to conduct in-depth collaboration sessions for the DCROs in November 2018, focused on project financing and frameworks for implementation and evaluation to further advance resilience work. The interactive workshop not only equipped the DCROs with new methods and tools to design and implement projects with resilience benefits, but also empowered them to directly apply these practices with the aim of building resilience capacity among departmental staff and City stakeholders.





## ACTION 48: RISE TO THE RESCUE

#### HOW THIS WILL HELP US

- Improves communication with residents
- Improves community cohesion
- Enhances community-based interventions
- Increases understanding of resilience

#### PERFORMANCE METRICS

- Number of RISE Guide downloads
- Number of GM&B municipalities using RISE Guide

#### **KEY COLLABORATORS**

LEAD: Municipal employees, contractors, and university students

#### **FUNDING**

124

GM&B municipalities may prioritize with existing funds

#### TIMEFRAME: SHORT-TERM (1-5 YEARS)

#### DESCRIPTION

How we communicate the needs of more complex projects both planned and underway in the GM&B region is paramount to gaining public support and engagement. GM&B municipalities will leverage the City of Miami Beach Resilient Integrated Strategic Engagement (RISE) Guide to ensure strong and consistent messaging that increases awareness and helps shape the narrative around resilience. The purpose of this action is to provide cities with new tools and resources to engage and dialogue with the communities of today about the vision for tomorrow. Communicating purpose, customizing products, and coordinating processes are the basis of a core framework that any city can use.

The City of Miami Beach created its RISE Guide out of a need for consistent and transparent city messaging surrounding the Miami Beach Rising Above stormwater and climate resilience programs. Cities can tailor this guide for their own use. The facts, tips, and training in the RISE Guide will empower staff in community dialogue, improving the public's trust and faith in city adaptation actions. Tools like the RISE Guide are essential to break down silos, build knowledge of resilience, and arm communicators and all departments with the information they need to speak with the community.



#### **UNIVERSITY OF MIAMI**

A graduate student intern attending the University of Miami School of Education and Human Development Community and Social Change Master's Program developed the guide based on models and theories from the field of community psychology. Community psychology focuses on social, cultural, economic, political, environmental, and historical influences to positively impact local communities at a systems level, not just the individual level.

UNIVERSITY OF MIAMI

SPOTLIGHT

## ACTION 49: COLLABORATE WITH UNIVERSITIES



#### TIMEFRAME: SHORT-TERM (1-5 YEARS)

#### DESCRIPTION

GM&B will challenge the spirit of innovation by enhancing its ongoing partnership with universities and industry experts to develop creative solutions to technical problems. GM&B will leverage research and expertise from local and regional academic institutions—such as Florida International University, Miami-Dade College, and the University of Miami—to help prepare for and address current and future shocks and stressors via a university collaborative. These institutions are committed to collaborating to move resilience forward with GM&B, which will foster a community-owned approach to adaptation measures and mitigation efforts. These institutions have research expertise in addressing 21st-century problems, such as housing, climate resilience, and transportation, and are seedbeds for innovative solutions to these challenges. The collaborative will work with the PIVOT Team to identify research priorities and will be convened yearly by the PIVOT Team to share and give updates on ongoing research and projects related to shocks and stressors.

These institutions have a history of collaboration with GM&B under a MetroLab agreement activated in 2017 to address the Zika outbreak. MetroLab is a City + University Collaborative for Urban Innovation and drives partnerships between local governments and universities to help the public sector adapt to rapid technology change.

## OBJECTIVE 12: LEVERAGE OUR EXPERIENCE

#### HOW THIS WILL HELP US

- Increases understanding of resilience
- Streamlines government processes
- Improves industry/job diversification

#### **PERFORMANCE METRICS**

- Number of projects developed in collaboration with universities and colleges
- Dollars received by partners to fund collaborative projects

### **KEY COLLABORATORS**

LEAD: Miami-Dade County

- Florida International University
- Miami-Dade College
- University of Miami
- Florida Climate Institute

#### **FUNDING**

Partially funded through GM&B staff time and university research grants



## ACTION 50: CREATE AN ACTIONABLE SCIENCE ADVISORY PANEL (ASAP)

#### HOW THIS WILL HELP US

- Reduces sea level rise and coastal flooding impacts
- Reduction in sunny day flooding
- Reduces stormwater flooding
- Attracts state and federal funding
- Increases understanding of resilience

#### PERFORMANCE METRICS

- Number of ASAP provided climate updates
- Number of experts regularly participating on ASAP

#### **KEY COLLABORATORS**

LEAD: Florida International University, Sea Level Solutions Center

- Southeast Florida Regional Climate Change Compact
- Florida Climate Institute and Other Academic Institutions in Southeast Florida
- South Florida Water Management District

#### **FUNDING**

Unfunded

126

#### TIMEFRAME: IMMEDIATE (0-1 YEAR)

#### DESCRIPTION

Science is complex, evolving, and critical in adapting to sea level rise and climate change. Florida International University's Sea Level Solutions Center will lead an Actionable Science Advisory Panel (ASAP) to make it easier for GM&B municipalities to use the best available science to inform planning and decision making associated with resilience efforts at the local government level.

ASAP's priority will be to provide data driven recommendations and best available science on locally appropriate standards and projections regarding future rainfall and temperature patterns, sea level rise, and groundwater levels. These projects are particularly important to the GM&B region because of the anticipated effects of climate change on regional hydrology and water management systems. ASAP will also be an adhoc resource to GM&B. helping to support Action 53: Share Bold Integrated Water Models made up of GM&B municipalities working in the modelling and infrastructure fields. ASAP will include interdisciplinary experts from multiple universities and colleges. ASAP's work will coordinate with and complement the work of the Southeast Florida Climate Change Compact and the Florida Climate Institute.

This action is derived from the Urban Land Institute's examination of City of Miami Beach's stormwater program, which resulted in suggestions that local science be used to provide recommendations about strategies and investments from a 30- to 70-year horizon. The Urban Land Institute also recommended new strategies for benchmarking to accommodate increased future risk and the changing climate.

#### SPOTLIGHT

#### FIU SEA LEVEL SOLUTIONS CENTER

The FIU Sea Level Solutions Center is a hub for international research, collaboration, education, communication, and outreach. Working with experts around the world, the Center develops useful sea level responses while collaborating with those on the ground to meet real-time needs. It provides support, leadership, personnel, and researchers who have significant international, national, regional, and local relationships. GM&B partners have a strong existing relationship with the Center and it is that strong relationship—combined with GM&B's sense of urgency—that will make ASAP a valuable tool for GM&B local governments.



## ACTION 51: RESILIENCE ACCELERATOR WORKSHOPS





#### TIMEFRAME: SHORT-TERM (1-5 YEARS)

#### DESCRIPTION

GM&B will commit to seeking resources—together with its university, nonprofit and corporate partners—to continue hosting resilience accelerator workshops. These workshops advance innovation and a holistic and inclusive approach to defining and implementing affordable housing and climate adaptation projects.

In August 2018, 100RC and Columbia University Center for Resilient Cities and Landscapes hosted a 3-day Resilience Accelerator workshop. Each participating jurisdiction selected a resilience project that faced a complex path towards implementation, such as aligning stakeholder and inter-agency interests or integrating engineering, land use, and public/private financing solutions. The objective was to improve the resilience value of each project while challenging the people and institutions delivering those projects to be more holistic, anticipatory, reflective, innovative, and radically action-oriented in their work. Each jurisdiction had an 8-10 member team with a mix of staff and outside experts. Each project team also had a facilitator and a visual facilitator to help guide the conversation and capture progress. The workshop began with an open session where the public and broader stakeholders were invited to learn about the projects and provide their input. Public, elected leaders, and key stakeholders were also invited at the end of the workshop to learn about the outcomes.

#### HOW THIS WILL HELP US

- Increases understanding of resilience
- Improves communication with residents
- Improves community cohesion
- Streamlines government process
- Reduces duplication of services

#### **PERFORMANCE METRICS**

 Number of resilience accelerator workshops held biannually

#### KEY COLLABORATORS LEAD: GM&B

LEAD: GM&B

- University Partners
- Private-Sector Partners
- Nonprofit partners

FUNDING

#### **CASE STUDIES**

## **RESILIENCE ACCELERATOR -BRICKELL BAY DRIVE**

The Brickell Bay Drive Accelerator was a 3-day workshop focused on the protection and adaptation of essential economic, natural, and human resources of the waterfront. Realizing the vulnerability to sea level rise, storm surge, and other challenges, the City of Miami selected the Brickell Bay Drive project as a demonstration project to incorporate more resilient design into waterfront standards. The scope of the project was increased through the 100RC Resilience Accelerator workshop held in August 2018.

The waterfront design standards addressed included: 1) accessibility and livability. 2) environmental enhancement. 3) risk reduction. 4) economy and tourism and 5) history and culture. The goal of the project was to improve flood and surge protection while still providing water access, and to improve public greenspace and connectivity while encouraging multimodal transportation options.

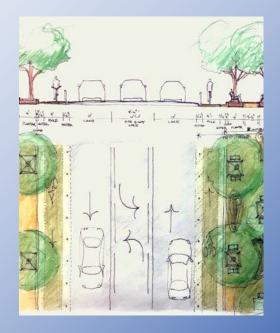
Key city departments and local and national experts participated and helped identify challenges as well as available resources. The project was made possible through the Brickell Adaptation Action Area, which allowed for more innovative design, and funding through the Miami Forever Bond. It was intended to serve as a model to update waterfront standards across the City and to provide an approach to public-private financing for construction and maintenance.

## RESILIENCE ACCELERATOR -WEST AVENUE

The West Avenue Resilience Accelerator was a 3-day workshop focused on addressing aging infrastructure while mitigating the impact of sea level rise. In conjunction with 100RC and Columbia University, the workshop brought together multidisciplinary expertise to provide guidance on urban design, innovative engineering solutions, and stakeholder engagement.

The workshop focused on process and design based on current and future environmental challenges, while considering costs and benefits. Throughout the workshop the City of Miami Beach team tested and evaluated elements of the West Avenue Project to develop modifications that enhance the projects resilience and build community consensus, while remaining fiscally responsible. As a result, the team identified appropriate enhancements based on the project's lifecycle, existing and future site challenges, and feedback from the local community.

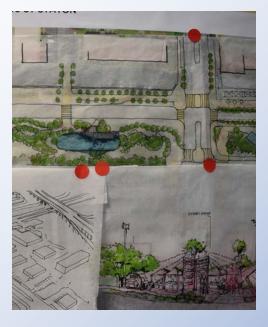




## CASE STUDIES

## RESILIENCE ACCELERATOR -SOUTH CORRIDOR TRANSIT HUBS

The South Corridor Transit Hubs Resilience Accelerator was a 3-day workshop focused on developing concept design for a transportation hub along the south corridor of the Miami-Dade County SMART Plan. In conjunction with 100RC and Columbia University, the workshop focused on design guidelines for a proposed transportation hub pilot at the intersection of SW 211th Street and U.S. Highway 1. Experts who participated in the accelerator ranged from a specialist in transit-oriented design and planning to an expert in affordable housing and an expert in pedestrian networks and parks. As part of this workshop, four overarching goals for transportation hubs were established: Adapt to change, prepare and protect communities, enhance multi-modal sustainable mobility, and reduce disparities. The experts outlined a mix of policy, programming, and capital improvements that can be made to achieve those goals. Because of this workshop, design concepts for transit hubs and first/last mile connections between the SMART Plan corridors and the regional non-motorized trail system (SMART Trails Master Plan) were developed.



## RESILIENCE ACCELERATOR -MILITARY TRAIL HOMES

Palm Beach County, a member of the Southeast Florida Climate Change Compact, was invited to participate in the Resilience Accelerator workshop as a way to extend the resources and benefits of this program to the greater southeast Florida Compact region. This Accelerator focused on developing resilient, dignified cottage homes to promote self-sufficiency and inspire future small-scale affordable housing to fulfill a vital need. The Military Trail Homes sit along an abandoned site on the SR 809 highway running through Palm Beach County. Key questions addressed during the accelerator were: (1) What innovative design solution can create a welcoming community for extremely low- and low-income people in a car-oriented commercial strip? And (2) How can this low-cost, small-footprint housing provide a model for developing other types of housing in the region? The accelerator began by identifying the top shocks and stressors that the future housing development needs to consider: an opioid epidemic, economic instability, extreme heat, mobility challenges, potential violence, and prioritizing housing for single mothers. The guiding principles developed and shared at the workshop included requests for proposals for a resilient traditional housing scheme.



129



## ACTION 52: CREATE A RESILIENT305 ARCGIS HUB

#### HOW THIS WILL HELP US

- Improves communication with residents
- Increases understanding of resilience
- Streamlines government processes

#### **PERFORMANCE METRICS**

- Number of Hub users
- Number of GM&B municipalities participating in Hub

#### **KEY COLLABORATORS**

LEAD: Miami-Dade County

GM&B

130

GM&B municipalities

#### **FUNDING**

Partially funded via Miami-Dade County staff time. Update of ArcGIS Hub post-launch is unfunded



#### TIMEFRAME: IMMEDIATE (0-1 YEAR)

#### DESCRIPTION

GM&B will work with Miami-Dade County to create a Resilient305 data-driven initiative on ArcGIS Hub. This cloud-based platform will be an opportunity to share open data, interact with users, and to provide progress updates on action items in the Resilient305 Strategy with local governments and the community at large. GM&B municipalities will have the opportunity to request access to the latest resilience data and create their own initiatives, facilitating data sharing and improving intergovernmental collaboration. The ArcGIS Hub will also create an opportunity to help keep the general community updated on the progress of the Resilient305 Strategy.

To help launch the Resilient305 actions, the GM&B team will create an advisory group of potential municipal representatives and community members to help set expectations for the initiative, inventory existing data, and advise creation of materials and data for the Resilient305 ArcGIS Hub.

**GOAL 3: PATHWAYS** 

#### **CASE STUDY**

# CREATE VISUALLY ENGAGING STORY MAPS TO COMMUNICATE RESILIENCE GOALS

Story maps are highly versatile tools that can be easily shared via social media and can be readily adapted to address any number of themes. Miami-Dade County has begun developing story maps to help visualize data and communicate various resilience challenges with the community. By collaborating with subject matter experts and GIS professionals, the County has been able to effectively demonstrate sea level rise as well as showcase what projects are underway to address the flooding. A second story map was developed to analyze both where to site transit stations and how stations could be reimagined to also serve as community resilience hubs, offering multiple public services and providing civic spaces. GM&B will continue to work with its partners to help tell its resilience stories using this new digital tool.







## ACTION 53: SHARE BOLD INTEGRATED WATER MODELS

#### HOW THIS WILL HELP US

- Reduces duplication of services
- Streamlines government processes
- Reduces stormwater flooding
- Reduces sea level rise and coastal flooding impacts
- Reduction in sunny day flooding
- Increases understanding of resilience

#### **PERFORMANCE METRICS**

Number of resources shared

### **KEY COLLABORATORS**

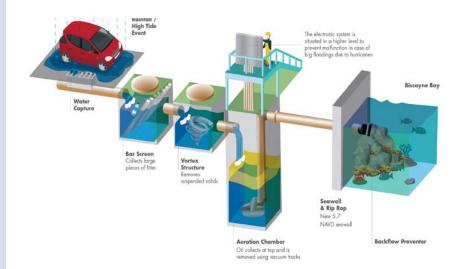
LEAD: Miami-Dade County + The City of Miami Beach

GM&B municipalities

#### **FUNDING**

Unfunded

132



#### TIMEFRAME: SHORT-TERM (1-5 YEARS)

#### **DESCRIPTION**

GM&B is at the forefront of climate change innovation, especially related to flood management. The Urban Land Institute, in its examination of the City of Miami Beach's stormwater program, commended the City for making a "courageous start to combat sunny day flooding...for its timely action, investment in physical infrastructure, identification of self-funding sources, and a decision to include sea-level rise and increased precipitation in planning." To build on lessons learned and improve consistency across its GM&B municipalities, GM&B will spearhead implementation of a step-by-step approach to hydrodynamic computer modeling developed by AECOM; this action will involve all GM&B municipalities. Steps include inventorying current efforts and moving towards developing shared data: improving assumptions for sea level rise, rainfall, and groundwater; and compiling a library of modeling efforts. By working together with its GM&B municipalities. GM&B can make complex water modeling for infrastructure planning better, faster, and cheaper for GM&B municipalities through collaboration and enhanced tools.

Flood management is incredibly complex and using integrated hydrodynamic computer modeling is an action that will benefit the entire GM&B region. GM&B municipalities can build on existing data and work completed, reducing duplication of efforts and saving time and money. Routine meetings to build knowledge and relationships are key to understanding how to use these data. This modeling effort will result in decreased modeling costs and faster construction of capital projects based on modeling outcomes. The products of this action will include a centralized data repository and a library of models to help understand scenarios, assumptions, limitations, boundary conditions, and when to use them. To kick off this action, GM&B will create a sample resolution with an interlocal agreement to be adopted by participating cities. This resolution should include a municipal commitment and funding model to move forward with this action.

### ACTION 54: EMPLOY A ONE WATER APPROACH

#### **TIMEFRAME:** SHORT-TERM (1-5 YEARS)

#### DESCRIPTION

One of the goals for improving water resilience for GM&B is to move towards a "One Water" approach, which was detailed by the U.S. Water Alliance publication, One Water Roadmap: The Sustainable Management of Life's Most Essential Resource, published in 2016. As one of five global cities selected by The Rockefeller Foundation to help develop the international City Water Resilience Approach. GM&B will use the City Water Resilience Approach to assess the resilience of its County-wide water supply and water infrastructure. The challenges and gaps to resilience will be identified and those results will be used to identify and develop indicators for a more resilient water supply and management system, improve interagency collaboration on water issues, and develop and implement a One Water Resilience Action Plan.

The One Water framework states that "all water has value and should be managed in a sustainable, inclusive, and integrated way." This is particularly true in southeast Florida, where, due to the porous limestone geology, hydrology, and climate of the region, water resources are intricately connected and highly managed to provide for water supply, flood protection, and other needs. The City Water Resilience Approach will also serve to improve collaboration and coordination on water issues, which meets the interests expressed by numerous stakeholders during the Resilient305 Strategy development phase.



#### SPOTLIGHT

#### **RESILIENT UTILITY COALITION**

The Resilient Utility Coalition (RUC) was created to advance utility infrastructure resilience efforts. Partners from public utilities, private industry, and academia are working together to operationalize policies/practices and build capacity among operators and partners in making our systems more resilient to hurricanes, infrastructure failure, increased precipitation, sea level rise, and saltwater intrusion. By operationalizing resilience through interdisciplinary and integrated planning, RUC is improving water quality, public health, and its use of resources with responsible investments. RUC was born in South Florida, inspired by the Southeast Florida Climate Compact, and nurtured by the 100RC network.



OBJECTIVE 13: DEVELOP SHARED RESOURCES

#### HOW THIS WILL HELP US

- Streamlines government processes
- Increases understanding of resilience
- Reduces sea level rise and coastal flooding impacts

#### PERFORMANCE METRICS

Publish Water Resilience Action Plan

#### **KEY COLLABORATORS**

LEAD: Miami-Dade County

- Resilient Utility Coalition
- Florida Department of Environmental Protection
- South Florida Water Management District
- U.S. Army Corps of Engineers

#### **FUNDING**

Partially funded by the Rockefeller Foundation



## ACTION 55: PLAN EFFICIENTLY & EFFECTIVELY TOGETHER

#### HOW THIS WILL HELP US

- Reduces duplication of services
- Replaces aging infrastructure
- Streamlines government processes
- Improves financial planning

#### **PERFORMANCE METRICS**

- Number of projects identified for improved coordination
- Dollars saved from coordinated or combined projects
- Number of violations of Miami-Dade County's Pavement Moratorium

### **KEY COLLABORATORS**

LEAD: Miami-Dade County

- Local utilities
- GM&B municipalities

#### **FUNDING**

134

Partially funded by Miami-Dade County

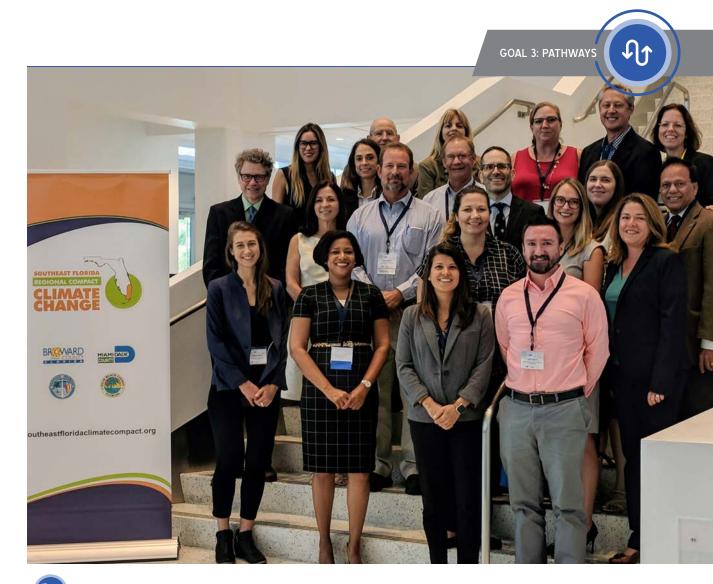


#### TIMEFRAME: IMMEDIATE (0-1 YEAR)

#### **DESCRIPTION**

Significant efficiencies and cost-savings can be achieved with better planning and coordination of capital projects. Miami-Dade County will spearhead an effort to improve intra- and inter-agency communication and coordination on planning and implementation of utility and other capital projects. This effort will build upon existing coordination of capital projects between the Miami-Dade Department of Transportation & Public Works (DTPW), the Miami-Dade Water & Sewer Department (MDWASD), and utility companies, as well as existing quarterly meetings of intra- and inter-agency utility and infrastructure staff. It will also take advantage of existing technology and software platforms, such as the iWASD open source GIS data hub, which reports on the status of construction and permitting projects. Initial steps will include broadening the scope and participation of the meetings and providing training and assistance on the iWASD platform to improve the use of this helpful data source. Miami-Dade County, led by MDWASD, is also implementing e-Builder, a role-based enterprise management tool that will assist County Departments in managing capital improvement and development project lifecycles and business processes. The e-Builder system will serve as a project control tracking system, integrated across departments for efficient and coordinated delivery of capital improvements.

Additionally, Miami-Dade County has taken steps that can be used as a foundation to better coordinate and inform GM&B municipalities and other agencies. For example, a Utility Round Table was established in October of 2013 by the Miami-Dade Division of Environmental Resources Management (DERM) as an effective forum for information exchange among utilities, design professionals, and regulators to improve communication, coordination, and feedback between the County and stakeholders, and to provide updates on existing and proposed regulations, policies, and procedures. Multiple benefits can be gained through improved coordination on capital projects including reduced disruptions, increased efficiencies and economies of scale, and reduced violation of the County's Pavement Moratorium. Page 141 of 394



SPOTLIGHT

#### SOUTHEAST FLORIDA CLIMATE CHANGE COMPACT

Southeast Florida has a young but rich history in regional collaboration to tackle complex issues. In the fall of 2009, about 100 leaders in the region convened the first annual climate leadership summit. By early 2010 each county—Palm Beach, Broward, Miami-Dade and Monroe—approved a simple yet powerful resolution committing to the Southeast Florida Climate Change Compact to work in earnest on climate change adaptation and mitigation efforts. The Compact staff steering committee is composed of county and municipal partners, as well as the South Florida Water Management District and TNC. With support from the Kresge Foundation and the Institute for Sustainable Communities, the Compact has produced many important resources for local governments including the unified sea level rise projections, a regional greenhouse gas baseline, two regional climate action plans, annual legislative priorities, extensive training opportunities, and 10 annual summits (with attendance surpassing 700 in 2018 at the Miami Beach Convention Center). This model of regional collaboration has been the source of inspiration to many other regional collaboratives from as far away as Durban, South Africa, to as close as our friends in Central Florida and the Tampa Bay area. Learn more at: http://www.southeastfloridaclimatecompact.org/.



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## ACTION 56: FINANCE A RESILIENT FUTURE

#### HOW THIS WILL HELP US

- Improves financial planning
- Increases understanding of resilience
- Streamlines government processes
- Attracts state and federal funding

#### PERFORMANCE METRICS

- Number of online hits of guide
- Number of GM&B municipalities assigning budget to resilience initiatives
- Outcome: Identification of implementation funding in GM&B budgets to advance Resilient305 objectives

#### **KEY COLLABORATORS**

LEAD: Miami-Dade County

- City of Miami Beach
- City of Miami

#### **FUNDING**

136

Partially funded by Miami-Dade County



#### TIMEFRAME: SHORT-TERM (1-5 YEARS)

#### **DESCRIPTION**

The success of a resilient budget depends on a diversified economy that reduces the impact of a financial shock, the flexibility to reallocate funds to critical projects that address shocks when needed, and allocation of funds that prioritize resilience objectives across departments. GM&B will identify and recommend funding in each entity's budget towards the implementation of Resilient305 objectives that reflect these success factors. To augment this initiative, GM&B will create an online guide and reference materials for other governments and agencies who wish to incorporate and prioritize resilience objectives in their budgets and strategic plans.

Leading by example, Miami-Dade County continues to organize its multi-billion dollar budget around the four dimensions of 100RC's City Resilience Framework: health and wellbeing, economy and society, infrastructure and environment, and leadership and strategy. The County's current FY 2018-19 Budget and Multiple Year Capital Plan includes specific references to operating expenditures and capital projects targeted towards resilience efforts. In FY 2019-20, the County will further prioritize resilience objectives by restructuring its strategic plan around the Framework's four dimensions and will establish a resilience accelerator program to support financing of resilience projects in the GM&B region.

The GM&B Resilient305 Strategy development phase gave the City of Miami Beach the opportunity to update its strategic plan through the lens of resilience. The City is increasing the resilience impact of capital projects through integrated planning and is also evolving traditional government services to plan for resilience shocks and stressors.

Resilience and innovation are cross cutting themes in the City of Miami's updated strategic plan, and priorities and actions identified during the GM&B Resilient305 Strategy development phase will be integrated into that plan. The City's interdepartmental Resilience Action Group is charged with implementing that strategy.

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## ACTION 57: LEVERAGE THE POWER OF PURCHASING

OBJECTIVE 14: LEVERAGE OUR DOLLARS



#### TIMEFRAME: IMMEDIATE (0-1 YEAR)

#### DESCRIPTION

Municipal purchasing can be a game changer in facilitating innovative solutions to societal challenges. Every year, local governments spend millions of taxpayer dollars procuring municipal goods and services. GM&B will arm local purchasing managers with tools and training to modernize local government procurement to address shocks and stressors, thereby accelerating efforts in resilience building. Procurement officials will learn how to change language in city solicitations to ensure that consultants not only understand stressors, shocks, and climate vulnerabilities, but also know how to address these matters in the most innovative ways possible.

Steps include creating a baseline inventory of resilient procurement policies throughout the cities within Miami-Dade County. A database of innovative procurements, tools, and practices will be created for GM&B municipalities to access. Recent creative examples from the City of Miami Beach include the development of design guidelines for historic properties in the face of sea level rise and an economic analysis of the stormwater program. Finally, a local platform for training opportunities will be created through the local National Institute of Government Purchasing (NGIP).

#### HOW THIS WILL HELP US

- Increases understanding of resilience
- Streamlines government processes

#### **PERFORMANCE METRICS**

- Number of resilient policies implemented by GM&B municipalities
- Number of innovative procurements
- Number of procurement trainings

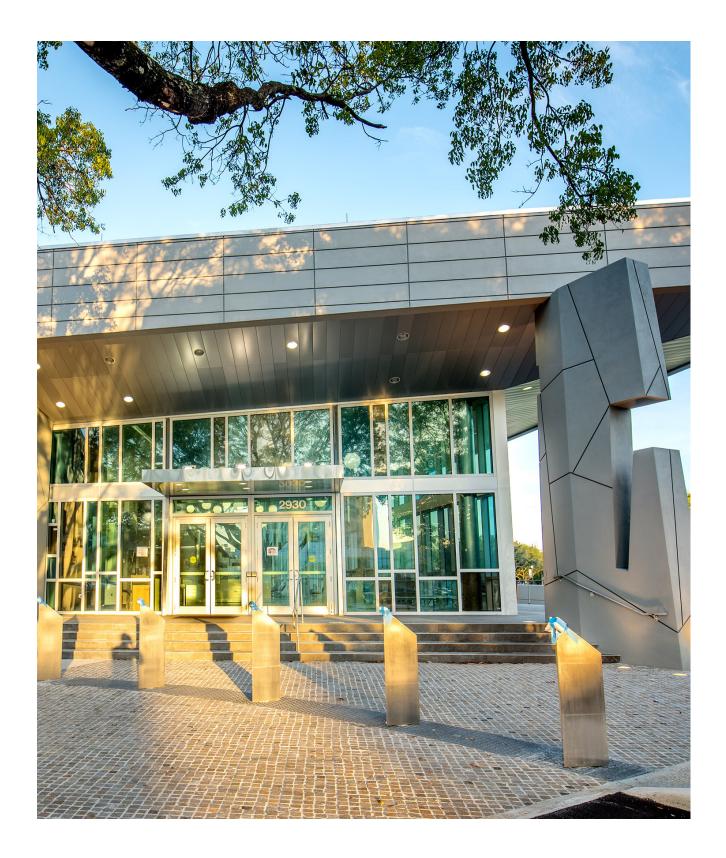
#### KEY COLLABORATORS LEAD: GM&B

- Participating GM&B municipalities
- National Institute of Government Purchasing (NGIP)
- Anchor institutions

#### **FUNDING**

Funding will be identified by each entity during the annual budget process

JJ



#### **CASE STUDY**

# MIAMI BEACH GREEN PURCHASING POLICY

The City of Miami Beach has created and adopted a Green Purchasing policy that includes elements of resilience to address shocks and stressors. Additionally, the City has recently processed three thought-provoking and cuttingedge solicitations that illustrate the type of changes required by municipal governments to address the challenges of our time:

- 1. Business case analysis/economic analyses of the City's stormwater program
- Development of design guidelines for historic preservation in the face of sea level rise and climate change
- Master design consultant for integrated water management

These solicitations challenged the consultant community to forge new relationships and to cross sectors to begin to answer the complex questions facing cities today.



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### ACTION 58: PILOT RESILIENCE FINANCING DECISIONS TOOLKIT

#### HOW THIS WILL HELP US

- Increases understanding of resilience
- Streamlines government processes
- Improves financial planning

#### **PERFORMANCE METRICS**

- Creation of a Resilience Financing Decisions Toolkit
- Number of resilient shoreline projects funded/ year

#### **KEY COLLABORATORS**

LEAD: Miami-Dade County

- The Nature Conservancy
- GM&B municipalities

#### **FUNDING**

140

Partially funded by Miami-Dade County



#### TIMEFRAME: SHORT-TERM (1-5 YEARS)

#### **DESCRIPTION**

GM&B will use the initial financing resources developed during the Resilient305 Strategy development phase to create a resilience financing decisions toolkit that will serve as a resource and guide for GM&B municipalities that are evaluating and prioritizing funding options for resilience-related projects. Technical experts and municipal stakeholders will be convened to identify gaps and additional resources to further enhance the toolkit. Resilient305 actions, such as the Sea Level Rise Strategy and The Nature Conservancy's nature-based coastal resilience project, will also inform development of the resilience financing decisions toolkit. Stakeholders and potential users will be brought together to vet a draft toolkit and help finalize it before release. The goal of this action is to provide resources and assistance to smaller cities with limited staffing and financial resources and to help better coordinate resilience projects across the GM&B region.

#### **CASE STUDY**

### INNOVATIVE INSURANCE FOR TOURISM INCOME IN THE CITY OF MIAMI BEACH

The City of Miami Beach has actively examined parametric insurance as part of the 100RC network. Parametric insurance is a form of risk transfer, paying an agreedupon amount when a specific condition is met. This is an excellent exercise for city managers, risk managers, and chief financial officers in determining their best financial risk reduction method. Such innovative insurance mechanisms were also a feature of the Urban Land Institute Advisory Services Panel invited by the City of Miami Beach for a global and interdisciplinary analysis of the City's stormwater program. As the leading revenue generator for GM&B and second in the State of Florida, tourism revenue is a key funding source and is governed by state statute.

Tourism revenue is relatively volatile because it is vulnerable to sudden changes in economic conditions and other shocks. While this revenue is critical to the City, there is also a risk from any significant negative impacts to both the Resort Tax Fund and the General Fund. Over the last few years, the City's tourism revenue has suffered from major events like Hurricanes Matthew and Irma, alarm over the Zika virus, the closing of the convention center during renovation, and economic recession. Given this variability, the City decided to seriously explore parametric insurance for its tourism revenue.





### ACTION 59: DEMONSTRATE THE COST BENEFITS OF RESILIENCE

#### HOW THIS WILL HELP US

- Replaces aging infrastructure
- Improves financial planning
- Improves communication with residents

#### **PERFORMANCE METRICS**

- Number of resilience infrastructure projects in cities evaluating costs and benefits
- Number of projects initiated due to study

#### **KEY COLLABORATORS**

LEAD: City of Miami Beach

GM&B

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#### **FUNDING**

Funded by each entity



#### TIMEFRAME: SHORT-TERM (1-5 YEARS)

#### DESCRIPTION

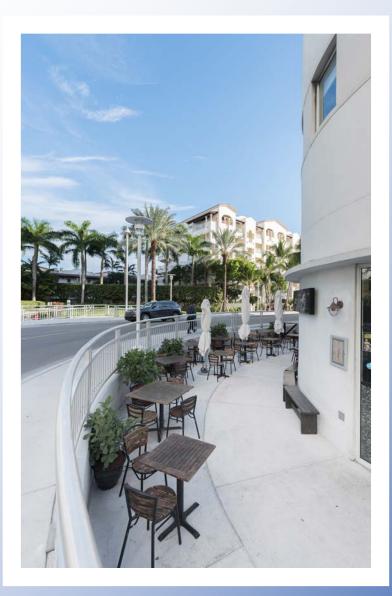
Cities need to invest in infrastructure now to reduce the risk of flooding today and well in the future. How to communicate the value of these investments is a developing field for many disciplines, from engineers and scientists to bankers and insurance companies. GM&B will lead (and learn from) all our cities as we define and communicate the benefits of resilience investments together. GM&B will share its approaches and lessons learned from a variety of studies and projects (such as those described in the following case study), including cost-benefit analyses in dollar terms, green infrastructure, and adaptation pathways. The more cities can work together to increase the understanding of resilience benefits for public and private property, the more we can help residents, businesses, elected officials, and the world be informed to make their own adaptation investment decisions. This action will also be part of Action 46: Resilient 35 in the 305 Network, which builds relationships and resilience across municipal governments. GM&B will also share this information for dialogue and learning with its participating Chambers of Commerce.

## CASE STUDY COST-BENEFIT ANALYSIS OF RESILIENCE INVESTMENTS

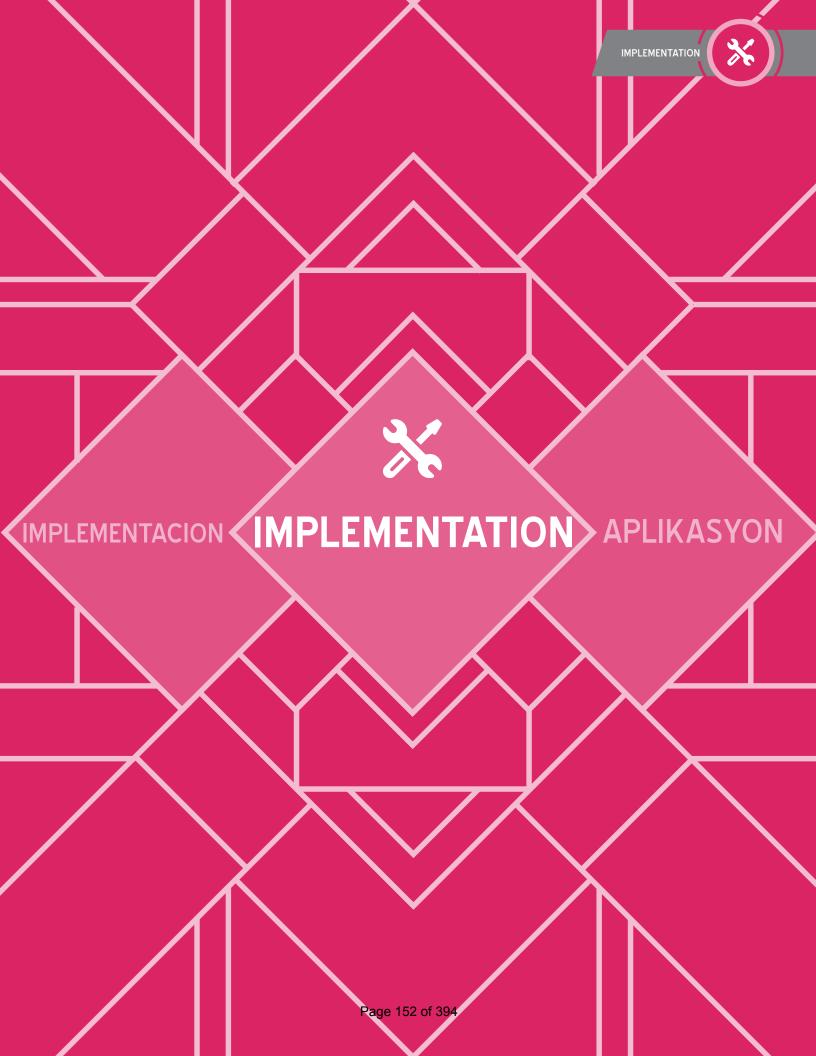
The City of Miami Beach's 'Business Case Analysis' is a one-of-a-kind project that will examine both the risks from sea level rise and rainfall. and demonstrate how the stormwater program can reduce this risk. The study will demonstrate the costs and benefits of doing nothing, of public infrastructure investment, and of varying levels of private adaptation investment. This type of cost-benefit analysis is a unique process and requires a diverse team from scientists to flood insurance experts—to begin to understand the complexity of these separate but related issues.

Miami-Dade County is conducting a county-wide assessment of the feasibility of various measures that can protect the community from impacts of sea level rise. This assessment estimates the economic feasibility of the multiple adaptation pathways under consideration.

Miami's updated stormwater master plan includes a costbenefit analysis of all recommended capital improvements. Considerations include risk reduction to lives and property, as well as environmental, economic, and quality-of-life impacts. To demonstrate the benefits of this approach, the City recently partnered with its Downtown Development Authority to contract Impact Infrastructure, Inc. to conduct a model, triple bottom line (environmental, social, and economic) cost-benefit analysis on a hybrid living shoreline project in the Brickell Area.







IMPLEMENTATION



# RESILIENT305 STRATEGY IMPLEMENTATION

#### PROGRESS, INNOVATION, AND VISION FOR OUR TOMORROW (PIVOT)

#### HOW THIS WILL HELP US

- Development of shared legislative priorities
- Increased understanding of resilience
- Streamline government processes

#### **PERFORMANCE METRICS**

- Number of actions underway
- Annual progress report

#### **KEY COLLABORATORS**

LEAD: Miami-Dade County

- The Miami Foundation
- GM&B Partners

#### **FUNDING**

Funded by The Miami Foundation and inkind support from the GM&B partners and participating entities.







Over the last three years, while Miami-Dade County, the City of Miami and the City of Miami Beach were developing this unified Strategy as Greater Miami & the Beaches, each entity has been busy developing and implementing comprehensive strategies and action plans to build resilience within their jurisdictions. This includes integrating resilience into city and county-wide strategies, budgets, comprehensive plans, and emergency management plans: appointing resilience liaisons from key departments: developing and passing bonds to finance resilient infrastructure; passing policies and securing funds to accelerate the creation and preservation of affordable housing; improving and expanding mobility options; expanding economic opportunities and mitigating flood risks. The unified Strategy development process informed and strengthened how we approached building resilience within our own jurisdictions. The Resilient305 Strategy will now become the overarching link of our planning efforts and the foundation for not only our individual strategies, actions, and investments, but also for the other municipalities, businesses, institutions and community organizations within Greater Miami & the Beaches.

We recognize that implementing each of the actions within the Resilient305 Strategy will require dedicated effort from a team that we call PIVOT or Progress. Innovation, and Vision for Our Tomorrow. The PIVOT team will look at resources, timeframes, and priorities to develop a work plan and oversee implementation and strategy progress.

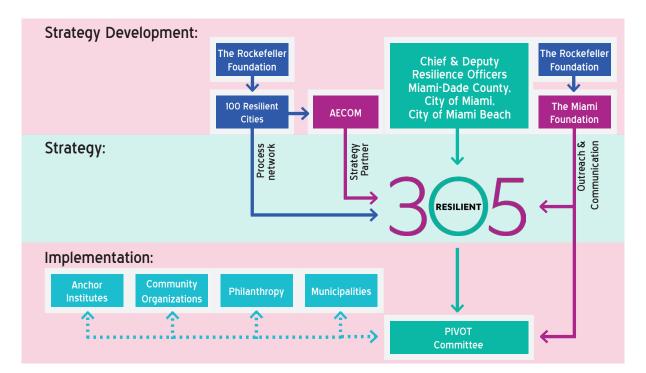
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IMPLEMENTATION



The initial PIVOT Team will be composed of a senior administrator and a CRO from each of the Greater Miami & the Beaches partners and a representative from The Miami Foundation. The CROs will continue to share management of the process and the appointed representatives will provide legislative and budget guidance for implementing the Strategy. The PIVOT team will ensure the region's diversity is reflected in actions undertaken by GM&B. Actions in the Resilient305 Strategy will be supported initially by staff resources from each entity and participating organizations.

As actions are undertaken, additional members from the community will be invited to join the PIVOT Team in support of the prioritized actions. The PIVOT Team will grow as additional GM&B municipalities and organizations join after they complete Action 45: Send your Boss to Boot Camp and designate a municipal CRO. Membership may also grow based on the stakeholders needed to help implement the Resilience Strategy actions. Committees will be formed over time, to address areas such as funding, communications, engagement for every action, legislative priorities, performance metrics, and equity.



#### **PIVOT SUPPORT**

Miami-Dade County and The Miami Foundation will closely collaborate to mobilize resources, maintain the budget, provide ongoing communications amongst relevant partners and the community, and promote implementation of the Strategy county-wide. Specifically, they will assist in establishing shared measurement practices and building partners' capacity to contribute and utilize resilience tools developed. This focused day to day work will help institutionalize resilience actions across municipalities and is essential to maintain public support and implement policy priorities.

#### **PIVOT ACTIONS**

The PIVOT Team will meet monthly, and CROs will report back to their respective Commissions with updates. Within the first six months of the Resilient305 Strategy release, the initial PIVOT Team will prioritize the first wave of immediate actions. The Team will create a monthly schedule of meetings, an initial workplan, and a communications plan for implementing the actions.

#### **PIVOT BENEFITS**

The PIVOT team will continue to share management of the process and the appointed representatives will provide legislative and budget guidance for implementing the Strategy. Team members will also be afforded the opportunity to collaborate with other organizations to promote resilience.



#### **ACTION TIMEFRAMES**

The table below sets out the actions included as part of Resilient305 and the associated timeframes for implementation. Ensuring each action is implemented according to this will keep momentum and energy, enable effective monitoring of performance metrics and will help build a resilient Greater Miami & the Beaches.

#### Immediate (0-1 year)

Action 1	Preserve and Restore Biscayne Bay
Action 2	Build Reef Biodiversity and Defenses
Action 11	Maximize Opportunity Zones
Action 32	Pilot an Arrest Diversion for Opioid Users
Action 36	Time to Volunteer
Action 39	Get the 311 on Resilence for the 305
Action 41	See it To Believe It
Action 43	Roll-out 5-Step Guide to Innovative Recovery
	Financing
Action 44	Bounce Forward 305 - Distribute Resilient
	Urban Land Use Essentials Guide
Action 45	Send your Boss to Bootcamp
Action 47	Train Employees to be Resilient
Action 50	Create an Actionable Science
	Advisory Panel (ASAP)
Action 52	Create a Resilient305 ArcGIS Hub
Action 55	Planning Efficiently & Effectively Together
Action 57	Leverage the Power of Purchasing

Short-te	rm (1·5 year)
Action 3:	Bolster Our Beaches
Action 4:	Expand Nature-Based Infrastructure
Action 5:	Integrate Resilience into Parks and Open Spaces
Action 6:	Reduce "Back Bay" Flooding
Action 7:	Implement Sea Level Rise Strategy
Action 8:	Develop Sea Level Rise Checklist for Capital
	Projects
Action 9:	Create Development Review Checklist
Action 10:	Strengthen Resilience Planning
Action 13:	Design a Better Bus Network
Action 14:	Drive into the Future
Action 15:	It's Electric
Action 16:	Expand Renewable Energy
Action 17:	Building Efficiency 305
Action 18:	Stay and Live in the 305
Action 19:	Redeveloping Resilient Public Housing
Action 20:	Build an Inclusive Economy
Action 21:	Train for Construction
Action 23:	Buy Local
Action 24:	Be Counted
Action 25:	Re-establish the Financial Capability
	Collaborative
Action 26:	Teach Kids to Save

#### **RESILIENT305 GOALS:**









#### Short-term (1-5 year)

Action 27:	Expand Youth Career Opportunities
Action 28:	Break the Cycle of Youth Violence
Action 29:	Respect Our Elders
Action 30:	Update the Social Services Master Plan
Action 31:	Advocate for Mental Health
Action 33:	Accelerate Progress of HIV/AIDS Strategy
Action 34:	Advance Pandemics Communication
Action 35:	Increase Neighborhood Response
Action 37:	Prepare Your Property
Action 38:	Support Resilience Hubs
Action 40:	Create a K-12 Plan for Resilience Literacy
Action 42:	Pre-planning for Post-disaster Toolkit
Action 46:	Resilient 35 in the 305 Network
Action 48;	RISE to the Rescue
Action 49:	Collaborate with Universities
Action 51:	Resilience Accelerator Workshops
Action 53:	Share Bold Integrated Water Models
Action 54:	Employ a One Water Approach
Action 56:	Finance a Resilient Future
Action 58:	Pilot Resilience Financing Decisions Toolkit
Action 59:	Demonstrate Cost Benefits of Resilience

-term	

Action 12:	Develop Mobility Hubs in the 305
Action 22	Promote Fair Chance Hiring



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# Acknowledgements

The Resilient305 Strategy is a milestone that could not have been completed without the diversity and passion of our community. Thank you to all of our partners in this journey—we look forward to your roles evolving and shaping the implementation of the Strategy and actions within it.

Miami-Dade County staff City of Miami staff City of Miami Beach staff The remaining 32 Municipalities within Miami-Dade County

#### Steering Committee Members

Gretchen Beesing, Catalyst Miami Truly Burton, Builders Association South Florida Jaret Davis, Beacon Council Erik Eikenberg, Everglades Foundation Maurice Ferre, MDX Valencia Gunder, New Florida Majority Bobbi Ibarra, Homes for All Marsha Jackman, Vailon Group Jorge Luis Lopez, Parks Foundation Michelle Mejia, Baptist Health Kendall Rebekah Monson, The New Tropic Delaney Reynolds, Sink or Swim Scott Robins, Developer Zerry Ihekwaba, City of Miami Jimmy Morales, City of Miami Beach

Jack Osterholt, Miami-Dade County

Javier Soto, The Miami Foundation

#### Phase II: Discovery (Focus) Area Members

Living with Water, Natural Resources Leads: Margarita Kruyff and Rod Braun

Living with Water, Coordinated Planning Leads: Ajani Stewart and David Martin

Living with Water, Innovative Finance Leads: Nick Fleischhacker & Sergio Masvidal

Advancing and Adapting Leads: Carlos Cruz-Casas and Shekeria Brown

**Building Prosperity Leads:** Stephanie Sylvestre and William Porro

A Thriving Community Leads: Dr. Hansel Tookes and Donovan Lee-Sin

Robust Recovery Leads: Carlos Castillo and Debbie Griner

Leadership for Tomorrow Leads: City of Miami Beach Commissioner Aleman and Irela Bague

Also, the countless organizations and dedicated experts who have contributed their time and knowledge in support of this Resilient305 Strategy.





























# MIAMI**BEACH** RISING ABOVE

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# OUR FUTURE IN FOCUS

2019

MIAMIBEACH

RISING

ABOVE

# **STRATEGIC PLAN** Through the Lens of Resilience

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# MIAMI BEACH OFFICIALS



Dan Gelber Mayor



Micky Steinberg Commissioner



Mark Samuelian Commissioner



Michael Góngora Commissioner



Raul J. Aguila City Attorney



Joy Malakoff Commissioner



Ricky Arriola Commissioner



John Elizabeth Alemán Commissioner



Rafael E. Granado City Clerk



Jimmy L. Morales City Manager

# **The Miami Beach Vision:**



**A SMART CITY** of high quality and efficient services and employees.



**MIAMI BEACH - THE CITY THAT EVOKES ALL SENSES** 

# WELCOME TO OUR STRATEGIC PLAN THROUGH THE LENS OF RESILIENCE

Strategic planning is an organization's process of defining its strategy, or direction, and making decisions on allocating its resources to pursue this strategy.

A Resilience Strategy is the product of a process during which a city develops a better understanding of the challenges it faces; reviews its ability to address those challenges; and unites people, projects, and priorities, so that cities can collectively act on their resilience challenges.

#### This is not your typical strategic plan.

Miami Beach is an experience. Our global standing and sub-tropical environment make it a dynamic place to live and work. Expectations are high from residents and visitors alike- and Miami Beach's leadership and employees deliver. While daily operations are critical to keep the city running, long-term vision and execution are crucial considering our climate change risks. Integrating resilience with traditional government strategic planning is forward thinking, essential, and generates a better quality of life for the community.

Miami Beach is not simply building resilience projects, we are strategically building resilience through our policies, projects and services. For this integration, we need a vision, strategy, actions, and every part of this city team.

#### Seeing our future through the lens of resilience:

Welcome to your Miami Beach Strategic Plan – and join us is in seeing the City through the Lens of Resilience. Miami Beach has reinvented its goals and objectives through the leadership of the City Commission and the Management Team. The resilience lens helps us clearly see our shocks and stresses. This gives all of us that are part of the Miami Beach team the opportunity to plan together, to reduce risk, and to create co-benefits.

Rather than having separate strategic and resilience plans, this one strategy will focus on the city's needs in both near-term and long-term time horizons. This will raise our ability to survive and even thrive in the event of significant shocks, like storms and special events, and to improve how we deal with daily stresses like aging infrastructure and congestion. Put on your lenses and get ready for some strategy.

# MESSAGE FROM CITY MANAGER

#### Honorable Mayor and City Commissioners

It is my pleasure to present you with the City of Miami Beach Strategic Plan Update through the Lens of Resilience. The city's strategic planning efforts have never been on a better path. Thanks to your leadership and support we have aligned City Commission goals to our management objectives and the elements of my own performance contract to ensure that we reach your vision. While our resilience journey began with sea level rise, flooding and stormwater, now our efforts are wider and broader. This plan highlights and prioritizes efforts to increase the co-benefits of resilience and to better plan for and recover from the shocks and stresses that will make us a strong and vibrant community.

I am an avid reader of Adam Bryant's "The Corner Office" in the Sunday New York Times. From time to time I share particularly inspiring articles with the management team. The importance of strategic planning for organizational success is immense "...it speaks to one of the most important roles of a leader; to boil down an organization's many priorities into a simple plan, so that employees can remember it, internalize it, and act on it." — Adam Bryant, *Quick and Nimble: Lessons from Leading CEOs on How to Create a Culture of Innovation*. This document is a simple plan that collects our priorities in one place. This makes it easier to cascade through departments, to align our work and sure we are all rowing in the same direction.

I want to thank my executive team, department directors and so many other members of the Miami Beach family for supporting this process and making this strategic plan relevant and valuable for the issues of today and the years ahead. I want to especially thank and recognize Susanne M. Torriente, Chief Resilience Officer; Amy Knowles, Deputy Resilience Officer; Elizabeth Wheaton, Environment and Sustainability Director; and Ines Mato, Senior Resilience Analyst. They connected the dots to produce this strategic plan update through listening carefully to leadership and employees, convening teams, promoting collaboration and strategically connecting the dots to our outside resources, primarily through the 100 Resilient Cities Network planning process, pioneered through the Rockefeller Foundation. I also want to thank John Woodruff, Chief Financial Officer and Tameka Otto-Stewart, Budget Director, for their support and agility in linking this work to the budget process- to make help sure funding follows priorities.

Yours truly,

Jimmy L. Morales Miami Beach City Manager



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# MESSAGE FROM YOUR CHIEF RESILIENCE OFFICER AND DEPUTY

Urban Resilience is the capacity of individuals, communities, institutions, businesses and systems within the region to survive, adapt, and grow – no matter what kinds of chronic stresses and acute shocks they experience.

3 CESILIENT 5

We are proud to be a part of updating the Strategic Plan through the Lens of Resilience. This strategy has the unique Miami Beach flavor that we know and love, but it also connects us

to actions, expertise and resources at a regional and global scale- all with the goal of benefiting Miami Beach. Throughout the strategy- you'll see references to actions in Resilient305, the Resilience Strategy created by Greater Miami and the Beaches, our unique partnership with Miami-Dade County and Miami.

We have already seen benefits through our selection as part of the Rockefeller Foundation's 100 Resilient Cities program. This grant award included a strategy planning process and important projects from industry and academic leaders such as the Urban Land Institute and Columbia University. The Urban Land Institute's Services Advisory Panel studied our stormwater program from a global perspective, and the City Manager created the READY (Resilient Enhancement Action Design for You) Team to assess and implement these recommendations.

Resilience is much more than stormwater, however. Shocks and stresses are part of every single department's priorities. Shocks are sudden, sharp events that threaten a city such as hurricanes, coastal flooding, infrastructure failure, cyberterrorism, heat wave, and disease outbreak. Stresses weaken the fabric of a city on a daily or cyclical basis such as pronounced poverty, overtaxed and underdeveloped transportation system, aging infrastructure, lack of affordable housing, rising sea level and coastal erosion. These are issues we know well- and actions to address them are woven throughout our strategic plan.

It's our pleasure in our roles as CRO and Deputy CRO to convene employees- to share available resources- to collaborate, integrate, and work together to create our shared Miami Beach vision. There is no better team, and no better time to implement our Strategic Plan through the Lens of Resilience.

A Chief Resilience Officer (CRO) is a top-level advisor to the city's mayor or chief executive. His/her task is to bring in stakeholders from across silos of government and sectors of society, and to access all available resilience building tools and experts to develop a resilience strategy.

# INTRODUCTION & BACKGROUND

#### RATHER THAN HAVING SEPARATE STRATEGIC AND RESILIENCE PLANS, ONE COMPREHENSIVE STRATEGY WILL FOCUS ON THE CITY'S NEEDS IN BOTH NEAR-TERM AND LONG-TERM TIME HORIZONS. THE CITY CAN BUILD RESILIENCE MORE EFFECTIVELY BY HAVING AN INTEGRATED APPROACH TO ALIGNING STRATEGIC PRIORITIES, RESOURCES, AND SERVICES.

#### Strategic Planning Made Simple: Vision, Goals, Objectives and Actions

This strategic plan has a simple structure, leading with the new long-term **vision** that provides direction for **five vision areas**. The existing mission resonates with City Commission and staff and remains "committed to providing excellent public service and safety to all who live, work, and play in our vibrant, tropical, historic community."

Each **vision area** includes

- City Commission **goals** developed at a Goals Conference in October of 2018. These goals are our organization's top policy priorities.
- Comprehensive management **objectives** that provide more specific direction to the management team for accomplishing the goals.
- Highlighted **actions** are the City Manager's top priorities for departments to implement. Additional important actions are identified and funded though the annual budget process.
- The most relevant **Resilient305** actions that Miami Beach will lead, support, and benefit from.
- Actions to reduce **shocks and stresses** are highlighted throughout the plan.





### HOW WAS THIS STRATEGY DEVELOPED?

The City of Miami Beach has been updating its strategic plan alongside the resilience strategy planning process.

### **MIAMI BEACH**

Community Workshops and 2019 Survey Commission Goals Conferences Management Team Sessions Strategic Plan *Through the Lens of Resilience* 

# **GREATER MIAMI AND THE BEACHES**

Preliminary Resilience Assessment Discovery Area Teams Opportunities and Assessment Tool Resilient305 Strategy

# BUILDING ON A STRONG FOUNDATION

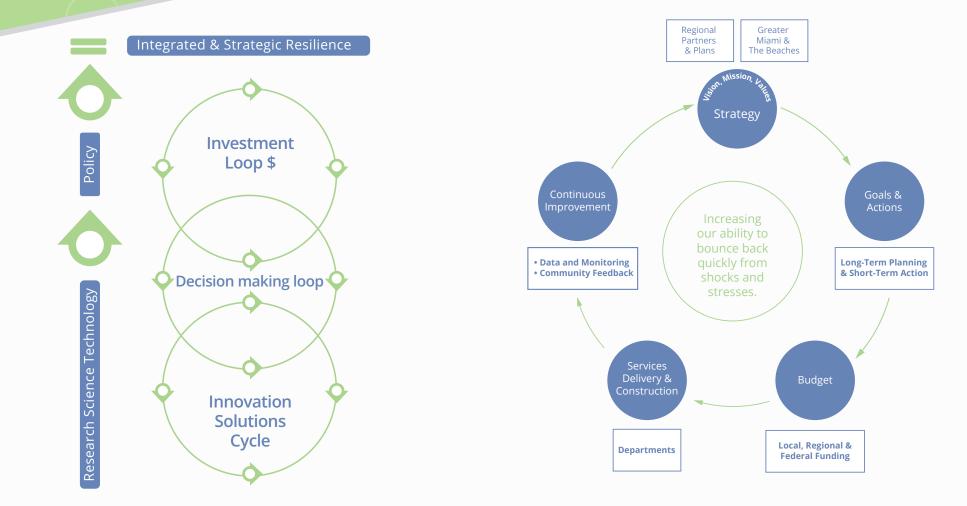
The City of Miami Beach has a strong tradition in strategic planning and performance excellence. In 2005, when the approach to strategy was launched, the city was a pioneer in municipal government. At the time, it was at the forefront of city governments, in terms of how it planned and aligned its budget.

The shift in understanding and priorities between the early 2000s and those emerging for 2019 and beyond are quite distinct. The resilience stategy model ties together regional resilience planning with a foundation in traditional strategic planning that includes addressing our most pressing shocks and stresses. Our resilience strategy model is designed to provide the services needed today, while planning for a city of tomorrow.

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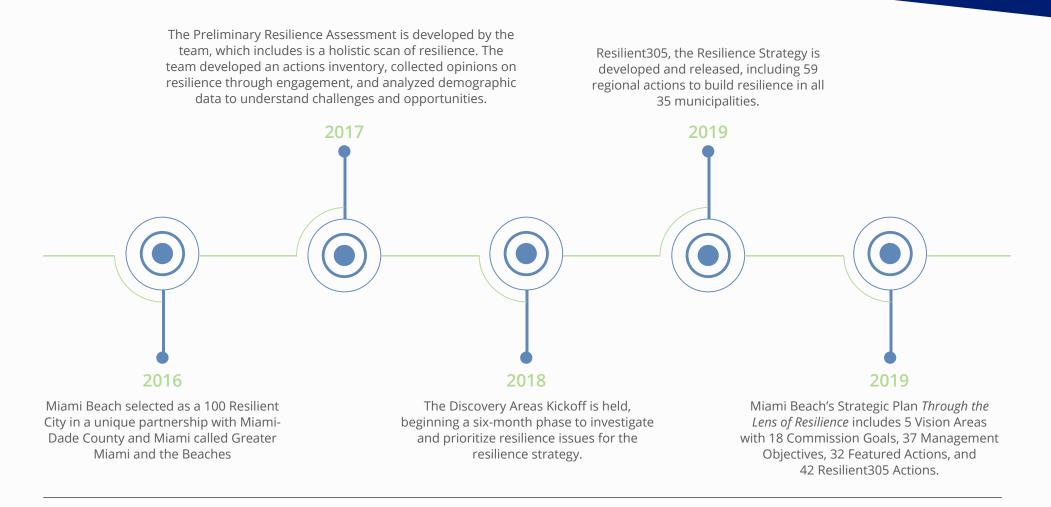
# MODELS:





12

Greater Miami and the Beaches validated that the highest priority shocks include: hurricanes, economic crash, rainfall flooding, and infrastructure failure (cybersecurity, major bridges and roadways, and sewer/ stormwater). The top stresses include: the transportation system, sea level rise and coastal erosion, aging infrastructure, the lack of affordable housing, and poverty. Miami Beach-specific feedback and data confirms many of these same concerns, and uses management objectives and focused actions to address them. Working together across departments, the City of Miami Beach is well positioned to meet these pressing realities.



The Rockefeller Foundation's City Resilience Framework provides a resilience lens for cities to understand and build capacity in key areas through targeted actions. The City of Miami Beach's Strategic Plan Through the Lens of Resilience joins goals, objectives, and actions designed to build resilience to minimize our shocks and stresses and create benefits that improve the quality of life.



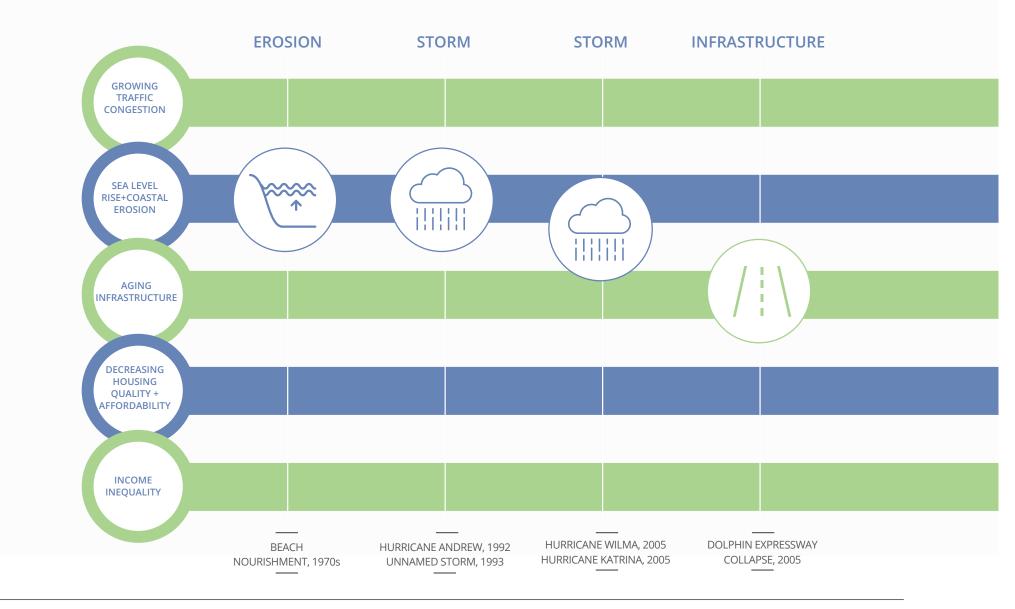
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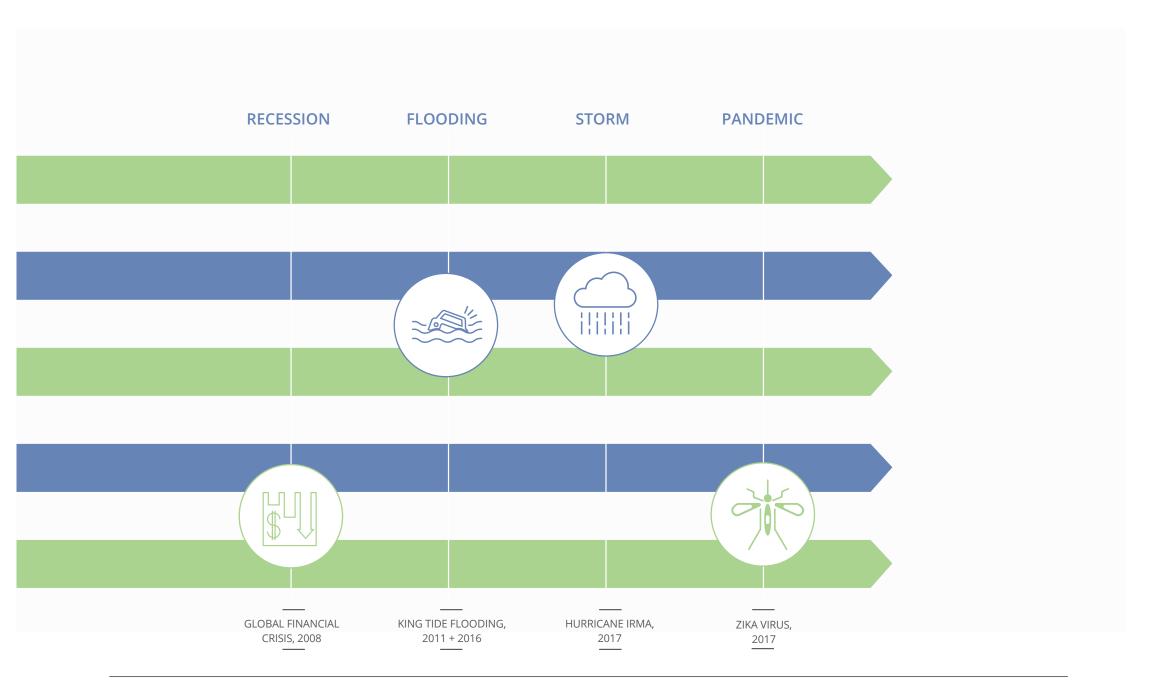


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# OUR CURRENT STRESSES AND PAST SHOCKS

As with many communities, Greater Miami and the Beaches' challenges have brought additional underlying issues to surface. Unforseeable circumstances and their consequences create opportunities for GM&B to strengthen its communities and better prepare for the next occurence. As we grow, we learn.







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### OBJECTIVES BUILD ON OUR ARTS AND CULTURE STRENGTHS, BALANCE TOURISM WITH QUALITY OF LIFE, REVITALIZE AREAS, AND SUPPORT EXCELLENCE IN OUR SCHOOLS.

COMMISSION GOALS

- Arts and culture (2050)
- Attract local residents (2050)
- Change nature of tourism (2050)
- North Beach Town Center (2020)
- Tourism balance improvements (2020)
- True City Center (2050) with MBCC Hotel (2020) and 17th St Garage
- 41st Street (2020)





A prosperous city with a special flavor of culture, arts, education, and business.

### MANAGEMENT OBJECTIVES



**Revitalize targeted areas and increase investment** through master plans and business vibrancy efforts as well as core services like safety and code enforcement. Better leverage our assets and parking lots. Areas include North Beach, Ocean Drive, 41st Street, Lincoln Road and Washington Avenue.

01

Market and promote Miami Beach as a world class arts, culture, and quality entertainment destination.

04

**Balance residents' quality of life** with tourism and special events through careful planning and exploring strategies from other global destinations.

- File

02

**Develop** the Convention Center campus including the hotel, parks, the Fillmore, and with partners to program conventions and shows.



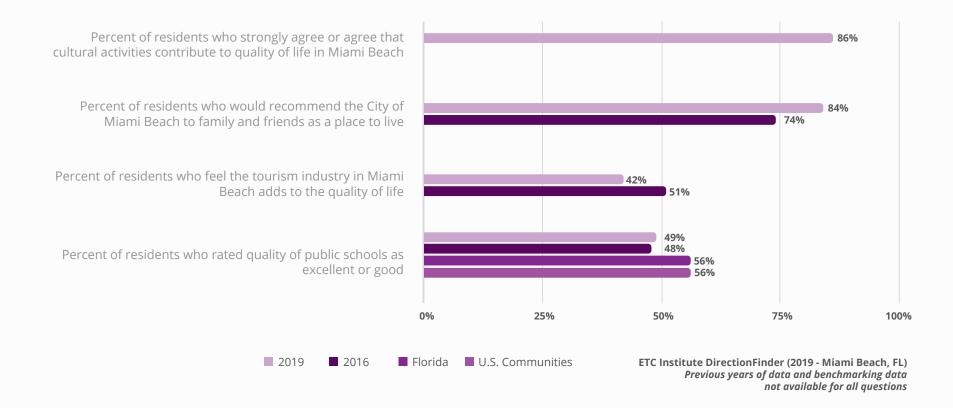
**Be known for (K-12) educational excellence** including expansion of enrichment programs into the Miami Beach school feeder pattern; including arts, culture, technology, college and vocational school, climate literacy, and counseling.



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## Resident Survey Highlights

### (by percentage of respondents rating the item 4 or 5 in a scale of 5 points)





### Resilient305 Actions:

- BUILD an Inclusive Economy.
- BE COUNTED
- **CREATE AND IMPLEMENT** a K-12 Plan for Resilience Literacy.

• **IMPLEMENT** robust marketing campaigns to promote city programs and cultural assets.

• **ELEVATE** the Collins Park Cultural District.

Miami Beach Actions

- **COMPLETE** the Convention Center Hotel by Art Basel 2022.
- **COMPLETE** Miami Beach Convention Center Parks and Art in Public Places (by Art Basel 2019).
- **DEVELOP** a renovation and finance plan for the Fillmore Theater.
- MAKE substantial progress on North Beach Town Center/Byron Carlyle/Ocean Terrace.
- **COMPLETE** Ocean Drive renovation, activation and programming underway.
- **COMPLETE** Lincoln Road renovation within 3 to 3.5 years.

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1051

# NEIGHBORHOODS

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### OBJECTIVES BUILD RESIDENT SATISFACTION THROUGH SAFETY, CLEANLINESS, PARKS, AND MODERN CODES.



### MANAGEMENT OBJECTIVES



Work with partners to address regional safety issues such as juvenile crime, identity theft, trafficking and terrorism.



**Provide quick and exceptional fire and emergency response.** Continuously improve emergency preparedness to better respond to shocks like hurricanes to bounce back as quickly as possible.



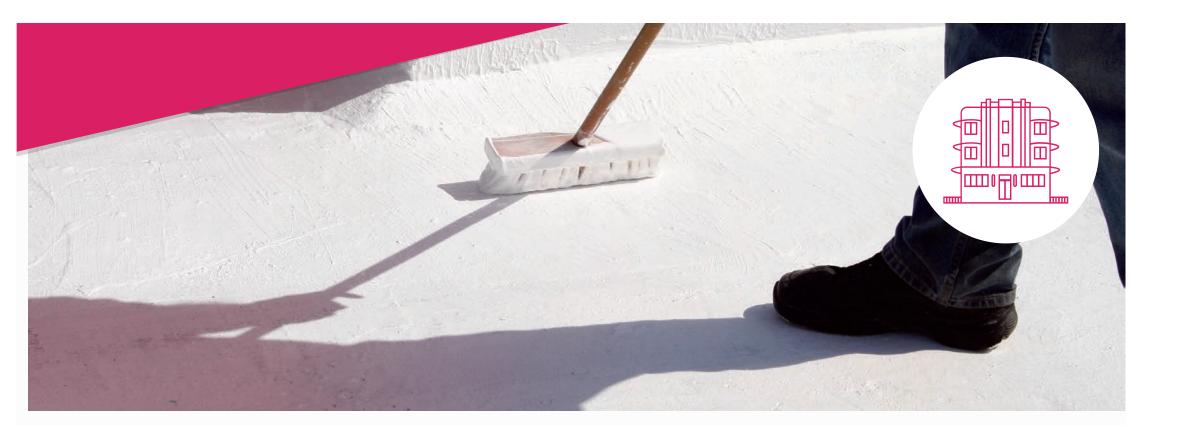
**Prevent and solve crime for residents and visitors** through the use of (but not limited to) communications, community policing, technology, cameras, park rangers, professional and ethical policing and code enforcement.



**Enhance the beautification, physical appearance and cleanliness of neighborhoods,** especially North Beach, City rights-of-way, town center areas, parks and beaches.



**Increase compliance with City Code** by creating more incentives for compliance versus penalties, especially in North Beach. Implement controls to prevent issues of unpermitted work or work exceeding permits on city projects.



06

**Evolve parks and green spaces to meet the changing needs of the community** through creating a Parks Master Plan to improve programming, facilities, cycling, and water management. The plan should include iconic art, cultural opportunities and appropriate lighting.

07

Modernize and streamline our old and complex land development regulations and City codes through routine and comprehensive reviews to be more user-friendly and to reduce conflicts.



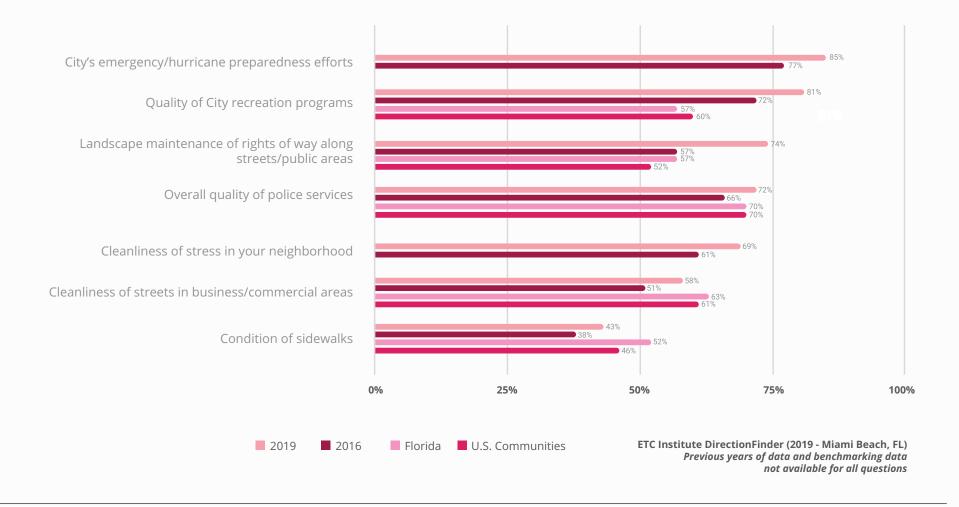
**Prioritize historic gems and create opportunities to build resilience into historic properties** to protect our unique Miami Beach identity.

## 09

**Proactively monitor the city for mosquito breeding grounds** and work cooperatively with Miami-Dade County to reduce the possibility of mosquito transmitted disease.

## Resident Survey Highlights

(by percentage of respondents rating the item 4 or 5 in a scale of 5 points)



28



• **INCREASE** Community Resilience through CERT.

• Time to **VOLUNTEER** or Get Involved

Actions

- **PREPARE** Your Property Resilient305
  - SUPPORT Resilience Hubs.
  - PRE-PLANNING for Post-Disaster Toolkit
  - ROLL-OUT 5-Step Guide to Innovative Disaster Recovery Financing
  - **BOUNCE** Forward 305 Distribute Resilient Urban Land Use Essentials Guide.

ctions: • **COMPLETE** Fire Station 1 within four years of site selection.

• **CREATE** an educational campaign to address public. perception of crime and the Police Department.

ACTIONS:

• CONTINUE AND IMPROVE the enhanced use of technology and crime data by the Police Department (new).

• **INCREASE** community outreach by the Police Department, including collaboration with neighborhood watch programs, private security and community groups.

• **CREATE** a Parks Master Plan.

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Beach

Miami

- **CREATE** Maurice Gibb Park full plan within four years.
- COMPLETE the Par 3 Park within three years.
- **COMPLETE** half of 600 Alton Park within four years.
- **COMPLETE** North Beach Oceanside Park.



# ENVIRONMENT AND INFRASTRUCTURE

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### OBJECTIVES PROTECT AND ENHANCE OUR ENVIRONMENT AND INVEST IN INFRASTRUCTURE PROJECTS AND ASSETS THAT BUILD RESILIENCE BENEFITS LIKE REDUCING FLOOD RISK AND INCREASING MOBILITY.



### MANAGEMENT OBJECTIVES

03

**Improve our aging drinking water and sewer infrastructure** to protect drinking water quality, public health and fire protection.

01

Work regionally and nationally to protect Biscayne Bay water quality and to maintain a healthy dune and beach system that provides storm protection, recreation and vital habitat for the public good.

02

Reduce greenhouse gas emissions and heat by strategically increasing energy efficiency, green space, tree canopy and pedestrian greenways, encouraging walkability and increasing storm water retention.



Reduce risk from storms, high tides, groundwater, and sea level rise by continuously improving our sea level rise adaptation and integrated stormwater program. Use the best science and technology, including green and blue infrastructure and mobility priorities while minimizing construction disruption, optimizing design aesthetics, and community engagement. Keep the entire program on-time, on-budget, and moving forward with adequate financing.



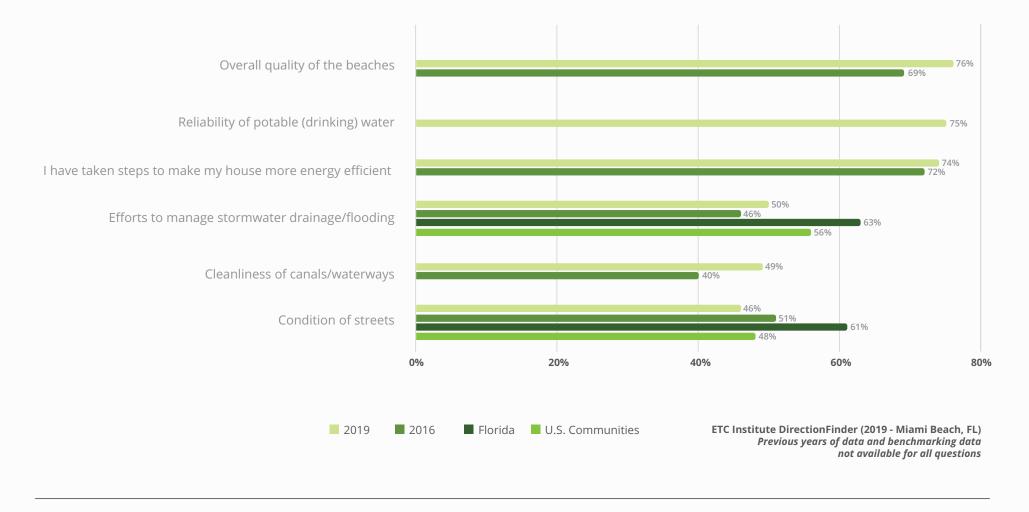
Make existing and new government assets and fleet efficient and sustainable, and minimize damage from storms and sea level rise.



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## Resident Survey Highlights

### (by percentage of respondents rating the item 4 or 5 in a scale of 5 points)



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• **DEVELOP** a plan to address aging water and sanitary sewer infrastructure.

ction

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Beach

ami

• **CONTINUE** the stormwater program and have projects fully underway in South, Mid and North Beach. Start immediately upon completion of Jacobs' analysis.

• **IMPLEMENT** controls to prevent issues of unpermitted work or work exceeding city projects.

• **IMPLEMENT** creative two-way engagement plan for projects.

• **PRESERVE** and Restore Biscayne Bay

- BUILD Reef Biodiversity and Defenses
- **BOLSTER** our Beaches
- NATURE-BASED Infrastructure More than Just Habitat!
- Resilient305 RESILIENT Parks

ctions:

 $\check{\triangleleft}$ 

• **REDUCE** "Back Bay Flooding"

- IMPLEMENT Sea Level Rise Strategy
- DEVELOP Sea Level Rise Checklist for Capital Projects
- CREATE Development Review Checklist
- **STRENGTHEN** Resilience Planning
- **EXPAND** Renewable Energy
- **BUILDING** Efficiency 305
- SEND Your Boss to Bootcamp
- **RESILIENT** 35 in the 305 Network
- **RESILIENCE** Training for All
- **RISE** to the Rescue
- **COLLABORATIVE** with Universities
- ACTIONABLE Science Advisory Panel (ASAP)
- **RESILIENCE** Accelerator Workshops



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### MANAGEMENT OBJECTIVES



**Improve the walking and biking experience** by providing safe, properly lit, shaded and well-maintained bike lanes, sidewalks, Beachwalk and Baywalk.



**Increase housing options for current and future residents.** Enable growth in housing that protects seniors and encourages first-time home-buyers.

## 01

Increase multi-modal mobility citywide and connectivity regionally improving transportation equity by implementing the Transportation Master Plan and leveraging state and federal plans and funds. Support access to a quality, regional workforce through improved transportation options to the mainland.

02

Address traffic congestion through solutions such as Intelligent Transportation System (ITS); targeting loading, ride share, and any other mobility disruption. 05

**Support affordable, compatible workforce housing** through public and private partners for key industries, including the use of development incentives.

## 06

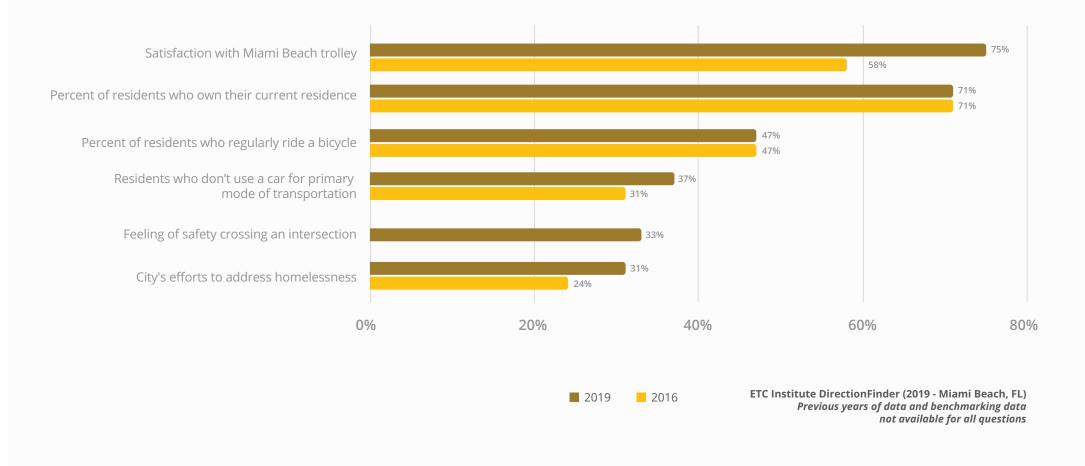
Address homelessness by continuously evolving and innovating services to help those wishing to end their personal homelessness.



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## Resident Survey Highlights

(by percentage of respondents rating the item 4 or 5 in a scale of 5 points)





### Resilient305 Actions:

- **DEVELOP** Mobility Hubs in the 305
- **DESIGN** a Better Bus Network
- **DRIVE** into the Future!
- IT'S Electric!

### Miami Beach Actions:

- **IMPLEMENT** the Transportation Master Plan.
- **IMPLEMENT** Bus Rapid Transit on the Julia Tuttle Causeway.
- **COMPLETE** the Beachwalk.
- MAKE substantial progress on the Baywalk.

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# ORGANIZATIONAL INNOVATION

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enge



### OBJECTIVES IMPROVE STRATEGIC DECISION MAKING AND FINANCIAL STEWARDSHIP, MAKING THE CITY MORE BUSINESS FRIENDLY AND USER-FRIENDLY WITH AN EMPLOYEE CULTURE OF PROBLEM SOLVING AND ENGAGEMENT.



### MANAGEMENT OBJECTIVES

# 03

**Implement the General Obligation (GO)** Bond projects on-time and on-budget, through responsible oversight and coordinated project phasing.

## 01

02

Implement City Commission goals and policies through the strategic plan and budget with routine reporting through quarterly Commission goals conferences. Enhance decision making information through fact-based analyses, data, dashboards, and surveys. Streamline the delivery of services using best practice research, outsourcing, and benchmarking.

**Ensure strong fiscal stewardship** by making sure expenditure trends are sustainable over the near and long-term, using payas-you-go, innovative funding (such as grants and financing), integrating resilience and sustainability, and innovative risk management. Focus on long-term viability of parking, sanitation, pensions and health plans.



**Improve two-way communications and engagement** for construction projects and emergencies within neighborhoods, using creative tools such as an engagement toolbox.

# 05

**Empower employees to provide excellent customer service, be problem solvers and solution finders** through a building a culture of process improvement. Use the Office of Inspector General as a resource to improve performance and identify inefficiencies.





Maximize the use of innovative technology to help us be a Smart City, including open data, online transactions for customers, and threats like cyber-security.



**Improve employee safety and wellness.** Offer an excellent wellness program and explore policies to better align city functions for the modern workforce, including work hours (flex hours and days), travel, cell phones and social media.

## 80

Attract and retain top talent, building a strong professional public administration team and implement succession planning.



**Increase intergovernmental cooperation** through City Commission and administration relationship building with local, regional and national connections and strengthen the Miami Beach lobbying effort.

## 09

**Foster rewarding careers** through training and assignments, and align the management team decision-making, evaluations, and system of rewards.



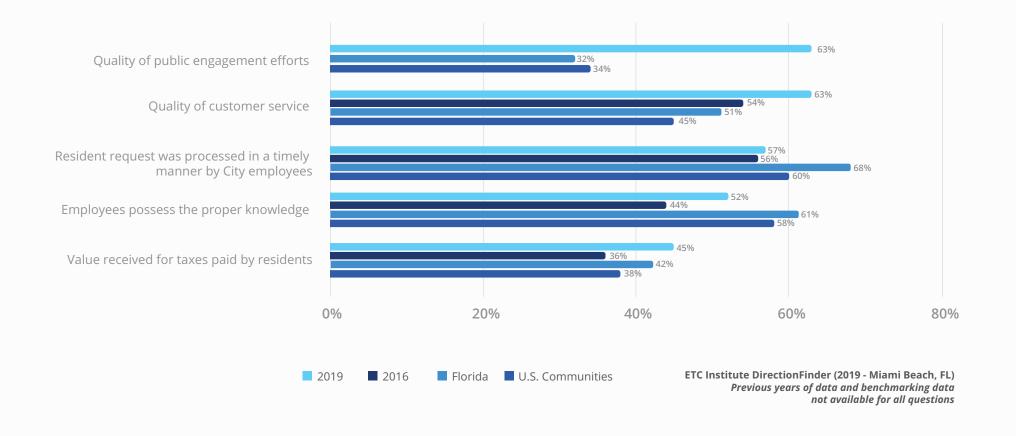
Create an environment for interdepartmental collaboration.

## Resident Survey Highlights

(by percentage of respondents rating the item 4 or 5 in a scale of 5 points)

Fall

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46



• GET the 311 on Resilience for the 305.

Actions: • **SEE** it to Believe it

- CREATE a Resilient305 ArcGIS Hub.
- SHARE Bold Integrated Water Models.
- **IMPLEMENT** the One Water Framework.
- PLANNING Efficiently & Effectively Together.
- **FINANCING** a Resilient Future.
- THE POWER of Purchasing
- Resilient305 • PILOT Resilience Financing Decisions Toolkit.
  - **DEMONSTRATE** the Costs and Benefits of Resilience Improvements.
    - ctions: • **IMPLEMENT** program budgeting. • COMPLETE GO Bond Quick Wins.
    - **IMPLEMENT** engagement toolbox.  $\triangleleft$ 
      - CONDUCT outreach to new residents, including tours of city hall.
    - Beach • CONVENE quarterly meetings of HOA presidents with senior staff.
      - MAKE 50% of all customer transactions with the city available online within two years.
    - Miami • **CREATE** an open data program.

# BOUNCING FORWARD

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The Miami Beach Strategic Plan through the Lens of Resilience is our shared roadmap. While this plan includes our defined priorities at a moment in time - implementation is sure to be dynamic and we will need to be agile in addressing the issues, shocks and stresses that arise. Many of the strategic plan actions are underway, and others have yet to begin. Miami Beach will implement this plan while also supporting the Resilient305 Strategy to advance resilience in our city, county, and region. Tools such as the Resident Survey, automated dashboards and quarterly performance meetings will help us to be agile and move forward to achieve our priorities. The tools include:

**Resident and Business Survey:** The survey is conducted every two years to measure resident satisfaction with services and to understand community priorities. Conducted since 2005, this statistically valid survey provides benchmarking and trend data to assess areas that need improvement as well as services exceeding expectations. Survey results inform the budget processes.

**Dashboards:** The City will grow in its use of Power BI, a business analytics tool, to measure performance citywide, increase transparency and help departments make data-driven decisions. Dashboards provide powerful visualizations and advanced data analysis, allowing departments to create their own automated dashboards with the support of Information Technology Services. Three pilot dashboards have been created and departmental dashboards are underway. As the use of dashboard evolves, the city can better track performance and inform strategy and budgets.

**Quarterly performance meetings:** Having a structure to track progress toward established objectives is essential for implementation. Quarterly meetings will keep a focus on progress, reduce bottlenecks and build cross-departmental collaboration.

**PIVOT Team:** The city will be a key participant in the Resilient305 Strategy implementation as part of the Progress, Innovation, and Vision for our Tomorrow (PIVOT) team. PIVOT will look at resources, timeframes, and priorities to develop a work plan and oversee implementation.

The purpose of strategic planning is to define our goals- and to work together in achieving them. In the true spirit of resilience planning, we plan with the goals of reducing risk, creating cobenefits that improve our quality of life. Through this we become ready to not only bounce backbut to bounce forward.

### ACKNOWLEDGEMENTS

Miami Beach's Strategic Plan Update through the Lens of Resilience was inspired by the 100 Resilient Cities initiative of the Rockefeller Foundation and the leadership of the Miami Beach Mayor and City Commission. It builds upon the strong history of strategic planning in Miami Beach.

Special thanks to all Miami Beach staff who provided expertise along the way, and who contributed toward the development of the Greater Miami and the Beaches Resilient305 Strategy and the Strategic Plan update.



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### **A PROSPEROUS CITY** with a special flavor of culture, arts, education, and business.

A SAFE CITY with a mosaic of residents enjoying life in iconic and historic NEIGHBORHOODS.





A RESILIENT COASTAL CITY with a thriving environment and modern infrastructure.

A PEOPLE-FIRST CITY where the pedestrian is prioritized in mobility options and community



www.mbrisingabove.com.



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### MIAMIBEACH

City of Miami Beach, 1700 Convention Center Drive, Miami Beach, Florida 33139, <u>www.miamibeachfl.gov</u>

### COMMITTEE MEMORANDUM

- TO: Sustainability and Resiliency Committee
- FROM: Jimmy L. Morales, City Manager
- DATE: June 26, 2019

#### SUBJECT: REVIEW OF RESILIENCE STRATEGY WORKPLAN - PLANNED AND IN PROGRESS RESILIENCY PROJECTS

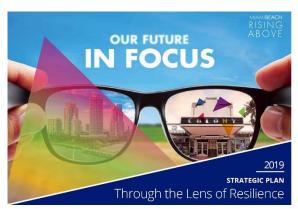


I am pleased to announce that *Resilient305*, our comprehensive regional resilience strategy was launched on May 30<sup>th</sup>, 2019 (attachment 1). Miami Beach has been on the journey of building a resilience strategy for nearly three years. Since being selected by the 100 Resilient Cities initiative of the Rockefeller Foundation in 2016, Miami Beach's chief resilience officer (CRO) and extended city staff have been working closely with Miami-Dade County and Miami CROs as the *Greater Miami and the Beaches* team. The strategy contains 59 actions to lift our entire region and including all cities.

In parallel with this strategy effort, the city has been updating our *Strategic Plan Through the Lens of Resilience* (attachment 2). This strategic plan is complete and incorporates the City Commission goals, the recent community survey, and *Resilient305* actions important for Miami Beach's resilience (Attachment 2). Rather than

having separate strategic and resilience plans, this one comprehensive strategy will focus on the city's needs in both near-term and long-term time horizons. The city can build resilience more effectively by having an integrated approach to aligning strategic priorities, resources, and services.

Action has been underway throughout both planning processes. For the city's strategic plan, executive staff are implementing action plans developed to address the City Commission goals conference priorities. Ongoing implementation of the full strategic plan will include routine progress checks through executive staff and the development of performance data dashboards. *Resilient305* actions will be woven into our implementation, with the first *Resilient305* implementation team (PIVOT) meeting to prioritize actions being scheduled for June 25<sup>th</sup>.



By having these documents, we are best positioned for success, through directing our own funding and services, and better leveraging external funding sources. I am proud of these documents that contain our top priorities as an organization. The full *Resilient305* strategy can be viewed at <u>www.resilient305.com</u>. My next steps are to bring both strategies to the full City Commission on July 17th, 2019.

## MIAMIBEACH

#### <u>Item 2.</u> COMMITTEE MEMORANDUM

TO: Sustainability and Resiliency Committee

FROM: Jimmy L. Morales, City Manager

DATE: June 26, 2019

#### SUBJECT: SUSTAINABILITY COMMITTEE

#### **RESPONSIBLE DEPARTMENT:**

Dave Doebler, Committee Chair

#### <u>Analysis</u> VERBAL REPORT AT COMMITTEE MEETING.

#### ATTACHMENTS:

#### Description

No Attachments Available

Туре

#### <u>Item 3.</u> COMMITTEE MEMORANDUM

TO: Sustainability Resiliency Committee Meeting

- FROM: Jimmy L. Morales, City Manager
- DATE: June 26, 2019

SUBJECT: DISCUSSION ON CITY OF MIAMI BEACH STORMWATER, SANITARY SEWER, AND WATER INFRASTRUCTURE BEST MANAGEMENT PRACTICES

#### **RESPONSIBLE DEPARTMENT:**

Environment and Sustainability

LEGISLATIVE TRACKING: Item C4U - May 11, 2016 Commission Meeting

SPONSORED: Commissioner Micky Steinberg

#### Analysis VERBAL REPORT AT COMMITTEE MEETING

#### ATTACHMENTS:

#### Description

No Attachments Available

Туре

#### <u>Item 4.</u> COMMITTEE MEMORANDUM

TO: Sustainability Resiliency Committee Meeting

FROM: Jimmy L. Morales, City Manager

DATE: June 26, 2019

SUBJECT: DISCUSS UPDATES TO THE CITY CODE REFERENCING TURTLE NESTING

#### **RESPONSIBLE DEPARTMENT:**

Environment and Sustainability

#### **LEGISLATIVE TRACKING:**

Item C4F - September 25, 2017 Commission Meeting

#### **SPONSORED:**

Commissioner John Elizabeth Aleman I Co-Sponsor Commissioner Joy Malakoff

#### Analysis

#### VERBAL REPORT AT COMMITTEE MEETING.

#### ATTACHMENTS:

#### Description

LTC 158-2019 Sea Turtle White Paper

Туре

Other

City of Miami Beach, 1700 Convention Center Drive, Miami Beach, Florida 33139, www.miamibeachfl.gov

Jimmy L. Morales, City Manager Tel: 305-673-7010, Fax: 305-673-7782

#### 158-2019

NO. **LTC #** 

TO: Mayor Dan Gelber and Members of the City Commission

FROM: Jimmy L. Morales, City Manager

DATE: March 20, 2019

SUBJECT: Sea Turtle White Paper

The success of the sea turtle conservation in Miami Beach depends on collaborative efforts between the U.S. Fish and Wildlife Service (USFWS), Florida Fish and Wildlife Conservation Commission (FWC), Miami-Dade County and City of Miami Beach.

LETTER TO COMMISSION

The attached white paper provides an overview of sea turtle conservation efforts in the city. We have invited FWC's senior leadership team to discuss best management practices, timelines, and solutions that align with the unique challenges that our coastal community encounters.

Should you have any questions, please contact Elizabeth Wheaton, Environment and Sustainability Director, at 305-673-7010.

Attachment – Sea Turtle White Paper

SMT/ESW/MKW/FCT/YP

City of Miami Beach, 1700 Convention Center Drive, Miami Beach, Florida 33139, <u>www.miamibeachfl.gov</u> OFFICE OF THE CITY MANAGER

March 18, 2019

Eric Sutton Executive Director Florida Fish and Wildlife Conservation Commission 620 South Meridian Street Tallahassee, FL 32399

Dear Mr. Sutton:

Miami Beach is a vibrant coastal city in Southeast Florida that is home to more than 90,000 residents and welcomes nearly 9 million visitors annually. Our role as an international tourism destination and as an urban community poses some unique challenges. Today, I write to you to share the opportunities that we see to work together to improve sea turtle protection, while addressing the unique challenges of our community. Attached is an overview developed by my team.

We are requesting a meeting with you or your senior team to discuss past practices, current conditions and potential solutions moving forward. My Chief Resilience Officer, Susy Torriente had an introductory call with your Chief of Staff, Jennifer Fitzwater in February. With a new administration at the helm, I am confident that we can discuss enhancements to our current practices and build upon our working relationships among the city, county and state. I invite you to visit our community for a tour and I would also like to visit you in Tallahassee.

Thank you for your consideration and I look forward to working with you and your team.

Sincerely, Jimmy L. Monales City Manager

CC: Jennifer Fitzwater, FWC Chief of Staff Dr. Thomas Reinert, Regional Director Robbin Trindell, Biological Administrator III Michele Burger, Chief of Staff, Office of Mayor Dan Gelber, City of Miami Beach Susanne M. Torriente, Chief Resilience Officer, City of Miami Beach Elizabeth Wheaton, Director of Environment & Sustainability, City of Miami Beach

#### City of Miami Beach Sea Turtle Protection Overview

#### Sea Turtle Habitat

The City of Miami Beach is one of several coastal cities in the state of Florida that serves as a nesting habitat for three different species of endangered and/or threatened marine turtles. The Atlantic loggerhead turtle (*Caretta caretta*), Atlantic green turtle (*Chelonis mydas*), and Leatherback turtle (*Dermochelys coriacea*) lay their nests along the city's seven miles of beaches every year from early April through early November. On an annual basis, the city's beaches can host an average of 100-110 nests, while the average nest can host up to 110 eggs, contingent on the species.

Sea turtles in the wild are susceptible to predation, disease, and even beach erosion. In urban environments, such as Miami Beach, they can run into issues with fishing gear, beach furniture, vehicles, people, and the biggest challenge of all, light pollution. Sea turtle hatchlings are born with the instinct to head toward the brightest light on the beach after hatching, which is usually the light of the sky reflected off the ocean surf. In coastal areas with artificial lighting, hatchlings may become disoriented and travel in the wrong direction away from the ocean, potentially never making it to the water.

Disorientations are a common occurrence in coastal cities that also serve as sea turtle habitats. Upland lighting and overall light pollution draw hatchlings away from the water. In Miami Beach, disorientations generally occur as a result of upland lighting and are documented by the local sea turtle permit holder.

#### Federal & State Enabling Legislation

The Federal Endangered Species Act (ESA) of 1973 and Florida's Marine Turtle Protection Act (379.2431, Florida Statutes) serves to protect sea turtle populations by restricting activities (possession, disturbance, harassment) that harm or could harm marine turtles, their nests, their eggs, or their hatchlings. Florida statutes also dictate that a specific authorization is required from Florida Fish and Wildlife Conservation Commission (FWC), as a delegated authority from the U.S. Fish and Wildlife Service (USFWS), to conduct scientific, conservation, or educational activities that directly involve sea turtles, their nests or their hatchlings in the state of Florida.

#### State & County Role

At the state level, FWC is responsible for ensuring compliance with Florida statutes. They also enforce turtle conservation permits, respond to and investigate incidents, and make changes to permits and permit requirements. Miami-Dade County, through their Sea Turtle Monitoring Program, is the local sea turtle permit holder and the lead on conservation activities. As dictated by their FWC permit (#MTP-18-017), county staff conducts daily morning inspections to identify, mark off and, where applicable, relocate nests, to inventory hatched nests, and to document hatchling disorientations. No beach activities (sand sifting, litter collection, concessionaire operations) are allowed to begin before the daily survey is completed and county staff gives the "all clear". This restriction prevents the loss of sea turtle tracks used to identify nests, as well as

potential collisions with nesting sea turtles or newly laid nests. All nests identified by county staff during the survey are marked and surrounded by caution tape the same morning they are discovered, signaling the public to maintain a safe buffer of at least 10 feet.



AGENCIES WITH DEFINED LEGAL RESPONSIBILITIES

#### State Guidance for Locals

In 2016, FWC updated the Marine Turtle Conservation Handbook, the document that provides guidance for the FWC sea turtle permit holders. One major change specified within the updated handbook is that most nests will no longer be relocated, screened or caged. These options are considered a last resort to be used sparingly only if fully authorized by the state. Another change in the updated handbook requires that permit holders leave more nests in place, rather than relocate them as has been done for the last 30 years. These changes are intended to reduce the risk of embryo and hatchling mortality associated with moving the eggs and caging the nests. The focus is now on reducing human activity and artificial lighting rather than nest relocation, placing the burden on better management of potential human threats. Relocation is still used as another last resort in extenuating circumstances, such as with nests that would have otherwise been damaged by inundation, erosion, or other substantial threats as determined by the county and FWC.

In the past, loggerhead nests in selected segments of Miami Beach, such as our entertainment and cultural districts, were often relocated due to concerns over artificial light that could cause disorientations. As less nests are relocated, Miami Beach has seen an increased number of reported disorientations adjacent to these areas, like Lummus Park and Marjorie Stoneman Douglas Park in South Beach. After the conclusion of the 2018 season, local sea turtle permit holder reports indicated that over half of all nests citywide experienced disorientation. This represents a significant increase when compared to disorientation rates prior to 2016, when nests adjacent to the entertainment districts or areas with evident threats to sea turtle populations were relocated with more frequency. It should be noted that prior to the revisions of the handbook, disorientation reports were not mandatory; therefore, limited data exists before 2016.

#### City of Miami Beach Today

As the community within which the nesting and hatching habitat is located, the City of Miami Beach helps connect all the entities involved in sea turtle protection by making recommendations to the state and county, ensuring compliance with the city's sea turtle protection ordinance, and overseeing education and outreach to our residents and visitors.

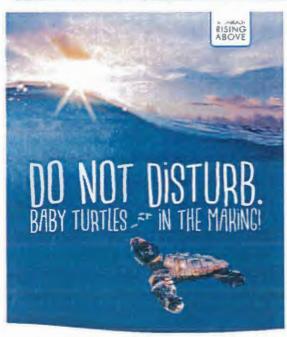
Miami Beach is highly visited barrier island community located in southeast Florida between Biscayne Bay and the Atlantic Ocean. In 2017, **Miami Beach attracted over 58% of the 15.86 million overnight visitors that stayed within Greater Miami and the Beaches**. As listed within the 2017 Visitors Profile and Economic Impact Study, these visitors spent an approximate **\$25.97** billion during their stay and noted that the beaches and the Art Deco/South Beach district were the top tourist destinations of the region. In 1986, Ocean Drive and other neighboring areas within South Beach were first designated as historic and listed on the National Register of Historic Places for their distinct architecture.

#### Safety & Lighting Needs in Miami Beach

Our entertainment and cultural districts attract an abundance of visitors to enjoy both daytime and evening activities. Lighting is one tool used by the city to ensure the safety of our residents and visitors. Lighting in public areas helps our police force to reduce crime. In high impact zones such as Ocean Drive (5<sup>th</sup> Street to 14<sup>th</sup> Street), our Police Department relies on enhanced lighting as an effective crime prevention tool. Enhanced lighting can improve surveillance and increase the risk of offenders being detected. People feel safer in well illuminated areas, which increases activity, can further improve surveillance, and ultimately deter crime.

The University of Chicago Crime Lab New York published a study in 2017, which highlights the New York City Housing Authority's (NYCHA) deployment of light towers to 39 NYCHA housing developments and found these sites experienced crime rates that were significantly lower than control areas without this type of lighting. Index crimes in many lit areas were cut by 39% over areas that did not receive the lighting improvements. In Miami Beach, a city owned garage received upgraded lighting due to complaints of auto burglaries and other crimes inside the property. The police department found a significant drop in the total cases reported by an estimated 58.33% decrease and a decreased in calls for service of 62.95% after the new lighting was installed. Proper lighting not only deters crime, but it enhances the safety of pedestrians and users of public space. A properly lit sidewalk will prevent trip and falls. Drivers can better identify

pedestrians at crosswalks when rights of ways are properly lit. The same applies to drivers being able to detect bicyclists on the roadway.



SEA TURTLE EDUCATION CAMPAIGN - MIAMI BEACH

DEPARTMENT AND BEN HICKS PHOTOGRAPHY)

(COURTESY OF CITY OF MIAMI BEACH COMMUNICATIONS

#### Miami Beach Existing Efforts and Ongoing Program Improvements

MBRISING ABOVE COM/SEATURTLES

#MRSHARETHESHORE

The City of Miami Beach takes many steps to reduce disturbance of sea turtles during nesting season, while maintaining a safe environment for our residents and visitors. City departments continuously work on short-term and long-term strategies for better protecting our native sea turtle population. This includes internal trainings, lighting community workshops, educational retrofits, campaigns, and enforcement. For example, in 2018, the city launched an educational campaign which included a public service announcement (PSA), printed ads, and both organic and paid social media posts reminding the public to not disturb sea turtle nests. The social media campaign was viewed over 500,000 times and the PSA received over 200.000 views.

In addition, the Code Compliance Department provides targeted outreach. Prior to the start of 2018 sea turtle season, Code Compliance staff conducted in person site visits to each of the 153 private beachfront properties to alert them of the upcoming start of nesting season and to provide

them with educational information on sea turtle conservation and lighting requirements. By the end of the season, they issued 42 Notice of Violations, of which all but three have come into compliance to date. The pending three properties are awaiting a Special Masters hearing.

As the city plans, designs, and constructs projects along the beachfront, sea turtle friendly fixtures will replace existing non-compliant lights on public property. These projects include those programmed in our capital budget, as well as those approved in 2018 by the Miami Beach voters for funding through the issuance of a General Obligation Bond (G.O. Bond).

Moreover, the city is revising its existing special event guidelines to ensure that special considerations are given to sea turtle populations, especially for events taking place on or adjacent to the beach. In addition to minimizing the number of allowable events, the city will work to restrict the evening run times of each event to minimize the need for lighting. The city also has two Beachfront Monitors that conduct enhanced event and evening inspections to ensure that all beachfront equipment is safely secured and stored west of marked sea turtle nests.

The city is always looking for opportunities to enhance our existing initiatives and coordinates regularly with county, FWC, and USFWS staff to brainstorm new ideas, prevent problems, and quickly resolve issues. On March 6, 2019, an interagency meeting was held at FWC's South Region Office between FWC, Miami-Dade County and the city. Interagency coordination meetings continue throughout the year with standing monthly conference calls. Open communication between all four agencies, as well as the data provided by the county allow the city to continuously adjust our efforts, prepare for upcoming special events, better direct education efforts, and prioritize enforcement inspections in areas with high nest densities and/or significant lighting issues.

#### **Opportunities**

Balancing public safety needs and sea turtle protection can be difficult for communities up and down the coast and is a particular challenge for Miami Beach due to our volume of visitors and our highly urbanized environment. Sea turtles require darkness and while we are working to reduce light pollution throughout our city, adequate lighting is critical in addressing public safety concerns, particularly in the cultural, commercial and entertainment districts of our city. This is why heavily visited areas like Lummus Park were designated for nest relocation in the past. As more nests are left *in situ*, lights necessary for keeping these areas safe are of increased concern.

The City of Miami Beach has already made several short-term and long-term changes to better protect our native sea turtle population. However, this is a complex issue that requires careful thought and collaboration between all the agencies working toward sea turtle protection in Miami Beach to identify out-of-the-box "hands on" and administrative sea turtle conservation solutions to supplement lighting compliance efforts.

#### Options for Discussion



RESTRAINING CAGE - BROWARD COUNTY (COURTESY OF NOVA SOUTHEASTERN UNIVERSITY)

There are several sea turtle conservation strategies listed within the Marine Turtle Conservation Handbook that could be explored to address areas with high rates of mortality and disorientation, such as the entertainment districts. All options listed are only intended for individuals whose permits authorize them to carry out those activities as dictated by FWC. One option is to consider relocations for entertainment district hatchings. As previously the mentioned, relocation is used as a last resort and only for nests that are located in naturally hazardous areas such as those that are too close to the water line. However, relocating nests could potential have a negative impact on the development of embryo since an adequate incubation environment greatly influences the growth of the eggs. It is important to note that prior to 2016, almost all nests from the entertainment districts were relocated to Haulover Beach. Another option is the implementation of restraining cages or protective perimeters. These cages are placed over the nest with the goal of collecting all emergent hatchlings. This is also considered to be a last resort option and could be used when nests are deposited in areas that may prevent hatchlings from being able to access the water successfully. As per the Marine Turtle Conservation Handbook, this option may be allowed in some beaches if the local municipality or jurisdictional entity is actively working with FWC to address and reduce lighting challenges. Broward County is permitted to use this method for a specific number of loggerhead nests in certain areas of their beaches.

Lighting is an issue throughout all coastal areas with sea turtle activity, including our National Parks. Although not used within the State of Florida or listed as an option within Marine Turtle Conservation Handbook, the implementation of silt fencing around emerging nests has been used as an option in other states. The Cape Hatteras National Seashore located in North Carolina is a 67-mile long series of islands managed by the National Parks Service. Since 2005, black silt fencing has utilized by park management staff and placed around most sea turtle nests to decrease the amount of artificial light that shines on each site, thereby decreasing the negative effects of light on hatchlings. The fencing is placed only when the nest approaches its predicted hatching period and is removed right after the hatchlings have emerged. Cape Hatteras National Seashore follows management guidelines defined by the North Carolina Wildlife Resources Commission in the Handbook for Sea Turtle Volunteers in North Carolina and USFWS species recovery plans.



SILT FENCING - CAPE HATTERAS NATIONAL SEASHORE {COURTESY OF SEA TURTLE MONITORING AND MANAGEMENT AT CAPE HATTERAS NATIONAL SEASHORE: 2017 ANNUAL REPORT}

In Miami Beach, Miami-Dade County staff is responsible for documenting nests and disorientations and providing reports based on their findings. However, the city receives limited data from the county. As of today, Miami Beach receives the number of nests, number of false crawls, and disorientation reports. While we do receive nest counts, the city is not provided with nest locations and the nest incubation timeline. Receiving this information with specific locations of nests will help the city prioritize outreach to properties located nearby. Detailed data can help us provide more targeted code enforcement and operational changes to yield greater impact.

#### **Conclusion**

In summary, Miami Beach is already working with our partners at the county, state and federal government to use certain conservation strategies for sea turtle protection on our beaches. We want to build on our existing efforts by looking at other conservation strategies that can help us further decrease sea turtle disorientation, while meeting the needs of our vibrant urban beach community. Some of the opportunities that we would like to explore further with FWC include but are not limited to:

- Opportunity 1: Relocating nests in high impact areas such as the entertainment districts.
- Opportunity 2: Installing a protective mesh for nests in areas with high artificial light exposure as listed within the handbook and practiced within Broward County.
- Opportunity 3: Utilizing silt fencing around the portion of the nests that are exposed to upland lighting, creating a barrier and minimizing the possibility of disorientations.
- Opportunity 4: Continuing to pilot lighting improvements in areas with high disorientations, allowing for flexibility to explore alternative options such seasonal lighting to meet the needs of all agencies.
- Opportunity 5: Following best management practices such as working with the permit holder to obtain accurate data such as nest location and numbers. For example, NOVA Southeastern University (Permit Holder) works closely with the City of Fort Lauderdale to obtain timely data.

Through collaborative discussion of these and other conservation opportunities in consideration of our community's unique challenges, the City of Miami Beach knows we can have a positive impact on sea turtle protection, such as reducing sea turtle disorientation. These strategies can also help further support the ongoing efforts of all city departments to address existing lighting challenges in areas that do not provide excessive public safety challenges. The conservation of sea turtle populations and the safety of residents and visitors are equally important to the City of Miami Beach and the definitive goal is to find a balance between both.

Thank you for your consideration in this matter. We appreciate any guidance that can be provided in helping reach this goal.

#### <u>Item 5.</u> COMMITTEE MEMORANDUM

TO: Sustainability Resiliency Committee Meeting

FROM: Jimmy L. Morales, City Manager

DATE: June 26, 2019

SUBJECT: DISCUSSION ON ARTIFICIAL REEFS

#### **RESPONSIBLE DEPARTMENT:**

Environment and Sustainability

#### LEGISLATIVE TRACKING:

Item C4 AI - May 16, 2018 Commission Meeting

#### **SPONSORED:**

Commissioner Ricky Arriola

#### <u>Analysis</u> MEMO ATTACHED.

#### ATTACHMENTS:

Description

Artificial Reefs Memo

**Type** Memo

City of Miami Beach, 1700 Convention Center Drive, Miami Beach, Florida 33139, <u>www.miamibeachfl.gov</u>

#### COMMITTEE MEMORANDUM

TO: Sustainability and Resiliency Committee

FROM: Jimmy L. Morales, City Manager

DATE: June 26, 2019

#### SUBJECT: Discussion on Artificial Reefs

#### BACKGROUND

At the City Commission meeting on May 16, 2018, the Mayor and City Commission referred a discussion to the Sustainability and Resiliency Committee (SRC) on artificial reefs. The item was sponsored by Commissioner Ricky Arriola.

At the SRC meeting on November 28, 2018, the University of Miami's Laboratory for Integrative Knowledge (ULINK) Coastal Resilience Team presented a partnership project with the City of Miami Beach to develop and test coastal resilience strategies that combine grey and green infrastructures to reduce the vulnerability of coastal communities. The project will investigate the role of healthy coral reefs on wave attenuation and how they impact mitigation on coastal structures using a set of tank-based validation tests through the Surge-Structure-Atmosphere-Interaction (SUSTAIN) laboratory. At the meeting, the SRC passed a motion directing staff to develop a long-term strategic plan on how to make a viable artificial reef system that enhances resiliency, decreases beach erosion, and create an eco-tourism base for our economy.

The ULINK research will help inform a future long-term approach that complements strategies that are being explored by the United States Army Corps of Engineers (USACE) and Miami-Dade County. The USACE in partnership with Miami-Dade County are looking at long-term strategies for beach renourishment in a two-year planning study. As this project progresses, staff will provide updates to this Committee.

#### ANALYSIS

City staff has been working with the ULINK Coastal Resilience Team and Miami-Dade County's Regulatory and Economic Resources (RER) team on test project that looks at artificial reefs and natural reefs restoration to reduce storm surge risk.

On June 10, 2018, City staff visited the University of Miami's Surge Structure Atmosphere Interaction Facility (SUSTAIN), where the ULINK Coastal Resilience team demonstrated how they are using a one-of-a-kind wave tank to test different man-made reef designs (including different berm heights and shapes, as well as different coral species, sizes) under simulated storm wind and wave conditions. The goal of the simulation is to identify which design would best perform breaking up wave energy before it gets to shore. During the visit, city staff discussed working with RER team in order to permit a test site off Miami Beach to investigate the performance of the designs.

City staff is working with the RER team on the potential for piloting reef structures with and without transplanted corals, deploying the units off-shore of Miami Beach, and the potential for utilizing off-shore structures to enhance habitat and provide storm surge protection. The potential pilot will test the performance of coral fragments mounted onto modules under natural conditions and then, coral survivorship and growth will be monitored at pilot sites. Along with the model being tested at the SUSTAIN lab, the ULINK team will be able to compare the results under the modelling and under natural conditions. The pilot will provide first-ever actual measurements of reductions in wave energy as a result of deployment both with and without restored coral. The goal is to have a pilot completed within the next 12 months.

The innovative aspect of the ULINK activities is the specific deployment of these structures with coastal protection in mind and the results of the pilot will assist with the identification of places where nature-based solutions for coastal defense can be deployed cost-effectively. Although there may be permitting complexities to further extend the pilot along our coast, the long-term results would be extremely beneficial to assist the city deploying both grey and green infrastructure mechanisms for coastal protection and storm surge risk reduction.

#### CONCLUSION

The following is presented to the members of the Sustainability and Resiliency Committee for discussion.

JLM/SMT/ESW/fct

#### <u>Item 6.</u> COMMITTEE MEMORANDUM

TO: Sustainability Resiliency Committee Meeting

FROM: Jimmy L. Morales, City Manager

DATE: June 26, 2019

#### SUBJECT: DISCUSSION REGARDING PRIVATE SEAWALLS

#### **RESPONSIBLE DEPARTMENT:**

City Manager's Office | Public Works

#### LEGISLATIVE TRACKING:

Item R7F - December 12, 2018 Commission Meeting

#### **SPONSORED:**

**City Commission** 

#### BACKGROUND:

At the December 12, 2018 City Commission meeting, during Item R7F, private seawalls were discussed and assigned to Public Works for further dialogue at the Sustainability and Resiliency Committee. Subsequently, at the January 29, 2019 Commission Goals Conference Retreat, Commission Aleman requested that a financial seawall strategy be developed to encourage private property owners to retrofit seawalls. In addition, the Urban Land Institute's Advisory Services Panel Report (2018) recognized the need to create financing for private seawall enhancements. The City Manager's READY team is charged with vetting the ULI recommendations. As part of the READY team, John Woodruff, Chief Financial Officer (CFO), convened an interdisciplinary team to specifically examine funding and financing options for private seawalls. Private seawall elevation assessment and funding options were discussed at the March 20, 2019 Sustainability and Resiliency Committee and staff committed to conducting research and bringing back a framework of options as an interdisciplinary team.

#### Analysis

The City of Miami Beach is investing in aging infrastructure to reduce flood risk, adapt to climate change, and is committed to building resilience on several fronts. Over the last few years the city has updated its land use development regulations for new construction to address water retention, setbacks and increase in base flood and freeboard elevation. These measures also contemplate sea level rise scenarios to reduce the risk to the new inventory of buildings.

While public investments and regulations are fully underway, the city realizes that the private homeowner, business owner and land owner need to take steps to invest in and protect personal private property. These investments, while beneficial in the long-run, can be rather expensive in the

short-term. This issue is also of interest to the Southeast Florida Climate Change Compact (Compact) which includes Palm Beach County, Broward, Miami-Dade and Monroe and more than 100 cities.

The READY team's objectives were to examine public and private financing options. The CFO examined options such as a Special Assessment District with the assistance of the Legal Department from the public perspective and private financing options with Julie Santamaria, the city's financial advisor. Several challenging issues were identified with creating Special Assessment Districts for this purpose including:

• Seawall improvements would serve a private purpose versus a public purpose,

• Negotiating voluntary agreements with each individual property owner since access to private property would be necessary,

• Difficulty dealing with owners that opt out,

• The city taking on the construction risk of the projects as the project manager on behalf of the individual property owners

• Challenge of assessing properties inland benefitting from the improvements a portion of the assessment

• The cost of the projects (tens of millions) would be on the city's books until the assessment is completely paid off which negatively affects the city's debt capacity and bond rating

Ideally, the City would be a facilitator assisting property owners obtain private financing and vetting a pool of contractors. The Chief Resilience Officer (CRO) discussed the topic with the Staff Steering Committee of the Compact. Staff's recommendation is to issue a Request for Interest (RFI) to survey the appetite of the financial and banking sector to create innovative and economical financing packages to incentivize owners to invest in their property. The innovative tool would be available to the four counties and cities of the Compact to address this item that crosses municipal boundaries and increasing the customer base for the financial and banking sector.

To provide adequate information needed for financing options, an understanding of existing private seawall elevation is needed. Staff is aware, anecdotally, of low-lying seawalls that have been overtopped during high tides and storm events and that have impacted public storm drainage infrastructure. To gather actual elevation data, staff examined data from Miami-Dade County, however it is not detailed enough to determine the height of seawalls. To understand feasible options, staff accessed the Business Case Analysis Pool of Qualified Consultants and examined in-house capabilities. Four options were explored, ranging from: drone photogrammetry- cost \$13,000 (in-house), drone LIDAR- cost \$93,000 (in-house), boat LIDAR- cost \$270,000 (consultant), or aerial LIDAR for \$415,350 (consultant).

Staff recommends conducting drone LIDAR in-house. Attachment 1 contains additional details on costs and benefits. In summary, the drone LIDAR can be conducted without accessing private property, will provide the highest quality data, and can be completed the fastest. The information can also be utilized by the city for multiple purposes ranging from planning to modeling. The city is fortunate to have staff capable of conducting the assessment. As the cost of the drone LIDAR equipment is not currently budgeted, the city is seeking grant opportunities since this equipment could potentially be utilized by other cities within the Compact and Miami-Dade County.

To move forward, a phased approach is recommended, including:

Phase 1: Release the Request for Interest (RFI) for the financial and banking sector. Seek funding sources for drone LIDAR equipment. Inventory initial areas of known areas of low elevation. (time estimate: three-months)

Phase 2: Prioritize funding and financing for the areas of low elevation, including notification to private property owners. Continue gathering the elevation of remaining private seawalls to create a full assessment of private seawall needs. (time estimate: four-months)

Phase 3: Categorize seawall vulnerability by elevation, assessing the timeframe associated with retrofitting seawalls to reduce risk. Expand funding and financing options and use. (time estimate: three-months)

Staff acknowledges that legislation will be needed if the intent is to require seawall improvements. For example, the City of Fort Lauderdale requires properties to raise seawalls if the seawall allows tidal waters to impact adjacent properties or the public rights-of-way.

#### **CONCLUSION:**

This information is presented to the members of the Sustainability and Resiliency Committee for further discussion. Staff recommends working with the Southeast Florida Climate Change Compact to develop a Request for Interest (RFI) to survey the appetite of the financial and banking sector to create innovative and economical financing packages to incentivize owners to invest in their property. Staff also recommends that drone LIDAR be conducted in-house to reduce cost, achieve the best quality, and avoid needing to access private properties. Staff recommends that funding for the seawall elevation assessment be obtained through grants or through the city's annual budget process.

Type

Other

#### ATTACHMENTS:

#### Description

Seawall Elevation Assessment

#### SEAWALL ELEVATION ASSESSMENT OPTIONS

OPTION	ТҮРЕ	COST	TIME	PROS	CONS
Option 1	In-house <u>drone</u> photogrammetry	\$13,000 + Staff time 1-GIS, 2 Survey Staff	4-6- months (assuming 2 sunny field days per week)	<ul> <li>Private property access not needed</li> <li>Accuracy is within 1.5 inches</li> <li>High quality photos</li> <li>Data obtained for seawalls and adjacent properties</li> <li>Digital Elevation Model (DEM) can be extracted</li> <li>Data will be readily available and easy to use</li> </ul>	-Staff resource time -Clear weather needed -Results will have obstruction from tree vegetation -Long post-processing time.
<b>Option 2</b> *TECHNICAL STAFF RECOMMENDATION	In-house <u>drone</u> LIDAR	\$93,000 + Staff time 1-GIS, 2 Survey Staff	4-months (assuming 2 field days per week- less flight paths and sun is not needed in comparison to Option 1)	-Private property access not needed -City can fly areas on demand -Accuracy is within 1.5 inches -Weather and tree vegetation obstruction is not an issue. -3D High Density Point Cloud -Full DEM and DTM with multiple uses for planning and engineering -Lasers allow highest quality and reduces obstruction -Post- processing time is minimal -Compatible with GIS and CAD	-Staff resource time
Option 3	Consultant <u>boat</u> LIDAR seawall line	\$270,000	6-months	- No staff resource time except for project management	<ul> <li>Private property owners will need to allow the target being set on the sea walls (every 1000 ft or so).</li> <li>Docks and boats will obstruct the seawall elevation line</li> </ul>

#### SEAWALL ELEVATION ASSESSMENT OPTIONS

OPTION	ТҮРЕ	COST	TIME	PROS	CONS
					<ul> <li>Will need personnel on the dock/ seawalls to set the targets.</li> <li>Data is not usable for any other purpose other than an elevation line</li> <li>Consultant boat and equipment needs- dock and space</li> <li>Deliverable will not meet GIS and Engineering needs</li> <li>Data will not be readily available</li> <li>Hardware and software owned by consultant</li> </ul>
Option 4	Consultant <u>aerial</u> LIDAR all points near seawall	\$415,350	6-months	<ul> <li>No staff resource time except for project management</li> <li>-3D High Density Point Cloud</li> <li>Data for top of seawalls</li> <li>Accuracy is within 1.5 inches</li> <li>-Weather and tree vegetation obstruction is not an issue.</li> <li>DEM and DTM extracted</li> <li>Compatible with GID and CAD</li> </ul>	<ul> <li>Private property owners will need to allow the target being set on the sea walls (every 1000 ft or so).</li> <li>Will need personnel on the dock/ seawalls to set the targets.</li> <li>Data will not be readily available and easy to use</li> <li>Hardware and software owned by consultant</li> <li>Staff will still need to process to extract additional the data</li> </ul>

#### <u>Item 7.</u> COMMITTEE MEMORANDUM

TO: Sustainability Resiliency Committee Meeting

- FROM: Jimmy L. Morales, City Manager
- DATE: June 26, 2019

SUBJECT: DISCUSSION ON EXPANDING THE PLASTIC BAG ORDINANCE IN MIAMI BEACH.

#### **RESPONSIBLE DEPARTMENT:**

City Attorney's Office

#### LEGISLATIVE TRACKING:

Item C4 T - February 13, 2019 Commission Meeting

#### **SPONSORED:**

Commissioner Micky Steinberg I Co-sponsored by Commissioner Michael Gongora

#### <u>Analysis</u>

#### VERBAL REPORT AT COMMITTEE MEETING.

#### ATTACHMENTS: Description

No Attachments Available

Туре

#### <u>Item 8.</u> COMMITTEE MEMORANDUM

TO: Sustainability Resiliency Committee Meeting

FROM: Jimmy L. Morales, City Manager

DATE: June 26, 2019

#### SUBJECT: AN ORDINANCE OF THE MAYOR AND THE CITY COMMISSION OF THE CITY OF MIAMI BEACH, FLORIDA, AMENDING CHAPTER 46 OF THE CODE OF THE CITY OF MIAMI BEACH, ENTITLED "ENVIRONMENT," BY CREATING ARTICLE VIII THEREOF, TO BE ENTITLED "SALE OF SUNSCREEN PRODUCTS," TO PROHIBIT THE SALE OF SUNSCREEN PRODUCTS CONTAINING OXYBENZONE OR OCTINOXATE, OR BOTH; AND, PROVIDING FOR REPEALER, SEVERABILITY, CODIFICATION, AND AN EFFECTIVE DATE.

#### **RESPONSIBLE DEPARTMENT:**

Environment and Sustainability

#### LEGISLATIVE TRACKING:

Item R5 N - March 13, 2019 Commission Meeting

#### **SPONSORED:**

**Commissioner Michael Gongora** 

#### <u>Analysis</u>

VERBAL REPORT AT COMMITTEE MEETING

#### **UPDATE:**

Supplement 06.24.19 - Presentations/ Reports provided by:

Joanna C. Walczak, SE Regional Administrator from the Office of Resilience & Coastal Protection

Carys L. Mitchelmore, Professor, University of Maryland Center for Environmental Science

Kurt A. Reynertson, Ph.D. Global Consumer Regulatory and Stewardship Policy Johnson & Johnson Consumer Inc.

#### ATTACHMENTS:

#### Description

Type

Attachment A: Joanna C. Walczak, SE Regional Administrator from the Office of

D	Resilience & Coastal Protection	Other
D	Attachment B: Dr. Carys L. Mitchelmore, Professor, University of Maryland Center for Environmental Science	Other
۵	Attachment C: Kurt A. Reynertson, Ph.D. Global Consumer Regulatory and Stewardship Policy Johnson & Johnson Consumer Inc.	Other
D	Attachment D: Sunscreen MEMO	Memo
D	Attachment E: Sunscreen Ordinance	Other



### Restoring Resilience Update on Florida Reef Tract Coral Disease Outbreak Response Efforts

### Joanna C. Walczak, SE Regional Administrator Office of Resilience & Coastal Protection – SE Region

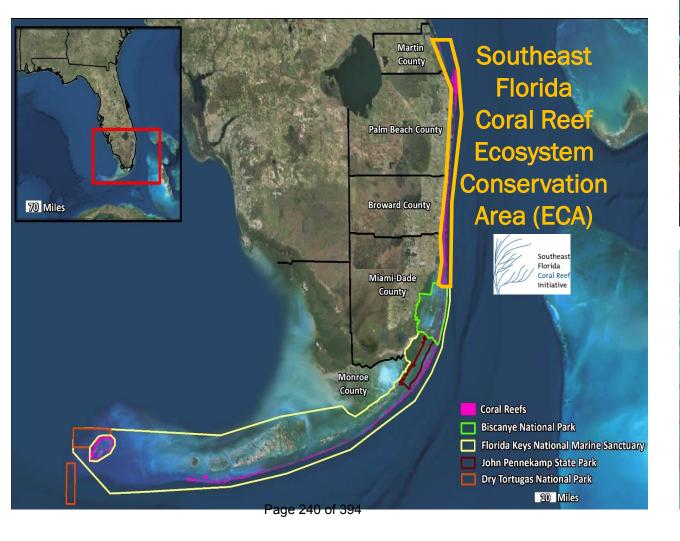
Page 239 of 394

Tim Grollimund



## Florida's Coral Reefs

### Florida Reef Tract





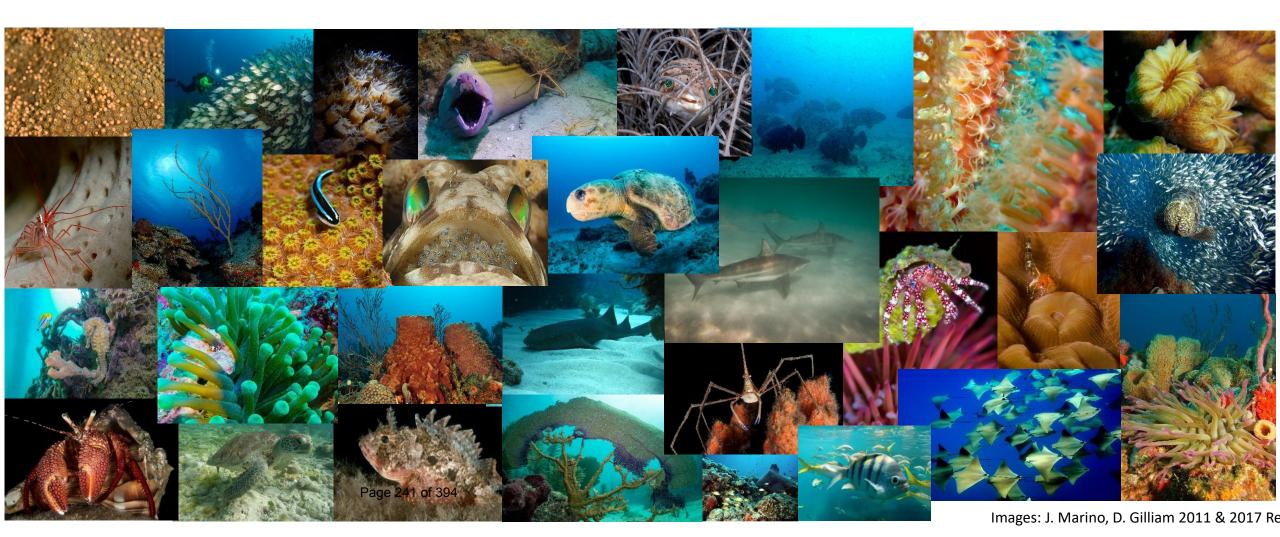


Images: DEP, D. Gilliam, NOAA



# Florida's National Treasure

Ecologically Diverse





## **Coastal Resilience**

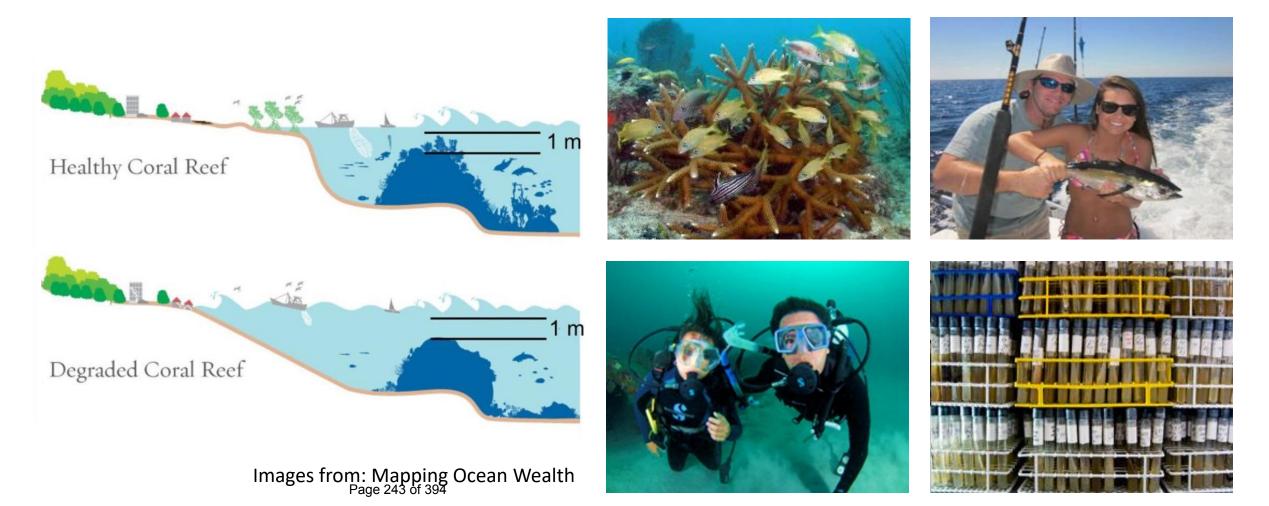
**Economically Essential** 





# **Economically Essential**

Coastal Protection, Fishing, Tourism

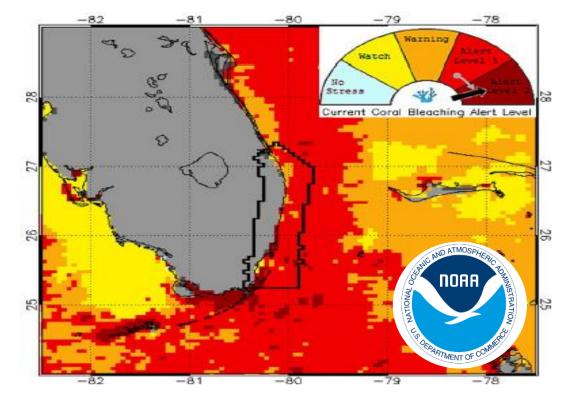




## **Global Stressors**

Increased frequency & severity of extreme thermal events (hot & cold)





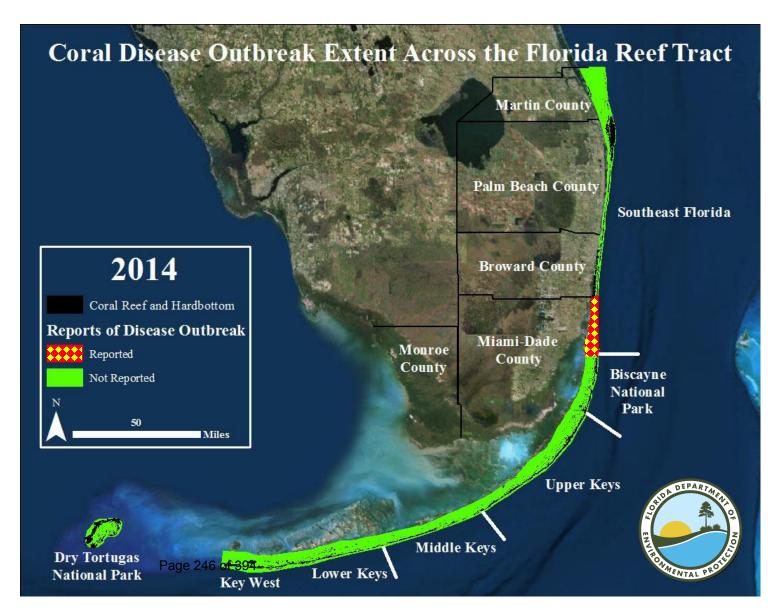
Ocean (& coastal) acidification



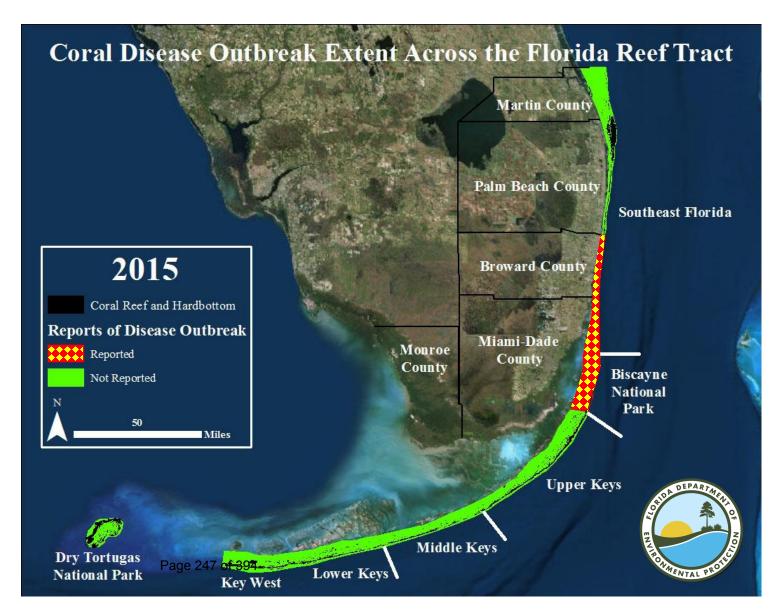
## **Local Stressors**



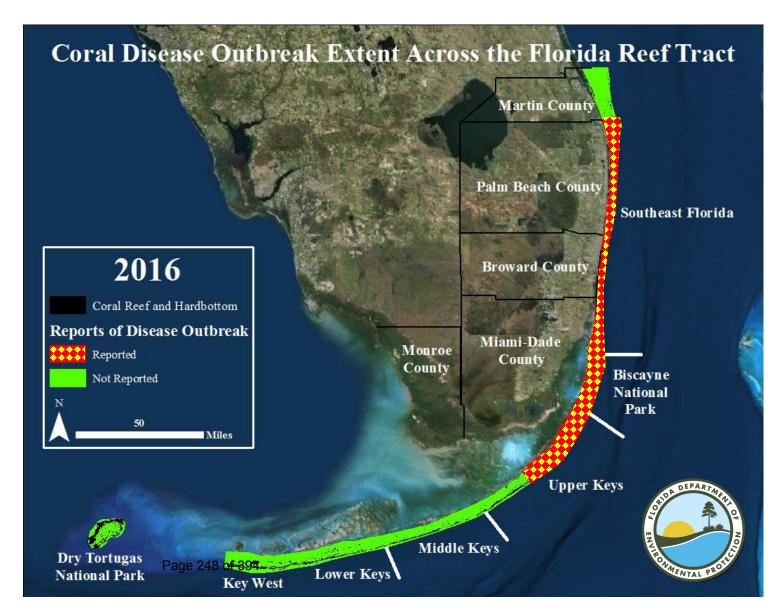




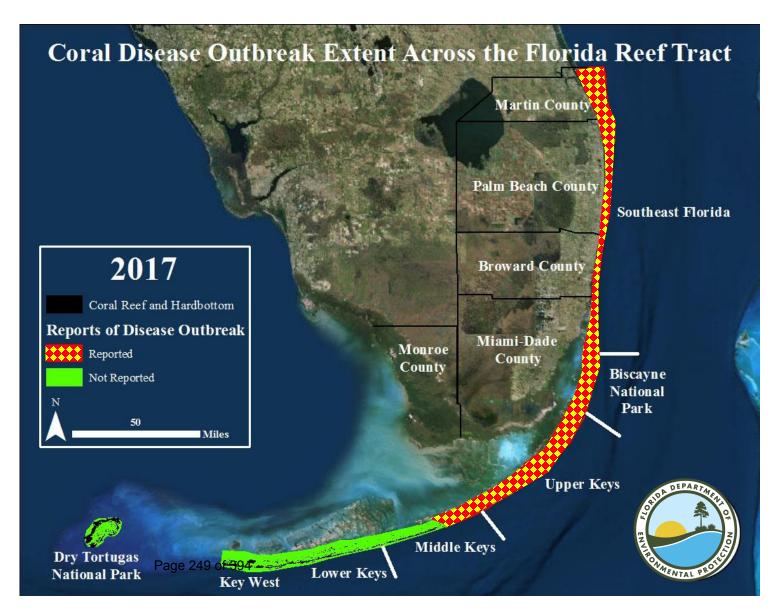




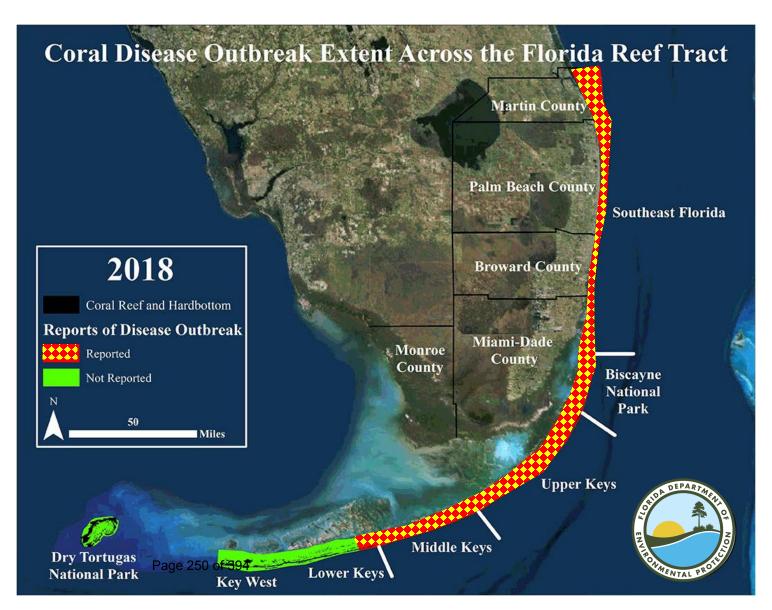




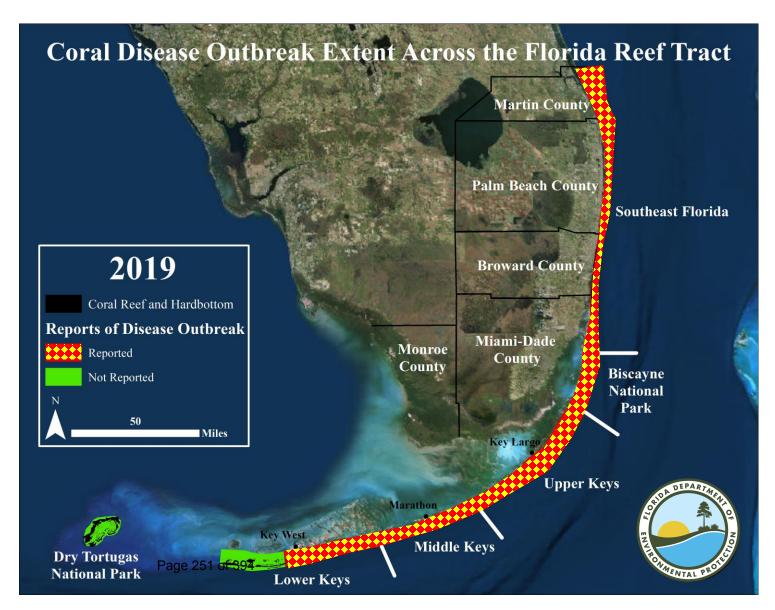














## **Stony Coral Tissue Loss Disease**





### **Coral Species Affected**

### More than half of Florida's reef-Affected building coral species are susceptible





## **Levels of Disease Within Species**

# 



### **Levels of Disease Within Species**

## Very High = 66% to 100% (in certain species)



### Florida's Coral Disease Outbreak Progresses Rapidly





### Florida's Coral Disease Outbreak





### Florida's Coral Disease Outbreak

#### Reported effectively dead (<5% alive) in December 2015





### **Disease Response Partners**

**Coordinated Multi-Faceted Response Effort** 







### **Disease Identification Training**

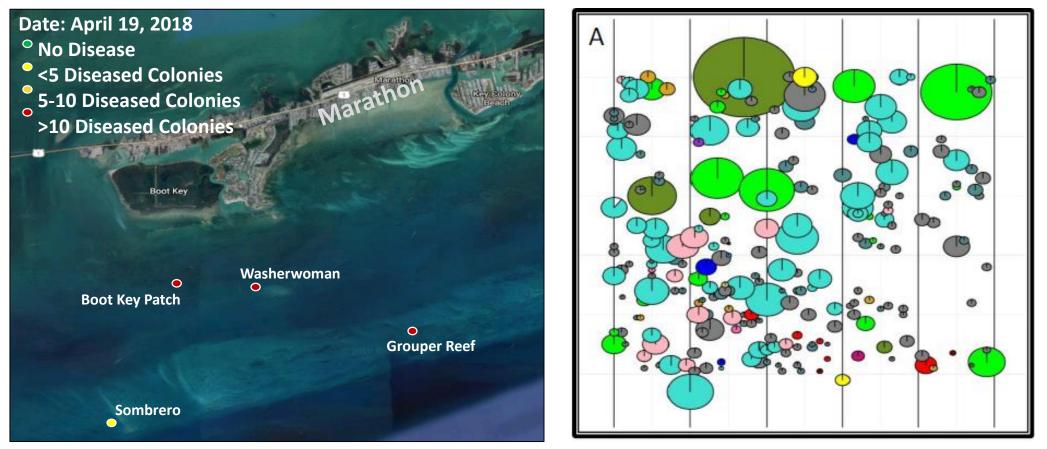






## **Disease Surveys & Monitoring**

Distribution, Prevalence, Severity, and Associated Impacts

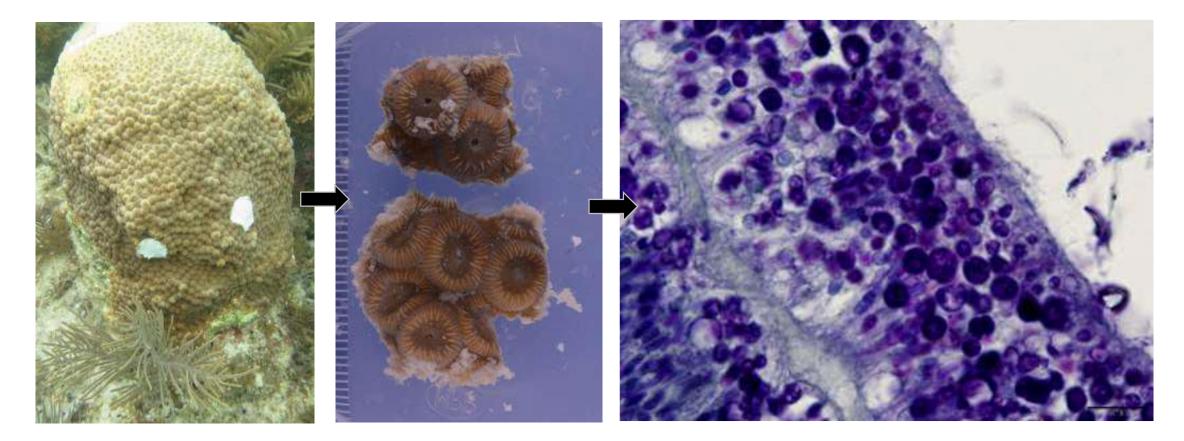


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### **Search for the Pathogen**

Identify Potential Pathogen(s) and Characterize the Disease(s)





### **Technical Expert Workshops** *November 2017 and July 2018*

- **3-Day Coral Disease Technical Workshops**
- Intervention action framework
- Coral rescue
- Restoration trials
- Community engagement
- Recommendations for response capacity and restoring ecosystem resilience





July Workshop Participants. Photo: FDEP





#### **Rescue Healthy Corals to Preserve Genetic Stock**







### **Innovative Disease Intervention**

**Treating Lesions on Priority Corals** 

Laboratory trials (Research & Development)



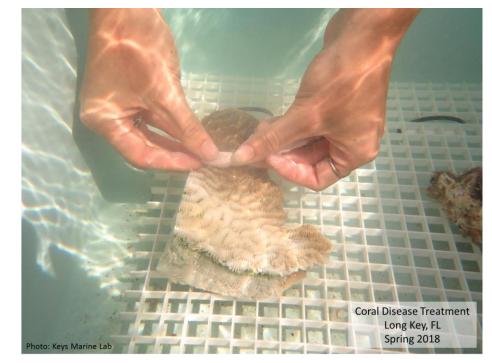




## Legislative Funding – FY 17-19

DEP-funded \$3 million+ in coral disease projects:

- Surveillance and monitoring
- Spatial modeling
- Lab-based treatment trials
- Sample collection
- Pathogen isolation experiments



• Water quality monitoring for new coral reef Ecosystem Conservation Area (ECA)

#### Florida DEP.gov/rcp/coraldisease

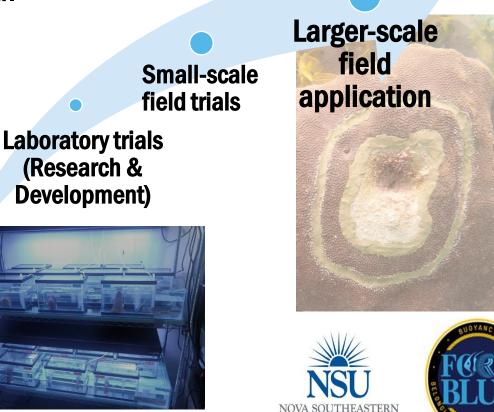


## Legislative Funding – FY 19/20

## DEP is funding \$4+ million in additional coral disease response projects:

- Intervention and coral rescue "Strike Teams"
- Land-based infrastructure support for rescued wild corals
- Locating and propagating survivors
- Restoration Trials

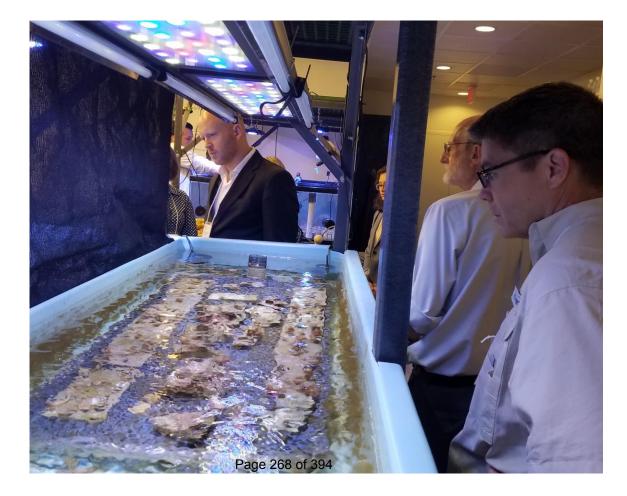
## FWC and Mote received an additional \$1.1 million for other coral-related projects

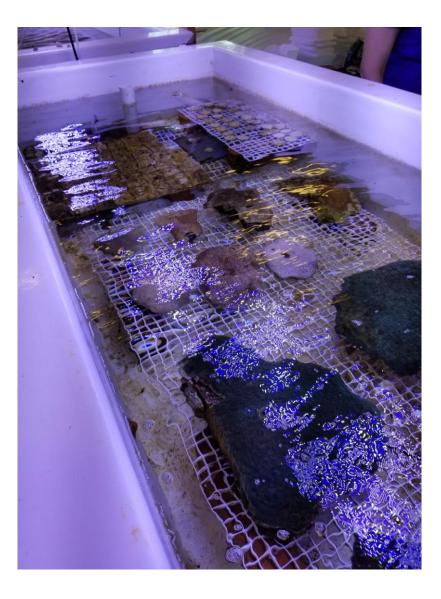




### **Restoring Resilience**

#### **Restoration Trials**







## **Restoring Resilience**

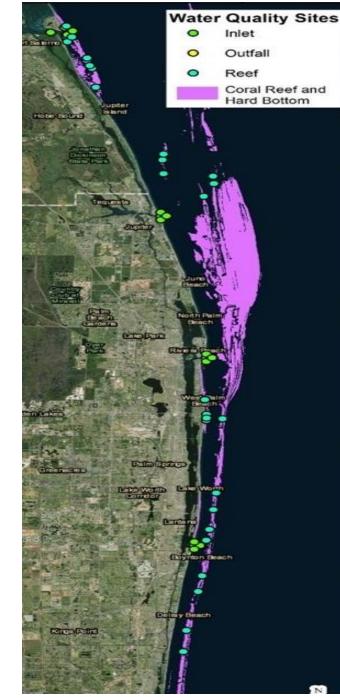
#### **Coral Reef Water Quality Monitoring**

Sampling began September 2017 at inlets, wastewater outfalls, and reef sites

- $\,\circ\,\,$  115 sites monitored monthly from Miami to Stuart
- $\circ~$  9 inlets in 4 counties and 105 miles of coastline
- 132,000+ data points generated annually

**Pilot Project is looking for:** 

- Potentially harmful levels of nutrients
- $\circ$   $\,$  Indicators of freshwater sources  $\,$
- Sedimentation/turbidity Page 269 of 394





### **Restoring Resilience**

Short Term: Enhance Disease Response Capacity



Long-term: **Reduce Local Stressors** & Restore **Environmental Conditions** Resilient Reefs

Triage



# Thank you!



### Joanna C. Walczak Joanna.Walczak@FloridaDEP.gov

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Dear Ms. Tonioli and members of the Sustainability and Resiliency Committee,

First, I would like to introduce myself, I am Carys Mitchelmore, a Professor at the University of Maryland Center for Environmental Science. I am an aquatic toxicologist with over 25 years of scientific research experience and have published over 70 peer-reviewed scientific papers, book chapters and technical reports, served on several committees at the National Academies of Sciences and testified before Congress and other state and federal regulatory bodies about my research. We currently face huge challenges to protect our coastal and oceanic ecosystems. Thousands of chemical contaminants enter our oceans and so my research focuses on understanding how these chemicals and other stressors, interact with and impact organisms. I am very concerned about the declining health of our coral reefs which is why I having been working with corals for over 20 years now, investigating the impacts of chemical contaminants on them, researching novel antioxidant pathways and determining causes of oxidative stress and damage in the host coral and their symbionts.

As a coral toxicologist I have been following the science and legislative activities regarding the organic UV filters, oxybenzone and octinoxate and their potential impacts to coral. I understand that the Sustainability and Resiliency Committee is collecting information on this subject. As a Professor who is actively conducting research in this area and as an educator and advocate for science I would like to offer any help you need in gathering the scientific data on the impact of UV filters to coral. The enclosed PowerPoint includes some of the material that I have presented at recent scientific meetings and in the letter below I highlight a few of the main points regarding coral reef health and the organic UV filters oxybenzone and octinoxate.

#### First, corals are in serious decline, and the scientific consensus is that major threats are increased temperatures due to climate change, and disease, while the sunscreen components oxybenzone and octinoxate are currently implicated essentially by a single study.

Many coral threats are due to people and include implications of climate change, physical damage, biological changes, increased inputs of sediment, nutrients and many different organic and inorganic chemical pollutants. In comparison to the large number of studies investigating increased temperatures on coral there are very few that have looked at the effect of chemical contaminants, with even fewer published on the impact of UV filters to coral. Essentially, the research that was presented during the legislative activity on UV filters in Hawaii came from one primary study. This single study does not provide sufficient evidence to determine the environmental risk of oxybenzone to coral, and it does not even examine or provide any evidence for octinoxate.

#### Second, there is very limited scientific data on oxybenzone and octinoxate concentrations in seawater and their impacts on corals; not enough data to conduct a risk assessment. It is an emerging field of research.

Determining the environmental risk of a chemical contaminant to coral requires two sets of scientific data; the concentration of the chemical in seawater coupled with coral toxicity studies. During the Hawaii legislation, there were no published concentrations of octinoxate in seawater from Hawaii and data in the primary publication mentioned earlier showed that only 1 of 7 seawater samples from Hawaii contained a measurable level of oxybenzone. Recently my laboratory together with colleagues significantly expanded the data set on the concentration of UV filters in seawater near Hawaii's coral reefs. We collected seawater at 19 sites in Oahu, Hawaii, finding low parts per trillion concentrations of oxybenzone but no measurable levels of octinoxate in any of the 57 samples, even those collected at the high tourist sites along Waikiki Beach.

A graph in the PowerPoint presentation enclosed summarizes all of the oxybenzone concentrations reported in seawater from around the world's coral reefs. These studies highlight that oxybenzone concentrations are very variable between sites/locations, water depths, distance from the

shoreline and time of year etc., but overall the majority of samples are in the parts per trillion concentration range.

There are even fewer studies looking at the impacts (toxicity) of oxybenzone and octinoxate on corals. During the Hawaii legislation two limited toxicity studies were available, although data was mainly reported from the one primary paper mentioned earlier. However, as an emerging field of research, more studies on oxybenzone and octinoxate toxicity to corals are being conducted and published. Currently there are five publications in total (two were just published in 2019 so there are now four for oxybenzone and two for octinoxate although some studies are limited as they are looking at products not single UV filters).

#### Third, the mere presence of oxybenzone or octinoxate in seawater does not imply toxicity and there are substantial methodological limitations to the primary study being leveraged.

With advances in analytical chemistry we can now detect chemicals at extremely low levels but that does not equate to harm. All chemicals are toxic at some concentration, which is why it is important to conduct risk assessments to determine if the concentrations of the chemical found in seawater are at levels that may cause harm.

Using the most conservative and appropriate toxicity threshold from the primary study (i.e. the LC50 (lethal concentration that results in 50% mortality of the population) for the longest exposure time of 24 hours in the light) the PowerPoint presentation graph shows that most oxybenzone seawater concentrations reported globally are below this toxicity threshold, except for the seawater concentration data points from that primary study.

In addition to the low number of oxybenzone and/or octinoxate toxicity studies in coral, there are also many limitations in the data provided in the primary publication used. This primary study does not provide any toxicity data on octinoxate and there are also many other methodological limitations, which are too numerous to list but I would be happy to expand upon and explain them at a later time. Thus, the research in the primary study is not sufficient to conclude a link between oxybenzone and octinoxate and coral decline.

#### Finally, many more robust scientific studies are needed to determine the risk of these chemicals to corals, so that management decisions can prioritize the stressors that are the most damaging to Florida's coral reefs.

Much more research is needed to determine the risk of UV filters to corals. Scientists from academia, government, and industry need to work together to conduct additional environmental monitoring and toxicology studies. As an emerging field of research many more studies are already being conducted to look into this issue in more detail. In fact, since the primary publication was highlighted during the Hawaii legislation there has been a doubling of research papers looking at oxybenzone and octinoxate toxicity in corals. The new oxybenzone study shows toxicity thresholds (i.e. impact concentrations) at much higher levels in two species of coral, both in larvae and adults, compared to the original primary paper. Furthermore, the new recently published Hawaii UV-filter monitoring study reported very low parts per trillion concentrations of oxybenzone and no measurable concentrations of octinoxate in seawater.

I have provided a list of references at the end of the PowerPoint presentation. I would be happy to send you any of these publications and expand on any of the above topics in detail with you at a later date.

Yours sincerely,

Dr. Carys Mitchelmore Professor, mitchelmore@umces.edu Overview on the State of the Science regarding the Sunscreen organic UV-filters Oxybenzone and Octinoxate and Coral Reef Health

> Dr. Carys L. Mitchelmore Professor, UMCES, Chesapeake Biological Laboratory

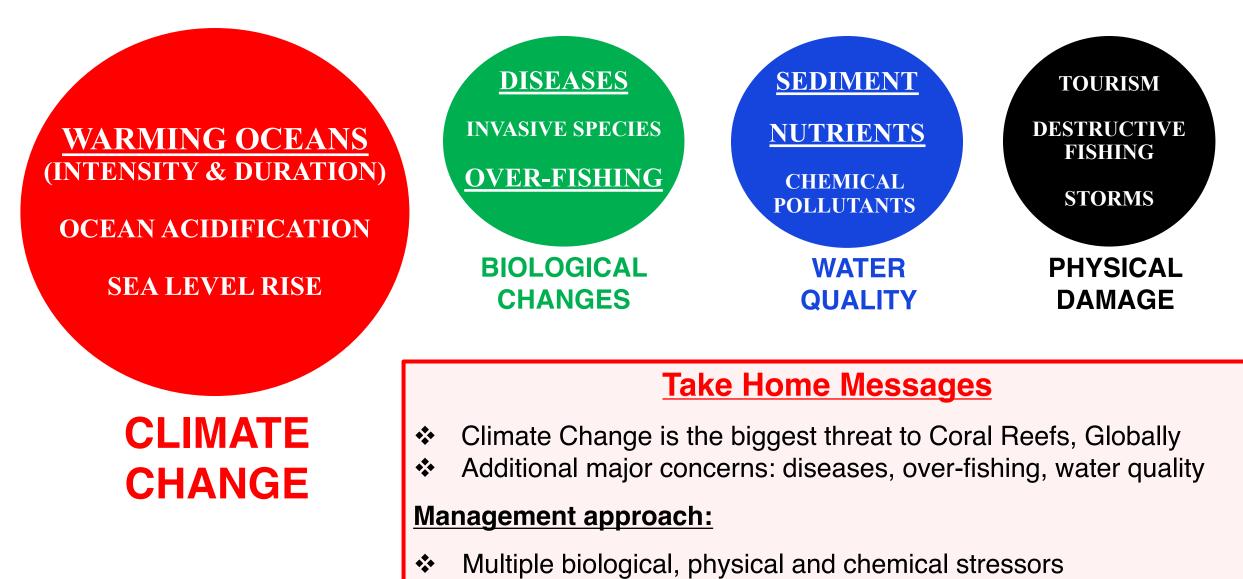
University of Maryland CENTER FOR ENVIRONMENTAL SCIENCE CHESAPEAKE BIOLOGICAL LABORATORY Post Office Box 38 Page Solomons, Maryland 20688 mitchelmore@umces.edu

410-326-7283

Page 274 owww.umces.edu

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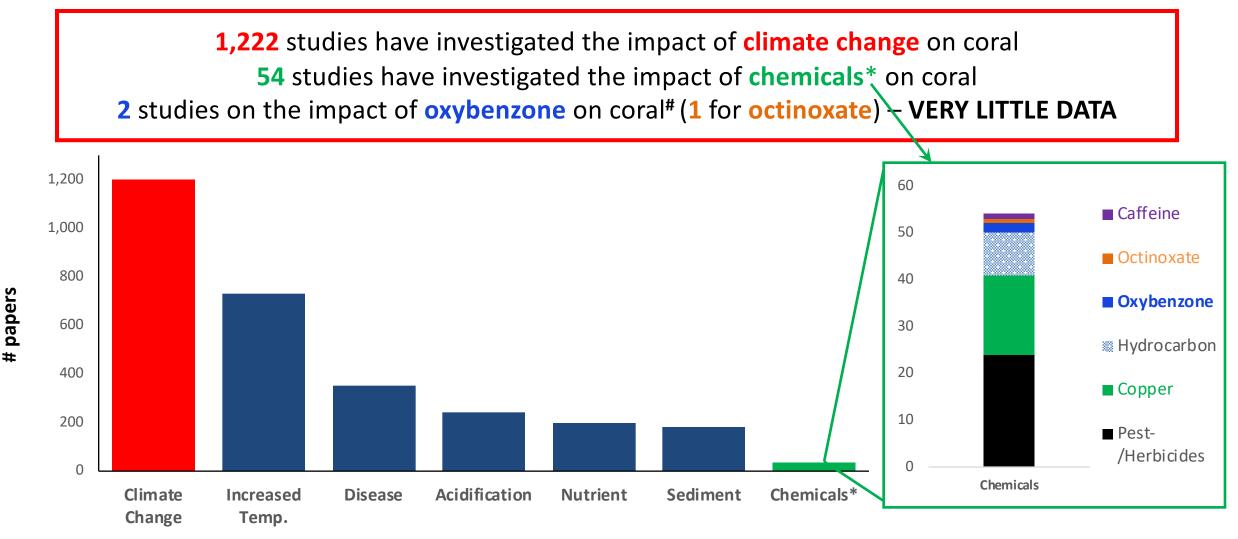
### **Many Threats to Coral Reefs**



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Conduct risk assessments to identify and prioritize problems

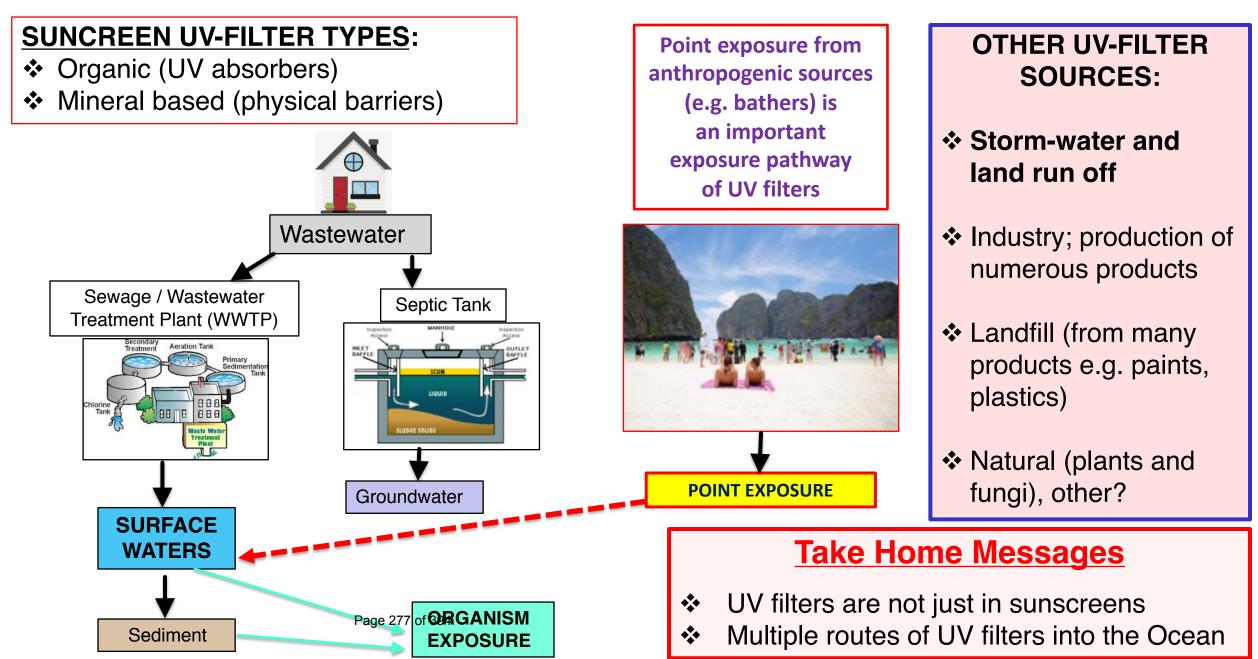
#### What is the Scientific Literature on Coral Health?



Citations generated from a 'Topic' search in the Web of Science that included the terms: "coral bleaching" AND "climate change" (or the other column categories in the graphs) as of 05/02/19 \*; pesticides/herbicides, copper, hydrocarbon and oxybenzone **#: In total there are 3 papers for oxybenzone and 2 papers for octinoxate in intact corals (two of these papers are from 2019)** 

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#### **UV filters: Sources and Exposure Routes to the Environment**



#### **How Does Science Measure Environmental Risk?**

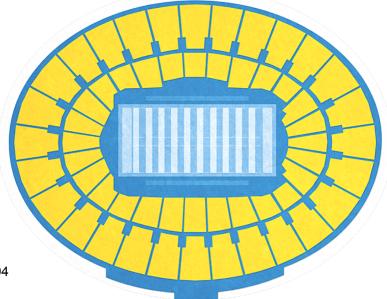
- Detection or presence of a chemical does NOT mean harm
- Concentration and time (duration) of exposure is critical to determine harm
- Every chemical is TOXIC at some concentration/dose
- So the **REAL question** to ask is: Does the coral get exposed to UV filters at toxic concentrations?

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WHAT IS A PART PER TRILLION?

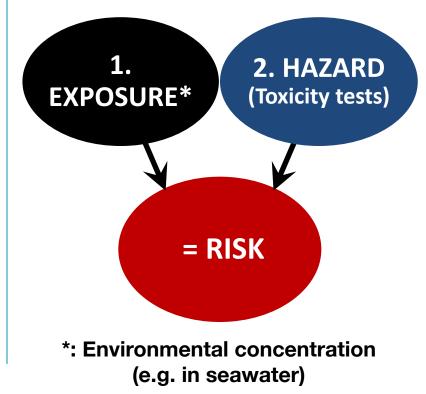
nanograms/liter (ng L<sup>-1</sup>)

= 10 drops added to the Rose Bowl (filled with water)



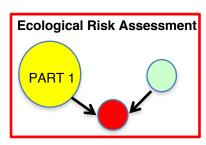
HOW DO WE KNOW IF A CHEMICAL IS A PROBLEM?

> CONDUCT A RISK ASSESSMENT (2 data sets needed)



#### State of the Science for UV filters – Exposure Summary

**QUESTION:** What are the concentrations of oxybenzone (BP-3) and octinoxate (EHMC) in seawater near coral reefs?



- A few (<10) global studies on various UV filter concentrations in seawater, one study in coral</p>
- Some show a link with/reflect recreational activity

#### For Hawaii specifically:

- BP-3 one study, Oahu/Maui (Downs et al. 2016): 6 of 7 samples <Limit of quantitation (LOQ), one sample at 19,200 ng L<sup>-1</sup>
- EHMC or other UV filters: no published studies
- ✤ No data on levels of UV filters in Sediment or corals

#### **Take Home Messages:**

- Oxybenzone (BP-3): Most concentrations in the ng L<sup>-1</sup> (parts per trillion), some μg L<sup>-1</sup> (parts per billion; ppb), one sample in US Virgin Island (USVI; at 1.395 mg L<sup>-1</sup> (ppm) from Downs et al. 2016).
- Octinoxate (EHMC): Very little data; most concentrations are non-detects or at ng L<sup>-1</sup> levels.
- Variable concentrations with;
  - Location (Vertical/horizontal)
  - Season (time of year/day)
  - Distance from shoreline
  - Depth (e.g. 30 times lower at coral depth than surface measurements; Tsui et al. 2017)
- Most studies are surface seawater, also n=1; no replicates (except one study is n=2).
- Limited data for Hawaii on BP-3 (one sample), no published data for EHMC : SEVERE LACK OF DATA

#### JUST PUBLISHED (Mitchelmore et al. 2019): First COMPREHENSIVE Study ON UV FILTERS in Hawaii

- Robust, comprehensive sampling design; multiple and replicated samples; 19 sites measured in triplicate
- Measured UV filters in seawater, sediment and coral tissue (looked for 13 UV filters)
- Found very low levels of oxybenzone in seawater across all the sites – low parts per trillion concentrations (ng L<sup>-1</sup>)

 Found NO measurable octinoxate levels in any of the 57 seawater samples

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Contents lists available at ScienceDirect Science of the Total Environment

Science of the Total Environment 670 (2019) 398-410

journal homepage: www.elsevier.com/locate/scitotenv

Occurrence and distribution of UV-filters and other anthropogenic contaminants in coastal surface water, sediment, and coral tissue from Hawaii



Carys L. Mitchelmore <sup>a,\*,1</sup>, Ke He <sup>b,c,1</sup>, Michael Gonsior <sup>a</sup>, Ethan Hain <sup>b</sup>, Andrew Heyes <sup>a</sup>, Cheryl Clark <sup>a</sup>, Rick Younger <sup>d</sup>, Philippe Schmitt-Kopplin <sup>e,f</sup>, Anna Feerick <sup>b</sup>, Annaleise Conway <sup>a</sup>, Lee Blaney <sup>b</sup>

<sup>a</sup> University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory, Solomons, USA

<sup>b</sup> University of Maryland Baltimore County, Department of Chemical, Biochemical, and Environmental Engineering, 1000 Hilltop Circle, Engineering 314, Baltimore, MD 21250, USA

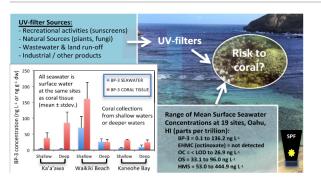
<sup>c</sup> University of Maryland School of Medicine, Department of Epidemiology and Public Health, Baltimore, 660 West Redwood Street, Howard Hall 103, MD 21021, USA <sup>d</sup> PO Box 376, Solomons, MD, USA

<sup>e</sup> Research Unit Analytical BioGeoChemistry, Helmholtz Zentrum München, German Research Center for Environment Health, Neuherberg D-85764, Germany <sup>f</sup> Analytical Food Chemistry, Technische Universität München, Freising-Weihenstephan D-85354, Germany

#### HIGHLIGHTS

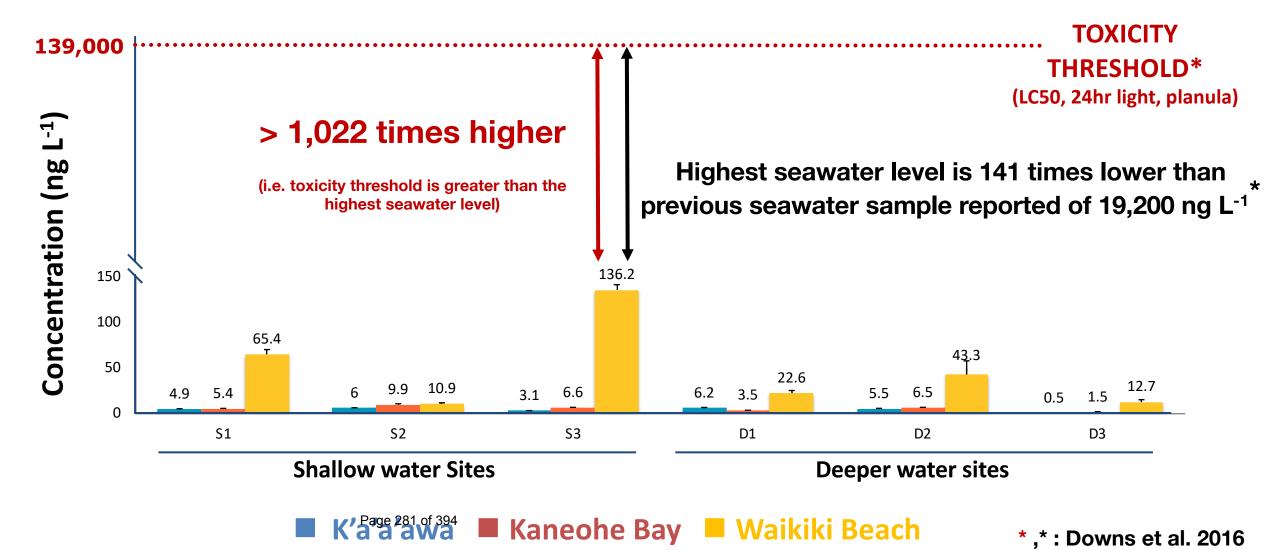
- First report of UV-filters in coral tissue
- from a USA coral reef.
  At least 8 UV-filters detected in matched surface seawater, sediment and coral tissue from 19 sites in Oahu, Hawaii.
- UV-filter concentrations in the parts per trillion (ng L<sup>-1</sup>) in surface seawater and in ng g<sup>-1</sup> dw. in sediment and corals.
- Octinoxate, 11 hormones and sucralose were not detected in surface seawater but surfactant degradation products were.
- Overall highest UV-filter concentrations in all matrices were for homoslate and octisalate.

#### GRAPHICAL ABSTRACT



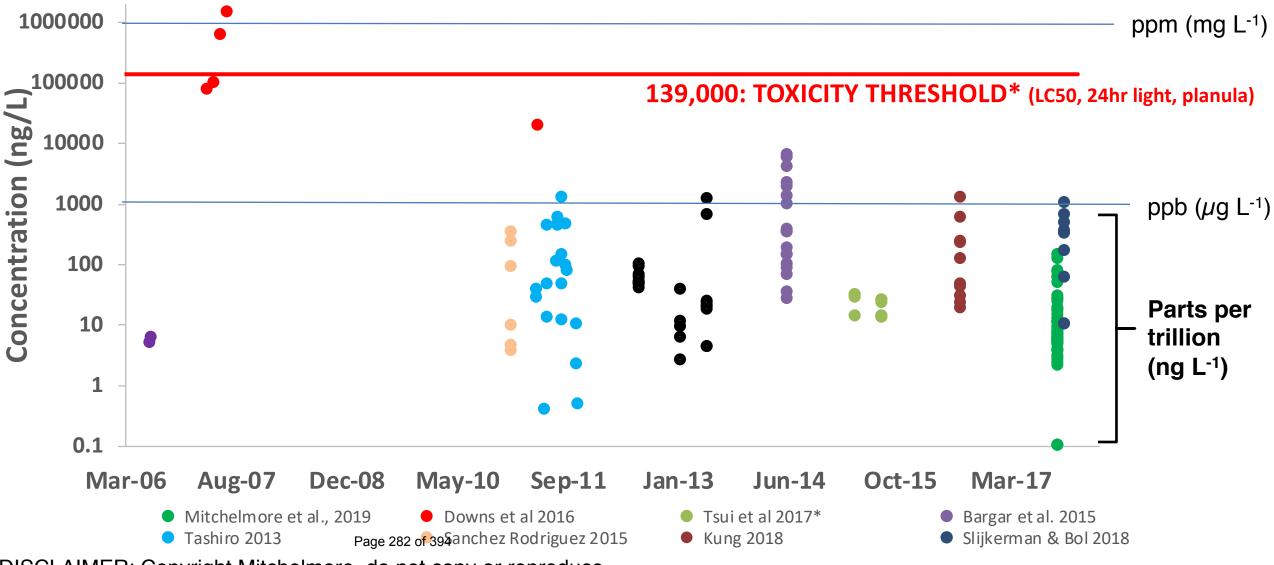
#### VERY LOW LEVELS OF OXYBENZONE IN OAHU, HI SEAWATER: well below REPORTED harmful level TO CORAL

(average of n=3 samples / site, 19 sites; total 57 samples; October 2017: Mitchelmore et al. 2019)



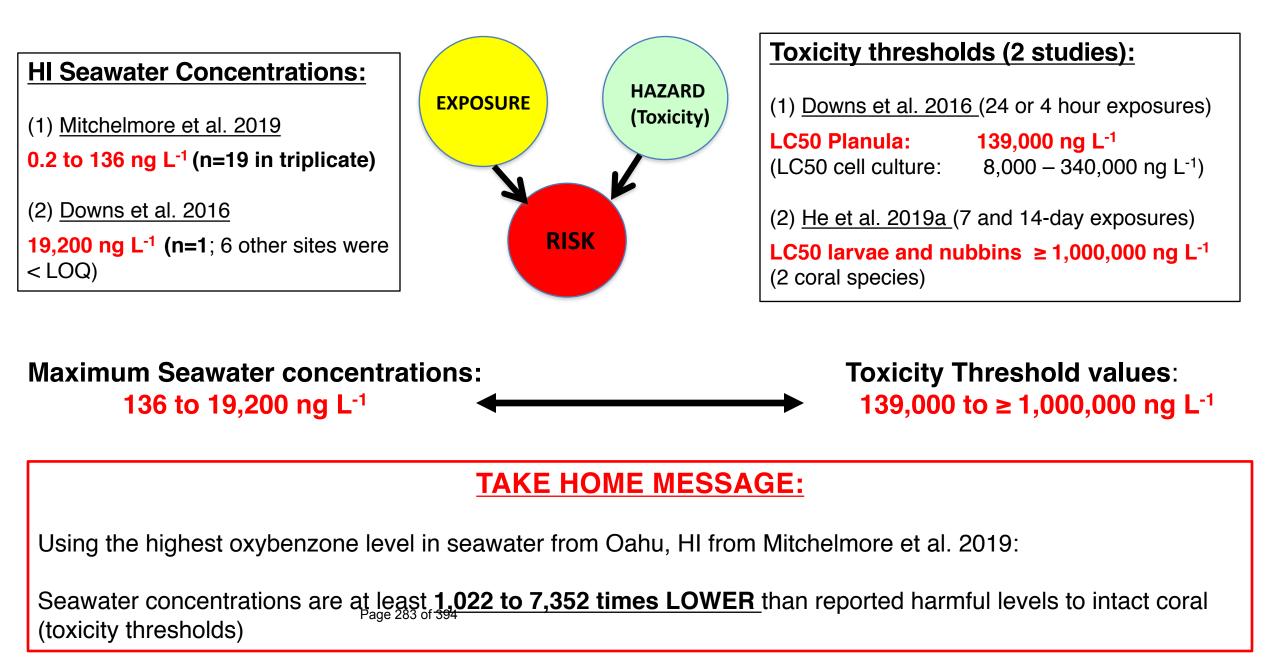
#### Most Oxybenzone Seawater Concentrations From Global Reefs: Also well below reported harmful level to coral

NOTE: LOG SCALE



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### In summary: Oxybenzone risk to Hawaii Corals



### **UV FILTERS AND CORAL REEFS: KEY CONCLUSIONS**



Coral reefs are in decline, we need to protect them



Hundreds of chemicals are in seawater near reefs ; many more toxic than UV filters



Major problems are climate change, disease, excess sediments and nutrients



Very little evidence that sunscreen UV filters are harming coral health, especially at environmentally relevant concentrations in seawater



UV filters are not a priority risk compared with other coral stressors (most studies show low and variable levels in seawater)



Much more research is needed for an accurate environmental risk assessment on UV filters and corals (and other chemicals too)

### References for PART 1: Environmental Exposure

#### (i.e. seawater concentrations of oxybenzone, octinoxate near corals)

**1. Bargar, T.A., et al. 2015.** Synthetic ultraviolet light filtering chemical contamination of coastal waters of Virgin Islands national park, St. John, U.S. Virgin Islands. Marine Pollution Bulletin, 101, 1, 193-199.

**2. Downs C.A., et al. 2016.** Toxicopathological effects of the sunscreen UV filter, Oxybenzone (benzophenone-3), on coral planulae and cultured primary cells and its environmental contamination in Hawaii and the U.S. Virgin Islands. Arch. Environ. Contam. Toxicol. 70, 2, 265-288.

3. Goksoyr, A., et al. 2009. Balsa Raft Crossing the Pacific Finds Low Contaminant Levels. ES&T, 43, 13, 4783-4790.

**4.** Kung, T.A. et al. 2018. Survey of selected personal care products in surface water of coral reefs in Kenting National Park, Taiwan. STOTEN, 635, 1302-1307.

**5. Sánchez Rodríguez, A. et al. 2015.** Occurrence of eight UV filters in beaches of Gran Canaria (Canary Islands). An approach to environmental risk assessment. Chemosphere, 131, 85–90.

**6. Tashiro Y. & Kameda, Y. 2013.** Concentration of organic sun-blocking agents in seawater of beaches and coral reefs of Okinawa Island, Japan. Mar. Pollut. Bull. 77, (1-2), 333-340.

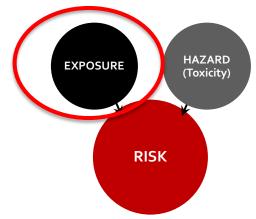
**7. Tsui M.M.P., et al. 2017.** Occurrence, distribution and fate of organic UV filters in coral communities. Environmental Science and Technology. 51, 8, 4182-4190.

**8. Tsui M.M. et al. 2014**. Occurrence, distribution and ecological risk assessment of multiple classes of UV filters in surface waters from different countries. Water Res. 67, 55-65.

#### **NEW STUDY:**

**9. Mitchelmore et al. 2019.** Occurrence and distribution of UV-filters and other anthropogenic contaminants in coastal surface water, sediment, and coral tissue from Hawaii. Science of the Total Environment, 670, 398-410.

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### References for PART 2: Hazard (Toxicity)

(i.e. toxicity studies of oxybenzone and octinoxate in corals)

**1. Danovaro R., et al. 2008.** Sunscreens cause coral bleaching by promoting viral infections. Environ. Health. Perspect. 116 (4), 441-447. (oxybenzone and octinoxate; also products\*)

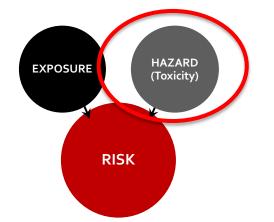
**2. Downs C.A., et al. 2016.** Toxicopathological effects of the sunscreen UV filter, Oxybenzone (benzophenone-3), on coral planulae and cultured primary cells and its environmental contamination in Hawaii and the U.S. Virgin Islands. Arch. Environ. Contam. Toxicol. 70, 2, 265-288. (oxybenzone)

**3.** He, T., et al. 2019a. Comparative toxicities of four benzophenone ultraviolet filters to two life stages of two coral species. STOTEN, 651, 2391–2399. (oxybenzone)

**4. He, T., et al. 2019b.** Toxicological effects of two organic ultraviolet filters and a related commercial sunscreen product in adult corals. Environ. Pollut., 245, 462-471. (octinoxate; also products\*)

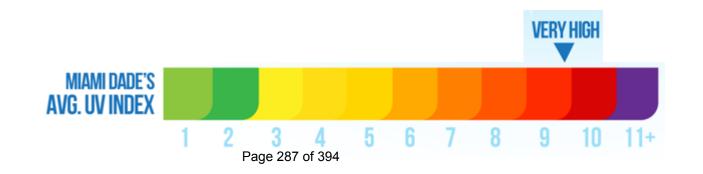
NOTE: also a study in soft coral (Xenia sp.) but product only (contains oxybenzone and other UV filters:

**5.** \*McCoshum, S. M. et al. 2016. Direct and indirect effects of sunscreen exposure for reef biota. Hydrobiologia, 776, (1), 139–146. (product contains oxybenzone)



# Skin Cancer is a Public Health Epidemic in Miami Beach & Florida

- Florida has one of the highest skin cancer rates in the country
- Miami-Dade county has the 4<sup>th</sup> highest number of melanoma cancer deaths in the state (between 2011-2015)
- 1,559 new cases of melanoma in the county (between 2011-2016)
- 210 deaths reported due to melanoma in the county (between 2011-2015)

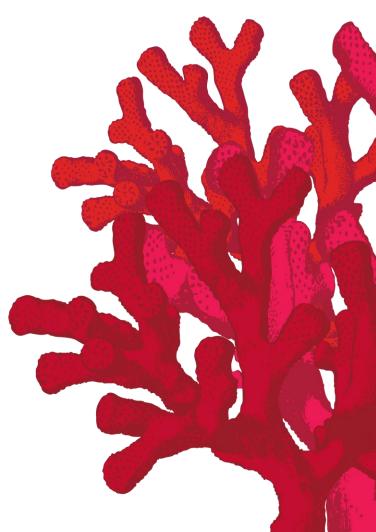




Have Been Diagnosed Between 2011-2016

# Science Does Not Support Oxybenzone as a Cause of Coral Reef Bleaching

- The recent ban on oxybenzone in Key West is based on two studies that are hampered by major methodological problems.
- These studies cannot be extrapolated to reflect the true natural complexity and ecosystem of a coral reef
- These two studies have not been replicated or validated by more recent and better controlled studies.
- There are no published studies showing oxybenzone is a stressor to corels in the Keys.



# Robust Studies Show Global Warming as Key Factor in Coral Decline

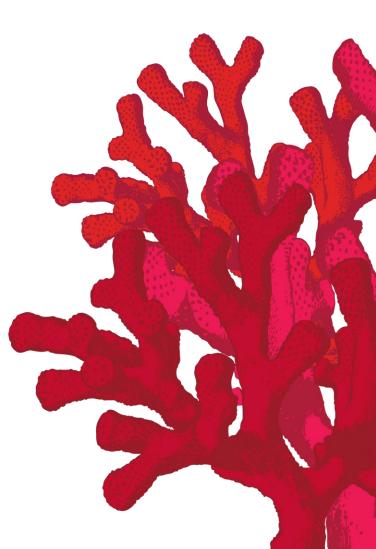
- Respected studies provide conclusive evidence of the link between global warming and coral bleaching
  - A peer-reviewed study published in 2017 showed that the patterns of coral bleaching prevalence and mortality in the 4sectors in Hanauma Bay Nature Preserve in Hawaii are linked to localized heating, due to circulation patterns
  - An Australian study showed that the warmest sea surface temperatures (SSTs) along the Great Barrier Reef on record correlated to a mass coral bleaching event in the Great Barrier Reef Marine Park
- According to National Oceanic and Atmospheric Administration (NOAA) and other global institutions, the cause of coral reef bleaching and degradation is due to global climate change, ocean acidification, and unsustainable fishing practices

Johan David Martin, A Climate Services Perspective on Two Significant Climate and Weather Events in Australia, BoM, Docklands, Australia; American Meteorological Society Meeting 2017 Rodgers et al. Patterns of bleaching and mortality following widespread warming events in 2014 and 2015 at the Hanauma Bay Nature Preserve, Hawai`i. PeerJ, 2017;5:e3355; DOI 10.7717/peerj.3355



# Local Factors Causing Coral Decline

- Stony Coral Tissue Loss disease (SCTLD)
- Sedimentation from dredging
- Shipping (ballast water discharge spreads disease & invasive species)
- Local boating (anchor damage)
- Careless divers (damage, spread disease)
- Overfishing
- Invasive species
- Agricultural and urban storm run-off and WWT effluent (septic)



# More Research is Needed ... and is Underway

### Sunscreen Wash-Off Study Starts: April 1, 2019 | Completed: August 31, 2019

This study will quantify the amount of sunscreen actives that get washed off from 3 different sunscreen formulations. Using a porcine skin model, this study will mimic people swimming in the ocean. This model study will analyze several sunscreen filters used in typical sunscreen products.

### Coral Tox Study Starts: April 1, 2019 | Completed: August 31, 2019

This study, in combination with the wash-off study and previously published environmental monitoring data, will provide the most accurate-to-date environmental risk assessment of sunscreen use. This study will use a hard coral species and measure acute and chronic toxicity, making it far more realistic assessment of true environmental conditions than the Downs study, which relies primarily on cell culture studies. Previous coral toxicity studies on oxybenzone and octinoxate have not been designed with the rigor needed by regulatory agencies for environmental risk assessments.

### Anthropogenic Aquatic Stressor Study (sponsored by CHPA) Starts: April 1, 2019 | Completed: May 31, 2019

An independent consultancy has been retained by the Consumer Healthcare Products Association (CHPA) to conduct an assessment of local human stressors on coral in the Florida Keys. Publicly available data sets and published literature will provide information specific to the Keys to model and quantify the relative impact of various stressors affecting coral reefs in the Florida Keys. If data is available, Miami waters will be included.

Other research groups in academia, government, independent research organizations, and industry are also conducting new research given the lack of reliable data.

## Backup Info

## Products That Market As "Reef Safe" May Compromise Consumer Protection

- Most sunscreen products that claim reef safe are mineral-only. Mineral-only formulas often:
  - on average, have lower PFA values (see chart below)
  - have more variability due to differences in mineral particle properties
  - typically are more expensive
  - have a white/chalky appearance, and can be more difficult to spread

- > Chemical sunscreens provide unique performance benefits:
  - offer 4x UVA protection
  - can deliver protection above SPF 60
  - provide the best protection with higher SPF
  - a better feeling sunscreen that spreads easily and is more appealing to users

Sunscreen Technology	PFA Average SPF 30	PFA Average SPF 50	PFA Average SPF 70	Overall Average
Mineral/Chemical Blend	3.3	6.9	NA	5.8
Mineral Blend (TiO <sub>2</sub> +ZnO)	7.7	11.9	NA	9.3
Chemical Oxybenzone-Free	17.4	22.6	NA	20.6
Chemical with Oxybenzone	20.3	23.7	24.4	22.7

protection from UVA rays. Results are based on laboratory tests of leading brands.

PFA measures sunscreen

# Reef-Safe Is Not a Regulated Category

- The Federal Trade Commission (FTC) requires that all claims in advertising be truthful and not misleading
  - Competent and reliable scientific evidence must support all claims
- Although the FTC developed "green guides" that include a series of environmental claims, "reef-safe" is not included and is not a regulated claim
- These terms are defined differently by each manufacturer that uses them, and are not supported by any credible science, creating confusion in the marketplace



### There Are Only Nine Commonly Used FDA-Approved UV Filters

Active Ingredient / UV Filter Name	UVA	UVB	Photostable (Light proof)	Formulation (Easily Combined)	Organic (Chemical)	Mineral (Physical)	Skin Compatibility
Avobenzone			*	*	×		**
Ensulizole (Phenylbenzimidazole Sulfonic Acid)		•	**	***	X		***
Homosalate			**	****	X		***
Octinoxate (Octyl Methoxycinnamate)			**	***	×		***
Octisalate (Octyl Salicylate)			**	***	X		***
Octocrylene			**	****	X		***
Oxybenzone			****	****	×		***
Titanium dioxide			***	***		X	****
Zinc oxide			***	***		X	****

 $\star$  poor  $\star \star$  moderate  $\star \star \star$  good  $\star \star \star \star$  excellent

NOTE: Formulation rating is based on decades of J&J R&D experience; all other parameters are based on the scientific literature

### Each UV Filter Plays a Unique Role in Sun Protection

- UV filters work in different ways, alone and in combination with other filters, to protect skin
  - Some predominantly protect against UVB rays, others predominantly protect against UVA rays, and some do both
- Formulating sunscreen is like baking a cake scientists use different amounts and combinations of filters, choosing each for very specific reasons
  - UV filters are not interchangeable just like a chef can't substitute water for cream in a recipe and expect the same results



# Oxybenzone is Critical and Irreplaceable for Broad Spectrum (UVA/UVB) Sun Protection

- Oxybenzone is unique: one of two FDA-approved filters that provide protection from both UVA and UVB rays (broad spectrum)
- Oxybenzone helps stabilize other UV filters so they don't break down on exposure to the sun
- Oxybenzone helps formulators provide better aesthetics, so people are more likely to apply/re-apply for optimum protection
- Oxybenzone is required for high SPF values (SPF 70+)
  - SPF value in actual use is directly related to the density/amount of sunscreen applied if 50% of the tested amount of SPF30 is applied, the actual SPF value is SPF15
  - Because most people under apply, high SPF provides a margin of safety in actual use
- Oxybenzone is in 9 out of 10 of the sunscreens that consumers prefer and most often use, and in 70% of overall sunscreen products on the market
  - Although there are other sunscreens without oxybenzone available at online retailers, none provide the same breadth and depth of UV protection as sunscreens with oxybenzone

# **Consumer Needs Are Personal**

- Dermatologists agree the best sunscreen is the one you prefer to use
- People consider several factors in choosing a sunscreen including:
  - Formula sensitivities: how it feels on skin, fragrance or no-fragrance
  - SPF value
  - Product form, e.g. stick, lotion or spray
  - Special needs, e.g. sensitive or acne-prone skin, sports, wet skin
- A variety of choice in sunscreen is important to meeting consumer needs, and helping them to follow sun protection guidelines





City of Miami Beach, 1700 Convention Center Drive, Miami Beach, Florida 33139, www.miamibeachfl.gov

Ordinance – R5 N

### SUPPLEMENTAL COMMISSION MEMORANDUM

- TO: Honorable Mayor and Members of the City Commission
- FROM: Raul J. Aguila, City Attorney
- DATE: March 13, 2019

**First Reading** 

SUBJECT: AN ORDINANCE OF THE MAYOR AND THE CITY COMMISSION OF THE CITY OF MIAMI BEACH, FLORIDA, AMENDING CHAPTER 46 OF THE CODE OF THE CITY OF MIAMI BEACH, ENTITLED "ENVIRONMENT," BY CREATING ARTICLE VIII THEREOF, TO BE ENTITLED "SALE OF SUNSCREEN PRODUCTS," TO PROHIBIT THE SALE OF SUNSCREEN PRODUCTS CONTAINING OXYBENZONE OR OCTINOXATE, OR BOTH; AND, PROVIDING FOR REPEALER, SEVERABILITY, CODIFICATION, AND AN EFFECTIVE DATE.

#### RECOMMENDATION

Pursuant to the request of Commissioner Michael Góngora, the above-referenced Ordinance is submitted for consideration by the Mayor and City Commission at the March 13, 2019 City Commission meeting.

The proposed Ordinance bans the sale or distribution of any SPF sunscreen product that contains oxybenzone or octinoxate, or both ingredients. According to scientific research, oxybenzone and octinoxate have adverse effects on coral reefs and sea life as more specifically set forth in the attached Exhibits A-D.

Legislative Tracking Office of the City Attorney

<u>Sponsor</u> Commissioner Michael Góngora



### Toxicopathological Effects of the Sunscreen UV Filter, Oxybenzone (Benzophenone-3), on Coral Planulae and Cultured Primary Cells and Its Environmental Contamination in Hawaii and the U.S. Virgin Islands

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Received: 17 July 2015 / Accepted: 13 September 2015 © Springer Science+Business Media New York 2015

Abstract Benzophenone-3 (BP-3; oxybenzone) is an ingredient in sunscreen lotions and personal-care products that protects against the damaging effects of ultraviolet light. Oxybenzone is an emerging contaminant of concern in marine environments—produced by swimmers and municipal, residential, and boat/ship wastewater discharges. We examined the effects of oxybenzone on the larval form (planula) of the coral *Stylophora pistillata*, as well as its toxicity in vitro to coral cells from this and six other coral species. Oxybenzone is a photo-toxicant; adverse effects are exacerbated in the light. Whether in darkness or light, oxybenzone transformed planulae from a motile state to a deformed, sessile condition. Planulae

Electronic supplementary material The online version of this article (doi:10.1007/s00244-015-0227-7) contains supplementary material, which is available to authorized users.

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exhibited an increasing rate of coral bleaching in response to increasing concentrations of oxybenzone. Oxybenzone is a genotoxicant to corals, exhibiting a positive relationship between DNA-AP lesions and increasing oxybenzone concentrations. Oxybenzone is a skeletal endocrine disruptor; it induced ossification of the planula, encasing the entire planula in its own skeleton. The LC50 of planulae exposed to oxybenzone in the light for an 8- and 24-h exposure was 3.1 mg/L and 139  $\mu$ g/L, respectively. The LC<sub>50</sub>s for oxybenzone in darkness for the same time points were 16.8 mg/L and 779  $\mu$ g/L. Deformity EC<sub>20</sub> levels (24 h) of planulae exposed to oxybenzone were 6.5 µg/L in the light and 10 µg/L in darkness. Coral cell LC<sub>50</sub>s (4 h, in the light) for 7 different coral species ranges from 8 to 340  $\mu$ g/L, whereas LC<sub>20</sub>s (4 h, in the light) for the same species ranges from 0.062 to 8 µg/L. Coral reef

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contamination of oxybenzone in the U.S. Virgin Islands ranged from 75  $\mu$ g/L to 1.4 mg/L, whereas Hawaiian sites were contaminated between 0.8 and 19.2  $\mu$ g/L. Oxybenzone poses a hazard to coral reef conservation and threatens the resiliency of coral reefs to climate change.

Oxybenzone (BP-3; benzophenone-3; 2-hydroxy-4methoxphenyl phenylmethanone; CAS No. 131-57-7) often is used as an active ingredient in sunscreen lotions and personal-care products, such as body fragrances, hair-styling products, shampoos and conditioners, anti-aging creams, lip balms, mascaras, insect repellants, as well as dishwasher soaps, dish soaps, hand soaps, and bath oils/ salts (CIR 2005; http://www.goodguide.com/ingredients/ 184390-oxybenzone). BP-3 and other benzophenone derivatives often are found as contaminants in boating, residential, and municipal wastewater effluents and are considered "emerging environmental contaminants of concern" by the U.S. Environmental Protection Agency (Eichenseher 2006; Richardson 2006, 2007; Blitz and Norton 2008; Gago-Ferrero et al. 2011; Kameda et al. 2011; Rodil et al. 2012; Aquero et al. 2013).

Between 6000 and 14,000 tons of sunscreen lotion, many of which contain between 1 and 10 % BP-3, are estimated to be released into coral reef areas each year, putting at least 10 % of the global reefs at risk of exposure, and approximately 40 % of coral reefs located along coastal areas at risk of exposure (Shaath and Shaath 2005; UNWTO 2007; Danovaro et al. 2008; Wilkinson 2008). In Okinawa, BP-3 levels on coral reefs that were 300-600 m away from public swimming beaches ranged from 0.4 to 3.8 pptrillion (Tashiro and Kameda 2013); in South America, sediments near coral communities/reefs contained BP-3 concentrations between 54 and 578 pptrillion (Baron et al. 2013). Schlenk et al. (2005) discovered through a Toxicity Identification Evaluation that BP-3 was unequivocally identified as the source of estrogenic activity in marine sediments near wastewater outfalls. Although the half-life in seawater is several months, BP-3 can act as a pseudo-persistent pollutant; its contamination of a site may be constantly renewed, resulting in ecological receptors experiencing persistent exposure (Vione et al. 2013). Concerns regarding the adverse impacts of exposure to BP-3 on coral reefs and other marine/aquatic ecosystems have led to either banning oxybenzone-containing products in marinemanaged areas (e.g. Mexico's marine ecoparks; Xcaret 2007; Xel-há 2007) or public relations campaigns by management agencies to encourage reduction of environmental contamination of sunscreen lotions by swimmers (e.g. "Protect Yourself, Protect the Reef" Bulletin U.S. NPS 2012).

BP-3 exhibits a number of toxicological behaviors ranging from the molecular level to multi-organ system pathologies (Gilbert et al. 2012). Benzophenones, Arch Environ Contam Toxicol

including BP-3, are documented mutagens that increase the rate of damage to DNA, especially when exposed to sunlight (Popkin and Prival 1985; Zeiger et al. 1987; Knowland et al. 1993; NTP 2006). BP-3 produced a positive mutagenic response by inducing the umu operon (genotoxicity assay Nakajima et al. 2006). Benzophenones, and especially BP-3, either can act directly as genotoxicants or become genotoxicants by bioactivation via cytochrome P450 enzymes (Takemoto et al. 2002; Zhao et al. 2013). The types of damage to genetic material by benzophenones include oxidative damage to DNA, formation of cyclobutane pyrimidinic dimers, single-strand DNA breaks, crosslinking of DNA to proteins, and an increase in the formation of DNA abasic sites (Cuquerella et al. 2012). Benzophenones also exhibit pro-carcinogenic activities (Kerdivel et al. 2013). BP-3 can generate reactive oxygen species, which are potential mutagens, when applied topically to the skin followed by UV light exposure (Hanson et al. 2006).

BP-3 is a reproductive toxicant whose mechanisms of action and its pathological effects are poorly characterized in various model species. In mice studies, BP-3 exposure significantly affected fecundity, as well as inducing unexplained mortality in lactating mothers (Gulati and Mounce 1997). Studies in both mice and rats demonstrated that generational exposure to BP-3 reduced body weight, increased liver (>50 %) and kidney weights, induced a 30 % increase in prostate weight, a reduction in immunocompetence, and significantly increased uterine weight in juveniles (Gulati and Mounce 1997; French 1992; Schlumpf et al. 2008; Rachon et al. 2006). In mammals, BP-3 is renowned for having estrogenic and anti-androgenic activities, causing activation of estrogen receptor proteins and inhibition of androgen receptors (Morohoshi et al. 2005; Suzuki et al. 2005; Kunz et al. 2006; Molina-Molina et al. 2008; Nashez et al. 2010). Topical application of BP-3 to the skin has been shown to be absorbed and transferred to breast milk, creating risk to breast-fed neonates (Hany and Nagel 1995). In addition, an association between exposure to benzophenones and an increased occurrence of endometriosis in women was recently found by Kunisue et al. (2012).

In fish, BP-3 actions are similar to those in mammals, causing an endocrine disruption by modulating estrogen receptor signaling pathways, inducing reproductive pathologies, and reducing reproductive fitness (Kunz et al. 2006; Coronado et al. 2008; Cosnefroy et al. 2011; Bluthgen et al. 2012). Chronic exposure to BP-3 in fish resulted in reduced egg production, induction of vitellogenin protein in males, and a significant reduction in egg hatchings (Nimrod and Benson 1998; Coronado et al. 2008). These findings raise the possibility of "gender shifts" in fish exposed to BP-3 during the entirety of their

life history or during "windows of sensitivity" (Coronado et al. 2008).

A few studies exist that have evaluated the effects of BP-3 exposure in invertebrates. In insects, BP-3 inhibited expression of the *usp* gene (ultraspiracle protein)—a protein that combines with the EcR protein to form the ecdysone receptor, which controls aspects of developmental and reproductive processes (Ozáez et al. 2013). Gao et al. (2013) found that BP-3 exposure resulted in oxidative injuries, reduced glutathione, and adversely affected cell viability in the protozoan ciliate, *Tetrahymena thermophila*.

Since the 1970s, coral reefs have been devastated on a global scale. Regional weather and climate events often are responsible for acute events of mass-mortality of coral reefs (Carpenter et al. 2008). However, the long-term causative processes of sustained demise often are locality specific (Edinger et al. 1998; Rees et al. 1999; Golbuu et al. 2008; Smith et al. 2008; Downs et al. 2011, 2012; Omori 2011). Records of coral recruitment in many areas of the Caribbean, Persian Gulf, Red Sea, Hawaiian Islands, and elsewhere have exhibited precipitous declines (Richmond 1993, 1997; Hughes and Tanner 2000; Rogers and Miller 2006; Williams et al. 2008). This is most apparent in the deterioration of juvenile coral recruitment and survival rates along coastal areas (Dustan 1977; Miller et al. 2000; Abelson et al. 2005; Williams et al. 2008). As with other invertebrate species, coral larvae (i.e., planula) and newly settled coral (i.e., recruits) are much more sensitive to the toxicological effects of pollution compared with adults (Kushmaro et al. 1997). Hence, even small impacts to larval development and survival can have significant effects on coral demographics and community structure (Richmond 1993, 1997). To manage BP-3 pollution and mitigate its effect on the ecological resilience of coral reefs, the toxicological effects of BP-3 on larval survival and development need to be characterized (Fent et al. 2010; US EPA 2012; NRC 2013).

In this study, we examined the toxicological effects of exposures to varying concentrations of BP-3 on the larval form (planula) of the scleractinian coral *Stylophora pistillata*, the most abundant coral species in the northern Gulf of Aqaba, Red Sea (Loya 1972). Many chemical pollutants affect organisms differently when exposed to light, a process known as chemical-associated phototoxicity (Yu 2002; Platt et al. 2008). Because reef-building corals are photosynthetic symbiotic organisms, and many coral species have planulae that are photosynthetically symbiotic (e.g., *S. pistillata*), we examined the effects of BP-3 exposure in planulae subjected to either darkness or to environmentally-relevant light conditions. Histopathology and cellular pathology, planula morphology, coral bleaching, DNA damage as the formation of DNA abasic

lesions, and planula mortality were measured in response to BP-3 exposure. Median lethal concentration (LC<sub>50</sub>), effect concentration (EC<sub>20</sub>), and no observable effect concentrations (NOEC) were determined for coral planulae exposed to BP-3 in both darkness and in light. Coral planulae are a relatively difficult resource to procure for toxicological studies. Therefore, primary coral cell cultures were used in in vitro toxicological tests of BP-3 to examine their validity as a surrogate model for coral planulae in generating an effect characterization as part of an Ecological Risk Assessment. The confidence in this model was examined by comparisons of the LC<sub>50</sub> results of BP-3-exposed planulae to the BP-3 LC50 of coral cells (calicoblasts) from adult S. pistillata colonies. Coral-cell toxicity testing was conducted on six other species that originate from either the Indo-Pacific or Caribbean Sea/Atlantic Ocean basins to provide in vitro data on the species' sensitivity distribution of BP-3. To determine the environmentally relevant concentration of BP-3 in seawater on coral reefs, we measured BP-3 concentrations at various locations in the U.S. Virgin Islands and the U.S. Hawaiian Islands.

#### **Materials and Methods**

#### **Pianula Collection and Toxicity Exposures**

Planula collection and planula-toxicity exposures were conducted at the Inter-University Institute of Marine Sciences (IUI) in Eilat, Israel. *Stylophora pistillata* (Esper 1797) planulae were collected from the wild within the IUI designated research area by placing positively buoyant planula traps over *Stylophora* colonies measuring more than 25 cm in diameter. Permit for collection was given to Y. Loya by the Israel National Park Authority. Traps were set between 17:00 and 18:00 h, and then retrieved at 06:00 h the next morning. Planulae were inspected and sorted by 07:15 h, and toxicity exposure experiments began at 08:00 h.

Experimental design and culture conditions were based on modified (for coral) guidelines set forth in OECD (2013) and described in Downs et al. (2014). This experiment for BP-3 was conducted concurrently with the study conducted in Downs et al. (2014).

All seawater (ASW) was made artificially using Fisher Scientific Environmental-Grade water (cat#W11-4) and Sigma-Aldrich sea salts (cat#S9883) to a salinity of 38 parts per thousand at 22 °C. Benzophenone-3 (BP-3; 2-Hydroxy-4-methoxyphenyl-phenylmethanone; Aldrich cat#T16403) was solubilized in dimethyl sulfoxide (DMSO) and then diluted with ASW to generate stock solutions and exposure solutions. Solutions of BP-3 for toxicity exposures each contained 5 microliters of DMSO per one liter and were of the following concentrations: 1 mM BP-3 (228 parts per million), 0.1 mM BP-3 (22.8 mg/L; parts per million), 0.01 mM BP-3 (2.28 mg/L; parts per million), 0.001 mM BP-3 (228  $\mu$ g/L; parts per billion), 0.0001 mM (22.8  $\mu$ g/L; parts per billion), and 0.00001 mM (2.28  $\mu$ g/L; parts per billion). For every exposure time-period, there were two control treatments with four replicates each: (a) planulae in ASW, and (b) planulae in ASW with 5 microliters of DMSO per 1 L. There was no statistical difference between the two controls for any of the assays.

Planulae were exposed to different BP-3 concentrations during four different time-period scenarios: (a) 8 h in the light, (b) 8 h in the dark, (c) a full diurnal cycle of 24 h, beginning at 08:00 in daylight and darkness from 18:00 in the evening until 08:00 h the next day, and (d) a full 24 h in darkness. For the 24-h exposure, planulae from all treatments were transferred to new 24-well microplates with fresh ASW/BP-3 media at the end of the 8-h daylight exposure before the beginning of the 16 h dark exposure.

At the end of the 8 and 24-h time points, chlorophyll fluorescence, morphology, planula ciliary movement, and mortality were measured, while at least one planula from each replicate of each treatment was chemically preserved, and the remaining living planulae were flash frozen in liquid nitrogen for the DNA apyrimidinic (AP) site assay.

### Chlorophyll Fluorescence as an Estimate of Bleaching

Chlorophyll fluorescence was measured using a Molecular Dynamics microplate fluorometer with an excitation wavelength of 445 nm and an emission wavelength of 685 nm. Fluorescence measurements were taken at the end of the 8-h light and dark periods of BP-3 exposure. All ten planulae in each replicate well were measured in aggregate. Each well was measured independently of the other wells. Justification and caveats for this assay are described in Downs et al. (2014).

#### **DNA Abasic Lesions**

DNA abasic or apurinic/apyrimidinic lesions (DNA AP sites) were quantified using the Dojindo DNA Damage Quantification Kit-AP Site Counting (DK-02-10; Dojindo Molecular Technologies, Inc.) and conducted as described in Downs et al. (2014). Four individual planulae (one from each well) from each treatment were individually assayed. Only planulae that were relatively intact were assayed, even if scored as dead. Planulae from 228 ppm BP-3 at 8 h in the light were not collected, because there were no coherent planulae.

#### Transmission Electron Microscopy

Transmission electron microscopy was used for tissue and cellular pathomorphology assessment on three planulae from each treatment. Methodology for this technique was described in Downs et al. (2014). At least three planula from each treatment were collected and fixed for analysis.

#### Coral Cell Toxicity Assay

Cultured colonies of S. pistillata (Esper 1797) were obtained from Exotic Reef Imports (www.exoticreefim ports.com) and did not need a permit for possession. Cultured colonies of *Pocillopora damicornis* (Linnaeus 1758) was provided by the National Aquarium and did not need a permit for possession. Montastrea annularis, Montastrea cavernosa (Linnaeus 1766), and Porites astreoides (Lamarck 1816) were obtained from the Florida Keys National Marine Sanctuary under permit# FKNMS-2011-139. Cultured colonies of Acropora cervicornis (Lamarck 1816) and Porites divaricata (Lesueur 1821) were provided by Dr. Cheryl Woodley of the U.S. National Oceanic and Atmospheric Administration and did not need a permit for possession. Corals were maintained in glass and Teflonplumbed aquaria in 36 ppt salinity artificial seawater (Type 1 water using a Barnstead E-Pure filter system that included activated carbon filters) at a temperature of 24 °C. Corals were grown under custom LED lighting with a peak radiance of 288 photosynthetic photon flux density µmol/ m<sup>2</sup>/s. Light Spectra ranged from 380 to 740 nm. Light was measured using a Licor 250A light meter and planar incidence sensor. Description of coral cell isolation from each species is described in Downs et al. (2010, 2014).

Exposure experiments of cells were conducted in PTFE-Telfon microplates. Cells of all species except Acropora cervicornis were exposed to BP-3 concentrations in cell culture media of 570 parts per trillion to 228 parts per million for 4 h in the light, whereas Stylophora cells also were exposed for 4 h in the dark. Acropora cervicornis cells were exposed to BP-3 concentrations in cell culture media of 570 ng/L (parts per trillion) to 228 mg/L (parts per million) for 4 h in the light. Lighting was from custom LED fixtures that had wavelength emissions from 390 to 720 nm with a light intensity of 295  $\mu$ mol/m<sup>2</sup>/s of photon flux density.

Viability was confirmed using the trypan blue exclusion assay. There were four replicate wells with cells per treatment. Duplicate aliquots of cells from each replicated wells were collected into a microcentrifuge tube, centrifuged at  $300 \times g$  for 5 min, and the supernatant aspirated. Cells were gently resuspended in culture media that contained 0.5–1.5 % (w/v) of filtered trypan blue (SigmaAldrich, cat#T6146), and incubated for 5 min. Viable versus dead cells were counted using a modified Neubauer hemocytometer (Hausser-Levy Counting Chamber).

Sampling and analysis of benzophenones in seawater samples via gas chromatography-mass spectrometry (GC--MS) and liquid chromatography-mass spectrometry (LC--MS). Dichloromethane, methanol, acetone are pesticidegrade solvents (Fisher Scientific). Analytical standards were purchased from Sigma Aldrich and included: Benzophenone (cat# B9300), Benzhydrol (cat#B4856), 4-hydroxybenzophenone (cat#H20202), 2-hydroxy-4-methoxy benzophenone (cat#H36206), 2,4-dihydroxy benzophenone (cat# 126217), 2-2'-dihydroxy-4-methoxy benzophenone (cat# 23578), 2,3,4-trihydroxy benzophenone (cat# 260576), 2,2',4,4'-tetrahydroxy benzophenone (cat#T16403). Internal standard solutions (phenanthrene-d10 and chrysene-d12) were purchased from AccuStandard Inc. (New Haven, CT).

Field personnel collecting samples were subject to an Alconox Liqui-Nox detergent decontamination immediately before entering the sampling site and did not apply any sunscreen lotion or nonorganic personal-care products to their body for at least 21 days before sampling. Between 100 and 500 mL of seawater were collected approximately 35 cm below the surface of the water into EPA-certified clean, amber jars. In the field, water samples were extracted using Phenomenex C18 solid phase extractions columns that were first activated with methanol. All columns were capped and then shipped and stored frozen at -80 °C or colder.

Extraction of analytes from seawater samples collected in the U.S. Virgin Islands (under a U.S. National Park Service permit, STT-045-08) followed the methodology described in Jeon et al. (2006). Seawater samples were collected using precleaned 1-L amber glass bottles with Teflon lined lids (I-Chem, 300 series, VWR). Seawater samples were extracted using C-18E cartridges (500 mg, 6 mL Phenomenex Inc.) on a vacuum manifold (Phenomenex Inc.). Cartridges were conditioned with 5 mL of methanol and then 5 mL of water, after which the seawater samples were then added to the column. Following extraction, the cartridges were dried for 10 min, capped, and frozen until processed. The cartridges were eluted with 2 mL of acetone followed by  $2 \times 5$  mL dichloromethanc. The extracts were evaporated to dryness under a gentle stream of nitrogen. Then, 50 µL of MSTFA (N-Methyl-N-(trimethylsilyl) trifluoroacetamide, Sigma-Aldrich) was added, capped, vortexed for 30 s, and heated at 80 °C for 30 min. Extracts were transferred to gas chromatography vials with a rinse step to a final volume of 1 mL and the internal standard was added. Percentage recovery for all 8 target analytes using this method with seawater was >95 %.

Seawater samples from Hawaii were collected using precleaned one liter amber glass bottles with Teflon lined lids (I-Chem, 300 series, VWR). Samples were extracted using C-18E cartridges (500 mg, 6 mL Phenomenex Inc.) on a vacuum manifold (Phenomenex Inc.). Cartridges were conditioned as indicated in the previous paragraph and eluted with 5 mL of methanol. For LC-MS analysis, samples were run on an AB\_SCIEX 5500 QTRAP Triple Quadrupole Hybrid Linear Ion Trap Mass Spectrometer with a Spark Holland Symbiosis HPLC for analytical separation. The analytes were measured with MRM (multiple reaction monitoring) followed by switching to ion trap functionality (Q3-LIT) to confirm the fragmentation pattern of the MRMs. The source was set at 700 °C and the gasses were set to 60 arbitrary units of nitrogen. The curtain gas was set at 45 arbitrary units, and all MRMs were optimized using infusion based introduction of analytical standards. Analytical separation was performed using a Phenomenex Hydro RP  $4.6 \times 50$  2.6  $\mu$ m particle size stationary phase, with the mobile phase composed of methanol and water with the addition of 0.1 % formic acid and 5 mM of ammonium acetate in both phases. The flow rate was set at 0.9 mL per min, and a ballistic gradient and re-equilibration was run over 5 min. Percentage recovery for target analytes was >85 %, Limit of Detection was 100 pptrillion, and Quantitative Limit of Measurement was 5 ppbillion (µg/L).

#### Statistical Methods

OECD (2006) was used as a guidance document for our approach in the statistical analysis of the data. To address different philosophies and regulatory criteria, Effect Concentration response (EC20 and EC50) and median Lethal Concentration response (LC<sub>50</sub>) were determined using three initial methods: PROBIT analysis (Finney 1947), linear or quadratic regression (Draper and Smith 1966), and spline fitting (Scholze et al. 2001). Data were analyzed using linear or quadratic regression and PROBIT methods individually for each experiment, based on model residuals being random, normally distributed, and independent of dosing concentrations (Crawley 1993, Fig. 5.1), as well as having good fit, statistically significant, and biologically interpretable regressors (Agresti 2002; Newman 2013). Spline fitting did not meet these criteria. In several analyses, BP-3 concentrations as  $\log_{10}(x + 1)$  were transformed to conform to model assumptions.

Data were tested for normality (Shapiro-Wilk test) and equal variance. When data did not meet the assumption of normality and homogeneity, the no-observed-effect concentration (NOEC) was determined using Kruskal-Wallis one-way analysis of variance, using Dunnett's Procedure (Zar 1996) to identify concentrations whose means differed

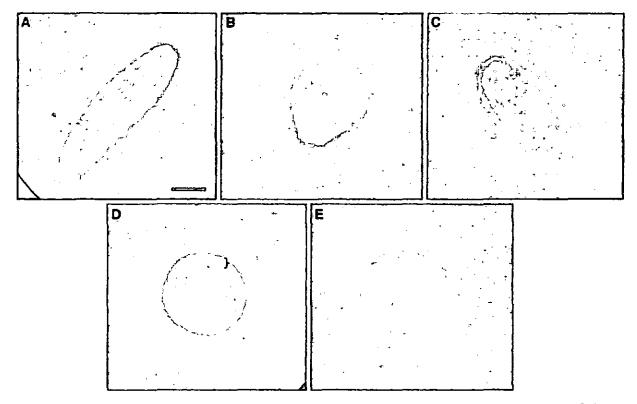


Fig. 1 Stylophora pistillata planulae exposed to various treatments of benzophenone-3 (BP-3). a Control planula exposed for 8 h in light. b Planula exposed to 22.8 parts per billion ( $\mu g/L$ ) BP-3 for 8 h in the light. c Planula exposed to 228 parts per billion ( $\mu g/L$ ) BP-3 for 8 h in

significantly from the control (Newman 2013). When variances among treatments were heterogeneous, we verified these results using a Welch ANOVA. In cases where responses were homogeneous within the control treatment (i.e., all planulae survived) or another concentration (i.e., all planulae died or were deformed), the Steel Method (Steel 1959) was substituted, which is the nonparametric counterpart to Dunnett's Procedure (Newman 2013). Four replicates of each experimental concentration provided good statistical power for parametric analyses, but it is cautioned that the relatively small sample size for the nonparametric Steel Method (Steel 1959) made results of this test less powerful. To facilitate comparisons among other treatment means, figure legends include results of Newman-Keuls Method post hoc test, which compares each concentration to all others.

Parametric (Pearson's r) or nonparametric (Spearman's  $\rho$ ) regression analyses were used to determine the relationship between mortality of coral planulae and coral cells. Coral planulae are available only immediately after spawning and a strong association between these two responses would allow mortality of coral cells to serve as a surrogate for this reproductive response. JMP version 9.0 or 10.0 (SAS Institute, Inc.,

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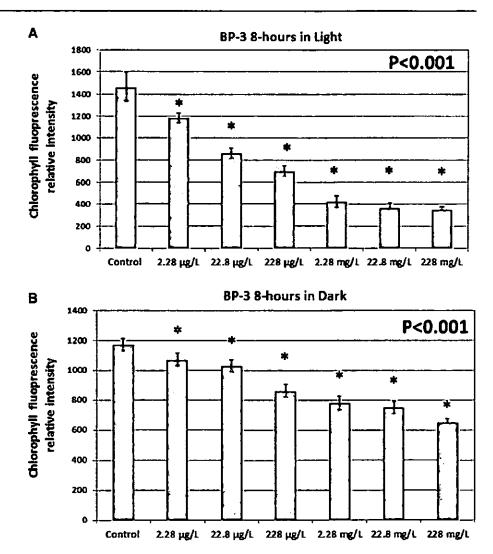
the light. d Planula exposed to 2.28 parts per million (mg/L) BP3 for 8 h in the light. e Planula exposed to 28.8 parts per million (mg/L) BP3 for 8 h in the light. Scale bar is 0.5 mm

Cary, NC), SAS version 9.3 and SigmaPlot 12.5 (Systat Software, Inc., San Jose, CA) were used for analyses.

#### Results

#### Toxicopathology

Planulae under control conditions have an clongated, "cucumber-like" morphology with organized rows of zooxanthellae-containing gastrodermal cells running from the aboral pole to the oral pole (Fig. 1a; "brown dots" in the rows are individual zooxanthella cells). Normal planulae are in near-constant motion, being propelled by cilia that cover the elongated body. Within the first 4 h of exposure of planulae to BP-3 in both light and darkness, planulae showed a significant reduction in ciliary movement and the morphology had significantly changed from the elongated form to a deformed "dewdrop" (Fig. 1b). At 228 µg/L BP-3, planulae contain noticeably less zooxanthellae (brown spots) indicative of "bleaching" (Fig. 1c). The mouth of the planula at the oral pole began to increase three- to fivefold in diameter at the end of the 8-h exposure Fig. 2 Relative chlorophyll fluorescence emission at 685 nm with excitation at 445 nm of planulae of Stylophora pistillata exposed to various treatments of benzophenone-3 (BP-3). Bars show treatment means with whiskers representing  $\pm 1$ standard error of the mean. N = 4 replicates per treatment. a Planulae exposed to various BP-3 concentrations for 8 h in the light. Treatment means with different letters differed significantly from the control at  $\alpha = 0.05$ , based on Kruskal-Wallis one-way analysis of variance on ranks followed by a Dunnett's Method post hoc test against a control. b Planulae exposed to various BP-3 concentrations for 8 h in the dark. Treatment means with different superscript letters differed significantly from the control at  $\alpha = 0.05$ , based on one-way analysis of variance followed by a Dunnett's Method post hoc test against control



(Fig. 1d). By the end of the 8 h of exposure for all BP-3 concentrations, the oral pole was recessed into the body in deformed planulae (Fig. 1b) and the epidermis of all the deformed planulae took on a white opaque hue. For planulae exposed to the higher concentrations of BP-3, it was apparent that the epidermal layer had lost its typical transparency and become opaque (Fig. 1, bracket indicates opaqueness of epidermal layer).

At the end of the 8-h exposure, all planulae exposed to all of the concentrations of BP-3 became sessile. Additionally, there was a positive relationship between exposure to increasing concentrations of BP-3 and planula bleaching (Figs. 1a-e, 2). Bleaching is the loss of symbiotic dinoflagellate zooxanthellae, photosynthetic pigments, or both. Chlorophyll fluorescence as an indicator of the concentration of chlorophyll a pigment corroborated these visual observations; exposure to BP-3, whether in light or darkness, caused planulae to bleach (Fig. 2). The Lowest Observable Effect Concentration for inducing chlorophylldefined bleaching is 2.28  $\mu$ g/L in the light (P < 0.001, Dunnett's Method) and 22.8  $\mu$ g/L in the dark (P < 0.01, Dunnett's Method).

Normal planulae have four layers of organization. At the surface of the planula is the epidermis (Fig. 3a-c). The outer aspect of the epidermis has densely packed ciliated cells (Fig. 3a), spirocysts and nematocysts/blasts (Fig. 3b), and cells containing chromogenic organelles. Between the epidermis and the gastrodermal tissue layers is the mesoglea (Fig. 3c-d). Within the gastrodermal tissue are cells that contain symbiotic dinoflagellate zooxanthellae within an intracellular vacuole (Fig. 3e). Figure 3e depicts a healthy morphology, with the presence of starch granules, coherent chloroplasts, and the presence of a pyrenoid body that interfaces with chloroplasts. Figure 3f illustrates the integrity of chloroplasts (cp) within the dinoflagellate, especially the structure of the tri-partite rows of the

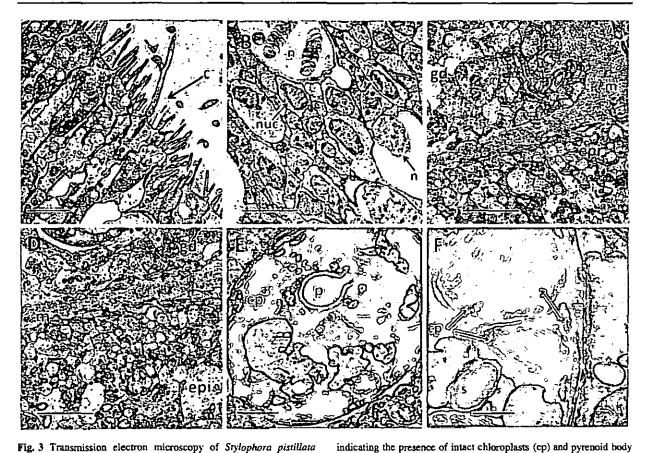


Fig. 3 Transmission electron microscopy of Stylophora pistillata planula control treatment. a Epidermal surface, indicating the presence of functional cilia (c) and tightly adjoined epidermal cells; bar indicates 2000 nm. b Epidermal surface indicates intact nematocysts (n) and nuclei (nuc); bar indicates 5000 nm. c Mesoglea (m) demarks the epidermal tissue (epi) from the gastrodermal tissue (gd); bar indicates 5000 nm. d Micrograph indicates the interface of the gastroderm (g), mesoglea (m), and epidermis (epi); bar indicates 5000 nm. e Zooxanthella in the gastrodermal tissue of planula,

thylakoid (t) membranes. Dinoflagellates from control planulae contained an abundance of starch granules (S), as well as the absence of vacuolated space between the dinoflagellate's thecal plate and the host's symbiophagic membrane (indicated by "{"; Fig. 3f).

Transmission electron microscopy of planula exposed to 288 parts per billion BP-3 for 8 h in the light (Fig. 4) showed that the planulae experienced catastrophic tissue lysis and cellular degradation in both the epidermis and gastrodermis, as well as partial collapse of the mesoglea (Figs. 3 vs. 4). At the surface of the epidermis, there was a complete loss of ciliated cells (Fig. 4a). The development and extent of cell death and tissue deterioration was greatest at the surface of the epidermis and became less pronounced at the center of the planula. In the middle area of the epidermal tissue, between the outer surface of the epidermis and its boundary with the mesoglea, the

indicates 2000 nm. f Close-up of cytosolic structure of zooxanthella. Chloroplasts (cp) exhibit intact chloroplastic membrane and coherent, parallel rows of thylakoid membranes. *Bracket* (]) indicates the absence of vacuolar space between the coral vacuolar membrane and the zooxanthella's thecal plate/membrane; *bar* indicates 500 nm incidence of autophagic cell death became more pronounced (Fig. 4b; Tsujimoto and Shimizy 2005; Samara

(p). Notice the absence of a vacuolar space between the coral vacuolar membrane and the thecal plates/membrane of the zooxanthella: bar

nounced (Fig. 4b; Tsujimoto and Shimizy 2005; Samara et al. 2008). Individual cells were dense with autophagic bodies, and many of the nuclei exhibited delamination of the nuclear bilayer membrane and vacuolization of the inner nuclear membrane containing chromatin (Fig. 4c; "}" indicates vacuolization; Eskelinin et al. 2011). None of the nuclei observed in the micrographs exhibited any signs of apoptosis, such as condensation of chromatin (Kerr et al. 1972; White and Cinti 2004; Taatjes et al. 2008). Specialized cells, such as spirocysts, also exhibited deterioration (Fig. 4d). The mesoglea exhibited structural deterioration; this vascular space contained an abundance of debris, including detached cells (Fig. 4e). The gastrodermis also exhibited extensive trauma (Fig. 4e-g). Many gastrodermal cells exhibited considerable dense autophagic bodies (Fig. 4f), although there were a few instances of

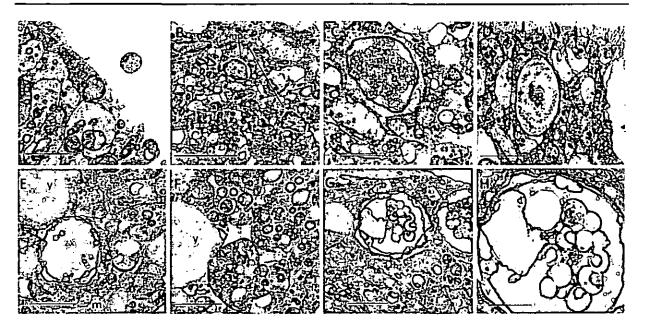


Fig. 4 Transmission electron microscopy of Stylophora pistillata planula exposed to 228 parts per billion ( $\mu g/L$ ) benzophenone-3 for 8 h in the light, a Surface of the epidermal layer; indicating a lack of cilia and cells dying either via necrosis or autophagic cell death; bar indicates 5000 nm. b Epidermal tissue where cells exhibit an abundance of vacuolated bodies, especially the presence of vacuolated nuclei (nuc); bar indicates 5000 nm. c Magnification of vacuolated nuclei (nuc) that completely lacks nuclear blebhing (a sign of apoptosis). "}" indicates 1000 nm. d Epidermal layer with

nuclear autophagy. Gastrodermal cells containing symbiotic zooxanthella exhibited the early stages of symbiophagy, with vacuolization occurring around the zooxanthella (Fig. 4e-g). None of the zooxanthellae showed "normal" morphologies. They instead displayed extensive internal vacuolization, homogenization of chromatin density, and chloroplast degradation, especially of the thylakoid membranes (Fig. 4g-h).

Transmission electron microscopy of planulae exposed to 228 µg/L BP-3 for 8 h in darkness (Fig. 5) exhibited a similar gradient of cell death and tissue deterioration from the surface of the planula to its center as seen in planulae exposed to BP-3 in the light, although the progression of cellular deterioration was not as severe (Fig. 5a-h). Along the surface of the epidermal tissue layer, ciliated cells were undergoing cellular degradation (Fig. 5a). The cell layer immediately below the ciliated cells was degraded, characterized by an abundance of vacuolated bodies and loss of the plasma membrane (Fig. 5b, c). Many of the nuclei exhibited partial delamination of the bilayer nuclear membrane, but unlike the nuclei observed in planulae exposed to BP-3 in the light, vacuolization was not complete and the bilayer was still partially anchored by nuclear pores (Fig. 5b, c). Deeper into the epidermal layer, along

vacuolated ciliated cells, spirocysts (sp) and nematocysts: bar indicates 5000 nm. e Micrograph depicts intersection of mesoglea (m) and gastrodermal tissue containing both zooxanthella (zx) gastrodermal cells and yolk (y); bar indicates 5000 nm. f Epidermal tissue adjacent to yolk exhibits extensive autophagic vacuolization; bar indicates 5000 nm. G Gastrodermal cells containing symbiophagic zooxanthellae. Zooxanthellae have undergone extensive internal vacuolization; bar indicates 5000 nm. h Increased magnification focused on vacuolated zooxanthella, (v) indicates symbiophagic vacuole; bar indicates 2000 nm

the boundary with the mesoglea, cellular degradation persisted, especially of the spirocysts (Fig. 5d). There is an extracellular matrix that acts as a barrier between the epidermal tissue and mesoglea, and again between the gastrodermal tissue and mesoglea. Under these conditions, the integrity of the boundary layer between the epidermis and mesoglea had severely deteriorated, whereas the boundary layer between the gastrodermis and mesoglea remained intact (Fig. 5e). Within the gastrodermis, a vast majority of the cells were alive, but exhibiting signs of massive autophagy (Fig. 5f; Klionsky et al. 2012). It should be noted that there were almost no instances of delamination of the nuclear membrane in the gastrodermal cells; nuclei looked healthy (Fig. 5f). Many of the cells were dense with autophagosomic bodies, and most of the zooxanthellae were undergoing symbiophagy, as indicated by the vacuolization around the dinoflagellate cell (Fig. 5f; Downs et al. 2009). In zooxanthellae that were not significantly degraded (Fig. 5f vs. h), thylakoids exhibited a pathomorphology similar to that found in zooxanthellae of corals exposed to heat stress (32 °C) in darkness; thylakoid lamellae were diffuse (Fig. 5g; Downs et al. 2013), suggesting that the zooxanthellae were directly affected by the BP-3 exposure. In contrast to the findings of Danovaro

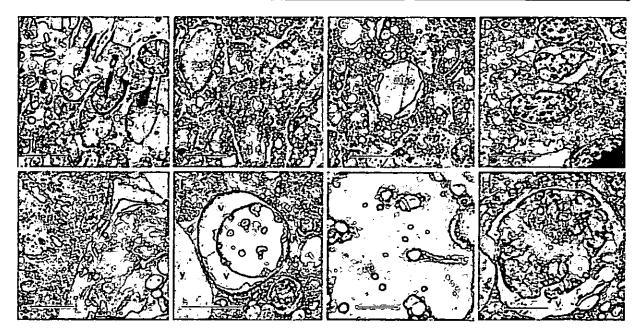


Fig. 5 Transmission electron microscopy of Stylophora pistillata planula exposed to 228 parts per billion ( $\mu g/L$ ) benzophenone-3 for 8 h in the dark. a Surface of the epidermal layer; ciliated cells are present, but undergoing early stages of autophagic cell death. Cells beneath the cilia layer exhibiting late stage autophagic cell death and necrosis. Note scratches in the micrograph; *bar* indicates 2000 nm. b Epidermal tissue area between cilia and nematocyst layer showing extensive vacuolization. Early stages of nuclear vacuolization (nuc). Note scratches in the micrograph; *bar* indicates 2000 nm. c Epidermal tissue in area exhibiting advanced stages of cell death; nucleus vacuolization (nuc). Note scratches in the micrograph: *bar* indicates 2000 nm. d Extensive vacuolization of cells surrounding

et al. (2008), viral inclusion bodies were not observed in our electron microscopy examination.

During the initial examination of the planulae using transmission electron microscopy, scratches in the microsections under observation were readily apparent (Figs. 5a-c and 6). Scratches to the microsection can arise as a result of hardened particles from the sample that scrape between the diamond blade and micro-sectioned sample (Carson 1997; Crang and Klomparens 1988). This is a common occurrence in biological samples that contain CaCO<sub>3</sub> skeleton (coral or vertebrates). These scratches are preventable if the samples are first decalcified before embedding in a resin and sectioned (Crang and Klomparens 1988). Coral planula samples do not normally need to be decalcified, because they should contain no aragonite skeletal matrix. An Alizarin red stain confirmed the presence of a CaCO<sub>3</sub> crystal matrix on the surface of the planula (data not shown; Barnes 1972). Decalcifying the fixed coral planulae with EDTA before embedding the sample in resin alleviated the "scratch" artifact and the remaining samples that were processed using a decalcification step were devoid of scratches.

nematocysts. Note scratches in the micrograph; *bar* indicates 5000 nm. e Mesoglea (m), gastrodermal and epidermal tissues. Symbiophagy occurring to zooxanthella (zx) surrounded by extensive vacuolization in neighboring cells; *bar* indicates 2000 nm. f Gastrodermal tissue and yolk (y). All cells exhibiting extensive vacuolization (v), especially within the gastrodermal cell surrounding the zooxanthella. Coral cells showing increased level of autophagosome content but no signs of autophagic cell death or necrosis; *bar* indicates 5000 nm. g Zooxanthella chloroplast with thylakoid dispersion-pathomorphologies. Chloroplast (cp); *bar* indicates 1000 nm. h Zooxanthella exhibiting extensive pyknosis; symbiophagic vacuole (v); *bar* indicates 1000 nm.

Increasing concentrations of BP-3 induced significantly higher levels of DNA AP lesions in planulae exposed to the light compared to the controls (Fig. 7a, b), as well as planulae exposed to BP-3 in the dark (Fig. 7c, d).

#### No-Observed-Effect Concentration

Lowest-observed-effect Estimating Concentration (NOECs) for planulae exposed to BP-3 for 8 h was problematic because responses in the control treatment were homogeneous (Shapiro-Wilk; P < 0.05); all planulae survived and were not deformed, so analyses defaulted to the less powerful, nonparametric method (Steel 1959). The NOEC for both the proportion of live coral planulae and nondeformed planulae exposed to BP-3 for 8 h in either the light or the dark was 228 ppmillion (mg/L) (Steel Method (Steel 1959), all Z > 2.32, P < 0.0809; Fig.8a, c). In contrast to the Steel Method, the NOEC for planulae in the light determined by a Kruskal-Wallis One-Way Analysis of Variance on Ranks was 228  $\mu$ g/L (H Statistic = 21.903;  $P \leq 0.001$ ; Dunnett's Procedure). The NOEC for planulae



Fig. 6 "Scratch" artifacts in transmission electron microscopy micrographs of *Stylophora pistillata* planula exposed to 288 parts per billion ( $\mu g/L$ ) benzophenone-3. When microsectioning planula embedded in a plastic resin without first decalcifying the sample, scratches can manifest on the mounted ultrathin sections. The scratches form as a result of the diamond blade fracturing the aragonite skeleton and pieces of the skeleton adhering to the edge of the diamond blade. As the contaminated blade cuts through the sample block, it scratches the ultrathin sections of the sample. These scratches can be alleviated by cleaning the diamond blade and removing aragonite skeleton in the sample through decalcification before embedding the sample in a resin. a Scratches apparent in ultrathin section of epidermal section of a planula; *bar* indicates 2000 nm. b Scratches apparent in ultrathin section of gastrodermal section of a planula; *bar* indicated 5000 nm

in the dark determined by a Kruskal-Wallis One-Way Analysis of Variance on Ranks was 228  $\mu g/L$  (H Statistic = 22.402;  $P \le 0.001$ ; Dunnett's Procedure).

Estimates for NOECs for planulae exposed to BP-3 for 24 h in light or darkness also were problematic because responses in the control and at all concentrations greater than 22.8  $\mu$ g/L (in certain cases,  $\geq 2.28 \mu$ g/L) were

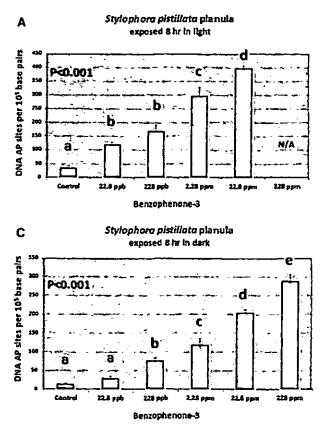
homogeneous (Fig. 8b, d); all planulae survived and were not deformed in the control but died at the higher concentrations (Laskowski 1995). Using the nonparametric Steel Method, we determined the NOEC as 2.28 µg/L for the proportion of coral planulae alive after 24 h of exposure to BP-3 in the light and 22.8 µg/L in the dark (both Z = 2.48, P = 0.0543). The corresponding NOECs for non-deformed planulae were identical to these values (Fig. 9a, c). In contrast, the NOEC for planulae exposed for 24 h in the light, determined by a Kruskal-Wallis One-Way Analysis of Variance on Ranks, was 228 µg/L (Fig. 9b; H Statistic = 22.084;  $P \le 0.001$ ; Dunnett's Procedure). The NOEC for planulae exposed for 24 h in darkness, determined by a Kruskal-Wallis One-Way Analysis of Variance on Ranks, was 228 µg/L (Fig. 9d; H Statistic = 22.112;  $P \le 0.001$ ; Dunnett's Method).

The NOEC for DNA abasic sites in planulae met ANOVA assumptions and was determined as 22.8  $\mu g/L$ (100 nM; one-way ANOVA  $F_{4,15} = 73.1$ , P < 0.0001,  $R^2 = 0.95$ ; Dunnett's Method for this comparison, P < 0.0001) when exposed in the light, and 22.8  $\mu g/L$ (100 nM) when exposed in the dark (Welch ANOVA  $F_{5,7,67} = 142.1$ , P < 0.0001; Dunnett's Method for this comparison, P < 0.0001). The NOEC for mortality of S. pistillata calicoblast cells was below the 570 ng/L concentration for cells exposed to the dark for 4 h (Fig. 10a, b). The NOEC for mortality of S. pistillata calicoblast cells was 570 ng/L for cells exposed to the light for 4 h (Fig. 10c, d).

#### LC50, EC50, and EC20 Values

Regression models used to estimate median  $LC_{50}$  (concentration expected to cause death in 50 % of the population),  $EC_{20}$  and median  $EC_{50}$  (effective concentrations, which adversely affect 20 and 50 % of the population, respectively) after 8 h of exposure to BP-3 had coefficients of determination ( $R^2$ ) between (0.91 and 0.97). Using regression models, the median  $LC_{50}$  for the proportion of live coral planulae exposed in the light was 3.1 mg/L, whereas for planulae exposed in the dark, the  $LC_{50}$  was 5.4 times higher: 16.8 mg/L (Table 1; Supplemental Fig. 1a, c). PROBIT analysis for  $LC_{50}$  in the light was 2.876 mg/L (mg/L), whereas  $LC_{50}$  in the dark was 12.811 mg/L (Table 1; Supplemental Fig. 2a, c).

Models used to estimate  $LC_{50}$  and  $EC_{50}$ , of coral planulae after 24 h of exposure to BP-3 continued to explain the substantial variation (0.86 <  $R^2 \le 0.997$ ). The 24 h- $LC_{50}$  for the proportion of live coral planulae, after exposure in the light, was just 103.8 µg/L (ppbillion) compared with 873.4 µg/L in the dark exposure (Table 1; Supplemental Fig. 1b, d). PROBIT analysis for 24-h  $LC_{50}$  in the light was 139 µg/L, whereas  $LC_{50}$  in the dark was 799 µg/L (Table 1; Supplemental Fig. 2b, d).



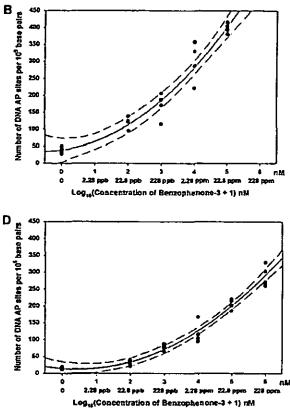


Fig. 7 Number of DNA apyrimidinic lesions in planulae of Stylophora pistillata exposed to various concentrations of benzophenone-3 (BP-3). Bars show treatment means of four replicates with whiskers representing  $\pm 1$  standard error of the mean. Treatment means with different letters differed significantly at  $\alpha = 0.05$ , based on Kruskal-Wallis one-way analysis of variance on ranks followed by a Student-Newman-Keuls Method post hoc test. a Planulae exposed

The 8-h EC<sub>50</sub> for nondeformed planulae exposed to BP-3 in the light and dark were much lower: 107 and 436  $\mu$ g/ L, respectively using regression modeling (Table 1; Supplemental Fig. 3a, c). PROBIT analysis for 8-h EC<sub>50</sub> in the light was 133 ppbillion ( $\mu$ g/L), whereas EC<sub>50</sub> in the dark was 737 µg/L (Table 1; Supplemental Fig. 4a, c). PROBIT analysis for 8-h EC<sub>20</sub> in the light was 6.3  $\mu$ g/L, whereas EC20 in the dark was 15.5 µg/L (Table 1; Supplemental Fig. 4a, c). The 24-h EC<sub>50</sub> for nondeformed planulae exposed in the light and dark were much lower: 17 ppbillion and 105 µg/L, respectively using regression modeling (Table 1; Supplemental Fig. 3b, d). PROBIT analysis for 24-h EC<sub>50</sub> in the light was 49  $\mu$ g/L, whereas LC<sub>50</sub> in the dark was 137 µg/L (Table 1; Supplemental Fig. 4a, d). PROBIT analysis for 24-h EC<sub>20</sub> in the light was 6.5 µg/L, whereas EC<sub>50</sub> in the dark was 10.4 µg/L (Table 1; Supplemental Fig. 4b, d).

for 8 h in the light. b Log-linear regression between DNA AP lesions of coral planulae of *Stylophora pistillata* exposed to concentrations of BP-3 for 8 h in the light. Quadratic regression line (*solid*) and 95 % confidence intervals (*dashed lines*) are shown. c Planulae exposed for 8 h in the dark. d Log-linear regression between DNA AP lesions of coral planulae of *Stylophora pistillata* exposed to concentrations of BP-3 for 8 h in the dark

The number of DNA abasic sites increased approximately tenfold across the BP-3 concentration gradient in the light, but nearly 20-fold in the dark (Fig. 7b, d). Similarly, the percentage of dead coral cells increased dramatically with increasing concentrations of BP-3, but the  $LC_{50}$  was much lower in the light at 39 µg/L than in the dark at 842 µg/L. PROBIT analysis for 4-b  $LC_{50}$  coral cells in the light was 42 ppbillion, whereas  $LC_{50}$  in the dark it was 679 µg/L (Table 2; Supplemental Fig. 5a, b).

#### Species Sensitivity Distribution Using Coral Cell Toxicity Assay

To provide a perspective of the differences in sensitivities of various species of Indo-Pacific and Caribbean coral reefs, the  $LC_{50}s$  and  $LC_{20}s$  with their corresponding upper

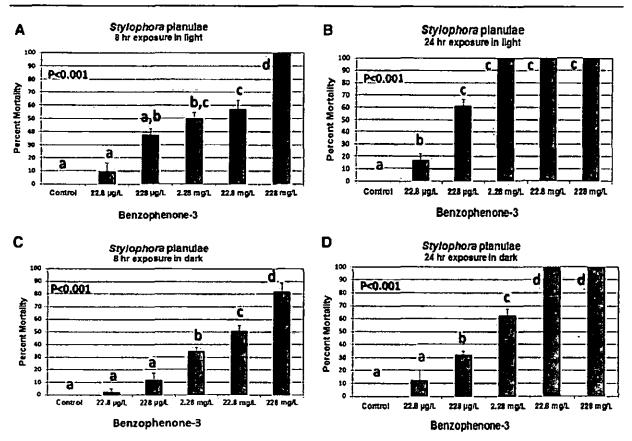


Fig. 8 Percent mortality of planula of Stylophora pistillata exposed to various concentrations of benzophenone-3. Bars show treatment means with whiskers representing  $\pm 1$  standard error of the mean. Treatment means with different letters differed significantly at  $\alpha = 0.05$ , based on Kruskal-Wallis one-way analysis of variance on

and lower 95 % confidence intervals for the two Indo-Pacific and five Caribbean species are provided in Table 1.

#### Correction Factor Between Mortality of Coral Planulae and Coral Cells

Coral cells were much more sensitive than coral planulae across a wide range of BP-3 concentrations, which makes cell mortality a potential indicator of reproductive and recruitment failures. To estimate the correction factor needed to translate coral cell mortality into potential mortality of coral planulae, one option is the use of a quadratic regression model to estimate these relationships: In the light ( $F_{2,21} = 43.8$ , P < 0.0001,  $R^2 = 0.81$ ) % mortality of planulae = 2.26 - 0.28 (% mortality of cells) + 0.0107 (% mortality of cells)<sup>2</sup> In the dark ( $F_{2,21} = 84.5$ , P < 0.0001,  $R^2 = 0.89$ ) % mortality of planulae = 0.86 - 0.0007 (% mortality of cells) + 0.0078 (% mortality of cells)<sup>2</sup>

ranks followed by a Student-Newman-Keuls Method post hoc test. a Planulae exposed for 8 h in the light. b Planulae exposed for 8 h in the light and then 16 h of darkness. c Planulae exposed for 8 h in the dark. d Planulae exposed for 24 h in the dark

#### **Environmental Chemistry Analysis**

The purpose of the chemical analysis was to conduct a cursory survey of BP-3 concentrations on coral reefs. Seawater samples were collected from bays in St. John Island, U.S. Virgin Islands: Caneel Bay, Hawksnest Bay, and Trunk Bay in April 2007 (Fig. 11a, b). Caneel Beach is managed by the resort, Caneel Bay. Samples were collected at approximately 16:30 h near the dive platform that adjoins the Caneel Beach and along a large coral community that spans from the edge of Caneel Beach to the edge of Honeymoon Beach. There were 17 swimmers in Caneel Bay in the 48-h period before sampling. Swimmers were monitored from the shore of the resort from dawn to dusk. No benzophenones could be detected in either of the samples collected in Caneel Bay.

Hawksnest Bay is a densely visited beach within the U.S. National Park system on St. John Island. In general, more than 1000 visitors per day can enter into this bay. On the day of sampling, more than 230 people entered the

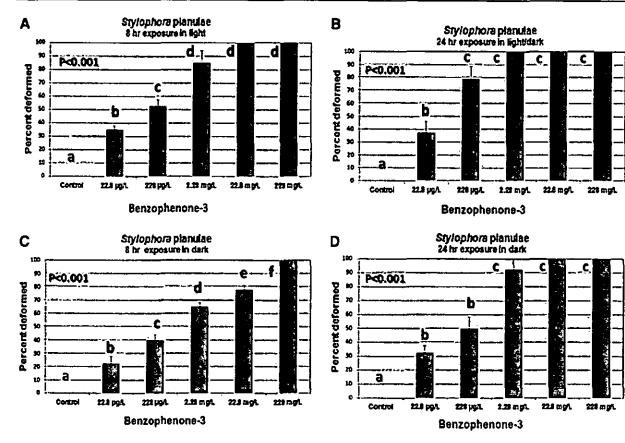


Fig. 9 Percentage of deformed planulae of Stylophora pistillata exposed to various concentrations of benzophenone-3. Bars show treatment means with whiskers representing  $\pm 1$  standard error of the mean. Treatment means with different letters differed significantly at a = 0.05, based on Kruskal-Wallis one-way analysis of variance on

water and swam within 20 m of the three large Acropora palmata spurs (coral reefs) indicated in Fig. 11c; the majority swam in the sandy grooves that lie between the coral-reef spurs. These spurs are very shallow (1-3 m deep), with live coral often protruding above the surface of the water during low tide. The concentration of BP-3 in the western groove was 75 ppbillion ( $\mu g/L$ ), whereas the larger, eastern groove had a BP-3 level of 95 ppbillion ( $\mu g/L$ ). Samples were collected between 17:00 and 17:40 h.

Trunk Bay is an iconic landscape and a highly managed natural resource area. Before 2009, there could be more than 3000 visitors on the beach and in the water at Trunk Bay. After 2009, National Park Service policy reduced the number to 2000 visitors per day (personal communication, Rafe Boulon, retired, USVI NP Chief, Resource Management). A coral community surrounds the island in Trunk Bay, as well as an abundance of gorgonians to the west of the island, and there was once a very extensive stand of *A. palmata* corals to the east of the island. At a site near the

ranks followed by a Student-Newman-Keuls Method post hoc test. a Planulae exposed for 8 h in the light, b Planulae exposed for 8 h in the light, then 16 h of darkness. c Planulae exposed for 8 h in the dark. d Planulae exposed for 24 h in the dark

edge of the Trunk Island coral community, BP-3 levels were 1.395 ppmillion (mg/L) (Fig. 11d). A sampling site 93 m east of the first sampling site contained 580 ppbillion ( $\mu$ g/L) BP-3 (Fig. 11d). Samples were collected at 11:00-11:24 h with more than ~180 swimmers in the water and ~130 sunbathers on the beach within 100 m of the two sampling sites.

Seawater samples were collected at five sites in Maunalua Bay, Oahu Island, Hawai'i on May 30, 2011 between 11:00 and 15:00 h (Fig. 12a, b). ASW samples were collected in public swimming areas in waters that were 1.3 m in depth and 35 cm from the surface of the water. Sites 1-4 had detectable levels of BP-3 (>100 pptrillion; ng/L) but were below the quantitative range of measurement (5 ppbillion ( $\mu$ g/L); Fig. 12b). Site 5 contained measurable levels of BP-3—19.2 ppbillion ( $\mu$ g/L) (Supplemental Fig. 6).

Samples were collected at two sites on June 3, 2011, along the northwest coast of Maui Island, Hawai'i (Fig. 12c). Kapalua Bay is a protected cove and has a public beach that can often see >500 swimmers/day in the peak tourism season (personal communication, Kapalua Dive Co.; Fig. 12d). A seawater sample was collected 40 m from shore near the center of the bay, immediately above remnants of a coral reef at 09:30 h. The Kapalua sample

Table 1 Regression and PROBIT determination of  $LC_{50}$  for planulae mortality when exposed to BP-3 in the light and dark, and the  $EC_{50}$  for planulae deformity when exposed to BP-3 in the light and the dark

Planulae mortality	LC 50
Regression to estimate LC <sub>50</sub> 8-h light	3.1 mg/L
PROBIT to estimate LC <sub>50</sub> 8-b light	2.9 mg/L
Regression to estimate LC <sub>50</sub> 8-h dark	16.8 mg/L
PROBIT to estimate LC <sub>50</sub> 8-h dark	12.8 mg/L
Regression to estimate LC <sub>50</sub> 24-h light	103.8 µg/L
PROBIT to estimate LC <sub>50</sub> 24-h light	1.39 μg/L
Regression to estimate LC <sub>50</sub> 24-h dark	873.4 μg/L
PROBIT to estimate LC <sub>50</sub> 24-h dark	799 μg/L
Planulae deformation	EC <sub>50</sub>
Regression to estimate EC <sub>50</sub> 8-h light	107 mg/L
PROBIT to estimate EC <sub>50</sub> 8-h light	133 mg/L
Regression to estimate EC <sub>50</sub> 8-h dark	436 mg/L
PROBIT to estimate ECso 8-h dark	737 mg/L
Regression to estimate EC <sub>50</sub> 24-h light	17 μg/L
PROBIT to estimate EC <sub>50</sub> 24-h light	49 µg/L
Regression to estimate EC <sub>50</sub> 24-h dark	105 μg/L
PROBIT to estimate EC50 24-h dark	137 µg/L
Planulae deformation	EC <sub>20</sub> (µg/L)
PROBIT to estimate EC <sub>20</sub> 8-h light	6.3
PROBIT to estimate EC20 8-h dark	15.5
PROBIT to estimate EC20 24-h light	6.5
PROBIT to estimate EC20 24-h dark	10.4

PROBIT determination of  $EC_{20}$  for planulae deformity when exposed to BP-3 in the light and the dark

had detectable levels of BP-3 but was below the quantitative range of measurement (5 ppbillion, 5 µg/L). From 06:30 to 09:30 h on the day of sampling, 14 swimmers had entered Kapaula waters. A seawater sample also was collected at Kahekili Beach Park, Maui Island, Hawai'i (Fig. 12e). Kahekili Beach is a public beach that also serves visitors from a number of nearby hotels and resorts. The sample was collected 30 m from shore, immediately above a coral reef. Unlike Kapalua, Kahekili is an exposed shoreline not protected within a bay, and retention time of contaminants is thought to be minimal because of the prevailing currents. The Kahekili sample had detectable levels of BP-3 but was below the quantitative range of measurement (5 ppbillion). Kahekili is a heavily visited beach and had 71 swimmers within 200 m of the sampling site at the time of sampling (11:45 h).

#### Discussion

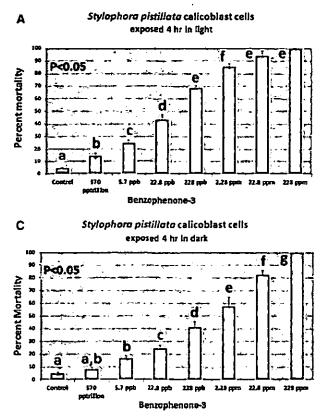
#### Toxicopathology

Benzophenone-3 is a phototoxicant and induces different toxicities depending on whether the planulae are exposed to the chemical in light or in darkness. Corals will usually release brooded planulae at night or spawn gametes at night (Gleason and Hofmann 2011). Planulae of broadcasting species (those that spawn eggs and sperm that are fertilized in the water column) are positively buoyant and planktonic, residing at or near the surface of the ocean for 2-4 days before they are able to settle (Fadlallah 1983; Shlesinger and Loya 1985; Harii et al. 2007; Baird et al. 2009). Light levels on a clear sunny day in tropic latitudes can be as high as or higher than 2000 µmol/m<sup>2</sup>/s of photosynthetically active radiation-five times more than what the corals experienced in this study, suggesting that actual environmental conditions may aggravate the phototoxicity. Whether the BP-3 pollution comes from swimmers, or from point and nonpoint wastewater sources, planulae will be at

Table 2 Differences in sensitivities of various species of Indo-Pacific and Caribbean coral reefs, the LC<sub>50</sub>s and LC<sub>20</sub>s of calicoblast cells exposed in vitro to benzopherone-3 with their corresponding upper and lower 95 % confidence intervals for the two Indo-Pacific and five Caribbean species. ( $\mu g/L$ ) = to parts per billion. (ng/L) = parts per trillion

Coral species	LC50 (µg/L)	95 % CI	LC20	95 % CI
Indo-Pacific species				
Stylophora pistillata (light)	42	28; 60	2 μg/L	1.14; 3.61
Stylophora pistillata (dark)	671	447; 984	14 μg/L	7:26
Pocillopora damicornis	8	4.96; 12.15	62 ng/L	24; 136
Caribbean-Atlantic species				
Acropora cervicornis	9	5.4; 14.5	63 ng/L	22; 150
Montastrea annularis	74	40; 126	562 ng/L	166; 1459
Montastrea cavernosa	52	36; 72	502 ng/L	247; 921
Porites astreoides	340	208; 534	8 μg/L	3; 16
Porites divaricata	36	21; 57	175 ng/L	60; 420

D Springer



B Percentage of dead coral cells 80 пM 22.4 pet 2.21 neb Log<sub>u</sub>(Concentration of Benzophenone-3 + 1) nM D 100 Percentage of dead coral cells 80 nM 22.8 pg 225 2.27 ---Log...(Concentration of Benzophenone-3 + 1) nM

Fig. 10 Percentage mortality of calicoblast cells of Stylophora pistillata exposed to various concentrations of benzophenone-3. Bars show treatment means (n = 4) with whiskers representing  $\pm 1$  standard error of the mean. Treatment means with different letters differed significantly at  $\alpha = 0.05$ , based on one-way analysis of variance followed by a Tukey's Honestly Significant Difference Test. a Calicoblast cells exposed for 4 h in the light. b Log-linear

risk from both forms of toxicities (Brooks et al. 2009; Futch et al. 2010; Pitarch et al. 2010).

As with our previous paper examining benzophenone-2 (Downs et al. 2014), the data in this paper are consistent with the observation by Danovaro et al. (2008) that "sunscreens compounds" cause coral bleaching. In the light, BP-3 caused injury directly to the zooxanthellae, independent of any host-regulated degradation mechanism. Based on the pathomorphology of the thylakoids within the chloroplasts, the most probable interpretation is that BP-3 induces photo-oxidative stress to the molecular structures that form the thylakoid membranes (Downs et al. 2013). In darkness, bleaching resulted from the symbiophagy of the symbiotic zooxanthellae; a process whereby the coral gastrodermal cell "digests" the zooxanthelia (Downs et al. 2009). Nesa et al. (2012) demonstrated that following exposure to light, the algal symbionts of corals increased the DNA damage to coral cells in coral planulae.

regression between coral cell mortality and concentrations of BP-3 for 4 h in the light. Quadratic regression line (*solid*) and 95 % confidence intervals (*dashed lines*) are shown. *Larger symbols* represent multiple coincident data points, with symbol area proportional to the number of replicates with the same value. c Calicoblast cells exposed for 4 h in the dark. d Log-linear regression between coral cell mortality and concentration of BP-3 for 4 h in the dark

Consistent with the Oxidative Theory of Coral Bleaching (Downs et al. 2002), Nesa et al. hypothesized that the sources of this damage was the production of oxygen radicals. If this is the case, then darkness-associated, BP-3induced bleaching may reduce the exacerbated morbidity experienced by "bleached" planulae that would occur during the periods of daylight. Regardless of the toxicological mechanism, managing exposure of corals to BP-3 corals will be critical for managing coral reef resilience in the face of climate-change pressures associated with coral bleaching (West and Salm 2003).

Autophagy was the dominant cellular response to BP-3 exposure (Figs. 4a-f, 5b-d; Yla-Antilla et al. 2009). Microautophagosomes were abundant in all cell types and larger vacuolated bodies of specific organelles were readily observed. None of the nuclei in any coral cell-types exhibited any of the classic signs of apoptosis, such as pyknosis or karyorrhexis of the nucleus (Krysko et al.

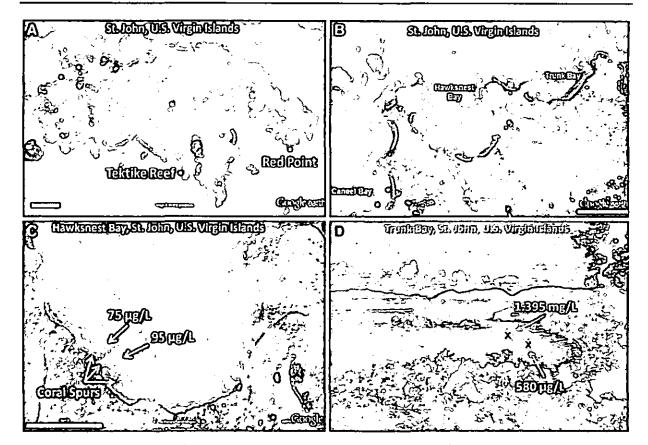


Fig. 11 Seawater analysis of benzophenone-3 (BP-3) in coral reef areas in St. John Island, U.S. Virgin Islands. a Aerial view of St. John indicating the five sampling sites, indicated by a yellow dot. No benzophenones were detected in samples from *Red Point* or at Tektite Reef. All samples were taken between 12:00 and 14:00 h. *Scale bar* is 1.5 km. b Aerial view of the three northwestern sites within St. John National Park: Trunk Bay, Hawksnest Bay, and Caneel Bay. The two benzophenones were detected in samples from Caneel Bay. *Scale bar* 

2008). The most fascinating aspect of these autophagic events were the delamination of the nuclear bilayer membrane (Figs. 4b, c, 5b, c), a classic hallmark of autophagic cell death and further evidence arguing against apoptosis as a regulated mechanism of cnidarian cell death (Tasdemir et al. 2008; Yla-Antilla et al. 2009; Klionsky et al. 2012). In both the light and the dark, there was a gradation of vitiated cells beginning at the surface of the epidermis to "non-morbid" cells in the gastrodermis that surrounded the yolk, In Figs. 4a and 5a, the cells are severely degraded; it is difficult to distinguish any mechanism of cell death, and the cells could easily be labeled as necrotic. Going 20,000 nm into the planula from the surface, cells exhibited the hallmarks of autophagic cell death. This tissue transect of the gradation of cell death is evidence for a model of cell death, first demonstrated in C. elegans, that

is 500 m. c Aerial view of the two sampling sites in Hawksnest Bay, St. John Island. Yellow arrows indicate three coral reef spurs that are dominated by the U.S. Threatened Species, Acropora palmata. Yellow arrows pointing at red dots indicate the sample site. Values indicate the concentration of BP-3 in the water column. Scale bar is 245 m. d Elevated view of Trunk Bay, St. John Island. Yellow arrows pointing to red "X" indicate the sample site. The values indicate the concentration of BP-3 in the water column at those two sites

requires autophagic degradation of cells for the manifestation of necrosis (Samara et al. 2008; Eskelinin et al. 2011).

BP-3 is a genotoxicant to corals, and its genotoxicity is exacerbated by light. Based on the current literature, this was not unexpected, but our data do underscore the threat that BP-3 may pose to not only corals but also to other coral-reef organisms (Hanson et al. 2006; Cuquerella et al. 2012). DNA AP lesions can be produced in response to oxidative interaction or alkylation events (Fortini et al. 1996; Drablos et al. 2004). Accumulation of DNA damage in the larval state has implications not only for the success of coral recruitment and juvenile survival, but also for reproductive effort and success as a whole (Anderson and Wild 1994; Depledge and Billinghurst 1999). Surviving planulae exposed to BP-3 may settle, metamorphose, and

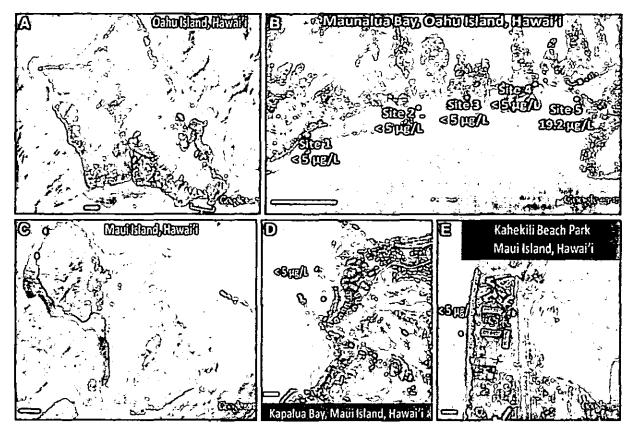


Fig. 12 Seawater analysis of benzophenone-3 (BP-3) in coral reef areas in Oahu and Maui islands, Hawai'i. *Yellow dots* indicate the sampling location in the panels. a Aerial view of Oahu indicating the five sampling sites. *Scale bar* is 5 km. b Aerial view of the five sampling site along the coast of Maunalua Bay, Oahu. Sites 1-4 had

develop into colonial adults, but they may be unfit to meet the challenges of other stressor events, such as increased sea-surface temperatures. Cnidarians are rather unusual in the animal kingdom in that the germline is not sequestered away from the somatic tissue in early stages of development; the somatic tissue gives rise directly to the germline during searce of the some of the source of the source

ment; the somatic tissue gives rise directly to the germline during seasonal reproductive cycles. Damage to the genomic integrity of coral planulae therefore may have farreaching and adverse impacts on the fitness of both the gametes in adults. The ossification of the planulae from exposure to BP-3 is

one of the strangest cases of developmental endocrine disruption to wildlife, although skeletal endocrine disruption in vertebrates is only now being recognized (Colburn et al. 1993; Depledge and Billinghurst 1999; Golub et al. 2004; Lind et al. 2004; Doherty et al. 2004; Agas et al. 2013). In mammals, estrogen and estrogenic compounds may influence different estrogen and thyroid hormone receptors, which affect bone growth and composition (Rickard et al. 1999; Lindberg et al. 2001; Golub et al. 2004). In classic vertebrate

levels of BP-3 that were detectable, but below the quantitative range. Scale bar is 1.5 km. c Aerial view of the two sampling sites in Maui, Hawai'i. Scale bar is 6 km. d Elevated view of Kapalua Bay, Maui. Scale bar is 100 m. e Elevated view of Kahekili Beach, Maui. Scale bar is 100 m

physiology, estrogen plays a complex role in ossification and skeletal maintenance, affecting both bone anabolism and catabolism (Simmons 1966; Väänänen and Härkönen 1996). In vertebrates, exposure to high levels of estrogen can result in skeletal hyperossification (Pfeiffer et al. 1940; Rickard et al. 1999). For "classic" endocrine disruptors, such as tributyltin and dioxin, ossification is inhibited, not induced (Birnbaum 1995; Jamsa et al. 2001; Tsukamoto et al. 2004; Finnila et al. 2010; Agas et al. 2013). Osteo-endocrine disruption is both complex and complicated; different compounds affect different cell types within the skeletal tissue differently (Hagiwara et al. 2008a, b; Agas et al. 2013). Benzophenones as endocrine disruptors are no exception; BP-3 and BP-2 showed contradictory effects on estrogen and aryl hydrocarbon receptors, and both compounds induced "...a kind of endocrine disruption that is not assessed by 'classical' estrogenic markers" (Schlecht et al. 2004; Seidlová-Wuttke et al. 2004; Ziołkowaska et al. 2006).

The ossification-induced opacity of the epidermal tissue layer of planulae was readily observed at the three highest concentrations of BP-3 exposure but was not visually obvious at the lower concentrations, although we know from the electron microscopy sample processing that ossification was present to a lesser extent in the lower BP-3 exposures. Many endocrine disruptors do not exhibit a "classic" monotonic exposure-response curve, but instead exhibit nonmonotonic behaviors (vom Saal et al. 1995; Conolly and Lutz 2004; http://epa.gov/ncct/edr/non-mono tonic.html). Ossification of planulae can be assayed by a variety of methods, including alizarin staining and calcein fluorescence. This study was not designed to be an exhaustive characterization of exposure-response behavior (i.e., regulatory toxicology); hence lower BP-3 exposure concentrations were not attempted. More comprehensive studies that examine the ossification response of both acute and chronic exposure of BP-3 in the lower pptrillion and ppquadrillion need to be conducted to determine accurately this endocrine behavioral response.

#### **Ecotoxicology and Species Sensitivity**

To conduct a relevant and accurate ecological risk or threat assessment, it is imperative that the species chosen reflects the structure of the specific coral-reef ecosystem being affected (Suter 2007). Stylophora pistillata used in this study, is indigenous to specific regions in the Indo-Pacific basins, and hence may not be a valid representative for coral-reef communities in Hawaii or the Atlantic/Caribbean basins. The use of coral planulae in research studies is a relatively difficult resource to obtain. It requires access to healthy coral colonies that are reproductively viable, spawning in specific dates and specific moon phases, and in addition, obtaining the necessary collection and transport permits. We therefore applied an in vitro primary cell toxicity methodology using a specific coral cell type that has been proposed as a surrogate for either planula or colonial polyp studies (Downs 2010). Comparison of LC505 of coral cells in the light (42 ppbillion; µg/L) and coral planula in the light for 8 and 24 h [2.876 ppmillion (mg/L) and 139 ppbillion (µg/L), respectively] exhibits a similar response. The increased sensitivity of in vitro cell models versus whole organism models is a common phenomenon and accepted principle (Blaauboer 2008; Gura 2008). Diffusion of BP-3 across the epidermal boundary layer and reaching concentrations that are toxic in the interior of the planula (e.g., gastroderm) versus direct exposure by cultured cells could likely be the major factor influencing the variation in LC<sub>50</sub> rate. Although there are obvious caveats to using in vitro models, this may be the only way to conduct ecotoxicological research and ecological risk assessments on coral species that are currently endangered with extinction, such as the species on the IUCN's Red List or species proposed/listed for protection under the U.S. Endangered Species Act.

When an environmental stressor impacts a community of organisms, different species may respond (tolerate) dissimilarly to one another; some species may tolerate the stressor at a particular level, whereas other species may succumb (Johnston and Roberts 2009; Maloney et al. 2011). This species sensitivity distribution is a crucial concept for ecological risk assessments and a predictor of the species composition of a community (community phase-shift) in reacting to a pollution stressor, as well as defining the probability of success for community/ecological restoration (Posthuma et al. 2002; van Woesik et al. 2012). This concept readily applies to corals and coral reefs. Coral bleaching in response to heat stress or freshwater input is an excellent example of this community behavior; some species have high tolerance to stress-induced bleaching, whereas others are highly susceptible, resulting in species-specific extinctions in localized areas (Goreau 1990; Loya et al. 2001; Jimenez and Cortes 2003). Species sensitivity distribution in response to pollutants in corals is also well documented, including synergisms between pollutants and heat stress (Loya 1975; Brown 2000; Fabricius 2005). For the Caribbean, the species sensitivity to BP-3 toxicity is consistent with the model for coral tolerance to general stress as set forth by Gates and Edmunds (1999): corals with slower growth rates, such as massive or boulder coral species, are inherently more tolerant than coral species with higher growth rates (e.g., branched species such as A. cervicornis and P. divaricata). In fringing reefs that have been impacted by anthropogenic stressors, especially fringing reefs near tourist beaches, Acropora species are the first to experience localized extinction. Species that tentatively endure a decade or longer of sustained stress, but are intermediate in their persistence, are the large boulder corals found in the genus Montastrea (synomym Orbicella). Coral cell toxicity data indicated that P. astreoides was at least 4.5× more tolerant to BP-3 toxicity than the second more tolerant coral species and at least  $38 \times$  more tolerant than the most sensitive species. This is consistent with observations that P. astreoides is usually the last to become extinct in a polluted-impacted locality and one of the first to recruit once water quality parameters reach a minimum level of habitability (Peters 1984; Lirman et al. 2003; Alcolado-Prieto et al. 2012). From a management perspective, these data can be used to predict the changes in coral-reef community structure when challenged with BP-3, regarding which species will become extinct, as well as the species that will persist in areas that are adjacent to tourist beaches, popular mooring sites, or near sewage discharges. These data also can be integrated directly into reef resilience management

plans against climate change, acting as both a measurable endpoint for management effectiveness and as a target (concentration of BP-3 in seawater on a reef) for establishing action values for reef management.

#### Management of BP-3 Pollution for Coral Reef Conservation and Restoration

What do these pathological toxicities induced by BP-3 mean demographically and ecologically for corals and coral reefs? Trunk Bay in St. John Island, the U.S Virgin Islands, may represent an example of this effect. Ecologically, this area has been severely degraded in the past 25 years, despite the limited input from human activities in the watershed and from marine sources. The most obvious input is recreational swimming at Trunk (Downs et al. 2011). During our monitoring of this site from 2005 to 2010, settlement of planulae and recruitment/survival of juvenile coral was almost 0 %. Established coral colonies in this area were assayed for regeneration of tissue over experimentally induced lesions (laceration-regeneration assay, a single diagnostic test for the general health of a coral; Fisher et al. 2007); not a single colony exhibited any regeneration of any of the lesions during the 5-year investigation (Downs et al. 2011). This was in contrast with Caneel Bay, which had undetectable levels of BP-3 resulting from a much lower density/rate of swimmers and has a flourishing coral community on its southern bank with an abundance of recruitment. These demographiclevel pathologies are consistent with the pathologies that manifest from BP-3 exposure. The pathologies exhibited at this site can be seen at other coral reef swimming areas the world over: Eilat, Israel (degraded with an abundance of sunscreen lotion users) versus Aqaba, Jordan (thriving coral reefs with swimmers that do not use sunscreen lotion; Fuad Al-horani, personal communication), Honolua Bay in Maui, Hawaii, Hanauma Bay Beach in Oahu, Hawaii, Seven Mile Beach in Grand Cayman, Bathway Beach in Grenada, Playa Langosta, and Playa Tortugas Beaches in Cancun, Mexico. At Okinawa, Tashiro and Kameda (2013) demonstrated that BP-3 contamination from beaches can travel over 0.6 km in distance from the pollution source. The threat of BP-3 to corals and coral reefs from swimmers and point and non-point sources of waste-water could thus be far more extensive than just a few meters surrounding the swimming area.

Acknowledgments The study in Israel was partially funded by the Israel Science Foundation (ISF) No. 1169/07 to Yossi Loya. No other organization or government provided Grant-in-aid funding for this project. The authors thank Dr. Jon Martinez and Dr. Katherine Schaefer for assistance with water sampling in Oahu, Hawai'i, Ms. Maya Vizel for her assistance with the planula exposure challenges, Dr. Gideon Winters for assistance with Molecular Dynamics microplate fluorimeter, and Dr. Fuad Al-Horani for his assistance with toxicological exposures. We sincerely thank Dr. Sylvia Galloway and Mr. James H. Nicholson for their work on formatting the figures for publication. We also wish to thank the U.S. National Park Service of the U.S. Virgin Islands National Park for their assistance. We wish to thank the two anonymous reviewers for their comments in improving the manuscript. C.A. Downs thanks the unidentified Virgin Islander in Cruz Bay who gave him insight into the hypothetical cause of the ecological collapse occurring at Trunk Bay; hypothesizing that the visible "sheen" on the surface of the water produced from swimmers' sunscreen lotions was somehow impacting coral reef health.

#### **Compliance** with Ethical Standards

Conflict of Interest The authors can identify no potential conflicts of interest, neither financial nor ethically, involved in the writing or publication of this manuscript.

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DOI: 10.1111/jocd.12449

#### **REVIEW ARTICLE**



## Dermatological and environmental toxicological impact of the sunscreen ingredient oxybenzone/benzophenone-3

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#### Summary

Oxybenzone (Benzophenone-3) is an emerging human and environmental contaminant used in sunscreens and personal care products to help minimize the damaging effects of ultraviolet radiation. The Center for Disease Control fourth national report on human exposure to environmental chemicals demonstrated that approximately 97% of the people tested have oxybenzone present in their urine, and independent scientists have reported various concentrations in waterways and fish worldwide. Oxybenzone can also react with chlorine, producing hazardous by-products that can concentrate in swimming pools and wastewater treatment plants. Moreover, adverse reactions could very well be increased by the closed loop of ingesting fish contaminated with oxybenzone and/or washing the ingredient off our bodies and having it return in drinking water as treatment plants do not effectively remove the chemical as part of their processing protocols. In humans, oxybenzone has been reported to produce contact and photocontact allergy reactions, implemented as a possible endocrine disruptor and has been linked to Hirschsprung's disease. Environmentally, oxybenzone has been shown to produce a variety of toxic reactions in coral and fish ranging from reef bleaching to mortality. Lastly, with the rise in skin cancer rates and the availability of more effective sunscreen actives such as micronized zinc oxide and titanium dioxide, serious doubts about the relative prevention benefit of personal care products containing oxybenzone must be raised and compared with the potential negative health and environmental effects caused by the accumulation of this and other chemicals in the ecosystem.

#### KEYWORDS

contact dermatitis, environmental contaminant, toxicity

#### 1 | INTRODUCTION

Consumer awareness about human health and environmental concerns associated with various ingredients used in personal care products is increasing markedly. Several state and Federal laws banning the use of polyethylene microbeads in cleansing scrubs, tooth pastes, and other consumer products were instituted in 2016 as a result of their presence in numerous fish species found in the food supply and the associated potential adverse health effects to humans.<sup>1</sup> In 2017, several bills have been introduced in the Hawaiian legislature that are designed to ban the use of oxybenzone in any consumer product—particularly if the intended use is near beaches—or, at a minimum, requiring a warning label stating that the chemical is harmful to coral and the aquatic environment. Oxybenzone is an aromatic hydrocarbon that acts as an ultraviolet (UV) light filter in sunscreen formulations. As would be expected, there has been significant debate regarding these proposed actions, with environmentalist calling for a ban on the chemical, industry voices questioning the scientific validity of the negative human/environmental toxicity data based on limited safety data conducted 20 to 40 years ago, and the

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medical profession expressing concerns related to increasing the rate of skin cancer should UV blockers, like oxybenzone, be removed from sunscreen formulations. The present review examines the scientific evidence related to oxybenzone and posits that alternative formulation strategies using micronized zinc oxide and/or titanium dioxide are available which avoid the toxic effects. It is hoped that this examination will be useful to the dermatology community as it considers how to best respond to patient questions related to human health and environmental concerns associated with the use of oxybenzone.

#### 2 | GENERAL INFORMATION

Common Name used on Drug Labels (Active Ingredient): Oxybenzone.

Common Name used on Non-Drug Labels (INCI Name): Benzophenone-3.

Common Technical/Chemical Name: 2-Hydroxy-4-Methoxyphenyl Phenylmethanone.

Common Trade Names: Eusolex 4360 and Escalol 567. Chemical Abstract Service (CAS) Number: 131-57-7. Molecular Weight (MW): 228.26 Daltons (g/mol).

#### 3 | USES

Oxybenzone is commonly used as a short-wave (290 to 320 nm) ultraviolet light (UVB) and mainly short-wave UVA light (320 to 340 nm) absorber at concentrations up to 6% in sunscreen preparations and up to 0.5% in personal care products as a photo-stabilizer minimizing color and odor changes. It has been reported to be used in over 2000 personal care formulations spanning numerous product categories from skin and hair care to color cosmetics and fragrances. Additionally, it is used in plastics as an ultraviolet light absorber and stabilizer. In 1990, oxybenzone was added to the Environmental Protection Agency High Production Volume Challenge Program which identifies ingredients manufactured or Imported into the United States in amounts equal to greater than one million pounds per year.

#### 4 | UV ABSORPTION SPECTRUM, SUNSCREEN EFFICACY TESTING, AND SKIN CANCER RATES

With the recent attempts in Hawall to ban the use of oxybenzone in sun protection factor (SPF) products, some have expressed concern over losing an effective UV absorber and possibly causing an increase in the number of skin cancers observed annually. The ability of a sunscreen product to protect against UV rays is not based on an individual ingredient contained in a formula, however, but rather how the formula performs, as a whole, when tested according to the Food & Drug Administration (FDA) guidelines for labeling and

effectiveness testing; sunscreen drug products for over-the-counter human use.<sup>2</sup> For example, a product could contain the most effective UV-absorbing ingredients allowed (avobenzone, titanium dioxide, or zinc oxide), but if it is formulated in an inappropriate way that product would deliver little to no protection from the damaging effects of UV rays. This reality underlies why FDA has established these guidelines and requires as a matter of law that all formulas be tested for efficacy and stability prior to being sold in the marketplace. Therefore, any product sold in the United States that claims a SPF and, further, makes a broad spectrum claim—regardless of the ingredient(s) used in the product—can be trusted to perform according to the package labeling and protect against the carcinogenic effects of the sun.

It is important to note that SPF testing (UVB) is conducted in 10 human subjects, as outlined in the FDA testing guidelines. However, broad spectrum (UVA) testing is an analytical method (in vitro) that measures if a product has a critical wavelength of at least 370 nm, which represents 90 percent of the total area under the curve in the UV region. Based on the FDA definition, only zinc oxide, titanium dioxide, avobenzone, menthyl anthranilate, oxybenzone, and octocrylene would qualify out of all the approved actives noted in the sunscreen monograph (Table 1). It is important to note that based on these classification criteria, oxybenzone just makes the critical wavelength cutoff of at least 370 nm for UVA claims and would be tied for last place with octocrylene in terms of broad spectrum performance.

The average annual number of adults treated for skin cancer in the United States Increased from 3.4 million In the 2002-2006 time period to 4.9 million annually between 2007 and 2011.<sup>4</sup> Correspondingly, the average annual total cost for managing skin cancer increased 126.2% from \$3.6 billion to \$8.1 billion. Importantly, the National Cancer Institute <sup>5</sup> consumer use data for adults aged 18 years or older between the years 2005 and 2015 report that 70.8% of all adults practice one of the three sun protective behaviors identified: (I) seeking shade and avoiding sun during peak hours (II) wearing protective clothing; and (III) using sunscreens. Of the three methods, only 33.7% reported applying sunscreens, while 38.4% relied on clothing and 39.1% usually sought shade.

Taking into account how products are tested for UV efficacy, the absorption spectrum of the currently approved FDA actives, and how

TABLE 1	Critical wavelength for commonly used UV filters with
an attenuati	on of 370 nm and above <sup>3</sup>

FDA monograph sunscreen ingredients drug label name (INCI/Common Name)	Attenuation In NM	Peak absorption
Octocrylene	290-370	305-325
Oxybenzone (Benzophenone-3)	2 <del>90</del> -370	290-300 & 325-340
Menthyl anthranilate	290-380	340-350
Avobenzone (Butyl Methoxydibenzoylmethane)	290-390	355-370
Titanium dioxide	290-400	290-320
Zinc oxide	290-400	290-385

consumers actually deal with protecting against sun exposure, it is unclear that products containing oxybenzone offer any distinct benefits over other available options when it comes to reducing elevated epidemiological trends in skin cancer. Indeed, for those sunscreen users who have concerns and want the strongest UV protective against the sun, zinc oxide has the best UV attenuation (290-400 nm) and peak absorption (290-385 nm) of all actives, covering 100% of the UVB and 95% of the UVA spectrum. Zinc oxide can be used individually or with other actives, if UV protection above an SPF 30 is required for very sun sensitive individuals, and with the advent of micronized particles (100 nm or larger) product, esthetics are excellent and promote patience compliance. Lastly, it is more likely that patients would receive better protection from frequent application of sunscreens rather than solely relying upon higher SPF factors. For example, a product with a SPF 30 protects against 97% of UVB whereas a product with a SPF 50 protects against 98%; however, to gain that additional 1%, a SPF 50 product may contain almost twice the concentration of sunscreen actives, potentially increasing the chance of adverse reactions, particularly in patients with sensitive skin.

#### 5 | SKIN REACTIVITY

In a study designed to describe allergens associated with a sunscreen source, the North American Contact Dermatitis Group evaluated both active and inactive Ingredients in sunscreen products that may cause contact dermatitis. Standard patch testing in 23 908 patients was conducted between 2001 and 2010 and identified 219 (0.9%) positive reactions. The top three most frequent allergens in sunscreens were as follows: oxybenzone (70.2% for 10% concentration, 64.4% for 3% concentration), DL-alpha-tocopherol (4.8%), and fragrance mix I (4.0%).<sup>6</sup>

Similarly, the European Scientific Committee on Consumer Safety (SCCP) published an opinion paper<sup>7</sup> based on a review of 20 publications involving 6378 patients that were photo-patch tested for oxybenzone and other sunscreen actives between the 1981 and 2003. A total of 159 positive reactions were noted, leading to the conclusion that oxybenzone is a photoallergen. By way of comparison, only 19 photoallergic reactions were noted in these studies to p-aminobenzoic acid (PABA) and 34 photoallergic reactions to the various PABA esters.

Verhulst and Goossens<sup>8</sup> recently published a review and update of cosmetic products that have been reported to produce contact urticaria. Causative agents cited included phenoxyethanol, polyaminopropyl biguanide, oxybenzone, menthol, and a number of plant-derived Ingredients including wheat and wheat protein hydrolyzates. Evidence of contact urticaria and, to a lesser degree, contactmediated anaphylaxis was reported to be caused by oxybenzone.

The American Contact Dermatitis Society listed benzophenones as the 2014 Allergen of the Year, covering both allergy and photoallergy reactivity based on research reported by Heurung et al<sup>9</sup> They sighted oxybenzone (benzophenone-3) as the most frequent reactor in the class as well as the most prominent agent found in 68% of the 201 sunscreen products assessed. The authors also noted that oxybenzone showed high rates of cross-reactivity with the sunscreen active octocrylene, as well as ketoprofen, a topical nonsteroidal antiinflammatory.

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Additionally, oxybenzone has a molecular weight (MW) of 228.26 daltons, which raises concerns historically as a MW below 500 daltons has been associated with most of the common contact allergens.<sup>10</sup>

Cumulatively, there appears to be sufficient research demonstrating that oxybenzone possesses the potential to induce/elicit contact allergy, photocontact allergy, and contact unticaria reactions in humans. To put this into perspective, the sunscreen active p-aminobenzoic acid (PABA) and its esters have also been reported to produce allergic contact and photocontact dermatitis reactions<sup>7,11</sup> at somewhat lower reactivity rates than oxybenzone; however, PABA was forced into obscurity in the United States as a result of concerns from the medical community about sensitivity and subsequent competitive pressures on industry.

#### 6 | ENVIRONMENTAL CONCERNS

in order to be effective, SPF products must be formulated to stay on the surface of the skin where they can reduce the penetration of UV energy to the underlying tissue. Therefore, when formulated in an effective SPF vehicle, oxybenzone demonstrates little absorption through the skin despite having a low MW. Gonzalez et al<sup>12</sup> observed an average excretion rate of 3.7% of the dose of a commercial sunscreen containing 4% oxybenzone when applied morning and night for 5 days. Accordingly, it is possible to estimate that if approximately 4% of oxybenzone in a sunscreen formulation is absorbed into the skin, 96% of the remaining dose is available to be washed off and enter various waterways. Corroborating this point, a 2008 study estimated that 4000 to 6000 tons of sunscreens were washed off in tourist reef areas annualiy13; as of 2017, scientists are currently estimating that 8000 to 16000 tons of sunscreen enter coral reefs each year.14 The increase is the result of the continued growth of the global sunscreen market, which is projecting to reach sales of \$11 billion by the year 2020. To better understand the implications of these figures, Tsui et al<sup>15</sup> sampled the waters of eight cities across four countries (China, United States, Japan, and Thailand) and the North American Arctic identifying twelve widely used aromatic hydrocarbon UV chemical filters. In general, concentrations of the chemicals increased with population density. Oxybenzone concentrations ranging from as high as 33 parts per trillion (ppt) in the Arctic to 5 parts per billion (ppb) in Hong Kong were identified. It should be noted that the surface waters sampled came largely from metropolitan areas featuring both commercial and industrial development, as opposed to beach or resort communities that see high levels of recreational water use by humans. Moreover, the concentrations in the Arctic waters suggest significant migration of toxic chemicals is occurring as current and tidal forces lead to water migration. The authors concluded that the findings represent various ecological risks to marine ecosystems, including promoting coral bleaching and adversely affecting reproduction in fish.

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In 2008, Danovaro et al<sup>13</sup> were one of the first to report that oxybenzone had a negative impact on coral causing bleaching and death at concentrations of 33 and 50 parts per million (ppm). Additional research published in 2015 by Downs et al<sup>16</sup> identified oxybenzone as a phototoxicant, genotoxicant, and a skeletal endocrine disruptor in coral. They determined a lethal concentration 50 (LC50) for coral larvae that ranged from 139 to 3100 ppb depending on the specific test conditions. Coral cell LC50s for seven different coral species ranged from 8 to 340 ppb. The authors went on to measure the amount of oxybenzone at various locations (bays and open waters) at two different locations: Concentrations in the sampled waters from the U.S. Virgin Islands ranged from 75 to 1400 ppb and the Hawaiian Islands 0.8 to 19.2 ppb. Based on these findings, the water concentration of oxybenzone currently in the Virgin Islands overlaps the LC50 calculated for coral larvae and coral cells, while the waters in Hawaii are starting to reach levels that are within the range of the LC50 for coral.

The identification and accumulation of oxybenzone in waters cause concerns not just to coral, but to many other aquatic species as well. Braush and Rand <sup>17</sup> reviewed oxybenzone toxicity in Daphnia magna (Invertebrate) and Oncorhynchus mykiss and Oryzias latipes (fish) and found LC50s of 1.9 ppm, 749 ppb, and 620 ppb, respectively. The authors further identified that UV filters have been shown to have bioaccumulation factors greater in fish than in water. For example, Gago-Ferrero et al<sup>18</sup> evaluated the accumulation of UV absorbers in a variety of fish in Spain and were able to extract oxybenzone from the tissue of white fish, rainbow trout, barb, chub, perch, and mussels. Taken together, these studies suggest the potential for increasing concentrations in species higher up in the trophic level, with humans poised to ingest the highest concentrations from the larger species that are regularly fished for human consumption.

UV filters enter the environment in two primary ways, directly from sloughing off while swimming around reefs or other waterways and indirectly via wastewater treatment plant (WWTP) effluent. In fact, even swimming in chlorinated pools and people washing sunscreens off their bodies while bathing raises several concerns. Researchers have observed that chlorine can react with oxybenzone producing chlorinated oxybenzone, which results in significantly more cell death than unchlorinated controls.<sup>19</sup> Another study evaluated oxybenzone transformation and kinetics after chlorination.<sup>20</sup> These results indicated that more genotoxic transformation products were produced in spite of the elimination of oxybenzone, posing potential threats to drinking water safety. Similarly, six water treatment plants in southeast Brazil evaluated WWTP levels of oxybenzone and observed (0.18 to 1.15 ppb) in both raw treated and chlorinated water, indicating that the compound was not removed by the water treatment process.<sup>21</sup> Additionally, Braush and Rand<sup>17</sup> reported that Switzerland estimated the input of 69 g of oxybenzone per 10,000 people per day into their WWTP.

The Centers for Disease Control and Prevention evaluated urinary samples obtained from 2517 participants aged 6 years and

older between 2003 and 2010 and identified oxybenzone levels ranging from 15 ppb up to 3 ppm.<sup>22</sup> Meeker et al<sup>23</sup> recruited 105 pregnant women in northern Puerto Rico to provide urine samples and complete questionnaire data at three times during gestation. Urinary concentrations of oxybenzone ranged from 41.0 to 66.4 ppb and a positive association between biomarker concentrations, and self-reported use of personal care products was reported. An intraclass correlation coefficient (ICC) of 0.62 was determined for oxybenzone which was the highest among all the chemicals identified in the study. In contrast, urine samples were collected from 33 young Danish men over a 3-month period 24 with ICCs ranging from 0.69 to 0.80 and with more than 70% of the urine samples having detectable levels of oxybenzone. These data suggest that while most oxybenzone in personal care products is not significantly absorbed, sufficient quantities do enter the body such that meaningful levels can be measured in urine that finds its way to WWTP. Oxybenzone and/or its metabolite 4-methylbenzophenone may be more ubiquitous than generally thought (e.g., not just in sunscreens, cosmetics, and fragrances). The international Agency for Research on Cancer<sup>27</sup> has identified several sources of dietary exposure to these molecules in food or addition to food as a flavoring agent, its presence in drinking water as a contaminant, and through its migration from food packaging, printing inks, or recycled paperboard.

Kim and Choi<sup>25</sup> observed that oxybenzone has been detected in water, soil, sediments, sludge, and biota. Based on their review, the maximum detected level in ambient freshwater and seawater was 0.13 ppb and 0.58 ppb, respectively, and in wastewater, influent was 10.4 ppb. They also noted that in humans, oxybenzone has been detected in urine, serum, and breast milk samples worldwide with receptor binding assays showing strong adverse endocrine effects, including anti-androgenic and anti-estrogenic activity. Predicted noeffect concentration (PNEC) for oxybenzone was derived at 1.32 ppb; the levels observed in ambient water are generally an order of magnitude lower than the PNEC, but in wastewater influents, hazard quotients greater than 1 were noted. Lastly, Huo et al<sup>26</sup> looked at the relationship between maternal oxybenzone exposure and Hirschsprung's disease (HSCR) as well as its potential mechanism. HSCR is a neonatal intestinal abnormality that is derived from the failure of enteric neural crest cells migration to hindgut during embryogenesis from 5 to 12 weeks. The results showed that maternal oxybenzone exposure was associated with offspring developing HSCR, likely due to the chemical's inhibiting migration of highly specific cells.

#### 7 | CONCLUSION

Based on the data reviewed, oxybenzone can be found globally in water, soil, sediments, sludge, and biota as well as in human urine, serum, and breast milk. As a sunscreen active, it is not as effective at protecting against UVA exposure as avobenzone, titanium dioxide, and/or zinc oxide. In humans, the chemical has been linked to Hirschsprung's disease is a confirmed contact allergen and photocontact allergen with some potential to induce contact urticaria and, to

a lesser degree, contact-mediated anaphylaxis. Environmentally, oxybenzone inhibits reproduction of coral and fish via embryo toxicity and/or causing male fish to be feminized, coral bleaching, and/or death. In summary, the potential negative health and environmental effects caused by the accumulation of this and other chemicals in the ecosystem needs to be taken into consideration by industry and regulatory agencies prior to the development and release of new and effective personal care products.

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How to cite this article: DiNardo JC, Downs CA. Dermatological and environmental toxicological impact of the sunscreen ingredient oxybenzone/benzophenone-3. J Cosmet Dermatol. 2017;00:1-5. https://doi.org/10.1111/jocd.12449



UNITED STATES DEPARTMENT OF COMMERCE National Oceanic and Atmospheric Administration NATIONAL OCEAN SERVICE Holings Marine Laboratory 301 Fort Johnson Road Charleston, South Carolina 29412

December 15, 2017

The Honorable Elle Cochran and Members of the Maui County Council West Maui Seat 200 S. High Street Wailuku, Hawaii 96793

Dear Council Member Cochran and Maui County Council Members:

I am writing in response to your request for comments on the science related to coral reefs and the impacts of sunscreens and cosmetics containing oxybenzone.

I am a NOAA scientist working within the National Ocean Service's National Centers for Coastal Ocean Science. I have over 30 years of experience in molecular and cellular biology, biochemistry and pathobiology, which I have applied to aspects of coral health and disease research for the past 20 years. I am also one of the co-authors of a 2016 peer-reviewed article in Archives of Environmental Contamination and Toxicology that examined the toxicological effects of oxybenzone on coral larvae, cultured primary coral cells and measured environmental concentrations in coral reef areas in the Caribbean and at multiple sites in Hawaii.

The preponderance of scientific evidence indicates that oxybenzone is toxic to coral and threatens overall coral reef health by:

- Inducing coral bleaching;
- harming or killing coral larvae by inducing gross deformities, DNA damage, and bleaching;
- acting as an endocrine disruptor; and
- bioaccumulating in coral tissue.

I have provide the attached summary of the relevant peer-reviewed literature (Appendix A) in support of this conclusion. As you will see, the research documenting the toxicity of oxybenzone on corals is extensive. While additional research may incrementally add to our understanding of its impacts to other coral reef species, additional research on the impacts of oxybenzone should not be a prerequisite to management action.

Sincerely,

Chery m. Woodley

Cheryl M. Woodley, PhD Coral Health & Disease Program and Coral Disease & Health Consortium



#### **Appendix A: Literature Review**

The weight of evidence, built over at least 20 years of research and hundreds of peer-reviewed scientific articles, demonstrates that oxybenzone is toxic to corals and other animals. Oxybenzone [aka, Benzophone-3; (2-hydroxy-4-methoxyphenyl)(phenyl) methanone] is present in aquatic1'2'3'4, marines'67'8'9 and coral reef environments10'11'12'13. It can convey multiple and different lethal and sub-lethal effects in aquatic taxa as diverse as marine bacteria14'15, microalgae16, protozoans17, cnideria18, molluscs19'20, sea urchins21, crustaceans22, and fish23'24'25.

Compounding the problem, oxybenzone becomes more toxic when the exposures occur in sunlight (or artificial light containing UV). Additionally, oxybenzone is also known to act as an endocrine disruptor with non-monotonic dose responses (meaning low doses can have greater endocrine disrupting effects than at higher doses)26'27'28. In addition, among these studies are also those that have developed ecological risk assessments (i.e., hazard quotients)29'30'31 for various receptor species (non-coral) exposed to oxybenzone in aquatic environments.

The first evidence showing that oxybenzone is a threat to coral reefs came in 2008, when Danovaro et al.<sup>32</sup> showed that oxybenzone could induce coral bleaching. Our work<sup>33</sup> provided evidence for more precise toxicity effects using exposure-response profiles and photo-enhanced toxicity characteristics of oxybenzone (i.e., oxybenzone is more toxic in sunlight) in corals and provided insights into the toxicopathology of corals exposed to oxybenzone. Multiple toxicity endpoints were assessed to determine toxicity for coral larvae including gross deformities, DNA damage, and bleaching. Cell mortality in primary coral cell cultures was used in an *in vitro* assay across multiple coral species to assess oxybenzone toxicity and species sensitivities to the compound. Our results showed that gross developmental deformities in coral larvae of differing degrees across all concentrations tested and after 8 h exposure their movements ceased. These gross observations were underscored by subcellular pathologies showing catastrophic tissue lysis and cellular degradation, particularly at the surface of the larvae. The larvae also displayed reduced chlorophyll fluorescence indicative of bleaching at all concentrations tested.

The accumulation of DNA damage underscores the potential threat of oxybenzone to corals and other coral reef organisms. It has implications for potential impacts to larval development, coral recruitment and juvenile survival and on a larger scale implications for impacts to the adult coral's reproductive effort and the fitness of coral populations exposed to oxybenzone now and in the future. Our laboratory studies included concentrations levels of oxybenzone that were in the same range as actual levels measured in coral reef zones in the U.S. Virgin Islands and in the Hawaiian sites on Oahu and Maui.

A follow-on experiment conducted in our laboratory with adult coral (*Fungia* sp.) showed that when exposed to a water accommodated fraction of a popular sunscreen formulation (Fig. 1), the corals exuded large amounts of mucus and lifted epithelial layers of their surface tissues. Analytical chemistry determined that coral tissues do bioaccumulate active sunscreen ingredients (results presented in 2016 at the International Coral Reef Symposium, Honolulu HI).

A new study<sup>34</sup> builds on previous work to provide further information indicating a high bioaccumulative potential for oxybenzone to accumulate into coral tissues and a preliminary risk assessment for coral species exposed to oxybenzone and other sunscreen contaminants. The authors caution of an increased risk during coral spawning seasons and for corals close to aquatic recreational hotspots.

The preponderance of scientific evidence provided by our work and that of many others supports a reasonable conclusion that oxybenzone is a threat to coral and can threaten overall coral reef health. Managing the exposure of corals and other reef organisms is one essential step for reducing this threat on reef ecosystems.

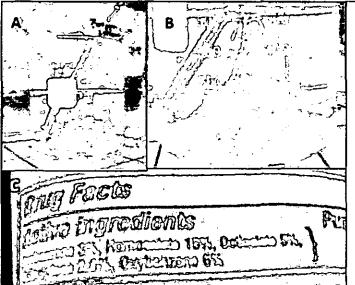


Fig. 1. Exposure-response of Fungia coral to commercial sunscreen lotion formulation. This experiment was to evaluate the response of coral to a water-accommodated fraction (WAF) of a commercial sunscreen formulation and to determine the amount of sunscreen components that are taken up into coral tissues. Panels A & B show response of Fungia sp. after 23 h exposure to WAF of a commercial sunscreen. Mucus sheets and expansion of surface epithelial tissues in response to sunscreen exposure, a reaction similar to that described by Danovaro et al (2008). Panel C is sunscreen product label of active ingredients in tested formulation. Tissue extracts of exposed corals showed oxybenzone levels could bioaccumulate to 220.7 parts per trillion (ng/L) after 48h exposure.

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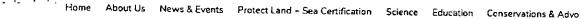
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# Most Sunscreens Can Harm Coral Reefs. What Should Travelers Do?

S February 19, 2018

Tags • Categories •

Avoiding non-biodegradable sunscreen may be the one solution to coral pleaching travelers have the most immediate and direct influence over.

After decades of learning that sunblock is vital to a healthy beach vacation, consumers may wonder what's wrongAfter decades of learning that sunblock is vital to a healthy beach vacation, consumers may 🛉 onder what's wrong with their Coppertone. But recent studies hk the active ingredients in protecting skin from damaging that f ultravolet rays to coral bleaching has led to a global push for more reef-safe sunscreens.

Chemicals in sunscreen that come off while swimming or travel through sewage systems when washed off in the shower are "bigger than dimate change," in causing coral reef damage, according to Craig Downs, the executive director of the Haereticus Environmental Laboratory based in Clifford, Va., which has studied the effects of sunsteen on coral reefs.

In 2015, Mr. Downs led a team that reported that oxybenzone, a common chemical found in sunscreens, is toxic to the symbiotic algae that live within corals, which provides their color and performs other vital duties, and also stunts the growth of corals. A 2008 European study published by Environmental Health Perspectives concided that sunscreen promotes viral infection in corals that can lead o bleaching. They estimated that up to 14,000 tons of sunsteen is deposited in the world's oceans each year.

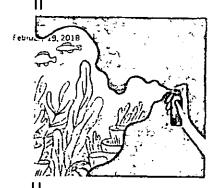


Recent studies have led to a global push for more reef-safe sunscreens.Credit: Chip Litherland for The New York Times

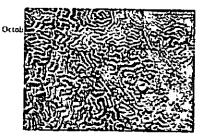
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#### Are Your Products Safe?

We've come up with a list of chemicals and attributes in personal care products (e.g., sunscreen lotions and sprays) that are found in a number of different aquatic and marine ecosystems that can have a detrimental effect on their existence. We call this list of chemicals and physical-attributes the "HEL LIST." <u>See the list here</u>

#### Help Save The Reefs!

We need YOUR assistance ... so do the coral reefs of the world and the wildlife that depend on them. Your donation in support of our work to better conserve and restore threatened environmental habitats and resources is very much appreciated.

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Most Sunscreens Can Harm Coral Reefs. What Should Travelers Do?

③ February 19, 2018





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ORDINANCE NO.

AN ORDINANCE OF THE MAYOR AND THE CITY COMMISSION OF THE CITY OF MIAMI BEACH, FLORIDA, AMENDING CHAPTER 46 OF THE CODE OF THE CITY OF MIAMI BEACH, ENTITLED "ENVIRONMENT," BY CREATING ARTICLE VIII THEREOF, TO BE ENTITLED "SALE OF SUNSCREEN PRODUCTS," TO PROHIBIT THE SALE OF SUNSCREEN PRODUCTS CONTAINING OXYBENZONE OR OCTINOXATE, OR BOTH; AND, PROVIDING FOR REPEALER, SEVERABILITY, CODIFICATION, AND AN EFFECTIVE DATE.

WHEREAS, the Mayor and the City Commission of the City of Miami Beach find that two chemicals contained in many sunscreens, oxybenzone and octinoxate, have significant harmful impacts on Florida's marine environment and residing ecosystems, including coral reefs that protect Florida's shoreline; and

WHEREAS, research has shown that oxybenzone and octinoxate cause mortality in developing coral; increase coral bleaching—an indicator of extreme stress, even at temperatures below 87.8 degrees Fahrenheit; cause genetic damage to coral and other marinorganisms; degrade the resiliency and ability of corals to adjust to climate change factors; and, inhibit the growth of new coral; and

WHEREAS, oxybenzone and octinoxate appear to increase the probability of hormonal disruption in sea life, and scientific studies show that both chemicals can induce feminization in adult male fish and increase reproductive diseases in marine invertebrate species, such as sea urchins, in vertebrate species, such as wrasses, eels, and parrotfish, and in mammals; and

WHEREAS, oxybenzone and octinoxate also induce deformities in the embryonic development of fish, sea urchins, coral, and shrimp and induce neurological behavioral changes in fish, all of which threaten the welfare of fish populations; and

**WHEREAS**, species that are listed as endangered pursuant to the federal Endangered Species Act and that inhabit this state's waters, including sea turtle species, marine mammals, and migratory, birds, may also be exposed to oxybenzone and octinoxate contamination; and

WHEREAS, in 2018, the state of Hawaii passed the first bill in the country banning the sale or distribution of over-the-counter sunscreens containing oxybenzone and octinoxate, which will take effect on January 1, 2021; and

**WHEREAS,** on February 5, 2019, the City of Key West became the first city in the country to ban the sale of sunscreens containing oxybenzone and octinoxate, which will take effect on January 1, 2021; and

**WHEREAS**, on February 5, 2019, Florida Senator Linda Stewart filed legislation (Senate Bill 708), which would ban the sale or distribution of sunscreens in Florida containing oxybenzone and octinoxate unless the user has a prescription from a licensed medical professional; and

WHEREAS, the Mayor and the City Commission of the City of Miami Beach find that preserving the City's marine life and ecosystems, including coral reefs, by prohibiting the sale of

sunscreen skin care products containing oxybenzone and octinoxate, which are harmful to coral reefs and our marine environment, is in the best interest of the City.

# NOW, THEREFORE, BE IT ORDAINED BY THE MAYOR AND CITY COMMISSION OF THE CITY OF MIAMI BEACH, FLORIDA:

**SECTION 1.** Chapter 46 of the Code of the City Miami Beach is hereby amended to create Article VIII thereof, to be entitled "Sale of Sunscreen Products," as follows:

#### CHAPTER 46 ENVIRONMENT

\* \*

#### ARTICLE VIII. SALE OF SUNSCREEN PRODUCTS

#### Sec. 46-212. Definitions.

The following words, terms and phrases, when used in this article, shall have the meanings ascribed to them in this section, except where the context clearly indicates a different meaning:

<u>Cosmetic product refers to products intended to be rubbed, poured, sprinkled, or sprayed on;</u> introduced into; or otherwise applied to the human body or any part thereof for cleansing, beautifying, promoting attractiveness, or altering the appearance.

<u>Octinoxate refers to the chemical ((RS)-2-Ethylhexyl (2E)-3-(4-methoxyphenyl)prop-2-enoate</u> under the International Union of Pure and Applied Chemistry chemical nomenclature registry; that has a chemical abstract service registry number 5466-77-3; whose synonyms include, but are not limited to, ethylhexyl methoxycinnamate, octyl methoxycinnamate, Eusolex 2292, Neo Heliopan AV, NSC 26466, Parsol MOX, Parasol MCX, Parsol MOX, and Uvinul MC80; and is intended to be used as protection against ultraviolet light radiation with a spectrum wavelength from 370 nanometers to 220 nanometers in an SPF sunscreen protection personal care product.

Oxybenzone refers to the chemical (2-Hydroxy-4-methoxyphenyl)-phenylmethanone under the International Union of Pure and Applied Chemistry chemical nomenclature registry; that has a chemical abstract service registry number 131-57-7; whose synonyms include, but are not limited to, benzophenone-3, Escalol 567, Eusolex 4360, KAHSCREEN BZ-3, Uvasorb MET/C, Syntase 62, UV 9, Uvinul 9, Uvinul M-40, Uvistat 24, USAF Cy-9, Uniphenone-3U, 4-methoxy-2hydroxybenzophenone and Milestab 9; and is intended to be used as protection against ultraviolet light radiation with a spectrum wavelength from 370 nanometers to 220 nanometers in an SPF sunscreen protection personal care product.

<u>SPF sunscreen protection personal care product includes, but is not limited to, lotion, paste, balm, ointment, cream, solid stick applicator, brush applicator, roll-on applicator, aerosol spray, non-aerosol spray pump, and automated and manual mist spray.</u>

<u>Sunscreen</u> means a product marketed or intended for topical use to prevent sunburn. Sunscreen does not include products marketed or intended to be used predominantly as a cosmetic product.

# Sec. 46-213. Sale of sunscreen products containing oxybenzone or octinoxate, or both; prohibition; Penalties.

- (a) <u>It shall be unlawful to sell, offer for sale, or distribute for sale in the City Miami Beach any</u> <u>SPF sunscreen protection personal care product that contains oxybenzone or octinoxate,</u> <u>or both, without a prescription from a licensed medical professional.</u>
- (b) Beginning July 1, 2019, the City shall engage in public education efforts to inform stores and shops within the City of Miami Beach that offer sunscreen products for sale of the provisions of this article and to provide assistance with identifying alternative sunscreen products.
- (c) <u>Beginning July 1, 2020, the City shall provide for a six-month warning period through and including December 31, 2020, during which the Code Compliance Department shall issue written warnings for violations of this article.</u>
- (d) <u>Beginning January 1, 2021, the code compliance department shall enforce the provisions</u> in this article.
- (e) If a Code Compliance officer finds a violation of this article, except as otherwise provided during the warning period in subsection (c), the Code Compliance officer shall issue a notice of violation. The notice shall inform the violator of the nature of the violation, amount of fine for which the violator is liable, instructions and due date for paying the fine, that the violation may be appealed by requesting an administrative hearing before a special master within ten days after service of the notice of violation, and that the failure to appeal the violation within ten days of service shall constitute an admission of the violation and a waiver of the right to a hearing.
- (f) A violator who has been served with a notice of violation must pay the following civil fine:
  - (1) First violation within a 12-month period ..... \$250.00;
  - (2) Second violation within a 12-month period ..... \$500.00;
  - (3) Third or subsequent violation within a 12-month period ..... \$1,000.00; or
  - (4) Request an administrative hearing before a special master to appeal the notice of violation, which must be requested within ten days of the service of the notice of violation. The procedures for appeal by administrative hearing of the notice of violation shall be as set forth in sections 30-72 and 30-73 of this Code. Applications for hearings must be accompanied by a fee as approved by a resolution of the city commission, which shall be refunded if the named violator prevails in the appeal.
- (g) Failure to pay the civil fine, or to timely request an administrative hearing before a special master, shall constitute a waiver of the violator's right to an administrative hearing before the special master, and shall be treated as an admission of the violation, for which fines and penalties shall be assessed accordingly.
- (h) <u>A certified copy of an order imposing a fine may be recorded in the public records, and thereafter shall constitute a lien upon any real or personal property owned by the violator, which may be enforced in the same manner as a court judgment by the sheriffs of this state, including levy against the violator's real or personal property, but shall not be</u>

deemed to be a court judgment except for enforcement purposes. After three months following the recording of any such lien that remains unpaid, the city may foreclose or otherwise execute upon the lien for the amount of the lien plus accrued interest.

(i) <u>The special master shall be prohibited from hearing the merits of the notice of violation or considering the timeliness of a request for an administrative hearing if the violator has failed to request an administrative hearing within ten days of the service of the notice of violation. The special master shall not have discretion to alter the penalties prescribed in this article. Any party aggrieved by a decision of a special master may appeal that decision to a court of competent jurisdiction.</u>

#### SECTION 2. REPEALER.

All ordinances or parts of ordinances in conflict herewith be and the same are hereby repealed.

#### SECTION 3. SEVERABILITY.

If any section, subsection, clause or provision of this Ordinance is held invalid, the remainder shall not be affected by such invalidity.

#### SECTION 4. CODIFICATION.

It is the intention of the Mayor and City Commission of the City of Miami Beach, and it is hereby ordained that the provisions of this ordinance shall become and be made part of the Miami Beach City Code. The sections of this ordinance may be renumbered or relettered to accomplish such intention, and the word "ordinance" may be changed to "section," "article," or other appropriate word.

#### SECTION 5. EFFECTIVE DATE.

This Ordinance shall take effect on the \_\_\_\_\_ day of \_\_\_\_\_, 2019.

PASSED AND ADOPTED this \_\_\_\_\_ day of \_\_\_\_\_, 2019.

ATTEST:

Dan Gelber, Mayor

Rafael E. Granado, City Clerk

<u>Underlines</u> denote additions Strikethrough denotes deletions

**APPROVED AS TO** FORM & LANGUAGE & FOR EXECUTION 3-12-19 City Attorney Date

(Sponsored by Commissioner Michael Góngora)

Page 339 of 394

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#### <u>Item 9.</u> COMMITTEE MEMORANDUM

TO: Sustainability Resiliency Committee Meeting

FROM: Jimmy L. Morales, City Manager

DATE: June 26, 2019

#### SUBJECT: DISCUSS THE CITY'S PLAN TO ADDRESS FLOODING AS A RESULT OF EXTREME RAIN EVENTS AS WELL AS ANY LESSONS LEARNED.

#### **RESPONSIBLE DEPARTMENT:**

City Manager's Office | Public Works

#### LEGISLATIVE TRACKING:

Item C4 K - June 5, 2019 Commission Meeting

#### **SPONSORED:**

Commissioner Mark Samuelian

#### <u>Analysis</u> VERBAL REPORT AT COMMISSION MEETING

### UPDATE:

D

Supplemental Information 06.24.19 - Item C4K Commission After-Action

#### ATTACHMENTS:

#### Description

Commission After-Action

Туре

Other

### **COMMISSION MEMORANDUM**

- TO: Honorable Mayor and Members of the City Commission
- FROM: Commissioner Mark Samuelian

DATE: June 5, 2019

SUBJECT: REFERRAL TO THE SUSTAINABILITY AND RESILIENCY COMMITTEE TO DISCUSS THE CITY'S PLAN TO ADDRESS FLOODING AS A RESULT OF EXTREME RAIN EVENTS AS WELL AS ANY LESSONS LEARNED.

#### ANALYSIS

On May 16, 2019 the City of Miami Beach experienced an extreme rain event that resulted in disruptive flooding in Sunset Harbour and other neighborhoods and was reported by various media outlets (attached). In order to plan ahead and best prepare for these events, this referral item should:

1. Understand the anticipated frequency of these extreme rain events

2. Review how the City's systems performed during this specific extreme rain event (i.e. amount of flooding, time in the streets, etc) and how the City measures performance (eg. City stormwater management dashboard - example attached)

3. Identify any lessons learned for the City and community

#### Legislative Tracking

Commissioner Mark Samuelian

#### ATTACHMENTS:

#### Description

- Extreme Rain Event 5/21 LTC
- Resident Email on Flooding
- D Stormwater Dashboard Example
- re: Miami Beach Flooding Article

City of Miami Beach, 1700 Convention Center Drive, Miami Beach, Florida 33139, www.miamibeachfl.gov

 Jimmy L. Morales, City Manager

 Tel: 305-673-7010, Fax: 305-673-778°

 NO. LTC #

 TO:
 Mayor Dan Gelber and Members of the City Commission

 FROM:
 Jimmy L. Morales, City Manager

 DATE:
 May 21, 2019

 SUBJECT:
 CITY EXPERIENCES EXTREME RAIN EVENT

The purpose of this Letter to Commission is to address the facts associated with the sudden and extreme rain event experienced on Thursday, May 16, 2019, which resulted in acute rain conditions in Sunset Harbour and other Miami Beach neighborhoods.

I would like to dissuade the speculation that pumps either "failed" or "turned on too late." The moment the storm began, the City deployed specialized teams to verify that the stormwater pump system was indeed operating properly. Pumps are not turned on manually; instead, they engage automatically when water in the systems reaches a certain level. The system functioned as expected during this event; however, the amount of rainfall received in a very short time exceeded the stormwater system's capacity.

Key facts associated with this rain event and the stormwater system capacity:

- According to the data captured at our City Hall weather station, 1.73 inches of rain fell in just 30 minutes. This is far greater than 0.30 inches of rain per hour, which is considered "heavy rainfall."
- To provide perspective, the 2.23 inches of rain that fell in just one hour is nearly half of what Miami-Dade has averaged during an entire month of May in the past 30 years. Please visit the <u>South Florida Water Management District</u> for more details. During the peak 30-minute period, we pumped more than 730,000 gallons of water out of the Sunset Harbour Neighborhood, which is more than an Olympic-sized swimming pool and translates to 1.5 million gallons of water per hour.
- The system is designed to deal with two challenges: preventing sunny day flooding caused by king tides and addressing flooding caused by stormwater. The improved system has worked very well with regards to sunny day flooding. In fact, the 12 king tides that we experienced in 2017 did not flood Sunset Harbour, even though they were higher than the most impactful event in 2013, which did cause substantial flooding in Sunset Harbour.
- With regards to stormwater management, the system is designed to drain a certain amount of water during a specific time-period. The critical factors are: the duration of rainfall and the intensity of the rain during that time. High intensity rain during a short period of time can overwhelm the stormwater system by introducing more water than it can process.

- The stormwater system will not prevent all flooding and private properties are encouraged to
  make improvements to reduce flood risks. Properties located below the base flood elevation
  (BFE) were particularly vulnerable to flooding. Low-lying private properties can reduce the
  immediate impact of flood water caused by intense rain storms by retrofitting interiors to handle
  flood waters and installing flood panels during the raining season in anticipation of rain events.
  Recall that the ULI team suggested that learning to live with water must be part of the resiliency
  program. There is no guarantee that the area will be dry, regardless of the intensity of a rain
  storm.
- Many of the photos submitted to the City were of ponding water in the grassy areas of public property or front yards. This is what these areas were intended to do during extreme rainfall events in order to protect the habitable areas of buildings. Consistent with the recommendations of the ULI panel these areas should continue to function in this way and the City will not be doing anything to eliminate short term standing water in green areas.
- We also received many reports of street flooding however the areas that reported street flooding either have not received stormwater improvements or those improvements have not been completed.

The City takes note of every rain event and is diligently exploring educational opportunities and policies to mitigate flood risks, including disincentivizing new construction from building at low elevations. Elevation is the best way to secure properties from flood risk. At your request, a City team member can offer potential solutions for your property's unique conditions. You may contact the Floodplain Manager, Mohsen Jarahpour at MohsenJarahpour@miamibeachfl.gov.



On May 22, 2019, at 9:55 AM, bruce backman < <mailto: >>> wrote:

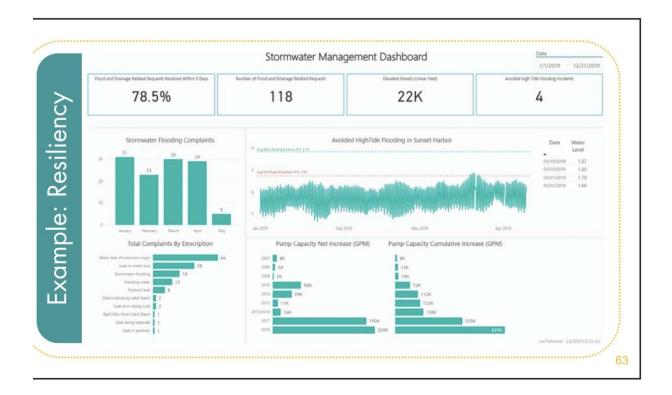
Hi Mark:

Were you aware of flooding last Thursday in Sunset Harbour? Azul Liquor got about 5 inches of rain. The Pubbelly restaurants, and Market clothing store flooded too, as well as Office Depot. I spoke with Eric Carpenter, who had been on site. He said the pumps worked as intended, but were simply overwhelmed by the sheer volume of water in such a short time. This does not leave the businesses in an enviable position.

Are they supposed to install their own supplemental pumping systems? Would the city allow them to connect, or would they just have to dump the water onto the street, where it would doubtless just flow back into their stores?

Summer time is the season for dramatic cloudbursts, (not to mention hurricanes). and perhaps pumps with greater capacity should be considered.





# heavy rain overwhelms miami beach

resiliency May 18, 2019



susan askew



#### heavy rain overwhelms miami beach:

#### city says pumps worked and cleared flooded areas quickly

Once again, a heavy rainfall overwhelmed Miami Beach on Thursday making it difficult for the City's infrastructure, both old and new, to keep up. But City officials say once the rain began to lessen in intensity, the new stormwater pumps worked and cleared flooded areas quickly.

Businesses in the Sunset Harbour area, the first to see its roads raised to combat flooding from sea level rise, have continued to be impacted by heavy rains that even the new pumps can't keep up with sometimes.

Tonya Daniels, Miami Beach Director of Marketing and Communications, wrote in an email, "At 1:00 pm, 1.73 inches of rain fell in 30 minutes, and another 0.5 inches of rain fell in the following 30 minutes" for a total of 2.23 inches in the one-hour period between 1 and 2:00.

"Our team considers 'heavy rainfall' as 0.30 inches of rain per hour," Daniels wrote. "The rainfall intensity of yesterday's event far exceeded this rate."

For comparison, she said, for the last 30 years, Miami-Dade County has average 5.15 inches of rain during the month of May. "In one hour, we experienced approximately half the amount of rain as averaged in an entire month of May." She pointed out what many experts have said, "Recent data suggests that extreme rain events are occurring more often."

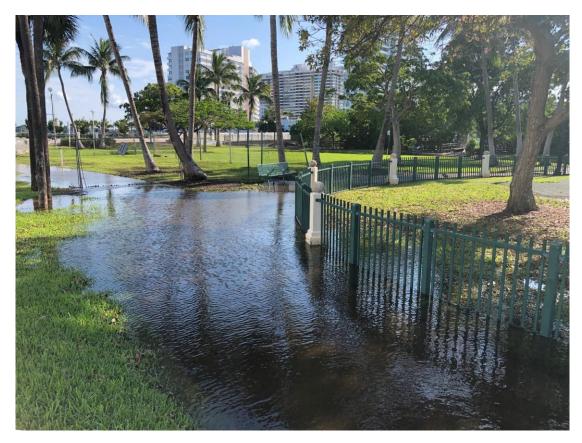
In response to Thursday's rain, Daniels said, "The City immediately deployed specialized teams and verified that pumps throughout the island operated properly. As soon as the rain began to slow down, standing water began to recede quickly. During the peak 30-minute period, we pumped more than 730,000 gallons of water out of the Sunset Harbour Neighborhood, which is more than an

Olympic sized swimming pool (660,000 gallons)."

"Prior to the installation of the pumps, a rainfall event of this magnitude would have caused catastrophic flooding throughout the city – flooding that would not have receded within an hour as we saw yesterday," Daniels wrote.

The City's statement came in too late Friday for us to talk with business owners in Sunset Harbour<br/>aboutLatestFilooding.

Photo at top: 31st Street and Indian Creek, Thursday, May 16



Maurice Gibb Park in Sunset Harbour after Thursday's rain.

#### <u>Item 10.</u> COMMITTEE MEMORANDUM

TO: Sustainability Resiliency Committee Meeting

FROM: Jimmy L. Morales, City Manager

DATE: June 26, 2019

SUBJECT: A DISCUSSION REGARDING A BIOSWALE PILOT PROJECT FOR 59TH STREET WEST OF ALTON ROAD.

#### **RESPONSIBLE DEPARTMENT:**

Public Works

#### LEGISLATIVE TRACKING:

ITEM C4 J - JUNE 5, 2019 Commission Meeting

#### SPONSORED:

Commissioner John Elizabeth Aleman

#### **BACKGROUND:**

The City of Miami Beach is investigating the use of stormwater infrastructure best management practices to address water quality issues for Biscayne Bay, which is designated an Outstanding Florida Water by the Florida Department of Environmental Protection. In addition, the City is looking for ways to integrate the City's green areas with the current stormwater program. One possible option to address both water quality and the stormwater integration green space is the use of bioswales. As an initial investigation into bioswales, the City is seeking to implement a pilot project as means to test the efficacy and value of this technology to provide water quality improvements and attenuation of the runoff from developed areas of the City.

#### <u>Analysis</u> PROJECT DESCRIPTION

The La Gorce neighborhood, West 59th Street, was targeted for this pilot project due historical flooding of low-lying homes along the street. The bioswale pilot project is located within the West 59th Street right-of-way, between Alton Road and Biscayne Bay. The runoff from the existing roads and sidewalks will be managed by a series of proposed bioswales.

For the purposes of this study, the design target is to manage the first 1.5-inches of the storm events within a typical year. Runoff from the impervious road and sidewalks will be directed to

multiple depressed storage areas (bioswales), where the design volume runoff will be captured and not discharged to the stormwater collection system of underground pipes, unless the storm event is larger than the 1.5-inch design volume.

#### **BIOSWALE OBJECTIVES**

Bioswales can improve stormwater runoff water quality by allowing solids and other pollutants to settle out of the water naturally in the bioswale depressions and the engineered soils beneath the surface of the basin, rather than passing into storm sewers and eventually the waterways and ecosystems.

The objective of this evaluation will focus on quantifying the benefits of using this approach and identifying feasible design alternatives to provide the water quality and volume attenuation benefits for the target demonstration site. A bioswale stormwater best management practice was selected by the City to be demonstrated at this site, since it will provide on-site retention of the runoff from lawns, driveways and roads within a residential neighborhood that is ripe for other infrastructure improvements.

#### **BENEFITS**

• Effective removal of suspended solids, nutrients (nitrogen and phosphorus) and other pollutants from stormwater before it enters the bay;

• Allows stormwater to infiltrate into the ground and replenishes the fresh water lens beneath Miami Beach – this supports robust green spaces;

• Captures the first flush (1.5-inches) of runoff from every rain event to remove contaminants; and

• Beautifies the area with attractive landscape and utilizes a variety of native plants to minimize maintenance requirements.

#### LIMITATIONS

• Bioswales are not intended to solve flooding in low lying areas;

• Periodic maintenance is required, for example the mulch will need to be replenished or replaced to maintain its functionality;

• Only the first 1.5 inches of large rain events will be captured – excess water will bypass the bioswale due to limited capacity; however, this adequately treats contaminated runoff per county and state regulations.

• Potential loss of parking when bioswales are located in swale areas currently used by property owners for parking.

• Costs of bioswales can be expensive. For this pilot project, the overall estimate cost is approximately \$850,000.

#### **UPDATE:**

Wade Trim is being considered for a pilot program on 59th Street, West of Alton Road. They have provided the City a rendering, and a planning-level cost estimate in the amount of \$850,000. This amount would include the design and construction of three different types of bioswales to be installed within close proximity to each other to allow the Administration to monitor and measure their relative efficacy, while allowing residents to observe bioswales in a neighborhood-built residential context.

#### **CONCLUSION:**

The following is presented to the members of the SRC for discussion and further direction.

#### ATTACHMENTS:

	Description	Туре
۵	Bioswale tree palette	Other
۵	Bioswale_basis of design	Other
D	BIOSWALE RENDERING	Other

## Palette of Trees Suitable for Use In Bio-Swales

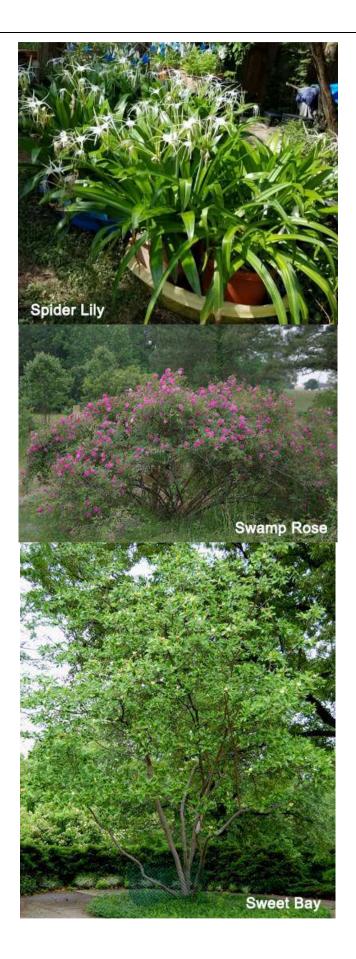




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# BIOSWALE BASIS OF DESIGN 59<sup>th</sup> Street Bioswale Pilot Project

MIB2003.01S

Revision No. 1

**FINAL** 

Prepared For:

The City of Miami Beach

March 15,2019



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# 1.0 PURPOSE

The City of Miami Beach is investigating the use of stormwater infrastructure best management practices to address water quality issues for Biscayne Bay, which is designated an Outstanding Florida Water by the Florida Department of Environmental Protection. As new infrastructure is being contemplated by the City for the La Gorce neighborhood to address climate resiliency, integrating stormwater best management practices such as bioswales is one of the strategies that can be deployed to address both water quality (treatment) and quantity (attenuation) concerns. As an initial investigation into bioswales, the City is seeking to implement demonstration projects as means to test the efficacy and value of this technology to provide water quality improvements and attenuation of the runoff from developed areas of the City.

## 2.0 PROJECT DESCRIPTION

West 59<sup>th</sup> Street in the La Gorce neighborhood was targeted for this demonstration project because of historical flooding of the low-lying homes along the street. The bioswale demonstration project is located within the West 59<sup>th</sup> Street 60-foot wide right-of-way between Alton Road and Biscayne Bay as shown in Appendix 1-Location Map. The runoff from the existing roads and sidewalks will be managed by a series of proposed bioswales. For the purposes of this study, the design target is to manage the first 1.5-inches of the storm events within a typical year. Runoff from the impervious road and sidewalks will be directed to multiple depressional storage areas (bioswales) where the design volume runoff will be captured and not discharged to the stormwater collection system of underground pipes unless the storm event is larger than the 1.5-inch design volume. Appendix 2 provides the details of the existing stormwater and utilities within the project area.

# 3.0 BIOSWALE OBJECTIVES

Bioswales can improve stormwater runoff water quality by allowing solids and other pollutants to settle out of the water naturally in the bioswale depressions and the engineered soils beneath the surface of the basin rather than passing into storm sewers and eventually the waterways and ecosystems. The objective of this evaluation will focus on quantifying the benefits of using this approach and identifying feasible design alternatives to provide the water quality and volume attenuation benefits for the target demonstration site. Bioswale stormwater best management practice was selected by the City to be demonstrated at this site since it will provide on-site retention of the runoff from lawns, driveways and roads within a residential neighborhood that is ripe for other infrastructure improvements.

# 4.0 REGULATORY AND STAKEHOLDER CONSIDERATIONS

As part of this evaluation, applicable regulatory requirements and stakeholder considerations were identified and reviewed to understand their impact on the design of the bioswales. These design criteria for the bioswales are summarized below. The test project area lies within WBID 322H and discharges to Southern North Bay within the Biscayne Bay Aquatic Preserve, see Figure 1.



#### Figure 1. WBID Map

As of the last assessment data the project area had been identified as shown in Table 1:

Assessment Date	Basis for Listing	Assessment Category	Assessment Category Description
5/12/2006	Nitrate	2	Not Impaired
11/2/2010	Dissolved Oxygen	4D	No Causative Pollutant
11/2/2010	Fecal Coliform	5	Verified for Impairment
11/2/2010	Mercury (in fish tissue)	5	Verified for Impairment
11/2/2010	Nutrients (Chlorophyll-a)	3B	Insufficient data
11/2/2010	Nutrients (Historic	3B	Insufficient data
	Chlorophyll-a)		

#### Table 1 – WBID Impairment Summary

Per the Florida Department of Environmental Protection (FDEP), Biscayne Bay is listed as an Estuary, with Biscayne Bay falling under Florida Administrative Code 62-302.532, and an Outstanding Florida Waterway, (OFW), with water quality standards set forth in sections 62-4.242(2) and (3), F.A.C. In discussions with the South Florida Water Management District, SFWMD, the area has no formal associated WBID's, thus water quantity requirements are per the presumptive criteria plus 50%, 1.5-inches, to meet existing OFW criteria. Outstanding Florida Water facts can be found in Appendix 3.

The Wade Trim design team identified the drainage area (DA) and sub-catchments as well as assigned the appropriate runoff estimates for each catchment. From this data the runoff estimates for the design storm (1.5-inches) were produced. This volume was then used to size the bioretention basins within the demonstration project area as defined by the City. Alternative designs for the basins were explored and the team recommended that three demonstration bioswale designs could be developed to manage the

design storm. Each alternative had design differences that would allow evaluation of the performance based on the design variations and constraints of the site.

#### 4.1 DESIGN STORM ANALYSIS

Rainfall required to meet the water quality requirement of 1.5-inches was used in this evaluation. The use of this runoff volume was assumed to capture the high-frequency, low-volume events within the typical rainfall year in Miami Beach. Daily precipitation totals from the nearest National Weather Station to the project site, Station S29Z, located within grid L9 of the DBHydro Hydrologic Monitoring Map in Appendix 4 data was used and can be found via the SWFWMD website at: <a href="https://www.sfwmd.gov/weather-radar/rainfall-historical/sites-and-basins">https://www.sfwmd.gov/weather-radar/rainfall-historical/sites-and-basins</a>

#### 4.2 BIOSWALE INFRASTRUCTURE SIZING AND PERFORMANCE

In optimal conditions the minimum separation from the seasonal groundwater elevation and the bottom of the bioswale is two-feet to ensure consistent infiltration rates for the bioswale. For this reason, an infiltration volume was not included in the sizing of the basins due to the high-water table occurring at the demonstration site. If an infiltration volume is used, it would require a more detailed soil evaluation and determination from a geotechnical engineer on an appropriate infiltration rate for the soils at each basin site. Therefore, the total basin area and soil matrix is designed to capture the design storm of 1.5-inches. Runoff reductions from this project will reduce the runoff entering Biscayne Bay 92% of the time in a typical year. The total volume removed was compared to the existing condition calculation to determine runoff reductions.

#### 4.3 NUTRIENT AND TSS REMOVAL PERFORMANCE

Urbanized areas such as the demonstration site export large quantities of pollutants during rain events to the areas receiving waters. To reduce the impacts to receiving waters from the high concentration of pollutants contained in this runoff, bioretention basins can be implemented to effectively remove these pollutants.

Based on the runoff volume generated for the design event, an estimate of the event means concentrations (EMC's) for Nitrates (TN), Total Phosphorus (TP) and Total Suspended Sediments (TSS) was estimated and this was compared to the expected bioswale pollutant removal efficiencies. The estimated efficiency percentages were derived from the similar published sources as that used for the pollutant EMC's. Table 2 summarizes the annual pollutant load removed by capture of the design rainfall event (1.5-inches) using bioretention.

Based on the project site area, 1.84-acres, the treatment volume require to treat 1.5-inches of rainfall would be 5220-cubic feet (cf). This calculation excluded the area over the bioswales. Complete CN, DCIA and Bioswale capacity calculations can be found in Appendix 5. Based on Nitrate, Phosphorous and Total Suspended Solids (TSS) removal efficiencies of 70%, 90% and 80% respectively; we found that the test BMPS could capture 64% of the Nitrates, 83% of the Phosphorous and 73% of the TSS that are currently discharging uninhibited to Biscayne Bay. Table 2 below provides the pertinent design input data and findings, see Appendix 6 for rainfall data and nutrient removal calculations.

59th Street	1.82	acres			
Rainfall	180	days			
Total Rainfall	65.42	inches			
events less than 1.5"	171	days			
1.5 or less first flush	60.24	inches			
Residential Roads Nutrient Loading					
Nitrogen loading	0.47	mg/l			
Phosphorus loading	0.39	mg/l			
TSS Loading	85.3	mg/l			
Nitrate Loading before Treatment		3.16	kg/year	6.95	lb/year
Phosphorus Loading before		2.62	kg/year	5.77	lb/year
Treatment		2.02		-	
TSS Loading before Treatment		573.6	kg/year	1261.9	lb/year
Nitrate Bypass BMP		0.25	kg/year	0.55	lb/year
Phosphorus Bypass BMP		0.21	kg/year	0.46	lb/year
TSS Bypass BMP		45.4	kg/year	99.9	lb/year
Nitrate Removal Efficiency		70%			
Phosphorus Removal Efficiency		90%			
TSS Removal Efficiency		80%			
Annual Mass Removal					
Nitrate Treat Capture		2.04	kg/year	4.48	lb/year
Phosphorus Treatment Capture		2.17	kg/year	4.78	lb/year
TSS Treatment Capture		422.5	kg/year	929.6	lb/year

### Table 2 – Bioswale Design Input and Findings

### 5.0 BIOSWALE DESIGN ALTERNATIVES AND MAINTENANCE

This bioswale design approach is a radical departure from traditional residential street stormwater management. Streets represent a significant portion of the impervious surfaces within a residential neighborhood and consequently contribute a large percentage of the stormwater runoff. In the traditional neighborhood street design, the right-of-way is planted with turf grasses and graded to be higher than the gutter pan of the road. Further, runoff drains from the individual lot, across the sidewalk, across the grass strip and into the gutter. The road is usually crowned in the middle so each side of the road drains to the gutter pan. The road drainage is then routed to a series of catch basins and piped to a nearby receiving water. While effective in moving the runoff from the street, it also moves runoff pollutants efficiently to the receiving waters and eliminates the opportunity for the rainfall to infiltrate the soils within the neighborhood greenspace of the public right-of-way.

The alternatives detailed in this report provide for a bioswale solution that "re-wires" the traditional runoff management method by diverting runoff from the streets to shallow depressions that are designed as linear shallow bioswale basin located between the curb and the right-of-way line. This diversion of the flow allows for the runoff entering the basin to be cleansed by the soil media and plantings within the bioswale as well as delay the runoff peak discharge until hours or days after the rain event. Further, the resultant discharge from the bioswale underdrain is significantly reduced due to the sponge-like capacity of the engineered soil mix used in the bioretention basins; where a percentage of the runoff entering the basin is held in pore spaces of the soil for later use by the plantings or infiltrated into the groundwater to recharge the shallow aquifer. The proposed site plan shows how runoff from the streets is directed to the gateway bioswales and routed through the existing stormwater pipes to a final large bioswale in the undeveloped right-of-way near the shoreline for final treatment prior to discharge to Biscayne Bay (See Appendix 7).

In this demonstration project, three alternative designs for these bioretention basins were developed. Alternatives 1 and 2 are site planned as gateway features located at the Alton Road/ W 59th Street intersection and due to this position have added design details because it is sited as a gateway landscape feature within the streetscape. Additional design elements such as signage and public education exhibits could be added as part of the final design package.

As was noted earlier, the mechanics of the basin are composed of a shallow depression (6") that has a bottom that is landscaped and composed of soils and vegetation to capture and treat runoff from the street. The engineered components of soil mixes, aggregate storage layers, and landscape plantings provide significant benefits for pollutant removal and biological uptake of pollutant metals and chemicals from the street runoff. Bioswales are especially appropriate for small drainage areas such as the demonstration site, the loading ratio of the drainage area to the basins is 8:1 and well within the maximum recommended ratio of 20:1. The engineered soil mixes provide additional field capacity over topsoil and can provide a minimum of 40% pore storage space to 60% pore storage space dependent on the final selection of the components of the soil mix. For this evaluation we have assumed the lower value of 40%.

There are subtle differences in the bioswale designs below the surface to demonstrate alternative water storage solutions such as using aggregates and pipe bundles to permit storage beneath the sidewalk zone as well design details for the basin edge treatments. Alternative 1 has full contact with existing subsoils beneath the engineered soil mix to allow for infiltration. The constraint to this solution is the high groundwater condition will be an issue at times during King Tides. Alternative 2 provides for a more robust storage layer that has an optional pipe-bundle storage zone beneath the sidewalk and behind and below the curb. The addition of pipe bundles will allow enhanced storage within a small footprint for the bioswale. In both alternatives, the sidewalk and curb will need to be reconstructed if the demonstrated design is to be implemented.

Alternative 3 is designed with a solid bottom to prevent high groundwater conditions from infiltrating the basin during high tides. This is especially important due to its proximity to the bay and its topographic elevation. While similar in overall structure, it does provide a larger footprint than the other linear bioswales and is designed to serve as a final polishing of the runoff prior to discharge to the bay. A flap gate can be added to the underdrain outfall to allow additional isolation from the high groundwater conditions at this specific location. See Appendix 8 for a detail of each alternative.

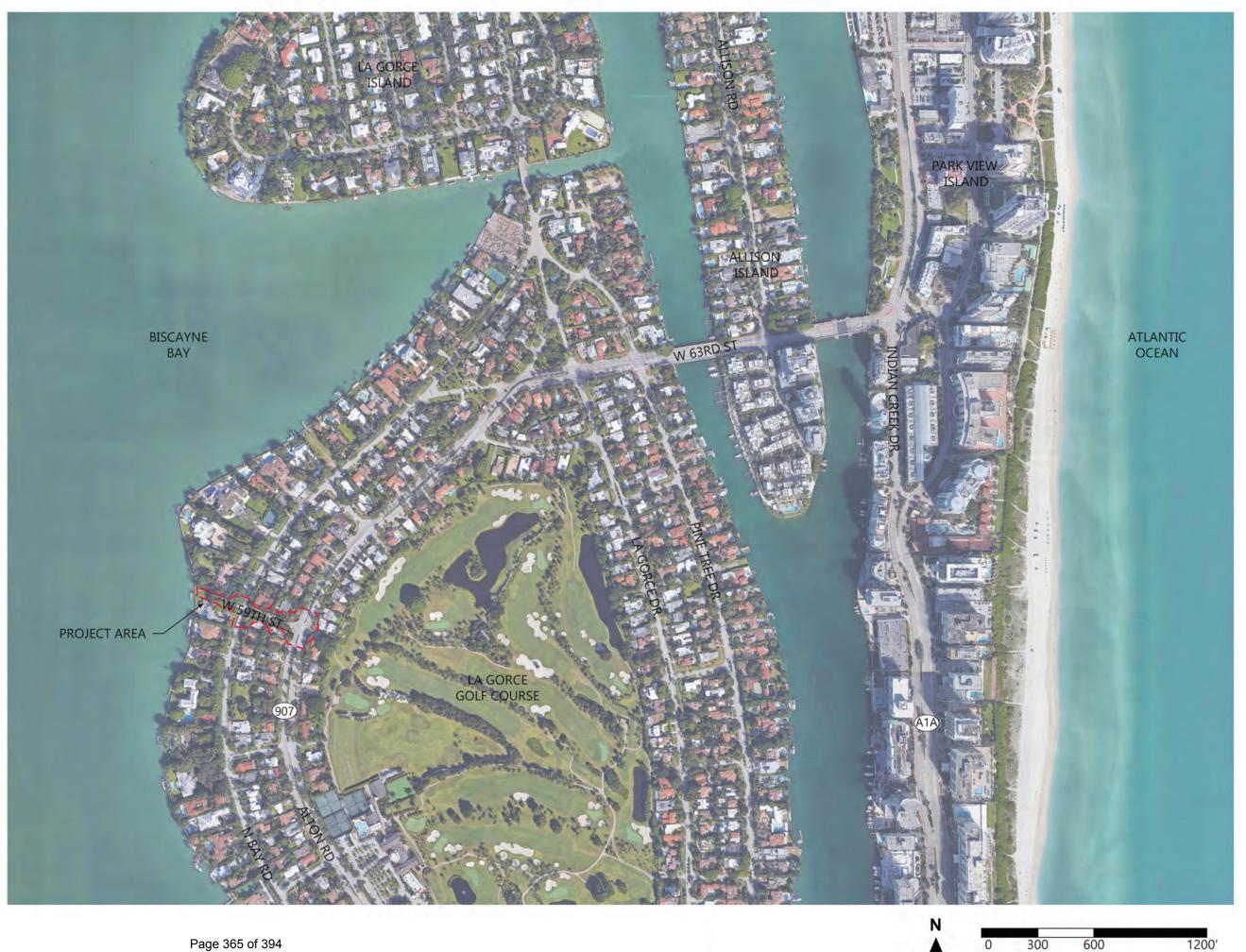
The aesthetic treatments are conceptually demonstrated in the three cross-sections for the alternatives. In Alternative 1, the bioswale edges near the sidewalks are layered with native stone to transition the slope near the sidewalk to the bottom of the basin and create a clean-defined edge near the pedestrian way. High impact plantings create seasonal color and texture while also providing nutrient and heavy metal sequestration. The plantings can provide the landscape enhancements that will transition the street edges to the landscape treatments of the residential lots of the neighborhood.

### 5.1 BIOSWALE MAINTENANCE

Bioretention cells and bioswales require routine maintenance to ensure hydrologic performance and aesthetic appeal. However, maintenance consists of the following categories:

- Irrigation: Water landscaping plants routinely throughout the first growing season (one inch of water per week). It is recommended to use native or adapted species to minimize any required irrigation. If drought-tolerant native plants are chosen, only water in times of significant drought after the plants are established. Otherwise, water as necessary.
- Weeding/Pruning: Prune landscaping plants and remove weeds approximately once per month depending on plants chosen and desired aesthetics. Perennial plants, if used, should be trimmed to ground at the end of the growing season to promote root growth. Remove excess trimmed organic material.
- Mulch: Mulch should be replenished every year or as necessary. It is important to not have a landscaping contract in place that specifies adding mulch annually since it is unnecessary and even undesirable to have excess mulch. If surface erosion is evident after heavy rains, mulch should be re-spread with consideration of adding velocity control measures, such as stone, in areas that experience repeat erosion.
- Sedimentation: Excess sediment can cause surface clogging and excessive ponding. Inspect semi-annually for sediment accumulation and remove any sediment buildup from road runoff. Add mulch or level existing mulch if sediment removal caused significant removal of mulch.
- Aesthetics: Inspect twice a year for trash or dead plants (or more frequently as needed). Trash and dead plant material should be removed and mulch re-spread, if necessary. The Field Guide for Maintaining Rain Gardens, Swales and Stormwater Planters (Oregon State University 2013) is a good maintenance reference and includes maintenance check lists, suggestions, and instructional photos.

# APPENDIX 1.0 LOCATION MAP



## APPENDIX 2.0 EXISTING CONDITIONS



## APPENDIX 3.0 OUTSTANDING FLORIDA WATER FACTS



### Florida Department of Environmental Protection

Bob Martinez Center 2600 Blair Stone Road Tallahassee, Florida 32399-2400 Rick Scott Governor

Carlos Lopez-Cantera Lt. Governor

> Noah Valenstein Secretary

### FACTSHEET ABOUT OUTSTANDING FLORIDA WATERS (OFW)

- Authority: Section 403.061(27), Florida Statutes, grants the Department of Environmental Protection (DEP) the power to establish rules that provide for a special category of waterbodies within the state, to be referred to as "Outstanding Florida Waters," which shall be worthy of special protection because of their natural attributes.
- ImplementingDEP is the agency that designates a waterbody as an OFW; however, eachAgency:OFW must be approved by an arm of DEP known as the EnvironmentalRegulation Commission (ERC). The ERC is a seven-member citizen's<br/>body appointed by the Governor.
- Regulatory Projects regulated by the Department a Water Management or Significance: District (WMD) that are proposed within an OFW must not lower existing ambient water quality, which is defined for purposes of an OFW designation as the water quality at the time of OFW designation or the year before applying for a permit, whichever water quality is better. In general, DEP cannot issue permits for *direct* discharges to OFWs that would lower ambient (existing) water quality. In most cases, this deters new wastewater discharges directly into an OFW, and requires increased treatment for stormwater discharging directly into an OFW. DEP also may not issue permits for *indirect* discharges that would significantly degrade a nearby waterbody designated as an OFW.

In addition, activities or discharges within an OFW, or which significantly degrade an OFW, must meet a more stringent public interest test. The activity or discharge must be "clearly in the public interest." For example, activities requiring an Environmental Resource Permit (ERP), such as dredging or filling within a wetland or other surface water or construction/operation of a stormwater system, must be clearly in the public interest.

In determining whether an activity or discharge that requires an ERP permit is not contrary to the public interest or is clearly in the public interest, DEP or the a WMD must consider and balance the following factors:

- 1. Whether the activity will adversely affect the public health, safety, welfare or the property of others;
- 2. Whether the activity will adversely affect the conservation of fish and wildlife, including endangered or threatened species, or their habitats;
- 3. Whether the activity will adversely affect navigation or the flow of water or cause harmful erosion or shoaling;
- 4. Whether the activity will adversely affect the fishing or recreational values or marine productivity in the vicinity of the activity;
- 5. Whether the activity will be of a temporary or permanent nature;
- 6. Whether the activity will adversely affect or will enhance significant historical and archaeological resources under the provisions of S. 267.061; and
- 7. The current condition and relative value of functions being performed by areas affected by the proposed activity.

<u>See</u> § 373.414(1)(a), Fla. Stat. (2010).

Activities orSome activities are not impacted by an OFW designation simplyDischargesbecause they do not require a permit from DEP or a WMD (exemptNot Affectedactivities). Additionally, other activities are grandfathered under theby an OFWOFW rule. Below are several examples of both scenarios.Designation:Designation:

- 1. Permitted activities or discharges existing on the date of designation and activities with a complete application on the date of designation, which are "grandfathered."
- 2. Activities **not** regulated by DEP for water quality protection purposes, such as fishing regulations, setback ordinances, restrictions on boat motor types, and boat speeds.
- 3. Restoration of seawalls at previous locations.
- 4. Construction of non-commercial boat docks, on pilings, of less than 500 square feet.
- 5. Temporary lowering of water quality during construction activities (with special restrictions).
- 6. Activities to allow or enhance public use, or to maintain preexisting activities (with certain safeguards required by Rule 62-4.242(2)(b), F.A.C.).

**List of OFWs:** A complete listing of Outstanding Florida Waters is provided in Rule 62-302.700 (9), Florida Administrative Code. Outstanding Florida Waters *generally* include surface waters in the following areas:

- National Parks
- National Wildlife Refuges
- National Seashores
- National Preserves
- National Marine Sanctuaries and Estuarine Research Reserves
- National Forests (certain waters)
- State Parks & Recreation Areas
- State Preserves and Reserves
- State Ornamental Gardens and Botanical Sites
- Environmentally Endangered Lands Program, Conservation and Recreational Lands Program, and Save Our Coast Program Acquisitions
- State Aquatic Preserves
- Scenic and Wild Rivers (both National and State)
- "Special Waters"

# "Special Waters" OFWs include 41 of Florida's 1700 rivers, several lakes and lake chains, several estuarine areas, and the Florida Keys:

Myakka River (lower part)
Ochlocknee River
Oklawaha River
Orange Lake, River Styx, and Cross
Perdido River
Rainbow River
St. Marks River
Santa Fe River System
Sarasota Bay Estuarine System
Shoal River
Silver River
Spruce Creek
Suwannee River
Tomoka River
Wacissa River
Wakulla River

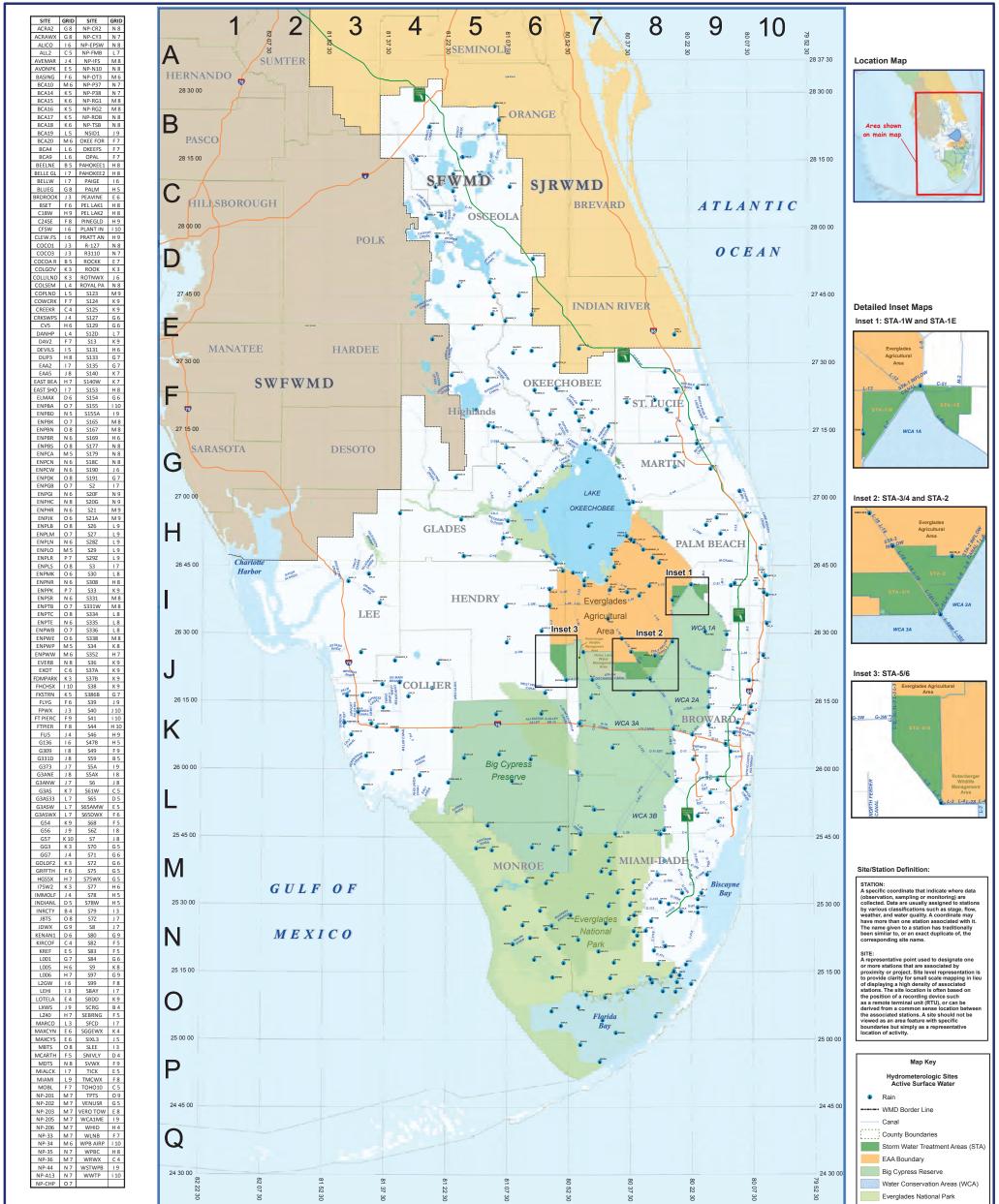
Lake Disston	Weekiwachee Riverine System
Lake Powell	Wekiva River
Lemon Bay Estuarine System	Wiggins Pass Estuarine System
Little Manatee River	Withlacoochee Riverine and Lake
Lochloosa Lake	

**Note:** The rule language describing the above "Special Water" OFWs is more detailed. For further information, refer to paragraph 62-302.700(9)(i), Florida Administrative Code.

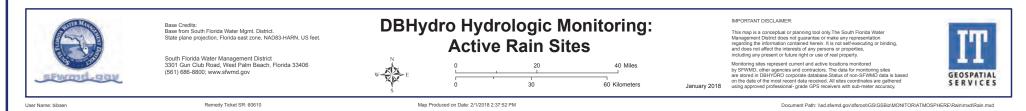
Requirement For a "Specia Water" OFW		Rulemaking procedures pursuant to Chapter 120, F.S., must be followed;
Designation:	2.	At least one fact-finding workshop must be held in the affected area;
	3.	All local county or municipal governments and state legislators whose districts or jurisdictions include all or part of a water body proposed for Special Water designation must be notified at least 60 days prior to the workshop in writing by the Secretary of DEP;
	4.	A prominent public notice must be placed in a newspaper of general circulation in the area of the proposed Special Water at least 60 days prior to the workshop;
	5.	An economic impact analysis, consistent with Chapter 120, must be prepared that provides a general analysis of the effect of OFW designation on local growth and real estate development, including such factors as impacts on planned or potential residential, industrial, agricultural or other development or expansion; and
	6.	The Environmental Regulation Commission may designate a water of the state as a Special Water after making a finding that the waters are of exceptional recreational or ecological significance and a finding that the environmental, social, and economic benefits of the designation outweigh the environmental, social, and economic costs (Rule 62- 302.700(5), F.A.C.).
For More Information Contact:	Prog	artment of Environmental Protection, Water Quality Standards gram at (850) 245-8346 or view the Water Quality Standards site at <u>https://floridadep.gov/dear/water-quality-standards</u> .

November 2017

## APPENDIX 4.0 DBHYDRO HYDROLOGIC MONITORING MAP



MAXCYN	E 6	SGGEWX	K 4
MAXCYS	E 6	SIXL3	J 5
MBTS	08	SLEE	13
MCARTH	F 5	SNIVLY	D 4
MDTS	N 8	SVWX	F 9
MIALCK	17	TICK	E 5
MIAMI	L 9	TMCWX	F 8
MOBL	F 7	TOHO10	C 5
NP-201	M 7	TPTS	09
NP-202	M 7	VENUSR	G 5
NP-203	M 7	VERO TOW	E 8
NP-205	M 7	WCA1ME	19
NP-206	M 7	WHID	Η4
NP-33	M 7	WLNB	F 7
NP-34	M 6	WPB AIRP	I 10
NP-35	N 7	WPBC	Η8
NP-36	M 7	WRWX	C 4
NP-44	N 7	WSTWPB	19
NP-A13	N 7	WWTP	I 10
NP-CHP	07		



## APPENDIX 5.0 CN, DCIA, AND BIOSWALE CAPACITY CALCULATIONS

### CN Computations for WBID Water Quality Calculations

Wade-Trim Project Number :	MIB2003
Wade-Trim Project Name :	BioSwale
Designed by:	MR
Date :	8/31/2018
	Type 1

#### Test - PRE-DEVELOPMENT (acres) 1.84

		Hydrologic	SCS Curve #	Area	Weight CN	TSS	Phosphorus	Nitrate
Land Use Type	SCS Soil Type	group	CN	Covered	value	mg/l	mg/l	mg/l
Other Impervious		B/D	0	0.00	0.00	0	0	0
Commercial or Business (85%) imper.		B/D	0	0.00	0.00	0	0	0
Dirt		B/D		0.00	0.00	0	0	0
Wetlands/Water		B/D		0.00	0.00	0	0	0
Woods		B/D		0.00	0.00	0	0	0
Grass/Open Space (Good Cond)		B/D	80	1.84	147.20	55	0.4	0.33
DCIA			0	0	0	0	0	0
Composite CN	80.00	(	Composite Area:	1.84		55	0.4	0.33
% DCIA	0.00		Total Area:	1.84				

### Post Test

		Hydrologic	SCS Curve #	Area	Weight CN	TSS	Phosphorus	Nitrate
Land Use Type	SCS Soil Type	group	CN	Covered	value	mg/l	mg/l	mg/l
Other Impervious		B/D	98	0.37	36.26	21	0.13	0.32
Commercial or Business (85%) imper.		B/D	95	0.00	0.00	0	0	0
Dirt		B/D		0.00	0.00	0	0	0
Wetlands/Water		B/D	98	0.00	0.00	0	0	0
Woods		B/D		0.00	0.00	0	0	0
Grass/Open Space (Good Cond)		B/D	80	0.87	69.60	180	2.22	1.46
DCIA			98	0.6	58.8	86	0.39	0.47
Composite CN	85.37		Composite Area:	1.24	-	117.375	1.203	0.908
% DCIA	32.61		Total Area:	1.84				
Volume Required for 1.5-inches over Area	5228.80							

0220.00				
Pipe Size (in)	% Voids	Length	Width	Height
	40	115.00	9.00	1.00
6.00	50	115.00	9.00	1.00
923.35				
	Pipe Size (in) 6.00	Pipe Size (in) % Voids 40 6.00 50	Pipe Size (in)         % Voids         Length           40         115.00           6.00         50         115.00	Pipe Size (in)         % Voids         Length         Width           40         115.00         9.00           6.00         50         115.00         9.00

1.84

### CN Computations for WBID Water Quality Calculations

Wade-Trim Project Number :	MIB2003
Wade-Trim Project Name :	BioSwale
Designed by:	MR
Date :	8/31/2018
	Type 2

### Test - PRE-DEVELOPMENT (acres) 1.84

		Hydrologic	SCS Curve #	Area	Weight CN	TSS	Phosphorus	Nitrate
Land Use Type	SCS Soil Type	group	CN	Covered	value	mg/l	mg/l	mg/l
Other Impervious		B/D	0	0.00	0.00	0	0	0
Commercial or Business (85%) imper.		B/D	0	0.00	0.00	0	0	0
Dirt		B/D		0.00	0.00	0	0	0
Wetlands/Water		B/D		0.00	0.00	0	0	0
Woods		B/D		0.00	0.00	0	0	0
Grass/Open Space (Good Cond)		B/D	80	1.84	147.20	55	0.4	0.33
DCIA			0	0	0	0	0	0
Composite CN	80.00	(	Composite Area:	1.84		55	0.4	0.33
% DCIA	0.00		Total Area:	1.84				

### Post Test

		Hydrologic	SCS Curve #	Area	Weight CN	TSS	Phosphorus	Nitrate
Land Use Type	SCS Soil Type	group	CN	Covered	value	mg/l	mg/l	mg/l
Other Impervious		B/D	98	0.37	36.26	21	0.13	0.32
Commercial or Business (85%) imper.		B/D	95	0.00	0.00	0	0	0
Dirt		B/D		0.00	0.00	0	0	0
Wetlands/Water		B/D	98	0.00	0.00	0	0	0
Woods		B/D		0.00	0.00	0	0	0
Grass/Open Space (Good Cond)		B/D	80	0.87	69.60	180	2.22	1.46
DCIA			98	0.6	58.8	86	0.39	0.47
Composite CN	85.37	(	Composite Area:	1.24		117.375	1.203	0.908
% DCIA	32.61		Total Area:	1.84				
Volume Required for 1.5-inches over Area	5228.80							

5220.00				
Pipe Size (in)	% Voids	Length	Width	Height
	40	115.00	9.00	1.50
6.00	50	115.00	9.00	1.00
1130.35				
	Pipe Size (in) 6.00	Pipe Size (in) % Voids 40 6.00 50	Pipe Size (in)         % Voids         Length           40         115.00           6.00         50         115.00	Pipe Size (in)         % Voids         Length         Width           40         115.00         9.00           6.00         50         115.00         9.00

1.84

### CN Computations for WBID Water Quality Calculations

Wade-Trim Project Number :	MIB2003
Wade-Trim Project Name :	BioSwale
Designed by:	MR
Date :	8/31/2018
	Туре 3

#### Test - PRE-DEVELOPMENT (acres) 1.84

		Hydrologic	SCS Curve #	Area	Weight CN	TSS	Phosphorus	Nitrate
Land Use Type	SCS Soil Type	group	CN	Covered	value	mg/l	mg/l	mg/l
Other Impervious		B/D	0	0.00	0.00	0	0	0
Commercial or Business (85%) imper.		B/D	0	0.00	0.00	0	0	0
Dirt		B/D		0.00	0.00	0	0	0
Wetlands/Water		B/D		0.00	0.00	0	0	0
Woods		B/D		0.00	0.00	0	0	0
Grass/Open Space (Good Cond)		B/D	80	1.84	147.20	55	0.4	0.33
DCIA			0	0	0	0	0	0
Composite CN	80.00	(	Composite Area:	1.84		55	0.4	0.33
% DCIA	0.00		Total Area:	1.84				

### Post Test

		Hydrologic	SCS Curve #	Area	Weight CN	TSS	Phosphorus	Nitrate
Land Use Type	SCS Soil Type	group	CN	Covered	value	mg/l	mg/l	mg/l
Other Impervious		B/D	98	0.37	36.26	21	0.13	0.32
Commercial or Business (85%) imper.		B/D	95	0.00	0.00	0	0	0
Dirt		B/D		0.00	0.00	0	0	0
Wetlands/Water		B/D	98	0.00	0.00	0	0	0
Woods		B/D		0.00	0.00	0	0	0
Grass/Open Space (Good Cond)		B/D	80	0.87	69.60	180	2.22	1.46
DCIA			98	0.6	58.8	86	0.39	0.47
Composite CN	85.37	(	Composite Area:	1.24		117.375	1.203	0.908
% DCIA	32.61		Total Area:	1.84				
Volume Required for 1 5-inches over Area	5228 80							

volume required for 1.5-inches over Area	5220.00				
minus area of the Bioswale	Pipe Size (in)	% Voids	Length	Width	Height
Volume in Voids (Bioretention Soil Mix)		40	170.00	16.00	2.00
Volume in Voids (Rock Bed)	6.00	50	170.00	16.00	1.00
Volume Provided (cf)	3523.95				

1.84

## APPENDIX 6.0 RAINFALL DATA AND NUTRIENT REMOVAL CALCULATIONS

### DBHydro Hydrologic Monitoring: Active Rain Site - Station S29Z

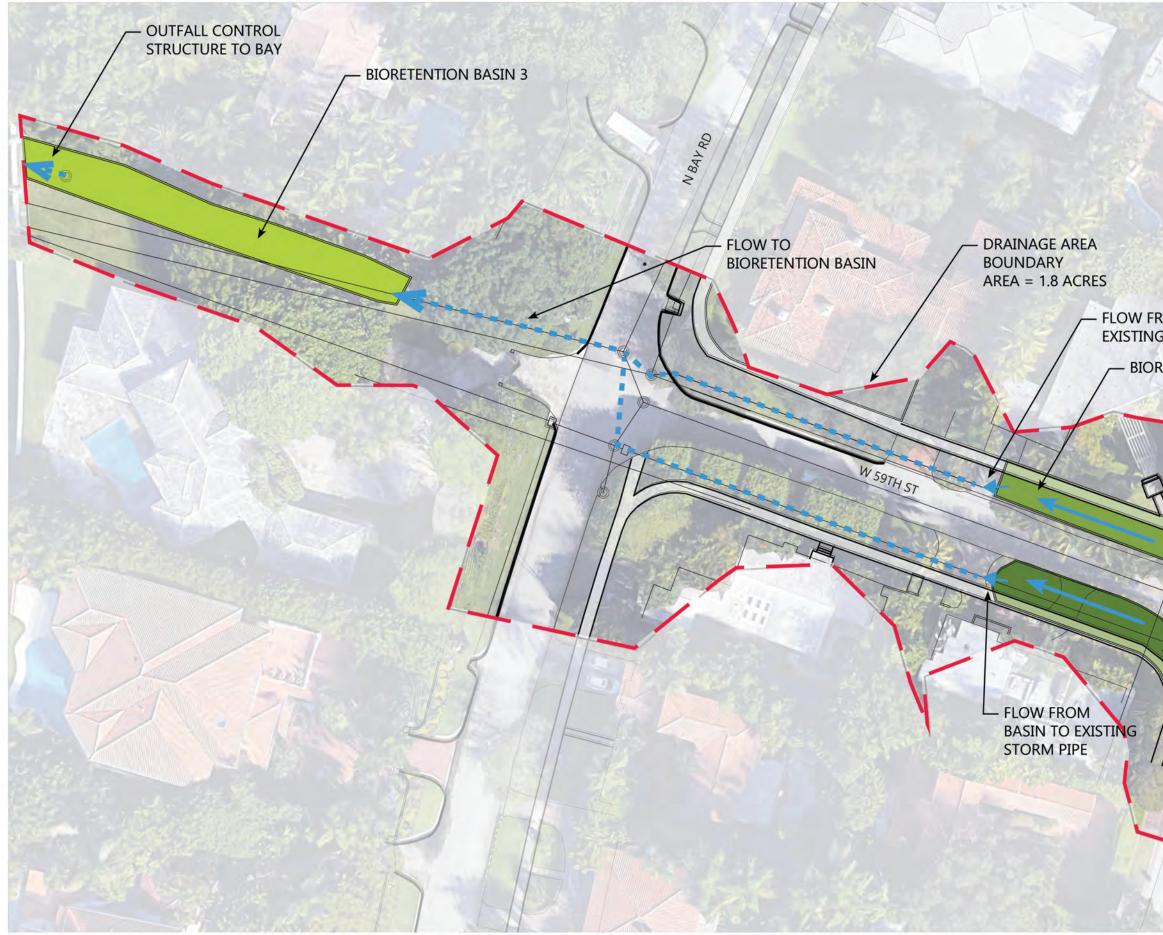
		Event less 1.5		Count of Events
Date	Rainfall	inches	Event under 1.5 inches	
2-Oct-18	0.02	0	0.02	1
1-Oct-18	0.43	0	0.43	1
30-Sep-18	0.11	0	0.11	1
29-Sep-18	0.16	0	0.16	1
28-Sep-18	0.01	0	0.01	1
27-Sep-18	0.01	0	0.01	1
26-Sep-18	0.01	0	0.01	1
25-Sep-18	0.01	0	0.01	1
22-Sep-18	0.21	0	0.21	1
20-Sep-18	0.26	0	0.26	1
17-Sep-18	0.01	0	0.01	1
16-Sep-18	0.01	0	0.01	1
15-Sep-18	2.67	1.17	1.5	0
10-Sep-18	0.11	0	0.11	1
9-Sep-18	0.01	0	0.01	1
8-Sep-18	0.14	0	0.14	1
7-Sep-18	0.05	0	0.05	1
6-Sep-18	0.07	0	0.07	1
5-Sep-18	0.19	0	0.19	1
4-Sep-18	1.69	0.19	1.5	0
3-Sep-18	0.62	0	0.62	1
2-Sep-18	0.42	0	0.42	1
1-Sep-18	0.07	0	0.07	1
31-Aug-18	0.49	0	0.49	1
30-Aug-18	0.95	0	0.95	1
29-Aug-18	0.06	0	0.06	1
28-Aug-18	0.44	0	0.44	1
27-Aug-18	0.05	0	0.05	1
26-Aug-18	0.29	0	0.29	1
24-Aug-18	0.21	0	0.21	1
23-Aug-18	1.51	0.01	1.5	0
22-Aug-18	0.1	0	0.1	1
19-Aug-18	0.24	0	0.24	1
18-Aug-18	0.03	0	0.03	1
17-Aug-18	0.28	0	0.28	1
15-Aug-18	0.06	0	0.06	1
14-Aug-18	1.25	0	1.25	1
13-Aug-18	0.3	0	0.3	1
12-Aug-18	0.89	0	0.89	1
11-Aug-18	1.91	0.41	1.5	0
10-Aug-18	0.69	0	0.69	1
8-Aug-18	0.01	0	0.01	1
7-Aug-18	0.19	0	0.19	1
6-Aug-18	0.22	0	0.22	1
5-Aug-18	0.02	0	0.02	1
4-Aug-18 2-Aug-18	0.22	0	0.22	1 1
2-Aug-18 31-Jul-18	0.01 0.32	0 0	0.01 0.32	1
30-Jul-18	0.32	0	0.32	1
29-Jul-18	0.33	0	0.19	1
28-Jul-18	0.19	0	0.32	1
27-Jul-18	0.02	0	0.02	1
26-Jul-18	0.02	0	0.71	1
25-Jul-18	0.12	0	0.12	1
24-Jul-18	0.12	0	0.58	1
23-Jul-18	0.00	0	0.01	1
22-Jul-18	0.07	0	0.07	1
21-Jul-18	0.07	0	0.11	1
20-Jul-18	0.01	0	0.01	1
19-Jul-18	0.9	0	0.9	1
18-Jul-18	0.08	0	0.08	1
17-Jul-18	0.03	0	0.03	1
		-		

14-Jul-18	0.01	0	0.01	1
13-Jul-18	0.07	0	0.07	1
12-Jul-18	0.58	0	0.58	1
11-Jul-18	2.2	0.7	1.5	0
9-Jul-18	0.01	0	0.01	1
8-Jul-18	0.01	0	0.01	1
4-Jul-18	0.07	0	0.07	1
2-Jul-18	0.66	0	0.66	1
1-Jul-18	0.06	0	0.06	1
30-Jun-18	1.42	0	1.42	1
29-Jun-18	0.25	0	0.25	1
	0.01	0		1
28-Jun-18			0.01	
25-Jun-18	0.3	0	0.3	1
24-Jun-18	0.24	0	0.24	1
16-Jun-18	0.31	0	0.31	1
16-Jun-18	0.31	0	0.31	1
15-Jun-18	0.96	0	0.96	1
14-Jun-18	0.01	0	0.01	1
13-Jun-18	0.04	0	0.04	1
12-Jun-18	0.07	0	0.07	1
11-Jun-18	0.17	0	0.17	1
10-Jun-18	0.36	0	0.36	1
9-Jun-18	0.03	0	0.03	1
				1
8-Jun-18	0.61	0	0.61	
5-Jun-18	0.01	0	0.01	1
2-Jun-18	0.01	0	0.01	1
1-Jun-18	0.02	0	0.02	1
31-May-18	0.6	0	0.6	1
30-May-18	0.28	0	0.28	1
-				
29-May-18	0.01	0	0.01	1
28-May-18	1.17	0	1.17	1
27-May-18	0.95	0	0.95	1
26-May-18	1.25	0	1.25	1
25-May-18	0.14	0	0.14	1
-				
21-May-18	0.61	0	0.61	1
20-May-18	3.07	1.57	1.5	0
19-May-18	0.11	0	0.11	1
18-May-18	0.97	0	0.97	1
17-May-18	0.47	0	0.47	1
16-May-18	1.56	0.06	1.5	0
-				1
15-May-18	0.52	0	0.52	
14-May-18	1.41	0	1.41	1
13-May-18	0.05	0	0.05	1
7-May-18	0.07	0	0.07	1
6-May-18	0.09	0	0.09	1
5-May-18	0.95	0	0.95	1
4-May-18	0.23	0	0.23	1
-				
28-Apr-18	0.47	0	0.47	1
24-Apr-18	0.12	0	0.12	1
23-Apr-18	1.13	0	1.13	1
22-Apr-18	0.29	0	0.29	1
16-Apr-18	0.16	0	0.16	1
12-Apr-18	0.01	0	0.01	1
•				
11-Apr-18	0.53	0	0.53	1
6-Apr-18	0.07	0	0.07	1
27-Mar-18	0.06	0	0.06	1
13-Mar-18	0.31	0	0.31	1
12-Mar-18	0.01	0	0.01	1
11-Mar-18	0.02	0	0.02	1
8-Mar-18	0.09	0	0.09	1
28-Feb-18	0.28	0	0.28	1
27-Feb-18	0.03	0	0.03	1
26-Feb-18	0.01	0	0.01	1
24-Feb-18	0.07	0	0.07	1
23-Feb-18	0.14	0	0.14	1
20-Feb-18	0.06	0	0.06	1
11-Feb-18	0.01	0	0.01	1

9-Feb-18	0.18	0	0.18	1	
4-Feb-18	0.11	0	0.11	1	
3-Feb-18	0.01	0	0.01	1	
30-Jan-18	0.05	0	0.05	1	
28-Jan-18	0.04	0	0.04	1	
16-Jan-18	0.01	0	0.01	1	
13-Jan-18	0.05	0	0.05	1	
12-Jan-18	0.01	0	0.01	1	
11-Jan-18	0.34	0	0.34	1	
10-Jan-18	0.34	0	0.34	1	
9-Jan-18	0.05	0	0.05	1	
4-Jan-18	0.05	0	0.05	1	
3-Jan-18	0.66	0	0.66	1	
10-Dec-17	0.27	0	0.27	1	
5-Dec-17	0.01	0	0.01	1	
30-Nov-17	0.35	0	0.35	1	
29-Nov-17	0.6	0	0.6	1	
28-Nov-17	0.09	0	0.09	1	
24-Nov-17	0.78	0	0.78	1	
22-Nov-17	0.01	0	0.01	1	
21-Nov-17	0.41	0	0.41	1	
17-Nov-17	0.05	0	0.05	1	
16-Nov-17	0.69	0	0.69	1	
14-Nov-17	0.09	0	0.09	1	
13-Nov-17	0.25	0	0.25	1	
12-Nov-17	0.02	0	0.02	1	
11-Nov-17			0.22		
	0.22	0		1	
10-Nov-17	0.01	0	0.01	1	
9-Nov-17	0.1	0	0.1	1	
7-Nov-17	0.05	0	0.05	1	
5-Nov-17	0.04	0	0.04	1	
4-Nov-17	0.08	0	0.08	1	
29-Oct-17	2.05	0.55	1.5	0	
26-Oct-17	0.07	0	0.07	1	
25-Oct-17	1.15	0	1.15	1	
22-Oct-17	0.08	0	0.08	1	
21-Oct-17	0.76	0	0.76	1	
20-Oct-17	0.21	0	0.21	1	
19-Oct-17	0.05	0	0.05	1	
17-Oct-17	0.03	0	0.03	1	
15-Oct-17	0.5	0	0.5	1	
14-Oct-17	0.09	0	0.09	1	
13-Oct-17	0.73	0	0.73	1	
12-Oct-17	0.04	0	0.04	1	
10-Oct-17	0.01	0	0.01	1	
7-Oct-17	0.04	0	0.04	1	
6-Oct-17	2.02	0.52	1.5	0	
5-Oct-17	1.28	0	1.28	1	
4-Oct-17	0.42	0	0.42	1	
3-Oct-17	0.9	0	0.9	1	
2-Oct-17	0.28	0	0.28	1	
	65.42	5.18	60.24	171	
59th Street		1.82	acres		
Rainfall		180	days		
Total Rainfall		65.42	inches		
events less than 1.5"		171	days		
1.5 or less first flush		60.24	inches		
		00.24	literies		
Posidential Posda Nutriant Loading					
Residential Roads Nutrient Loading		0.47			
Nitrogen loading		0.47	mg/l		
Phosphorus loading		0.39	mg/l		
TSS Loading		85.3	mg/l		
				. ,	
Nitrate Loading before Treatment			3.16	kg/year	6.95 lb/year
Phosphorus Loading before Treatment			2.62	kg/year	5.77 lb/year
TSS Loading before Treatment			573.60	kg/year	1261.92 lb/year

Nitrate Bypass BMP	0.25	kg/year	0.55 lb/year
Phosphorus Bypass BMP	0.21	kg/year	0.46 lb/year
TSS Bypass BMP	45.42	kg/year	99.92 lb/year
Nitate Removal Effic	0.70		
Phosphorus Removal Effic	0.90		
TSS Removal Effic	0.80		
Annual Mass Removal			
Nitrate Treat Capture	2.04	kg/year	4.48 lb/year
Phosphorus Treatment Capture	2.17	kg/year	4.78 lb/year
TSS Treatment Capture	422.55	kg/year	929.60 lb/year

## APPENDIX 7.0 PROPOSED SITE PLAN



FLOW FROM BASIN TO EXISTING STORM PIPE

0%

BIORETENTION BASIN 2

# FLOW FROM STREET

ALTONRD

BIORETENTION BASIN 1

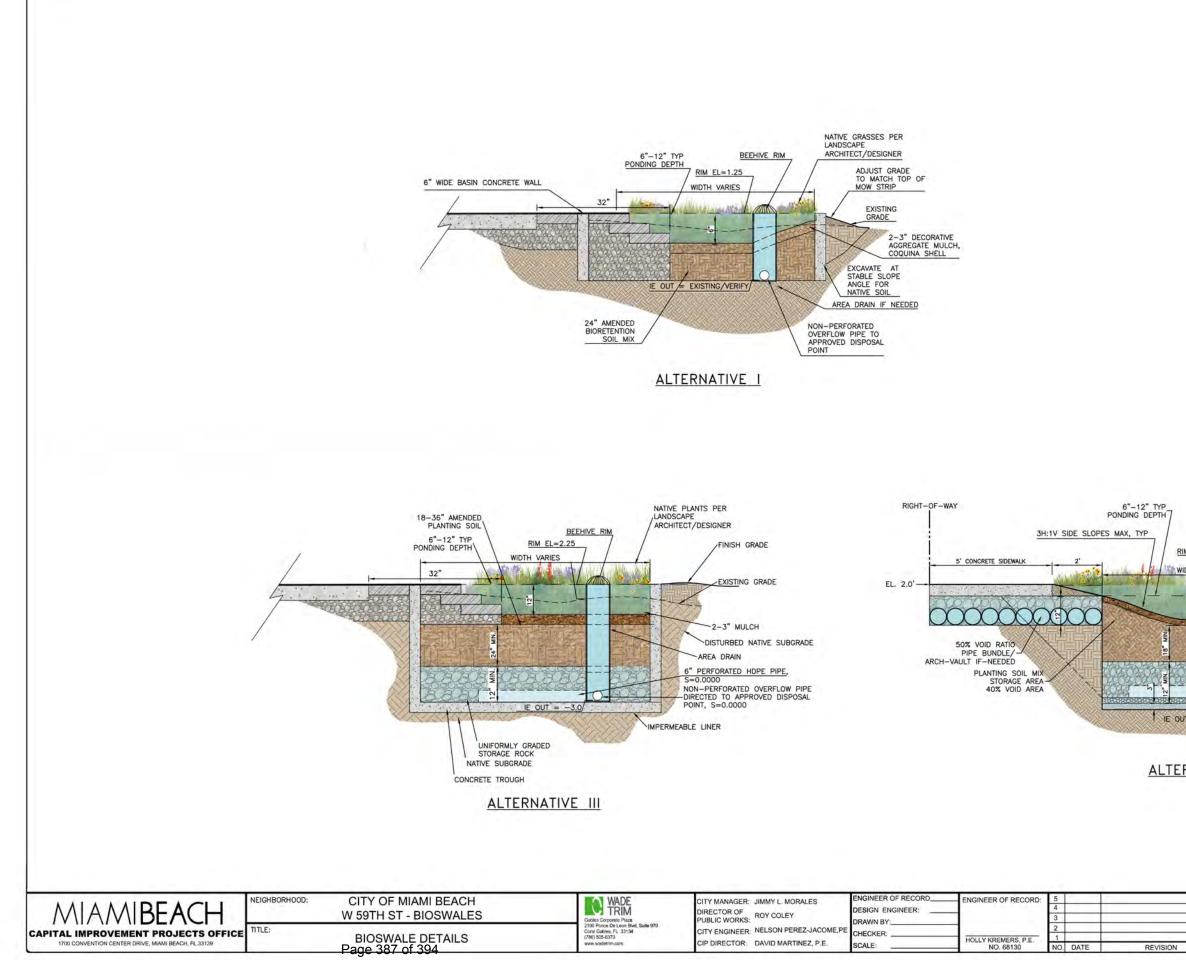
FLOW FROM STREET



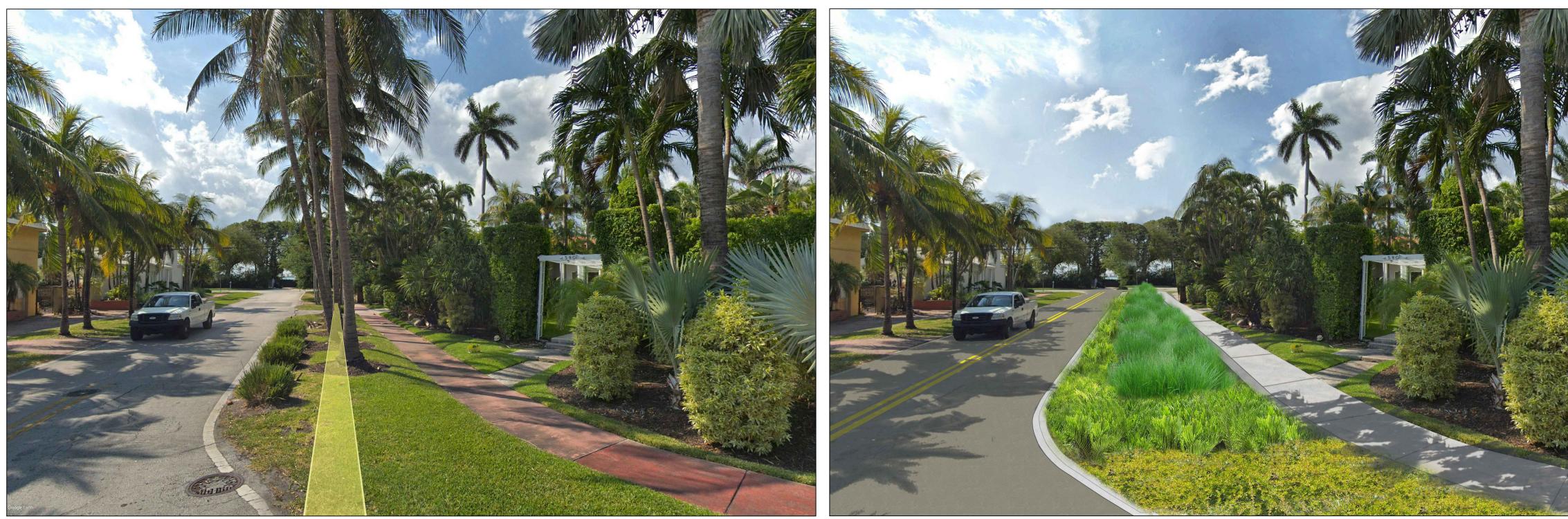
0 20 40

80'

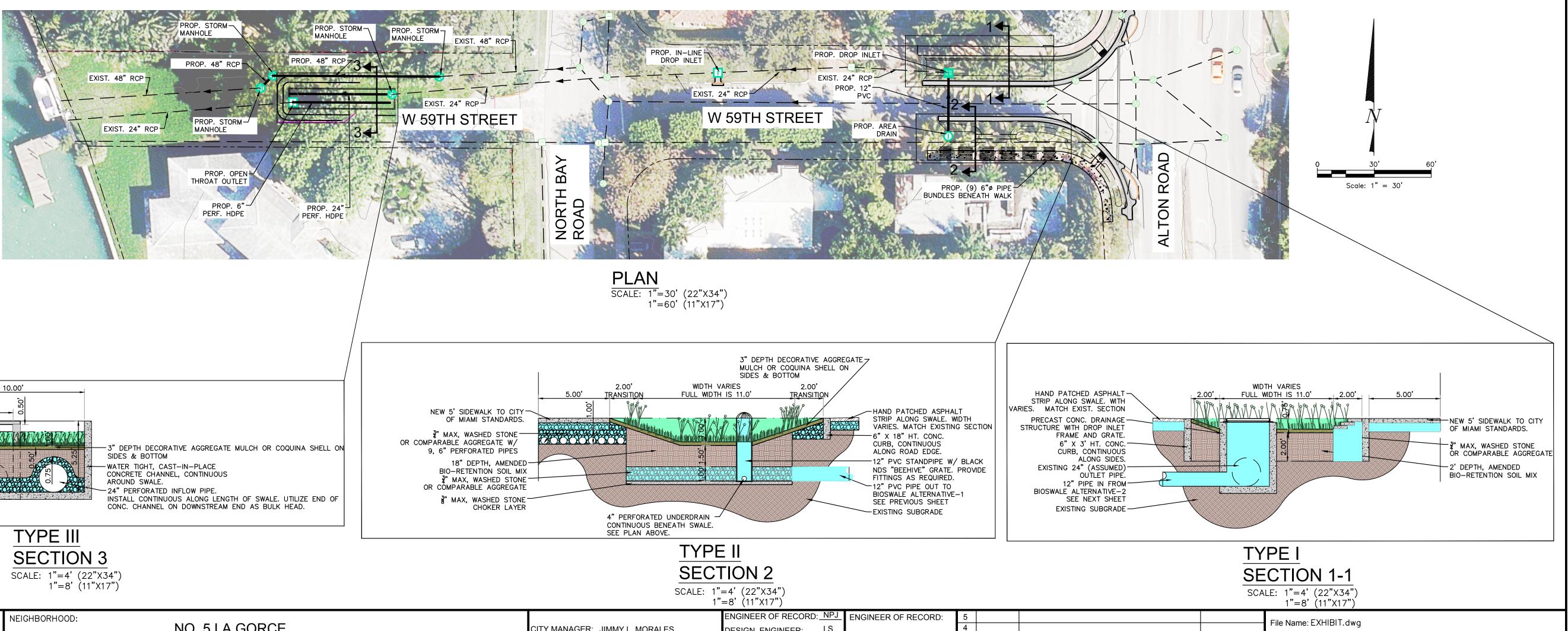
## APPENDIX 8.0 PROPOSED BIOSWALE DETAILS

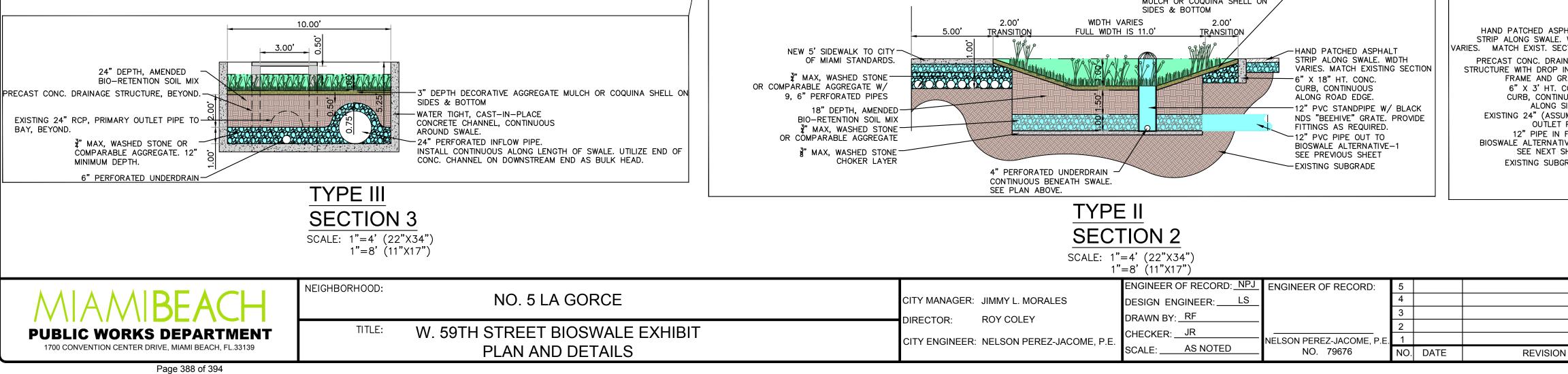


ACHTER/DECIMATIVE PLANTS PER ACHTER/DECIMATIVE PLANTS PER ARCHTEC/DESIGNER BERM AS NEEDED INSTALL LINER ABOVE TEL 1.50 INSTALL LINER



## **EXISTING CONDITIONS** (LOOKING WEST AT W. 59TH ST)





## PROPOSED TYPE I BIOSWALE (LOOKING WEST AT W. 59TH ST)

# BENEFITS

- Very effective in removing nutrients (nitrogen and phosphorus) and other pollutants from stormwater before it enters the bay
- Allows stormwater to infiltrate into the ground and replenishes the fresh water lens beneath Miami Beach
- Captures the first 1.5 inches of runoff from every rain event
- Beautifies the area with attractive plantings
- Uses a mixture of native plantings to minimize maintenance requirements

# LIMITATIONS

- Will not solve flooding in problem areas
- Periodic maintenance is required (replacing the mulch layer) to maintain functionality
- Large rain events (> 1.5 inches) will not be captured and will bypass the bioswales

Survey Reference: Page: <u>N/A</u> Work Order: <u>N/A</u> Field Book: <u>N/A</u> APP'D. BY Date: 04/01/2019 Sheet: 1 of 1 Drawing: EXHIBIT 1

### <u>Item 11.</u> COMMITTEE MEMORANDUM

TO: Sustainability Resiliency Committee Meeting

FROM: Jimmy L. Morales, City Manager

DATE: June 26, 2019

### SUBJECT: UPDATE ON THE PUMP STATION PLUMES ON WEST AVENUE

RESPONSIBLE DEPARTMENT: Public Works LEGISLATIVE TRACKING:

Item C4 U - February 13, 2019 Commission Meeting

BACKGROUND:

Analysis ITEM DEFERRED

ATTACHMENTS: Description

No Attachments Available

### <u>Item 12.</u> COMMITTEE MEMORANDUM

TO: Sustainability Resiliency Committee Meeting

FROM: Jimmy L. Morales, City Manager

DATE: June 26, 2019

### SUBJECT: DISCUSS THE USE OF PESTICIDES, HERBICIDES, AND FERTILIZERS ON BOTH PUBLIC AND PRIVATE PROPERTIES.

### **RESPONSIBLE DEPARTMENT:**

Environment and Sustainability

LEGISLATIVE TRACKING: Item C4 V - March 13, 2019 Commission Meeting

SPONSORED: Commissioner John Aleman

<u>Analysis</u> ITEM DEFERRED

ATTACHMENTS: Description

No Attachments Available

### <u>Item 13.</u> COMMITTEE MEMORANDUM

TO: Sustainability Resiliency Committee Meeting

FROM: Jimmy L. Morales, City Manager

DATE: June 26, 2019

SUBJECT: DISCUSSION REGARDING HOW GREEN INFRASTRUCTURE INCLUDING LIVING OR HYBRID SHORELINES CAN COMPLEMENT GREY INFRASTRUCTURE IN OUR CLIMATE ADAPTATION ON-GOING WORK

### **RESPONSIBLE DEPARTMENT:**

Environment and Sustainability

LEGISLATIVE TRACKING: Item C4N - April 13, 2016 Commission Meeting

SPONSORED: Commissioner Micky Steinberg

<u>Analysis</u> ITEM DEFERRED.

### ATTACHMENTS:

Description

No Attachments Available

### <u>Item 14.</u> COMMITTEE MEMORANDUM

TO: Sustainability Resiliency Committee Meeting

FROM: Jimmy L. Morales, City Manager

DATE: June 26, 2019

SUBJECT: DISCUSSION REFERRING A TASK TO THE CITY MANAGER'S READY TEAM IN ORDER TO BOTH OPTIMIZE PUBLIC ENGAGEMENT AND FACILITATE TIMELY COMPLETION OF PROJECTS

### **RESPONSIBLE DEPARTMENT:**

CIP I Marketing & Communications

LEGISLATIVE TRACKING: Item C4V - July 25, 2017 Commission Meeting

**SPONSORED:** Commissioner John Elizabeth Aleman

Analysis ITEM DEFERRED

ATTACHMENTS: Description

No Attachments Available

### <u>Item 15.</u> COMMITTEE MEMORANDUM

TO: Sustainability Resiliency Committee Meeting

FROM: Jimmy L. Morales, City Manager

DATE: June 26, 2019

SUBJECT: DISCUSSION REGARDING EXPLORING THE CITY OF MIAMI BEACH JOINING THE AMERICAN FLOOD COALITION

### **RESPONSIBLE DEPARTMENT:**

City Manager's Office | Environment & Sustainability

### LEGISLATIVE TRACKING: Item C4W - December 12, 2018 Commission Meeting

<u>SPONSORED:</u> Commissioner Mark Samuelian I Co-Sponsor Commissioner Joy Malakoff

### <u>Analysis</u> ITEM DEFERRED.

### ATTACHMENTS:

Description

No Attachments Available

### <u>Item 16.</u> COMMITTEE MEMORANDUM

TO: Sustainability Resiliency Committee Meeting

FROM: Jimmy L. Morales, City Manager

DATE: June 26, 2019

SUBJECT: DISCUSSION ON REPURPOSING OUR GOLF COURSES FOR THE FUTURE

### **RESPONSIBLE DEPARTMENT:**

Parks and Recreation | Public Works | Environment and Sustainability

LEGISLATIVE TRACKING: Item C4 AB - May 16, 2018 Commission Meeting

SPONSORED: Commissioner Ricky Arriola

<u>Analysis</u> ITEM DEFERRED.

ATTACHMENTS: Description

No Attachments Available