Contents

Executive Summary .............................................................................................................................. ES-1
1. Introduction ..................................................................................................................................... 1-1
  1.1 Miami Beach Setting ........................................................................................................ 1-1
  1.2 Opportunities and Benefits of BGSI in Miami Beach ....................................................... 1-2
  1.3 Public Engagement in Concept Plan Development ......................................................... 1-3
  1.4 Implementation Strategies and Partnerships for Blue-Green Stormwater Infrastructure in Miami Beach ................................................................. 1-3
  1.5 Intended Audience and BGSI Concept Plan Organization .............................................. 1-4
2. Blue-Green Stormwater Infrastructure ..................................................................................... 2-1
  2.1 Advantages and Limitations of BGSI ............................................................................... 2-1
  2.2 Qualitative Evaluation of BGSI Practice Applicability for Miami Beach ........................... 2-2
  2.3 Potential BGSI Locations ................................................................................................. 2-3
  2.4 BGSI Strategies ............................................................................................................... 2-5
  2.5 BGSI and Water Quality ................................................................................................... 2-5
  2.6 Size and Cost Considerations .......................................................................................... 2-6
  2.7 BGSI Performance Amid Rising Sea Levels and Shallow Groundwater ............................. 2-7
  2.8 BGSI and Mosquitoes ...................................................................................................... 2-7
  2.9 Maintenance Requirements and Responsibilities ............................................................ 2-8
  2.10 BGSI Fact Sheets ............................................................................................................ 2-8
  2.11 Additional BGSI Resources ........................................................................................... 2-10
3. Recommendations ...................................................................................................................... 3-1
4. References ................................................................................................................................... 4-1

Appendices

Appendix A BGSI FAQs
Appendix B Public Outreach Summary Report
Appendix C BGSI Practices and Strategies Fact Sheets
Appendix D BGSI Plant Matrices/Plant Palette Boards
Appendix E BGSI Pilot Project Concepts/Renderings
Appendix F Potential Project Location Maps

Tables
Table 2-1. BGSI Practice Applicability by Land Use ............................................................................. 2-4
Table 2-2. Pollutant Load Reductions Using BGSI ............................................................................... 2-5
Table 2-3. General BGSI Applicability and Feasibility in Miami Beach .............................................. 2-8

Figures
Figure 2-1. Primary Land Uses and Impervious Cover in Miami Beach ............................................ 2-3
Figure 2-2. Cumulative Rainfall Capture Curve (2000 to 2019) .......................................................... 2-6
Figure 2-3. Miami Beach Soil Storage Capacity ..................................................................................... 2-7
# Acronyms and Abbreviations

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>BGSI</td>
<td>Blue-Green Stormwater Infrastructure</td>
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<tr>
<td>CIP</td>
<td>capital improvement plan</td>
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<tr>
<td>DCP</td>
<td>design criteria package</td>
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<td>EPA</td>
<td>U.S. Environmental Protection Agency</td>
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<td>FAQs</td>
<td>frequently asked questions</td>
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<td>ft</td>
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<td>ft²</td>
<td>square foot (feet)</td>
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<td>ULI</td>
<td>Urban Land Institute</td>
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Executive Summary

Southeast Florida is often referred to as “ground zero” for climate change and sea level rise. In particular, the City of Miami Beach (hereafter, “the City”) has shown leadership in adapting to this change, investing in aging infrastructure and committing to use the best available information to continuously improve its approach. The City recently retained the services of the Urban Land Institute (ULI) to review its stormwater management and climate adaptation program. The ULI panel applauded the City’s commitment and encouraged several other approaches including a broader range of strategies such as blue and green infrastructure, not only pumps and pipes, in the City’s stormwater program.

The City already has a rich history in environmental stewardship through the City Commission and the Department of Environment & Sustainability. Examples include banning polystyrene, to the #PlasticFreeMB program, tree and landscape ordinances, a dune management system, progressive green building ordinances and encouraging blue and green roofs. The blue and green stormwater infrastructure (BGSI) strategies and concepts in this Plan are geared toward creating a more robust and well-rounded Miami Beach stormwater program that:

- Reduces flooding from the smaller, more frequent storms (BGSI on its own cannot eliminate flooding);
- Manages non-point source pollution to protect receiving waters from water quality impacts from stormwater runoff;
- Increases the infiltration of rainwater to sustain and replenish the freshwater lens under the City (thereby protecting soils and flora from being degraded by saltwater intrusion);
- Leverages innovative urban design to integrate BGSI practices into the landscape in highly aesthetic ways aligned with the culture and lifestyle of the City; and
- Provides social, environmental, and economic co-benefits that increase the value and contribution of BGSI.

On May 6, 2019, Jacobs was tasked with developing a Blue-Green Stormwater Infrastructure Concept Plan for the City of Miami Beach. In response, Jacobs assembled a multi-disciplinary team of experts including engineers, landscape architects, urban planners, and resiliency specialists to produce this Plan. The Plan included an evaluation of BGSI strategies, concepts, and locations that might be applicable in Miami Beach given its constraints as a densely built-out, low-lying coastal community and the constraints of the environmental regulatory process. The Plan recommends:

- Steps to formally incorporate BGSI policy into master planning, design standards, capital improvement plan (CIP) projects, codes, etc.
- Long-term funding considerations for successful implementation and maintenance
- Implementation of a range of demonstration projects
- Establishing innovation priorities possibilities
- BGSI partnerships among government, business, academia, and/or non-profits
- Advancing the science and modeling to better understand the interactions between flooding, precipitation, groundwater, and water quality as reported in the ULI findings
- The need for continued community engagement

The Plan also includes 15 BGSI practices and strategies fact sheets and 9 BSGI pilot project concept renderings, as well as potential project location maps and an inventory of FAQs from the public process.

Jacobs recommends that the City Commission accept this document and determine the extent by which to amend and incorporate BGSI into the City’s stormwater master plan, Public Works Manual, CIP standard operating procedures, language in future design packages, and guidance documents for staff project managers and consultants to ensure consideration and implementation.
1. Introduction

The coastal location of the City of Miami Beach (hereafter, the “City”) is what makes it such a desirable place in which to live, work and play. Its coastal location and relatively low elevation also make it susceptible to frequent, intense storm events, rising sea levels, and extreme tidal events (“sunny day” flooding). Additionally, as with all highly urbanized areas, non-point source pollution reduction is both an environmental management priority and critical to maintaining safe and aesthetically pleasing water-oriented lifestyles and tourism.

In 2018, the Urban Land Institute (ULI) issued its Stormwater Management and Climate Adaptation Review report for Miami Beach. ULI praised the City for its proactive efforts and provided a series of recommendations, including further exploration and integration of blue and green stormwater infrastructure (BGSI) into the City’s strategies and projects. The City is acting upon this recommendation with the development of this Concept Plan and the incorporation of BGSI solutions into several City projects currently under design or construction. These solutions harness natural processes using soils, vegetation, and the landscape as infrastructure. When thoughtfully designed, BGSI has been employed throughout the world to improve water and air quality, reduce flooding impacts, mitigate ecosystem fragmentation, reduce elevated surface temperatures, and provide many other community benefits. This document provides a compendium of BGSI practices and strategies that support the following objectives:

- Reduce flooding from the smaller, more frequent storms (BGSI on its own cannot eliminate flooding)
- Better management of non-point source pollution to protect receiving waters (surface and groundwater) from water quality impacts from stormwater runoff
- Increasing the infiltration of rainwater to sustain and replenish the freshwater lens under the City (thereby helping to protect soils and flora from being degraded by saltwater intrusion)
- Leveraging innovative urban design to integrate BGSI practices into the landscape in highly aesthetic ways aligned with the culture and lifestyle of the City
- Providing social, environmental and economic co-benefits that increase the value and contribution of BGSI

The BGSI practices and strategies in this document were developed with the intent of supporting and incentivizing a broad range of stakeholders to implement BGSI such that sufficient implementation scale can be achieved and so that the collective results have meaningful impact.

1.1 Miami Beach Setting

Miami Beach lies on a barrier island running along the southeastern coast of Florida with the Biscayne Bay on its western shore, across from the City of Miami. The island of Miami Beach was once covered with mangrove and wetland plant communities that provided a natural defense for Florida’s mainland against storm surge and the increased wave energy from tropical storm events. This natural protection of the Florida mainland coast allowed the Biscayne Bay ecosystem to flourish. In addition to surge and wave mitigation, the mangrove and wetland plant communities that once flourished on Miami Beach acted like a sponge in filtering and absorbing water, while providing habitat for many permanent and migratory...
species. This attractive South Florida landscape and climate has resulted in dense housing and commercial development over time with surface elevations in the City that range from near 0 to an average of 4.5 feet (ft) above sea level.

The City sits on a bed of porous limestone and groundwater elevations closely follow sea and tide levels. With sea and groundwater levels expected to rise, coupled with more frequent and intense storm events, the City has raised some of the most flood-prone roads and implemented new policies to help protect private development.

1.2 Opportunities and Benefits of BGSI in Miami Beach

In response to such dramatic climatic changes, there is the opportunity to change the way coastal cities like Miami Beach have historically incorporated centralized, grey infrastructure systems, such as pipes, pumps, and canals to address stormwater runoff by implementing an infrastructure system that integrates natural processes within the built environment. BGSI strives for more onsite stormwater management approaches that harness the power of nature to help manage stormwater at its source, instead of at or near the ends of pipes before stormwater discharges to receiving waters like Biscayne Bay. Using Florida-friendly vegetation as infrastructure increases the urban forest canopy, with companion ground-level plants that are urban-tolerant and that mimic the natural stormwater management processes employed by South Florida ecosystems that existed prior to land development. Water quality and regional ecosystem health can be improved using a network of thoughtfully sited Florida-friendly vegetated and soil-based systems that intercept, absorb, and filter pollutants in stormwater before it reaches local waterways, Biscayne Bay, and the ocean.

These systems also provide increased infiltration into the City’s subsurface limestone voids, mimicking the natural water cycle and recharging the City’s freshwater lens. This naturally occurring freshwater supply sits below the soil surface and has a critical role in supporting the health and diversity of Florida-friendly plant communities. A lack of a freshwater recharge, paired with rising sea levels, could result in saltwater intrusion within the root zones of vegetation, including the City’s beautiful trees, causing wilted growth and eventual death. Without shade and the natural cooling process of evapotranspiration from vegetation, surface temperatures will likely rise, further exacerbating the urban heat island effect.

The widespread implementation of BGSI across the City would create the opportunity to integrate innovative urban design concepts with improved stormwater management, in the process yielding multiple community and environmental benefits. Water has historically been central to public space design not
only as decorative elements but also in its capacity to provide opportunities for relaxation and respite. The incorporation of BGSI and other water features within urban spaces early in the planning process can offer many co-benefits that optimize livability and resilience in Miami Beach. Reclaiming the historically positive role water has had in Miami Beach can provide a living stage for interpretive South Florida education, while allowing alternative forms of transport, such as walking and biking to diversify Miami Beach’s transportation network while reducing carbon emissions that contribute to climate change. Innovative urban design considers the critical point of view that can only be provided by users of Miami Beach public space: the community, whose experiences and preferences are critical in shaping public space planning and design. BGSI should serve as a symbol of innovation through the creation of functional and memorable public spaces, not only for the people of Miami Beach, but also for the millions of annual visitors.

1.3 Public Engagement in Concept Plan Development

For this BGSI approach to be successful, it is critical that solutions fit the context of not only South Florida and Miami Beach, but also the context of existing site uses. Current site usage and programming can only be understood by engaging with the public early and often through various communication forums, such as public meetings, online surveys, social media, and other ways of gathering input across various demographics and neighborhoods. Although this Concept Plan was developed over a relatively short period of time, effective public outreach was conducted and valuable input was received through presentations at two City of Miami Beach Sustainability and Resiliency Committee meetings, a well-advertised and well-attended public meeting dedicated to BGSI, and the Miami Beach Rising Above website (www.mbrisingabove.com). The input and feedback received from these stakeholders guided the selection of BGSI practices and strategies in this Concept Plan and the urban design features to be included. A frequently asked questions (FAQs) document was also prepared to address common concerns related to BGSI implementation and is included in Appendix A. A detailed summary of public outreach activities is included in Appendix B.

1.4 Implementation Strategies and Partnerships for Blue-Green Stormwater Infrastructure in Miami Beach

The success of BGSI implementation also rests with increased partnerships that engage government, private business, residents, local community groups, and non-governmental organizations. Truly integrated solutions require input and expertise across a wide set of partners not only within neighborhoods and across the community, but also among the various City departments and other agencies. Communication and alignment on a strategy across City departments will result in better informed decisions and more holistic solutions through integrated BGSI planning. This alignment will be reinforced through neighborhood-level public outreach as specific local projects are planned, designed, constructed, and maintained.

In addition to site context, public engagement, partnerships, and aligned strategies, the science of BGSI in the Miami Beach context must be further advanced. Performance and other data must be collected, analyzed, and evaluated for solutions to be intelligently designed and to perform effectively.
1.5 **Intended Audience and BGSI Concept Plan Organization**

This document was developed for a wide range of stakeholders and is intended to inform master planning, capital improvement plan development, design criteria packages (DCPs), and policies on new development, building codes, and zoning. Given this wide audience, the document includes the following sections that can be used individually or collectively for different users and purposes:

- **Section 2, Blue-Green Stormwater Infrastructure**: includes general information about BGSI, the BGSI evaluation process, and the most and least applicable practices for the City.

- **Section 3, Recommendations**: focuses on critical next steps that should be taken to launch BGSI in the City and to support achieving sustainable implementation at-scale.

- **Section 4, References**: provides a partial list of resources used in the preparation of this Concept Plan.

Several appendices are also provided that include FAQs, 1-page fact sheets that focus on specific BGSI practices, multi-page fact sheets that cover BGSI strategies that entail multiple practices in various settings, renderings that illustrate potential application of BGSI in different contexts, and potential project location maps:

- Appendix A BGSI FAQs
- Appendix B Public Outreach Summary Report
- Appendix C BGSI Practices and Strategies Fact Sheets
- Appendix D BGSI Plant Matrices/Plant Palette Boards
- Appendix E BGSI Pilot Project Concepts/Renderings
- Appendix F Potential Project Location Maps
2. Blue-Green Stormwater Infrastructure

Green stormwater infrastructure typically uses vegetation and/or soils to treat and reduce stormwater flows. Examples are bioretention and permeable pavement.

Blue stormwater infrastructure temporarily stores and treats stormwater without significant reliance on vegetation. Examples are wet ponds and detention basins.

BGSI uses elements from both green and blue stormwater infrastructure. Implemented BGSI can vary greatly in appearance, from high-profile features to those that blend in seamlessly with the surroundings. BGSI is typically designed and sized to capture the more frequent storm events.

The focus of BGSI is stormwater runoff treatment and capture, which makes it different from coastal strategies (for example, living shorelines, dunes, mangrove plantings, and oyster or artificial reefs) that target stressors, such as wave energy, sea level rise, and storm surges.

2.1 Advantages and Limitations of BGSI

BGSI provides several stormwater benefits, as well as co-benefits, that improve regulatory compliance and positively impact the community:

- Water quality: BGSI can reduce many of the pollutants that threaten Biscayne Bay such as heavy metals, nutrients, sediment, and pathogens.

- Groundwater recharge: BGSI recharges the freshwater lens under the island. This can help keep salt water at bay and protect the health of trees.

- Detention/flood mitigation benefits: BGSI helps mitigate flooding from smaller, more frequent storms. Note: BGSI alone will NOT significantly reduce: “sunny day” flooding or flooding from major rainfall events or storm surge.

- Community benefits can include: urban heat island mitigation, air quality improvement, climate resiliency, enhanced aesthetics, and increased ecosystem health and biodiversity.

While the benefits of BGSI are significant, there are also limitations as described in more detail later in this section, including:

- The difficulties of the environmental permitting process.

- The physical space limitations for BGSI given the density of development in much of the City.

- Widespread BGSI requires changes to City policies, codes, and/or standard operating procedures (refer to Section 3).
• BGSI requires a commitment to and funding for maintenance.

2.2 Qualitative Evaluation of BGSI Practice Applicability for Miami Beach

BGSI practice types were qualitatively evaluated based on city/regional/national experience, stormwater performance, ease of implementation/maintenance, community/environmental benefits, cost efficiency, and climate change resilience. Practices that were determined to perform well across these areas and have practical applications in Miami Beach are as follows:

• Bioretention/Bioswales/Rain Gardens
• Blue & Green Roofs
• Constructed Wetlands/Floating Wetland Islands
• Detention Basins/Surface Storage
• Enhanced Tree Pits/Trenches
• Injection Wells (Pumped)
• Permeable Pavement
• Rainwater Harvesting
• Stormwater Planters
• Subsurface Infiltration/Storage
• Tree Canopy
• Wet Ponds

When and where to use each recommended BGSI practice depends on a variety of site-specific factors, such as land use, location, topography, groundwater elevation, soil conditions, and existing infrastructure.

The following BGSI practices are less applicable to Miami Beach because of their reduced water quality benefits, higher costs, lack of scalability, lower effectiveness when dealing with sea level rise and high tides, proprietary designs, limited applicability, or low storage capacities:

• Aboveground Detention Tanks
• Canal Enhancements
• Canopy Trees
• Drainage/Gravity Wells
• Exfiltration Trenches
• High-Flow Media Filters
• Living/Green Walls
• Subsurface Flow Wetlands

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1 Florida-friendly plants are strongly encouraged for vegetated BGSI practices as they are the climate-adapted, excel at ecosystem service, and enhance sense of place. Species such as duck potato, Fakahatchee grass, and red maple from the Florida wetland plant community are recommended, as are South Florida slash pine and saw palmetto from the South Florida pine flatwood plant community.

2 Ibid.

3 Although not typically thought of as BGSI, injection wells are included here as they reduce the volume of stormwater discharged, and with proper pretreatment/filtration can provide some water quality benefits.

4 Florida-friendly plants are strongly encouraged for vegetated BGSI practices as they are the climate-adapted, excel at ecosystem service, and enhance sense of place. Species such as duck potato, Fakahatchee grass, and red maple from the Florida wetland plant community are recommended, as are South Florida slash pine and saw palmetto from the South Florida pine flatwood plant community.

5 Although a BGSI practice fact sheet has not been developed for them, trees are a key component of BGSI, and the City is developing an Urban Forest Master Plan to provide a strategic framework to guide the City in managing, maintaining, planting, and preserving its urban forest. See www.mbrisingabove.com/climate-mitigation/urban-canopy-2/urban-forestry-master-plan/. 
Although not as readily applicable to Miami Beach, the above BGSI practices might still prove beneficial in certain settings. As discussed previously, such coastal practices as living shorelines, dunes, mangrove plantings, and oyster or artificial reefs are not the focus of this Plan on blue-green stormwater infrastructure. Appendix C provides detailed fact sheets on BGSI practices.

2.3 Potential BGSI Locations

BGSI can be used on and along roads, in parks and other open spaces, at schools and other public facilities, on rooftops, and on residential and commercial properties. Approximately 40 percent of Miami Beach is covered by impervious surfaces (buildings and pavements) that prevent water from soaking into the ground (see Figure 2-1). BGSI should be employed to treat runoff from these impervious surfaces and help preserve, enhance, and increase the City’s remaining pervious or “green” areas.

Figure 2-1. Primary Land Uses and Impervious Cover in Miami Beach

BGSI Practices and Strategies were developed with Miami Beach’s primary land uses and impervious cover distribution in mind

When choosing where to place BGSI practices, the following factors should be considered:

- BGSI is often most cost-effective when integrated with ongoing or planned City projects, such as those on the City’s Capital Improvement Plan, General Obligation Bond list, Transportation Master Plan, and Blueways Master Plan.
- Shallow, increasing, and/or seasonal groundwater elevations across the City limit the soil storage capacity and infiltration required for some BGSI practices to function. However, such limitations might potentially be overcome with underdrains, fill, and/or pumping. In addition, existing soil or groundwater contamination may impact BGSI design and construction.
- Depending on the BGSI practice type, offsets from utilities, buildings, and other structures may be required to protect those features from water damage.
- Factors such as budget, permitting, site conditions, neighborhood preferences, and ownership will influence the location and types of BGSI.

Table 2-1 lists the applicability of BGSI practices based on land use.
## Table 2-1. BGSI Practice Applicability by Land Use

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Bioretention/ Bioswales/Rain Gardens</th>
<th>Blue &amp; Green Roofs</th>
<th>Constructed Wetlands/ Floating Islands</th>
<th>Detention Basins/ Surface Storage</th>
<th>Enhanced Tree Pits/ Trenches</th>
<th>Injection Wells (Pumped)</th>
<th>Permeable Pavement</th>
<th>Rainwater Harvesting</th>
<th>Stormwater Planters</th>
<th>Subsurface Infiltration/ Storage</th>
<th>Wet Ponds</th>
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<td><strong>Commercial</strong></td>
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<td>Commercial Sites (Office, Retail, Restaurant, Hotel, High-Rise Residential, etc.)</td>
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<tr>
<td>Boulevards</td>
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<td>● ○ ○ ● ○ ○ ● ○ ○ ● ○ ○ ●</td>
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<tr>
<td>Main Streets</td>
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<tr>
<td>Neighborhood Streets (suburban)</td>
<td></td>
<td>● ○ ○ ● ○ ○ ● ○ ○ ● ○ ○ ●</td>
<td></td>
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<tr>
<td>Neighborhood Streets (urban)</td>
<td></td>
<td>○ ○ ● ○ ○ ● ○ ○ ● ○ ○ ●</td>
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<tr>
<td>Non-Motorized Streets</td>
<td></td>
<td>● ○ ○ ● ○ ○ ● ○ ○ ● ○ ○ ●</td>
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</tr>
</tbody>
</table>

= yes  ○ = no  ○ = limited
2.4 BGSI Strategies

The following BGSI strategies and their respective sub-strategies represent excellent opportunities throughout Miami Beach to implement numerous BGSI practices. These strategies address all the primary land uses in Miami Beach.

- **Commercial and Public Facilities**
  - Schools
  - Parking garages
  - Other facilities with building coverage greater than 90 percent of the site
  - Other facilities with building coverage less than 90 percent of the site

- **Parks and Open Spaces**
  - Golf courses
  - Open spaces
  - Parks
  - Pocket parks and plazas

- **Right-of-Way – Streets and Alleys**
  - Commercial streets
  - Residential streets
  - Street ends (where a street dead ends at a waterbody)
  - Non-motorized streets
  - Alleys

- **Single-family Residential**

2.5 BGSI and Water Quality

Protecting water quality for Miami Beach’s beaches and waterways is a priority as they provide habitat, a great quality of life, and opportunities for tourism. Stormwater runoff from urban areas can transport pollutants—including bacteria/pathogens, nutrients (such as nitrogen and phosphorus), sediment, and heavy metals—to waterways and beaches. BGSI can reduce many of these pollutants. By retaining rainfall, BGSI reduces stormwater discharges. Lower discharge volumes translate into reduced pollutant loads (see Table 2-2). BGSI also treats stormwater that is not retained (EPA, 2019). It should also be noted that BGSI can only improve the quality of the water that it receives (that is, the runoff from the drainage area that it serves) and has the capacity to treat. Therefore, extensive BGSI coverage would typically be required to have significant overall pollutant load reductions. As with all infrastructure, BGSI must be designed, constructed, and maintained to function properly over the long term.

Table 2-2. Pollutant Load Reductions Using BGSI

<table>
<thead>
<tr>
<th>BGSI Practice</th>
<th>Nitrogen</th>
<th>Phosphorus</th>
<th>Suspended Solids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioretention/Bioswales/Rain Gardens</td>
<td>70–80%</td>
<td>75–85%</td>
<td>80–90%</td>
</tr>
<tr>
<td>Blue &amp; Green Roofs</td>
<td>55%</td>
<td>55%</td>
<td>80–90%</td>
</tr>
<tr>
<td>Constructed Wetlands</td>
<td>20%</td>
<td>45%</td>
<td>60%</td>
</tr>
<tr>
<td>Detention Basins/Surface Storage</td>
<td>20%</td>
<td>20%</td>
<td>60%</td>
</tr>
<tr>
<td>Enhanced Tree Pits/Trenches</td>
<td>85%</td>
<td>85%</td>
<td>95%</td>
</tr>
<tr>
<td>Injection Wells</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permeable Pavement</td>
<td>80%</td>
<td>80%</td>
<td>85%</td>
</tr>
<tr>
<td>Rainwater Harvesting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stormwater Planters</td>
<td>70–80%</td>
<td>75–85%</td>
<td>80–90%</td>
</tr>
<tr>
<td>Subsurface Infiltration/Storage</td>
<td>85%</td>
<td>85%</td>
<td>95%</td>
</tr>
<tr>
<td>Wet Ponds</td>
<td>20%</td>
<td>45%</td>
<td>60%</td>
</tr>
</tbody>
</table>

Adapted from Tables B-5 and C-1 from Schueler and Lane (2015)
2.6 Size and Cost Considerations

An analysis of daily rainfall data for Miami Beach from 2000 to 2019 indicates that slightly more than 90 percent of the total rainfall comes on days with 2 inches or less of rainfall (see Figure 2-2). BGSI is generally sized to manage runoff from these events, which also contribute much of the pollution caused by stormwater. Although representing less than 10 percent of the total rainfall from 2000 to 2019, days with more than 2 inches of rainfall occur on average five to six times per year and often lead to flooding. In addition, the frequency of these larger events is predicted to increase with climate change (CH2M HILL, 2015). Because a 2-inch rainfall event is only approximately 25 percent of the much larger storms typically used to size flood control systems, such as pipes and pumps, BGSI is not considered a replacement for traditional “grey” infrastructure, but it can complement it. BGSI systems are generally sized to manage the runoff for areas that are 10 to 20 times larger than their footprint. For example, a bioretention system that is 1,000 square feet (ft²) can capture runoff from an area that is 10,000 to 20,000 ft².

The size and complexity of the design and construction influence the cost of BGSI. Examples of the factors impacting cost are project size, type(s) of BGSI, space constraints, the amount of pipe needed, presence of utilities, soil conditions, depth to water table, proximity to roadways/need for traffic control, and current site conditions.

Figure 2-2. Cumulative Rainfall Capture Curve (2000 to 2019)

Just over 90% of the total rainfall comes on days with 2 inches or less of rainfall.
2.7 BGSI Performance Amid Rising Sea Levels and Shallow Groundwater

Shallow and increasing groundwater elevations in portions of the City limit the soil storage capacity (see Figure 2-3) and infiltration required for some BGSI practices to function effectively. However, such limitations might potentially be overcome with underdrains, fill, and/or pumping. Other practices, such as wet ponds and constructed wetlands, can continue to function with shallow groundwater although their storage capacity may be reduced as groundwater levels increase. Blue and green roofs, rainwater harvesting, and floating wetland islands would typically not be impacted by rising groundwater.

Table 2-3 summarizes BGSI applicability and feasibility in Miami Beach based on current elevations and development patterns. Note that the applicability and feasibility of infiltration-based BGSI practices can typically be increased if the area where the BGSI practices are located is raised (that is, if additional separation to groundwater is created).

2.8 BGSI and Mosquitoes

Mosquitoes require standing water to be present for more than 7 days to grow. When properly designed, constructed, and maintained, BGSI will not promote mosquito breeding.

BGSI not intended to retain water is usually designed to fully drain within 3 days after a rainfall event. These BGSI practices require periodic inspections to ensure they are draining down adequately.

BGSI intended to retain water for greater than 7 days must include preventive methods to discourage mosquito growth. These methods can include:

- Screening
- Establishing a natural predator population
- Appropriate mosquito-specific larvicides

Figure 2-3. Miami Beach Soil Storage Capacity

Miami Beach has limited soil storage capacity, especially in the low-lying areas on its west side (Source: Paituvi, 2014)
Table 2-3. General BGSI Applicability and Feasibility in Miami Beach

<table>
<thead>
<tr>
<th>BGSI Practice</th>
<th>Low-lying Urban Areas</th>
<th>Low-lying Suburban Areas</th>
<th>Higher, Coastal Zone (east side, generally highly developed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioretention (may require a shallow design in low-lying areas)</td>
<td>🌟🌟🌟</td>
<td>🌟🌟🌟</td>
<td>🌟🌟🌟</td>
</tr>
<tr>
<td>Bioswales</td>
<td>🌟🌟</td>
<td>🌟🌟</td>
<td>🌟</td>
</tr>
<tr>
<td>Blue &amp; Green Roofs</td>
<td>🌟🌟</td>
<td>🌟🌟</td>
<td>🌟</td>
</tr>
<tr>
<td>Constructed Wetlands</td>
<td>🌟</td>
<td>🌟</td>
<td>🌟</td>
</tr>
<tr>
<td>Detention Basins/Surface Storage</td>
<td>🌟</td>
<td>🌟</td>
<td>🌟</td>
</tr>
<tr>
<td>Enhanced Tree Pits/Trenches</td>
<td>🌟🌟 (typical, higher if ground elevation is raised)</td>
<td>🌟🌟</td>
<td>🌟🌟</td>
</tr>
<tr>
<td>Floating Wetland Islands</td>
<td>🌟</td>
<td>🌟</td>
<td>🌟</td>
</tr>
<tr>
<td>Injection Wells</td>
<td>🌟🌟</td>
<td>🌟🌟</td>
<td>🌟 (ideally in southern and central areas, where the Biscayne Aquifer is highly absorbent)</td>
</tr>
<tr>
<td>Permeable Pavement</td>
<td>🌟🌟 (typical, higher if ground elevation is raised)</td>
<td>🌟🌟</td>
<td>🌟🌟</td>
</tr>
<tr>
<td>Rain Gardens (residential)</td>
<td>🌟</td>
<td>🌟</td>
<td>🌟</td>
</tr>
<tr>
<td>Rainwater Harvesting</td>
<td>🌟🌟</td>
<td>🌟</td>
<td>🌟</td>
</tr>
<tr>
<td>Stormwater Planters</td>
<td>🌟</td>
<td>🌟</td>
<td>🌟</td>
</tr>
<tr>
<td>Subsurface Infiltration/Storage</td>
<td>🌟🌟 (typical, higher if ground elevation is raised)</td>
<td>🌟🌟</td>
<td>🌟🌟</td>
</tr>
<tr>
<td>Tree Canopy</td>
<td>🌟🌟</td>
<td>🌟</td>
<td>🌟</td>
</tr>
<tr>
<td>Wet Ponds</td>
<td>🌟</td>
<td>🌟</td>
<td>🌟</td>
</tr>
</tbody>
</table>

=low  🌟=medium  🌟🌟=high

2.9 Maintenance Requirements and Responsibilities

BGSI practices require a variety of maintenance activities depending on the type of BGSI and various site-specific factors. Landscaped BGSI requires maintenance typical of other landscaped areas, potentially including debris and trash removal, pruning, weeding, replanting, erosion repair, and mulching. Many BGSI practices include devices for pretreatment of runoff that require periodic sediment and debris removal. Permeable pavements require the surface to be periodically cleaned (for example, with a street cleaning vehicle) to prevent clogging.

A variety of entities may be involved in BGSI maintenance depending on the situation. In parks and at other City-owned properties, the City would likely lead the maintenance activities (either with City staff or contractors) although they may be supported by residents and businesses through volunteer efforts, “Friends of” groups, “adopt-a-BGSI” programs, neighborhood associations, etc. Along commercial streets, business improvement districts and similar groups may lead maintenance activities. On private property, BGSI maintenance would be the responsibility of the property owner/manager. Maintenance procedures and responsibilities for BGSI on residential roads are still being formulated.

2.10 BGSI Fact Sheets

Each of the eleven BGSI practices recommended for implementation in Miami Beach has its own fact sheet (see Appendix C). Each practice fact sheet contains the following information:

- A general description of the BGSI practice, as well as an example photograph and/or schematic
- Advantages and potential limitations of using the practice in Miami Beach
• Applicability of the practice in the Miami Beach context
• Potential enhancements that could be employed to increase the performance of the practice
• Qualitative assessment (“high”, “medium”, or “low”) of various factors for each practice, **evaluated relative to other BGSI practices**
  
  – Expected Stormwater Performance
    • Water Quality – how effective is the practice at removing typical pollutants in stormwater runoff
    • Freshwater Lens Recharge – how effective is the practice at allowing stormwater to enter the soil (infiltration) and recharging the groundwater
    • Flood Mitigation – what is the practice’s potential for reducing flooding in its vicinity (that is, localized flooding)
  
  – Implementation
    • Capital Cost – anticipated cost to implement the practice in Miami Beach
    • Maintenance Cost – anticipated cost to maintain and/or operate the practice in Miami Beach
    • Scalability – what is the practice’s potential to be easily replicated in many locations in Miami Beach
    • Constructability – how easy will it be to construct the practice in Miami Beach and can negative impacts to natural and/or human-made features, pedestrians, traffic, businesses, tourism, etc. be limited during construction, with “high” indicating the easiest or least disruptive to such considerations
  
  – Community/Environmental Benefits
    • Improved Aesthetics – what is the practice’s potential to maintain if not enhance the unique look and feel of Miami Beach
    • Dual Use – what is the practice’s potential to provide other uses in addition to stormwater runoff control (for example, permeable pavement provides useable hardscape for multiple uses)
    • Habitat Creation – how effective is the practice at providing habitat for wildlife, including both land and aquatic species
    • Urban Heat Island Reduction – what is the practice’s potential to lower the ambient air temperature
  
  – Other Factors
    • Climate Change Resilience – how resilient and adaptive will the practice be to changing climate conditions, such as more frequent and powerful storms and sea level rise
    • Mosquito Vector Resistance – what is the practice’s potential to resist or limit the propagation of mosquitoes and the diseases they spread

Each of the four BGSI strategies recommended for implementation in Miami Beach has its own fact sheet (see Appendix C). Each strategy fact sheet contains the following information:

• A general description of the BGSI strategy, as well as an example photograph
• Advantages and potential limitations of using the strategy in Miami Beach
• Table of applicable BGSI practices for sites aligning to the specific strategy (that is, summary of which practices apply to most sites, some sites, or few or no sites [limited applicability])
• Descriptions of some of the common variations (or sub-strategies) for each strategy, along with photographs of applicable Miami Beach sites and constructed BGSI practices in similar settings
2.11 Additional BGSI Resources

- Rising Above Website
- Florida Field Guide to Low Impact Development: Bioretention Basins/Rain Gardens
- Florida Field Guide to Low Impact Development: Green Roofs/Eco-roofs
- Florida Department of Transportation Drainage Design Guide (Injection Wells covered in Chapter 7)
- Sarasota County Low Impact Development Guidance Document
- University of Florida Soil and Water Sciences Video Topics: Green Stormwater Infrastructure
- Constructed Floating Wetlands: A review of research, design, operation and management aspects, and data meta-analysis

Note that the City is not specifically endorsing any of the information provided in these sources and is providing them for general information to be used with discretion.

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6 http://www.mbrisingabove.com/climate-adaptation
8 http://buildgreen.ufl.edu/Fact_sheet_Bioretention_Basins_Rain_Gardens.pdf
9 http://www.buildgreen.ufl.edu/Fact_sheet_Green_Roofs_Eco_roofs.pdf
10 https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/roadway/drainage/files/drainagedesignguide.pdf
11 https://www.scgov.net/home/showdocument?id=33258
12 https://soils.ifas.ufl.edu/extension/videos/low-impact-development
13 https://apiors.plants.ifas.ufl.edu/site/assets/files/372369/372369.pdf
3. Recommendations

The preceding sections of this BGSI Concept Plan were developed to identify BGSI practices and strategies that will help manage stormwater and enhance climate resiliency by providing water quality benefits, freshwater lens recharge, and reduced localized flooding. The City has elected to achieve these goals by integrating BGSI into innovative urban designs that enhance the landscape, provide sustainability co-benefits, honor the local culture and aesthetic, add economic value, and enhance the quality of life for residents.

To achieve significant, widespread benefits, BGSI will need to be implemented throughout Miami Beach and the following recommendations aim to support the successful launch and scale-up of BGSI across the City.

- **Formalize BGSI requirements into existing policy, planning, and management systems.** For BGSI to achieve the requisite implementation scale and deliver the desired outcomes, specific requirements need to be integrated into the following:
  - **BGSI Policy.** Develop a policy that formally states the objectives of BGSI, including specific requirements to which the City will hold itself accountable, such as how BGSI will be incorporated into both public infrastructure and private development projects as well as retrofits of existing facilities. Existing governance processes (for example, audits and management reviews) should be updated to include confirming compliance with this policy.
  - **Codes, Ordinances, Zoning, and Permitting.** Current City codes, ordinances, and permits that affect stormwater management need to be reviewed and updated as needed to ensure they reflect a priority on BGSI solutions pursuant to the BGSI Policy that is developed. Existing relevant training and guidance for City staff and contractors should be updated to reflect the addition of BGSI priorities.

- **Design standards.** Develop a design manual that updates or supplements the City's current design details, typical road sections, and specifications to include BGSI practices.

Highest and best use analyses of the public golf courses will inform potential BGSI implementation.
- **Master Planning and Land Use Planning.** All relevant existing and/or in-progress master plans (water, wastewater, stormwater, transportation, urban forest, etc.) should be reviewed and updated as needed to include BGSI practices and strategies. BGSI-specific master planning should be done at the neighborhood level and support DCP development. In addition, highest and best use analyses should be conducted for the two publicly owned golf courses to inform planning discussions regarding the degree to which BGSI should be implemented at these locations.

- **Capital Improvement Plans.** The current portfolio of capital improvement projects should be reviewed and opportunities to integrate BGSI should be identified. These already planned and funded projects represent a significant opportunity to achieve a robust start to BGSI implementation. Some projects may be good candidates for pilot projects that could demonstrate the benefits of BGSI (see Appendix E).

- **Align City Departments on BGSI Policy and Include BGSI in Cross-Departmental Management.** The range of BGSI implementation scenarios (for example, transportation, parks, private property, etc.) span the range of City departments, indicating the need for alignment across all Miami Beach departments on BGSI policy, planning, and implementation.

- **Ensure long-term funding for BGSI implementation and maintenance, including incentives.** The successful scale-up of BGSI across the City depends on adequate funding for construction and long-term maintenance; the City should ensure adequate budgets are established each year. Additionally, to achieve the requisite level of BGSI implementation, practices will need to be implemented on both public and private property. The City should consider funding models that provide flexibility to contribute public funds to solutions implemented on private property because in some locations adequate public land may not be available and/or private land may provide a higher performance-to-cost return on investment. The City should also consider formalizing incentives (grants/rebates and stormwater fee credits) for the private implementation of BGSI. Any increase in the City’s stormwater fee should be accompanied with a credit program that not only provides a return on investment for private implementation of BGSI, but also includes a formal mechanism for the City to require maintenance of private BGSI facilities and/or encourage private maintenance of public BGSI systems in the adjacent public right of way.

- **Implement a portfolio of demonstration projects across the range of recommended BGSI strategies.** Demonstration projects are needed to provide residents, developers, regulators, contractors, and City personnel with a deeper understanding of the best ways to plan and implement BGSI. Ideally, these demonstration projects would be supported by grants such that the City can contribute to advancing the science of implementing BGSI solutions in the context of climate change.
adaptation. These demonstration projects could be designed considering specific innovations and in partnership with regulatory agencies, academia, and the community, so that results would build support for BGSI solutions. Capturing lessons learned and integrating these into subsequent BGSI planning and design standards will be critical to success.

- **Develop BGSI innovation priorities.** The City should identify specific innovation priorities intended to support the scale-up of high-impact BGSI practices within the unique local context, geared to overcome a variety of factors (for example, land availability, policy, technology, financial) that could impact progress. Innovation could focus on:
  - **Technology.** This innovation area could focus on how best to leverage smart technologies, the internet-of-things, and digital solutions to monitor performance and drive greater efficiency and effectiveness of BGSI solutions. Digital solutions could also provide efficient ways to share results with the community and interested stakeholders that increasingly receive information real-time in digital format.
  - **One Water or Water Neutrality.** This innovation area could focus on integration of grey, blue, and green infrastructure solutions to maximize performance and lower overall lifecycle costs. Water neutrality may offer an opportunity to incentivize the strategic and financial participation of the private sector in scaling BGSI across the City by creating methodologies and programs that enable business to offset their consumptive water use through BGSI solutions that manage/infiltrate equivalent volumes of water and deliver co-benefits; this could include a recognition program for businesses that achieve neutrality in support of the City’s sustainability efforts.
  - **BGSI Design.** This could focus on evaluating new and innovative BGSI technologies/techniques and combinations of these that are most effective in Miami Beach and could involve engaging with companies developing cutting-edge products to address local objectives, such as removal of specific pollutants of concern (for example, nitrogen, phosphorus, pathogens, and arsenic), and overcome implementation challenges, such as high groundwater, saline soils, and mosquitoes.
  - **BGSI Maintenance.** This innovation area could focus on meeting long-term maintenance needs of BGSI while also contributing to the development of a green economy workforce. Innovations in BGSI maintenance could be supported by the technology innovations (for example, smart sensors, mobile phone apps) discussed above.
  - **Alternative Delivery.** This innovation could focus on innovative financing and project delivery options. Innovative finance could include engaging the growing socially responsible investor community that are willing to provide lower-cost financing for solutions that deliver social and environmental benefits (for example, through environmental impact bonds). Innovative project delivery could include the purchase of BGSI performance from private enterprises that deliver BGSI solutions on private land.

- **Develop BGSI partnerships.** Full-scale implementation of BGSI will greatly benefit from leveraging a range of partnerships between government, business, academia, and civil society. Each potential partner has a different value proposition, so a formal strategy is recommended to guide partnership development and management. Potential partners types include:
  - **Conservation Organizations and Academia** – These partners can conduct research, augment technical understanding of risks and issues as well as recommend innovative solutions; they can also add credibility to, and voice their support for, plans and actions that support mutually beneficial goals.
  - **Regulatory Agencies** – These partners can help anticipate regulatory obstacles to innovative solutions and provide guidance on how they can be overcome. For example, one partnership could be with the Miami-Dade Regulatory and Economic Resources with a focus on how to resolve permitting issues related to BGSI.
  - **Technology Providers** – These partners can provide the range of measurement, data management, analytics, and visualization technologies that can support performance management/optimization, real-time control, management decisions, and transparency regarding BGSI practices and their performance.
– **Private Sector Enterprises** – There is a broad range of potential partners from the private sector. These could include companies developing cutting-edge BGSI products, industry and commercial enterprises incentivized to support BGSI implementation, and socially responsible private equity firms providing low-cost financing for BGSI.

– **Miami-Dade County and Florida Department of Transportation**. Partnership with these agencies is recommended, given the scale of opportunity for implementing BGSI solutions on county and state roads.

- **Advance the Science.** An integrated understanding of the hydrologic, hydrogeologic, sea level rise projections, increasing rainfall intensities, and storm surge estimates is needed to provide perspective regarding how these different factors combine to influence the feasibility and performance of BGSI practices. Developing this integrated understanding may require additional hydrologic and hydrogeologic integrated modeling.

Miami Beach recently developed a website dedicated to providing information on BGSI

- **Invigorate community engagement.** Miami Beach should continue community outreach on BGSI as its support will be critical to the successful scale-up of BGSI practices across the City. This could include programs that support or incentivize implementation of BGSI practices on residential property (for example, rain barrel and tree planting programs as well as assistance for rain gardens, permeable pavers, and other practices). A formal, long-term plan for continued community engagement should be developed and shared with the community so that it is aware of the process and can plan for participation. The engagement plan should consider ways to solicit meaningful input from millennials and other groups that may be less likely to attend in-person public meetings.
4. References


CH2M HILL Inc. 2015. Final Rainfall Intensity, Duration, and Frequency Projections Based on Climate Change for Miami-Dade County. Prepared for Miami-Dade County Water and Sewer Department. May.


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Wade Trim. 2019. *Bioswale Basis of Design (Revision No. 1, Final) for 59th Street Bioswale Pilot Project*.

Wade Trim. 2019. *W. 59th Street Bioswale Exhibit Plan and Details*.
# Contents

<table>
<thead>
<tr>
<th>Question</th>
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<tbody>
<tr>
<td>What is blue-green stormwater infrastructure?</td>
<td>1</td>
</tr>
<tr>
<td>Why should we use BGSI?</td>
<td>1</td>
</tr>
<tr>
<td>What are the water quality benefits of BGSI?</td>
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<td>How will BGSI fit into the city's flood mitigation strategies?</td>
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<tr>
<td>What community benefits can BGSI potentially provide?</td>
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<td>What BGSI practices are most applicable to Miami Beach?</td>
<td>3</td>
</tr>
<tr>
<td>What BGSI practices are less applicable to Miami Beach?</td>
<td>3</td>
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<tr>
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<td>4</td>
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<tr>
<td>Where can BGSI be used?</td>
<td>4</td>
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<td>Where is the City planning to implement BGSI?</td>
<td>6</td>
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<tr>
<td>How will BGSI function with rising sea levels and shallow groundwater?</td>
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<tr>
<td>How does BGSI get maintained?</td>
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<tr>
<td>Who will do the maintenance for BGSI?</td>
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<tr>
<td>Will BGSI promote mosquito breeding and the spread of disease?</td>
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<tr>
<td>Will BGSI reduce parking?</td>
<td>7</td>
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<tr>
<td>Will BGSI reduce recreational space?</td>
<td>7</td>
</tr>
<tr>
<td>What can the public do to promote BGSI in Miami Beach?</td>
<td>7</td>
</tr>
<tr>
<td>Where can I find more information on BGSI?</td>
<td>8</td>
</tr>
</tbody>
</table>
Frequently Asked Questions Concerning Blue-Green Stormwater Infrastructure

What is blue-green stormwater infrastructure?

Green stormwater infrastructure typically uses rainwater harvesting, vegetation, and/or soils to treat and reduce stormwater flows. Examples include bioretention (rain gardens) and permeable pavement.

Blue stormwater infrastructure temporarily stores and treats stormwater without significant reliance on vegetation. Examples are wet ponds and detention basins.

Blue-green stormwater infrastructure (BGSI) encompasses both green and blue stormwater infrastructure practices. Phrases like low-impact development techniques, sustainable site design, and stormwater best management practices have also been used to describe BGSI.

BGSI is typically designed and sized to capture more frequent storm events (for example, storms up to 1.5 or 2 inches) that make up most of the total rainfall in an average year, rather than extreme events that typically happen only infrequently and lead to larger drainage and flooding issues. Conveyance systems, such as pipes and pumps, are intended to address these larger events.

The focus of BGSI is the treatment and capture of stormwater runoff, therefore BGSI is different from coastal strategies (for example, living shorelines, dunes, mangrove plantings, and oyster or artificial reefs) that target coastal stressors like wave energy, sea level rise, and storm surges.

Why should we use BGSI?

BGSI can provide a range of both stormwater-related benefits as well as other community benefits. Stormwater benefits can include:

- Water quality improvement (more details under the next frequently asked question [FAQ])
- Groundwater recharge and replenishment of the freshwater lens under Miami Beach, helping to reduce saltwater intrusion and protect soils and tree roots from salt damage
- Some detention and flood mitigation benefits (particularly for thunderstorm-type nuisance flooding, more information follows under the FAQ “How will BGSI fit into the city’s flood mitigation strategies?”)

Other community benefits (also known as "co-benefits") can include:

- Urban heat island mitigation
- Air quality improvement
- Climate resiliency
- Habitat creation and improvement
- Multiple other community benefits, including job creation, improved urban aesthetics, increased property values, improved pedestrian safety, and enhanced recreational spaces.

More details on the stormwater and community benefits are included in the next 3 FAQs.

What are the water quality benefits of BGSI?

Protecting water quality for Miami Beach’s beaches and waterways is a priority as they provide habitat, a great quality of life, and opportunities for tourism. Stormwater runoff from urban areas delivers pollutants—including bacteria/pathogens, nutrients (such as nitrogen and phosphorus), sediment, and heavy metals—to waterways and beaches. BGSI has been shown to reduce many of these pollutants. By
retaining rainfall, BGSI reduces stormwater discharges. Lower discharge volumes translate into reduced pollutant loads. BGSI also treats stormwater that is not retained. ¹ It should be noted that BGSI can only improve the quality of the water that it receives (that is, the runoff from the drainage area that it serves) and has the capacity to treat. Therefore, extensive BGSI coverage would typically be required to have significant overall pollutant load reductions.

Like all infrastructure, BGSI must be designed, constructed, and maintained to function properly over the long term (for more on maintenance, see the FAQ “How does BGSI get maintained?”).

How will BGSI fit into the city’s flood mitigation strategies?

BGSI can complement “grey” infrastructure such as pipes and pumps. BGSI can provide some detention and flood mitigation benefits (particularly for thunderstorm-type nuisance flooding), but alone will provide little or no benefit for “sunny day” flooding resulting from king tides, flooding from major rainfall events, or flooding caused by storm surge from the Atlantic Ocean or Biscayne Bay. BGSI is typically designed for storms 2 inches or less (for the drainage area it serves), which is approximately 25 percent of the much larger storms typically used to size flood control systems, such as pipes and pumps.

What community benefits can BGSI potentially provide?

BGSI can potentially provide a suite of community benefits, as shown below in the graphic from the U.S. Environmental Protection Agency. The benefits vary significantly depending on the project location and setting, BGSI practice type(s), level of implementation, maintenance practices, etc.

Potential Environmental, Social, Economic, and Public Health Benefits of Green Infrastructure


What BGSI practices are most applicable to Miami Beach?

A wide range of BGSI practice types were evaluated based on city/regional/national experience, stormwater performance, ease of implementation/maintenance, community/environmental benefits, cost efficiency, and climate change resilience. The recommended practices were determined to perform well across these areas and have potential applicability in Miami Beach given the local context (soil and groundwater conditions, land uses, development patterns, climate, etc.).

The most applicable BGSI practices are:

- Bioretention/Bioswales/Rain Gardens
- Blue and Green Roofs
- Constructed Wetlands/Floating Wetland Islands
- Detention Basins/Surface Storage
- Enhanced Tree Pits/Trenches
- Injection Wells (Pumped)\(^2\)
- Permeable Pavement
- Rainwater Harvesting (Cisterns, Rain Barrels)
- Stormwater Planters
- Subsurface Infiltration and Storage
- Tree Canopy\(^3\)
- Wet Ponds

When and where to use each recommended BGSI practice depends on a variety of site-specific factors, such as land use, location, topography, groundwater elevation, soil conditions, and existing infrastructure.

What BGSI practices are less applicable to Miami Beach?

The following BGSI practices are less applicable to or less effective in Miami Beach due to their reduced water quality benefits, higher costs, lack of scalability, lower effectiveness when dealing with sea level rise and high tides, proprietary designs, limited applicability, or low storage capacities:

- Detention Tanks
- Exfiltration Trenches
- High-Flow Media Filters
- Living/Green Walls
- Gravity Wells
- Subsurface Flow Wetlands

Although not as readily applicable to Miami Beach, the above BGSI practices might still prove beneficial in certain settings.

---

\(^2\) Although not typically thought of as BGSI, injection wells are included here as they reduce the volume of stormwater discharged, and with proper pretreatment/filtration can provide water quality benefits.

\(^3\) Trees are a key component of BGSI, and the City is developing an Urban Forest Master Plan to provide a strategic framework to guide the City in managing, maintaining, planting, and preserving its urban forest. See www.mbrisingabove.com/climate-mitigation/urban-canopy-2/urban-forestry-master-plan.
What does BGSI look like?

BGSI can take many different forms, from landscaping elements such as rain gardens to permeable pavements that can look like normal pavements to wet ponds to blue and green roofs atop buildings. BGSI practices can vary from being dominant, high-profile features to blending in seamlessly with the surroundings. Some example images with established vegetation are provided on the next page (vegetated BGSI, like other landscaping, requires time to get established).

Where can BGSI be used?

BGSI can be used on and along roads, in parks and other open spaces, at schools and other public facilities, on rooftops, and on residential and commercial properties. Approximately 40% of Miami Beach is covered by impervious surfaces (buildings and pavements) that prevent water from soaking into the ground. BGSI should be employed to treat runoff from these impervious surfaces and help preserve, enhance, and increase the City’s remaining pervious or “green” areas.

When choosing where to place BGSI practices, the following factors should be considered:

- Depending on the BGSI practice type, offsets from utilities, buildings, and other structures may be required to protect those features from water damage.
- Factors such as budget, permitting, site conditions, neighborhood preferences, and ownership will influence the location and types of BGSI.

A rendering of bioretention and permeable pavement on a typical residential street in Miami Beach
Examples of BGSI Applications

- Pervious Concrete Parking Lot
- Wet Pond
  Source: Southwest Florida Water Management District
- Rain Garden
- Normal (left) and Porous Asphalt (Right)
- Infiltration Trench
- Blue-Green Roof Plaza
- Green Roof (in foreground) Adjacent to Marina
- Residential Rain Barrel
- Residential Rain Garden
- Floating Wetland Islands
- Stormwater Planter
- Permeable Paver Driveway
Where is the City planning to implement BGSI?

The City is planning to implement BGSI along roads, in parks and other open spaces, and at public facilities. City projects currently under design with BGSI components include Maurice Gibbs Park, Community Park (former par 3 golf course), 59th Street bioswale, and 1st Street stormwater improvements. In addition, preliminary concept renderings have been developed for the following:

- Residential street
- Commercial street
- Neighborhood park
- Miami Beach Golf Course (three scenarios)
- Collins Canal
- Street end (where a street dead ends at a waterbody)
- Garden apartments

There is also an opportunity to make policy and code changes to further encourage and/or require public and private BGSI implementation.

How will BGSI function with rising sea levels and shallow groundwater?

Shallow and increasing groundwater elevations in portions of the City limit the soil storage capacity and infiltration required for some BGSI practices to function effectively. However, such limitations might potentially be overcome with underdrains, fill, and/or pumping. Other practices, such as wet ponds and constructed wetlands, can continue to function with shallow groundwater although their storage capacity may be reduced as groundwater levels increase. Blue and green roofs, rainwater harvesting, and floating wetland islands would typically not be impacted by rising groundwater.

How does BGSI get maintained?

BGSI practices require a variety of maintenance activities depending on the type of BGSI and site-specific factors. Landscaped BGSI requires maintenance typical of other landscaped areas, potentially including: debris and trash removal, pruning, weeding, replanting, erosion repair, and mulching. Many BGSI practices include devices for pretreatment of runoff that require periodic sediment and debris removal. Permeable pavements require the surface to be periodically cleaned (for example, with a street cleaning vehicle) to prevent clogging.

Who will do the maintenance for BGSI?

A variety of entities may be involved in BGSI maintenance depending on the situation. In parks and at other City-owned properties, the City would likely lead the maintenance activities (either with City staff or contractors) although they may be supported by residents and businesses through volunteer efforts, “Friends of” groups, “adopt-a-BGSI” programs, neighborhood associations, etc. Along commercial streets, business improvement districts and similar groups may lead maintenance activities. On private property, BGSI maintenance would be the responsibility of the property owner/manager. Maintenance procedures and responsibilities for BGSI on residential roads are still being formulated.

Will BGSI promote mosquito breeding and the spread of disease?

If properly designed, constructed, and maintained, BGSI should not promote mosquito breeding. BGSI systems that are not intended to have prolonged ponding should typically empty within 3 days (mosquitoes require standing water to be present for greater than 7 days to grow) and should be checked frequently to ensure they are emptying as expected. BGSI that holds water for prolonged periods (for example, wet ponds, wetlands, and cisterns) must use other methods to prevent mosquito growth, such as screening, establishing a natural predator population, and/or appropriate mosquito specific larvicides.
It should be noted that mosquitos are present in Miami Beach regardless of BGSI and people should take appropriate precautions to prevent getting bitten (for information from Miami-Dade County, see www8.miamidade.gov/global/solidwaste/mosquito/home.page).

**Will BGSI reduce parking?**

Impacts to parking will be evaluated and discussed with stakeholders on a project-by-project basis. Some BGSI may reduce parking along streets and in parking lots if areas along them are used for vegetated BGSI. However, BGSI is often strategically located in areas where parking is not permitted already (for example, near fire hydrants and intersections) to minimize impacts to parking. In most cases there are BGSI options (for example permeable pavements) that do not reduce parking.

**Will BGSI reduce recreational space?**

Locations for BGSI in parks and other open spaces will be carefully considered to minimize impacts to the usage of the sites. In many cases, BGSI may serve both recreational and stormwater purposes (for example, a permeable pavement basketball or tennis court). BGSI can also enhance recreational spaces by providing additional landscape features.

**What can the public do to promote BGSI in Miami Beach?**

Private properties will be a key partner in the successful implementation of BGSI in Miami Beach. Residents and businesses can implement several types of relatively low-cost, low-maintenance BGSI practices on their properties, including rain gardens, trees, cisterns, and rain barrels. Property owners can also maintain, preserve, and enhance their existing green space, trees, and roadside swales. In addition, the public may be able to volunteer to help protect and maintain City-installed BGSI practices through grassroots adoption programs, if those programs are developed.
Where can I find more information on BGSI?

More information can be found at the following links/sources.

<table>
<thead>
<tr>
<th>Resource</th>
<th>Source/Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>MB Rising Above Website</td>
<td><a href="http://www.mbrisingabove.com">www.mbrisingabove.com</a></td>
</tr>
<tr>
<td>Florida Department of Transportation Drainage Design Guide (Injection Wells covered in Chapter 7)</td>
<td>fdotwww.blob.core.windows.net/sitefinity/docs/default-source/roadway/drainage/files/drainagedesignguide.pdf</td>
</tr>
<tr>
<td>Sarasota County Low Impact Development Guidance Document</td>
<td><a href="http://www.scgov.net/home/showdocument?id=33258">www.scgov.net/home/showdocument?id=33258</a></td>
</tr>
<tr>
<td>University of Florida Soil and Water Sciences Video Topics: Green Stormwater Infrastructure</td>
<td>soils.ifas.ufl.edu/extension/videos/low-impact-development/</td>
</tr>
<tr>
<td>Constructed Floating Wetlands: A review of research, design, operation and management aspects, and data meta-analysis</td>
<td>apirs.plants.ifas.ufl.edu/site/assets/files/372369/372369.pdf</td>
</tr>
</tbody>
</table>

Note that the City is not specifically endorsing the information provided in these sources but is providing them for general information to be used with discretion.
Appendix B

Public Outreach Summary Report
Resilience Conservation Series
Blue Green Infrastructure Public
Outreach Report
October 2019

Resilient, Integrated,
Strategic Engagement
## Table of Contents

**Meeting Notices** ......................................................................................................................... 3 - 4

**Website Project Page** ................................................................................................................... 5 - 7

**Community Outreach** ...................................................................................................................... 8 - 29
  - Every Door Direct Mail
  - Email Blast
  - Social Media Posts
  - Advertisement
  - Door-to-Door Photos

**Public Meeting** ............................................................................................................................... 30 - 71
  - Summary
  - Sign-in Sheets
  - Comment Cards
  - Social Media Posts
  - Photos

**Appendix** ........................................................................................................................................... 72
  - Presentation
  - Boards
  - FAQ
Resilience Conversation Series
Blue Green Infrastructure

Resilience Conversation Series
Join the City of Miami Beach and Jacobs Engineering for a resilience discussion about Blue Green Infrastructure (BGI). Learn how BGI enhances urban resilience by implementing blue (water) and green (plant-based) elements that mitigate flooding as well as:

- Preview BGI concepts being developed for Miami Beach.
- Learn how such methods deliver enjoyable recreational and social spaces.
- Provide community feedback and stay informed about what's next in the city's integrated water management plans.

Thursday, September 5 at 7 PM
City Hall Commission Chambers
1700 Convention Center Drive, Third Floor
Or watch LIVE on MBTV, AT&T Uverse 99, Atlantic Broadband 665

Stay tuned for other resilience conversation dates coming soon as part of this series. To learn more about the city’s progress on resilience initiatives, visit www.MBRisingAbove.com.

Initial Meeting

Learn More About Blue & Green Infrastructure
For the City’s Stormwater Management Program

Join the City of Miami Beach and Jacobs Engineering for a discussion on Blue & Green Infrastructure (BGI) to advance a more holistic living with water approach. Learn how BGI enhances urban resilience by implementing blue (water) and green (plant-based) elements that mitigate flooding as well as:

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Tuesday, September 17 at 6:30 PM
City Hall Commission Chambers
1700 Convention Center Drive, Third Floor
Or watch LIVE on MBTV, AT&T Uverse 99, Atlantic Broadband 665

To learn more about the city’s progress on resilience initiatives, visit www.MBRisingAbove.com. Stay tuned for upcoming resilience conversations.
EVALUATING BLUE-GREEN INFRASTRUCTURE

UPDATE: On Tuesday, January 21, 2020, the City held its second resilience conversation meeting. Click here to download the meeting presentation.

In April 2019, the City of Miami Beach contracted Jacobs Engineering in a three-task workorder. The first task focused on evaluating blue-green infrastructure (BGI) to advance a more holistic living with water approach.

As part of the City’s Resilience Conversation Series, on September 17, 2019 Jacobs Engineering engaged with the public to present BGI possibilities applicable to the City of Miami Beach.

The presentation illustrated how BGI enhances urban resilience by implementing blue (water) and green (plant-based) elements that help mitigate flooding, as well as:

- depicted how such methods deliver enjoyable recreational and social spaces;
- provided various renderings of BGI concepts designed for Miami Beach;
- offered a forum to facilitate community feedback.

Stay tuned for future public meetings to discuss tasks 2-3 of the workorder.

Download the meeting presentation: Jacobs Engineering Presents Blue-Green Infrastructure CMB

Review the BGI renderings: What is possible with BGI – Boards

Topic Q&A: BGI Q&A

Evaluating blue-green infrastructure (BGI)

In April 2019, the City of Miami Beach contracted Jacobs Engineering in a three-task workorder. The first task focused on evaluating blue-green infrastructure (BGI) to advance a more holistic living with water approach.

As part of the City’s Resilience Conversation Series, on September 17, 2019 Jacobs Engineering engaged with the public to present BGI possibilities applicable to the City of Miami Beach.

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http://www.mbrisingabove.com/your-city-at-work/resilience-strategy/community-meetings/
COMMUNITY OUTREACH

Every Door Direct Mail
Email Blast
Social Media Posts
Advertisement
Door-to-Door Photos
LEARN MORE ABOUT BLUE & GREEN INFRASTRUCTURE
For the City's Stormwater Management Program

Join the City of Miami Beach and Jacobs Engineering for a discussion on Blue & Green Infrastructure (BGI) to advance a more holistic living with water approach. Learn how BGI enhances urban resilience by implementing blue (water) and green (plant-based) elements that mitigate flooding as well as:

• Preview BGI concepts being developed for Miami Beach.
• Learn how such methods deliver enjoyable recreational and social spaces.
• Provide community feedback and stay informed about what's next in the city's integrated water management plans.

Thursday, September 5 at 7 PM
City Hall Commission Chambers
1700 Convention Center Drive, Third Floor

Or watch LIVE on MBTV
AT&T U-verse 99/ Atlantic Broadband 660

For more information on the city’s resilience initiatives, visit www.MBRisingAbove.com. Stay tuned for upcoming resilience conversations.

CONOZCA MÁS SOBRE LA INFRAESTRUCTURA AZUL Y VERDE
Para el Programa de Manejo de Aguas Pluviales de la Ciudad

La Ciudad de Miami Beach y Jacobs Engineering le invitan a participar en una conversación sobre la Infraestructura Azul y Verde, conocida en la industria como BGI. Aprenda cómo BGI mejora la resistencia urbana al cambio climático mediante la implementación de elementos azules (agua) y verdes (basados en plantas) que mitigan las inundaciones:

• Vista previa de los conceptos de BGI que se están desarrollando para Miami Beach.
• Aprenda cómo estos métodos proporcionan una experiencia agradable, con espacios recreativos y sociales.
• Proporcione su opinión sobre estos proyectos de la comunidad y permanezca informado sobre los próximos pasos en los planes integrados de la ciudad para la gestión del agua.

Jueves, 5 de septiembre a las 7 PM
Cámaras de la Comisión del Ayuntamiento
1700 Convention Center Drive, Tercer Piso

O vea el evento en vivo por MBTV
AT&T U-verse 99/ Atlantic Broadband 660

Due to Hurrican Dorian, the September 5 meeting is rescheduled to occur on Tuesday, September 17 at 6:30 p.m. RSVP below.

**Resilience Conversation Series**

**Blue Green Infrastructure**

Join the City of Miami Beach and Jacobs Engineering for a resilience discussion about Blue Green Infrastructure (BGI). Learn how BGI enhances urban resilience by implementing blue (water) and green (plant-based) elements that mitigate flooding as well as:

- Preview BGI concepts being developed for Miami Beach.
- Learn how such methods deliver enjoyable recreational and social spaces.
- Provide community feedback and stay informed about what’s next in the city’s integrated water management plans.

Thursday, September 5 at 7 PM
City Hall Commission Chambers
1700 Convention Center Drive, Third Floor
Or watch LIVE on MBY, KMAB Universe 99/Atlantic Broadband 660

Stay tuned for other resilience conversation dates coming soon as part of this series.
To learn more about the city’s progress on resilience initiatives, visit www.MBRisingAbove.com.

**RSVP HERE**
To download a copy of this invite click [here](#).
Follow us:

Facebook, Twitter, Instagram

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Eblast sent on 08/13/2019 - "You're Invited"
Eblast sent on 08/26/19 - "You're Invited"

---

Eblast sent on 09/03/2019 - "Date Changed"
Eblast sent on 09/05/2019 - "Date Changed"
Eblast Sent on 09/12/2019 - "Reminder"
Eblast sent on 09/16/2019 - "See you Tomorrow"
Due to Hurricane Dorian, we have had to postpone this meeting that was initially scheduled for this Thursday, to Tuesday, September 17 at 6:30 p.m.

Join the City of Miami Beach and Jacobs Engineering for a discussion on Blue & Green Infrastructure (BGI) to advance a more holistic living with water approach. Learn how BGI enhances urban resilience by implementing blue (water) and green (plant-based) elements that mitigate flooding as well as:

- Preview BGI concepts being developed for Miami Beach.
- Learn how such methods deliver enjoyable recreational and social spaces.
- Provide community feedback and stay informed about what’s next in the city’s integrated water management plans.

Tuesday, September 17 at 6:30 PM
City Hall Commission Chambers
1700 Convention Center Drive, Third Floor

Watch live on MBTV:
AT&T U-verse: Channel 99 | Atlantic Broadband: Channel 660 or visit: miamibeachfl.gov/government/mbtv/ to stream online.

Stay tuned for other resilience conversation dates coming soon.

Eblast sent on 09/12/2019 - "Save the Date"

Eblast sent on 09/16/2019 - "Reminder"
Resilience Conversation Series
Blue Green Infrastructure

City of Miami Beach Government
12 de agosto de 2019 🕒

Save the date for a resilience discussion with Jacobs Engineering. Join us on Thursday, September 5 at 7 PM or watch live on MBTV. #MBRisingAbove

Posted on August 12, 2019 - Facebook

City of Miami Beach Government
19 de agosto de 2019 🕒

Learn more about how we're implementing blue (water) & green (plant-based) elements to mitigate flooding, as part of the City's stormwater management program! #MBRisingAbove

Thursday, September 5 at 7 PM
City Hall Commission Chambers
Or watch live on MBTV, 5411 (VHF) or 66 (UHF).

Posted on August 19, 2019 - Facebook

City of Miami Beach Government
August 19, 2019 🕒

Learn more about how we’re implementing blue (water) & green (plant-based) elements to mitigate flooding, as part of the City’s stormwater management program!

... Continue Reading

Posted on August 19, 2019 - Twitter

City of Miami Beach Government
August 22, 2019 🕒

Join us for a discussion on Blue & Green Infrastructure (BGI) to advance a more holistic living with water approach.

#MBRisingAbove

Thursday, September 5 at 7 PM
City Hall Commission Chambers
Or watch live on MBTV, 5411 (VHF) or 66 (UHF).

Posted on August 22, 2019 - Facebook
Resilience Conversation Series
Blue Green Infrastructure

City of Miami Beach • @MiamiBeachNews • Aug 22, 2019
Join us for a discussion on Blue & Green Infrastructure (BGI) to advance a more holistic living with water approach! #MRisingAbove

To learn more about the city’s progress on resilience initiatives, visit www.MRisingAbove.com. Stay tuned for upcoming resilience conversations.

Posted on August 22, 2019 - Twitter

City of Miami Beach • @MiamiBeachNews • Sep 9, 2019
Join the City of Miami Beach for a discussion on blue & green infrastructure to advance a more holistic living with water approach

Tuesday, September 17 at 6:30 PM #MRisingAbove

More info can be found at www.MRisingAbove.com

Posted on September 9, 2019 - Twitter

City of Miami Beach Government
September 10, 2019 •
Preview blue & green infrastructure concepts being developed for Miami Beach and provide feedback during the first of our Resilience Conversation series #MRisingAbove

Learn more about Blue & Green Infrastructure for the City’s Stormwater Management Program

Join the City of Miami Beach and Jacobs Engineering for a discussion on Blue & Green Infrastructure (BGI) to advance a more holistic living with water approach. Learn how BGI enhances urban resilience by employing blue (treated) and green (plant-based) elements that mitigate flooding as well as:
- Preview BGI concepts being developed for Miami Beach.
- Learn how such methods deliver enjoyable recreational and social spaces.
- Provide community feedback and stay informed about what’s next in the city’s integrated water management plan.

Tuesday, September 17 at 6:30 PM City Hall Commission Chambers

Posted on September 10, 2019 - Facebook
Resilience Conversation Series
Blue Green Infrastructure

City of Miami Beach @MiamiBeachNews - Sep 16, 2019
Preview blue & green infrastructure concepts being developed for Miami Beach tomorrow, September 17 for the first of our Resilience Conversation series! #MBRisingAbove

Tuesday, September 17 at 6:30 PM
City Hall Commission Chambers
1700 Convention Center Drive, Third Floor

To learn more about the city's progress on resilience initiatives, visit www.MBRisingAbove.com. Stay tuned for upcoming resilience conversations.

Posted on September 16, 2019 - Twitter

City of Miami Beach @MiamiBeachNews - Sep 17, 2019
Join us tonight, September 17 at 6:30 PM for a discussion on blue & green infrastructure to advance a more holistic living with water approach!

#MBRisingAbove

Join the City of Miami Beach and Jacobs Engineering for a discussion on Blue & Green Infrastructure (BGI) to advance a more holistic living with water approach. Learn how BGI enhances urban resiliency by implementing blue (water) and green (plant-based) elements that mitigate flooding as well as:

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- Learn how such methods deliver enjoyable recreational and social spaces.
- Provide community feedback and stay informed about what's next in the city's integrated water management plans.

Tuesday, September 17 at 6:30 PM
City Hall Commission Chambers
1700 Convention Center Drive, Third Floor

To learn more about the city's progress on resilience initiatives, visit www.MBRisingAbove.com. Stay tuned for upcoming resilience conversations.

Posted on September 17, 2019 - Twitter
"We need to hear from the residents who will be living with these solutions so tonight is very important for our team."

Preview blue & green infrastructure concepts being developed for Miami Beach tonight during the first of our Resilience Convers... See More
Resilience Conversation Series
Blue Green Infrastructure

### MEETING NOTICES

**September 16 - 20, 2019**

<table>
<thead>
<tr>
<th><strong>MONDAY, September 16</strong></th>
<th>8:30 a.m.</th>
<th>Design Review Board*</th>
<th>Commission Chamber</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6:00 p.m.</td>
<td>Health Advisory Committee</td>
<td>City Manager’s Large Conf. Room, 4th Floor, City Hall</td>
</tr>
</tbody>
</table>

| **TUESDAY, September 17** | 9:30 a.m. | Art in Public Places Committee | TCED Conf., Room, 5th FL, 1755 Meridian Avenue |
|                          | 3:30 p.m. | Disability Access Committee | City Manager’s Large Conf. Room, 4th Floor, City Hall |
|                          | 5:00 p.m. | Affordable Housing Advisory Committee | Housing & Comm. Services Conf., Room, 555 17th Street |
|                          | 5:00 p.m. | Animal Welfare Committee (Pets Allowed) | Mayor’s Conference Room, 4th Floor, City Hall |
|                          | 6:00 p.m. | Police/Citizens Relations Committee | MBPD Community Room, 1100 Washington Avenue |
|                          | 6:30 p.m. | Blue/Green Infrastructure Management Program | Commission Chamber, 3rd Floor, City Hall |

| **WEDNESDAY, September 18** | 8:30 a.m. | Ad Hoc Inspector General Selection Committee | City Attorney’s Conf., Room 4th Floor, City Hall |
|                            | 9:00 a.m. | Land Use and Development Committee** | Commission Chamber, 3rd Floor, City Hall |
|                            | 6:00 p.m. | Miami Beach Smart City Street Lighting Design Standards Public Meeting | Miami Beach Regional Library 222 22nd Street |

| **THURSDAY, September 19** | 8:30 a.m. | City of MB Fire & Police Officer’s Pension Board | Fire & Police Pension Office Suite 355, 1691 Michigan Av. |
|                            | 9:00 a.m. | Special Master Hearings* | Commission Chamber, 3rd Floor, City Hall |
|                            | 3:00 p.m. | Audit Committee | Parking Dept., Conf. Room 2nd FL, 1755 Meridian Ave. |
|                            | 5:00 p.m. | General Obligation (G.O.) Bond Oversight Committee | City Manager’s Large Conf. Room, 4th Floor, City Hall |

### FRIDAY, September 20

**8:00 a.m.**

<table>
<thead>
<tr>
<th><strong>Finance and Citywide</strong></th>
<th><strong>Commission Chamber Projects Committee</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9th Floor, City Hall</td>
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</tbody>
</table>

For any and/or all of the above meetings, one or more members of the Miami Beach City Commission, and/or City board/commission members may be in attendance and participate in discussions.


**Commission Committee Aired live on NBTV**

No. 000399752801

**MIAMI BEACH**

We are committed to providing excellent public service and safety to all who live, work and play in our vibrant, historic community.

Members of the public may present radio/visual (radio) memos relating to agenda items at planned meetings held in the Commission Chambers for the City of Miami Beach. (The City of Miami Beach is committed to providing reasonable accommodations to meet the needs of persons with disabilities. If you require a reasonable accommodation(s), please contact the City at least five (5) business days in advance of the meeting so that we may provide the type of accommodation(s) that meets your needs. Call the City’s Accessibility Coordinator at 305-549-3209.)

Members of the public may present radio/visual (radio) memos relating to agenda items at any time prior to the regular start of the meeting. Members of the public who wish to present radio/visual (radio) memos shall be seated in the order they arrive. The City will provide a microphone, and other necessary equipment, if the public requests it. The City will not provide individuals with hearing impairments with captioning services or a sign language interpreter.

**TRANSPARENCY SUMMARY:**

- City staff must provide a transparency summary (if one has not been prepared) to City Commissioners prior to any meeting. The transparency summary will be made available to the public. The transparency summary shall include a description of each agenda item to be discussed, including the purpose of the item, the major issues to be discussed, and the action item(s) associated with the agenda item. The transparency summary shall also include any supporting documents or materials relevant to the agenda item.

**PUBLIC ACCESS:**

- The City will provide public access to the City’s official meetings by broadcast, webcast, or video recording. The public will have the opportunity to view the City’s official meetings via the City’s official website or through a broadcast network. The City will make all agenda items, reports, and other materials available to the public prior to the meeting.

**CITY ORDINANCE:**

- The City of Miami Beach has adopted a City Ordinance that requires all City meetings to be open to the public. The City Ordinance provides that any person who is present at a meeting shall have the right to address the City during the public comment period. The City Ordinance also requires that all City meetings be recorded and that the recordings be retained for a period of at least six months. The City Ordinance further requires that all City meetings be broadcast on a television station or through a webcast.

**CITY DEPARTMENT:**

- The City of Miami Beach is a grant-funded organization and as such, the City is subject to certain state and federal regulations and requirements. The City is also subject to the Freedom of Information Act (FOIA) and the Open Records Act (ORA). The City is committed to providing the public with access to information that is generated or received in the course of City operations. The City is also committed to protecting the privacy of individuals and the confidentiality of information that is protected by law.

**CITY POLICIES:**

- The City of Miami Beach has adopted a number of policies to ensure the integrity and effectiveness of City operations. These policies include, but are not limited to, the City’s conflict of interest policy, the City’s procurement policy, and the City’s personnel policy.

**CITY POLICIES AND PROCEDURES:**

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Resilience Conversation Series
Blue Green Infrastructure

Door-to-Door Photos

[Images of various scenes, including a grocery store, a flyer, and a newspaper on a table.]
Resilience Conversation Series
Blue Green Infrastructure
MIAMI BEACH

Resilience Conversation Series
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Public Outreach Report
Resilience Conversation Series
Blue Green Infrastructure

MIAMI BEACH

PUBLICATION REPORT

Resilience Conversation Series
Blue Green Infrastructure

MIAMI BEACH

ResilienceConversationSeries
BlueGreenInfrastructure
PublicOutreachReport
PUBLIC MEETING

Summary
Sign-in Sheets
Comment Cards
Social Media Posts
Photos
Discussion Briefing Summary
September 17, 2019 | 6:30 p.m.
City of Miami Beach City Hall Commission Chambers 1700
Convention Center Drive, Miami Beach, FL 33139

**Staff:**
Jacobs Engineering
Infinite Source Communications
City of Miami Beach Staff
See the attached sign-in sheets for attendees

**Key items Discussed:**
- Mayor Dan Gelber started the presentation giving a brief introduction of what the City of Miami Beach plans were regarding the project. He also introduced Jacobs Engineering and explained the overall goal of the briefing.
- The Public Works Director Roy Coley explained the purpose of the briefing, which was to review Blue and Green infrastructure. He also mentioned that the overall goal was to obtain public opinion, thoughts, and questions regarding the topic.

**Presentation:**
- Matt Alvarez of Jacobs Engineering introduced each team member and gave a project overview stating that together they evaluated all the possible options for Blue and Green Stormwater Infrastructure (BGSI) and looked at which of these options were most applicable in Miami Beach.
- The Jacobs Engineering team presented each slide and provided a detailed explanation on each topic, as well as encouraging feedback from the audience.

- What is BGSI?
- The following topics were discussed during the presentation
- Why should we use BGSI?
- What are the water quality benefits?
- How will the BGSI fit into the city’s flood mitigation strategies?
- Community (Co-Benefits) of BGSI.
- What BGSI practices are less applicable to Miami Beach?
- What BGSI practices are most applicable to Miami Beach?
- What does BGSI look like?
- Where can BGSI be used?
- Where is the city planning to implement BGSI?
- Preliminary concepts for:
  - Residential street
  - Collins canal
Resilience Conversation Series
Blue Green Infrastructure

- Commercial Street
- Neighborhood park
- Street ends
- Miami Beach Golf course
- Garden Apartments
- Will BGSI reduce parking?
- Will BGSI promote mosquito breeding?
- Where can the public do to promote BGSI in Miami Beach?
- What are the next steps?

Resident, Louise Bauer, stated that she would like to propose a solution that will be beneficial to the residents as well as to the City. She mentioned that the city had a violation on her neighborhood with Miami-Dade County on April 11, 2019 and that five months passed, and they still have not received a detailed response. Ms. Bauer said she feels that it is fair for all neighborhoods to finish the projects that started and after she will be in favor of advancing with future projects. She also stated that she is interested in Blue and Green infrastructure, but that she would like the City to first complete construction in her neighborhood and all other neighborhoods.

Resident, Lizette Hassell, asked if the team also speaking with condos and hotels to have them look at what they can contribute. Ms. Hassel also asked how these proposals can be incorporated at a condominium or a hotel.

- Public Information Officer, Ms. Monica Diaz, responded that part of the outreach process discussed is that there will be a series of opportunities, one-on-one meetings, briefings and also public meetings where they will be able to address these topics and also meet with stakeholders to make sure everybody is aware of these practices.
- Mr. Andy Potts of Jacobs Engineering stated that as part of the project plan they will have residential strategies with property owners and businesses. The team is also looking at potential opportunities to improve policies to encourage implementation on private properties.

Resident, Lily Furst, asked who was going to be responsible for the maintenance of the rain gardens at the street ends. She also inquired if in the case the residents have saltwater intrusion, would that type of vegetation be able to handle saltwater, and if the plants will survive. Furthermore, Ms. Furst also asked how the team will get developers to implement the green roofs and all options into their projects.

- Mr. Potts responded that maintenance is highly essential, the specific maintenance procedures are not set at this stage, but he explained that there will be a variety of entities and techniques that will help with the maintenance.
- A Jacobs team member added that on the outside of the room there where different boards, which display different vegetation options that are applicable for Miami Beach, which can survive the climate conditions of the City.
- Ms. Furst asked if there would be any flowers?
  - A Jacobs team member responded that there would be a few, but these gardens were going to be less flowering.
Resilience Conversation Series
Blue Green Infrastructure

- Resident, Gary Martinez, stated that it would be helpful to get a better idea on how this project is related to the Miami Beach’s overall efforts both in terms of infrastructure and conditions of cost. He inquired what would happen to this project, for example, if there was a storm surge, and if it would be able sustain some of the other treats that might be part of the environment. Mr. Martinez inquired if the residents are considering spending money on the project, how this would fit cost-wise, and what else should be considered in balancing the total cost.
  - Mr. Potts responded that there are things that are going through an evaluation process, but in terms of costs, there are ways cost can be reduced by integrating other improvements such as the Capital Improvement Projects that are currently going on. This often is very cost-effective and improves green strategies as part of those ongoing projects. He stated that in addition to costs, the City is also looking to the values that it brings.
  - Mr. Potts referenced the storm surge and stated that BGSI should be designed with this in mind although some damage would likely occur as it would to other landscaped systems and maintenance protocols will need to be developed for restoring systems after surge events.

- Resident, Glenna Norton, asked if the bioswales and rain gardens that the team are proposing encourage mosquitos, and how will this mosquito growth be prevented. Ms. Norton also asked how the high grasses and plants will impact the environment in terms of security, since this will probably encourage wildlife that can be attracted to this vegetation.
  - Mr. Potts responded that all the different projects that are being proposed are something that needs to be designed appropriately, so it will not create that type of environment. For example, if a system is meant to be dry most of the time, we must make sure it is working correctly, and that water leaves the surface within three days, so the mosquitos cannot grow. He further explained that the environment in more significant systems will generate or establish natural predators that will control mosquito growth.
  - Ms. Jade Paul of Jacobs Engineering added that these systems do get some predators or critters that will take care of the mosquitos.
  - Ms. Norton asked what a critter is.
  - Ms. Paul explained they are wildlife native to South Florida.

- Resident, Michael Laas, asked how this will evolve overtime and how this infrastructure will grow as things move up regarding the built environment, as well as the actual infrastructure itself.
  - A Jacob Engineering team member explained that the purpose is to integrate this project into the resident’s decision making, into the planning and overall capital improvement program, as well as in existing processes that are currently established. This is not something that will typically stand alone, it is something that will be integrated.
• Resident, Robert Kunst, mentioned that he is the president of We Love Lakeview Inc., and he stated that he was unhappy with the fact that they are meeting there for the first time on that level. Mr. Kunst said they asked several times to comply with the team before and to answer several questions on how the residents will deal with these issues. He also stated that for a year and a half, the City planned to initiate work in their neighborhood to have the streets raised even though their streets do not flood. He said the team needs to have real meetings with all the neighborhoods in the community, and he suggested that there should not be any rush decisions.
  o Mr. Joe Rozza of Jacobs Engineering explained that the whole purpose of Blue and Green infrastructure is to protect the environment. Mr. Rozza also mentioned that they are currently going through the process of getting feedback from the community and trying to create a vision of what is possible. He stated that what they are putting together now is a series of good practices that should be applied in the context of Miami Beach.

• Resident, Jeff Bercow, mentioned it floods by his house, down the street and most parts of his neighborhood. He would like to know if there is an opportunity within the design criteria management to also address the aging and deteriorating underground infrastructure on a neighborhood by neighborhood bases.
  o Mr. Potts responded that he could not give a specific answer at that stage, but he believes that the City is planning to address neighborhood needs comprehensively.

• Resident, Peter Luria, stated the city has a history of not listening to residents. The massive destruction of the mature tree canopy across the island and the main roads among Collins Canal and Indian Creek are prime examples of the City’s substantial focus on engineering solutions and dismiss residents’ concerns about the need to protect and enhance green infrastructure and help improve stormwater management. He expressed his concern that Jacobs engineering is repeating this behavior by refusing to listen to the Lakeview residents. He further stated that keeping the streets dry by pumping stormwater into Biscayne Bay and polluting this natural resource and economic engine of the local economy is misguided and short-sided. He continued by stating that the Blue and Green infrastructure discussion needs to address how to minimize harm to the environment. This does not resolve from the City resiliencies efforts. He stated that he is counting on the BGSI plan also to include a recommendation to averse the existing Miami Beach landscape order in section 126-16, requiring the adjacent property owner to be responsible to maintain trees. He also asked why Miami Beach was the only city in Miami Dade and Broward counties that does not keep the trees in their right-of-way. Planting large canopy trees in the right-of-way and requiring the adjacent property owners to be responsible for their maintenance is counter-productive for implementing and maintaining the healthy tree canopy. He stated this is a critical component of any action plan. Residents want to make sure that the city learns from their past mistakes.
• Resident, Ben Mosthoff, stated that over the past five years, Biscayne Bay’s entire ecosystem has transformed, and it is now dying, and stormwater is a contributing factor. He explained that Miami Beach should be serving as a role model for stormwater management. It is not sustainable and not blue; there should not be any discharge of stormwater in the Bay.

• Resident, Jennifer Kaiser asked what the overall cost was, and she stated there was not a budget presented. Ms. Kaiser also mentioned that the City has already the highest taxes and she asked if there was a possibility to create a volunteer maintenance program where the community can give back; that way the taxes do not need to go up. She also asked how long the project would take from start to finish and if they are planning to remove any trees.
  - Mr. Rozza of Jacobs Engineering responded that there should be an understanding of the relationship between cost and value because sometimes there is a need to focus on the value of things. Most of these issues relate to understanding the full picture of cost and benefits.
  - He further explained, in terms of how long this will take, and stated it is about going back to the process. He mentioned that they were on the stage of just bringing ideas, practices, and implementation strategies and trying to get a sense of what is going to work best in Miami Beach. The next step would be the design criteria packages, and that is when the ideas and concepts become specific. The transformation will happen over a long period, looking at gradual change, and as this evolves, the community will be able to see the benefits.
  - Ms. Paul of Jacobs Engineering added the goal is certainly to preserve as many trees as is feasible. She also mentioned they will perform an assessment to determine the quality of the tree. She explained saving a diseased tree would not be worthwhile at times.

• Resident, Alexander Zastera, stated that there would be a level of discomfort when it comes to some of the things residents are going to have to take on, but they are investing in the future.

• Resident, Alec Jimenez, asked how long a project like option two and option three for the Miami Beach Golf Course would take to be completed.
  - Mr. Matt Friesen of Jacobs Engineering responded that there are different factors to consider, but he stated that realistically they are looking at an approximately 10-year period.

• Resident, Rick Kendle, asked what the average cost of a bio-swale is. Moreover, he also asked how sea-level rise would be fixed when politicians dictate where sea level projects should be done.
• Resident, Chi-Chi Truong, asked if there was a possibility of a more permanent groundwater management solution or if the intent is that the vertical development will out phase sea level rise. Mr. Truong also asked if the team is looking at other storm events as well such as cloud sea, because that happens a lot and he wants to know if the Blue and Green strategies can handle its capacity.
  o A Jacobs Engineering team member responded that in terms of the cloud burst events, the team is looking at those and completed an analysis over the County on how storms are projected to intensity or change over time, and it would be considered as part of the project. In terms of groundwater management, there is a variety of options to maintain that separation from the ground over time.

• Resident, Abraan Gonzalez, stated that there are a large amount if problems for the residences and that in every neighborhood they will be assessing, people are living in these problems every day. Most importantly, the result will impact these people’s lives and their quality of life. He encouraged the team to include the residents in the process.
  o Ms. Paul responded by stating that reaching the residents will be part of the next steps because they want the input from the community.

• Resident, Ebru Ozer, stated that her comments would be related to the education component related to the project. She asked if they are considering an educational facility or school ground component, where one can also integrate this, because most of the problems that the community is seeing here today are because of the lack of education, no signages or perspectives. She added that the team should make this visible for the community. Ms. Ozer proposed school grounds to allow easy maintenance and monitoring, and she also asked how these projects would be monitored.
  o Ms. Paul responded that there are amazing opportunities to integrate Blue and Green to school grounds.
  o A Jacobs Engineering team member responded that they love the idea of education to create awareness; there is also an excellent opportunity to involve universities and conservation organizations.

• Resident, Jonathan Welsh, stated that he looks forward to working on this project with the team because it is the future.

• Resident, Francois Monot, stated that as a resident, he does not want streets torn down and raised. He believes it is a bad project that will not be helpful. He also mentioned that it looks like the is going forward with the project without consulting all the residents.
  o A Jacobs Engineering team member responded that the Blue and Green infrastructure does provide some flood relief and it also offers many water quality benefits. There is a cost associated with this benefit, but it can be very valuable.
Resilience Conversation Series
Blue Green Infrastructure

- Resident, Dave Duerler, stated he was very excited with the project because of the water quality benefits. However, there are some concerns about the current designs of pump stations and infrastructure. He asked if there was an opportunity to investigate ways on how it might be able to build additional Blue and Green infrastructure into the pump stations.
  - Mr. Potts responded that there are opportunities and that the team will be looking at those.

The Public Information Officer Ms. Diaz thanked the participants for attending the meeting and participating, and she encouraged them to continue providing feedback on the boards outside the room.
# Resilience Conversation Series
Blue Green Infrastructure Discussion

**Tuesday, September 17, 2019 | 6:30 PM**
City Hall Commission Chambers
1700 Convention Center Drive, Third Floor

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**NOTE:** The above information was recorded in real-time by a participant. It has not been verified by the panelists or organizers.
## Resilience Conversation Series

**Blue Green Infrastructure Discussion**

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**Location:** City Hall Commission Chambers  
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# Resilience Conversation Series

## Blue Green Infrastructure Discussion

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</tr>
<tr>
<td>Helen Kropf</td>
<td></td>
<td>305-968-5836</td>
<td><a href="mailto:hkelist@gmail.com">hkelist@gmail.com</a></td>
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<tr>
<td>Luke Hewes</td>
<td></td>
<td>786-330-5096</td>
<td><a href="mailto:lthomas@hospitalityintl.com">lthomas@hospitalityintl.com</a></td>
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<tr>
<td>Sam Koff</td>
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<td>305-903-0187</td>
<td><a href="mailto:rwillkes@adelphia.com">rwillkes@adelphia.com</a></td>
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<tr>
<td>Andrew Sykes</td>
<td></td>
<td>215-783-2801</td>
<td><a href="mailto:andrew.g.slyes@comcast.com">andrew.g.slyes@comcast.com</a></td>
</tr>
</tbody>
</table>
### Resilience Conversation Series

**Blue Green Infrastructure Discussion**

**Tuesday, September 17, 2019 | 6:30 PM**

*City Hall Commission Chambers*

1700 Convention Center Drive, Third Floor

<table>
<thead>
<tr>
<th>NAME</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Bruce Bender</td>
<td>Myself</td>
<td>305-975-0002</td>
<td>BB3052001.com</td>
</tr>
<tr>
<td>Ben Mostow</td>
<td>WE LOVE LAKEVIEW/MYSELF</td>
<td></td>
<td><a href="mailto:ARTYREEF@GMAIL.COM">ARTYREEF@GMAIL.COM</a></td>
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<tr>
<td>Harry Ohara</td>
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<td>Jeff Berania</td>
<td>Myself</td>
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<td><a href="mailto:jeffcon@zarzwinglaw.com">jeffcon@zarzwinglaw.com</a></td>
</tr>
<tr>
<td>Nancy Bernstein</td>
<td>Myself</td>
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<td><a href="mailto:nonge@nancyberstein.com">nonge@nancyberstein.com</a></td>
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<td>Neil Bienstock</td>
<td>Resident</td>
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<td><a href="mailto:bienstock@gmail.com">bienstock@gmail.com</a></td>
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<td>Arvello Alescu</td>
<td>APCE</td>
<td>305-592-7263</td>
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<td>305-673-7011</td>
<td><a href="mailto:laurenfred@miami.beach.gov">laurenfred@miami.beach.gov</a></td>
</tr>
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<tr>
<td>Hyun Eisenstein</td>
<td>self</td>
<td>305 535 2553</td>
<td><a href="mailto:MBPHOS2@GMAIL.COM">MBPHOS2@GMAIL.COM</a></td>
</tr>
<tr>
<td>Emily Mack</td>
<td>self</td>
<td>9057-239339</td>
<td><a href="mailto:finish@jamiabeach.com">finish@jamiabeach.com</a></td>
</tr>
<tr>
<td>Jeff Gula</td>
<td></td>
<td>305 504 5637</td>
<td>JeffGala@bell south.net</td>
</tr>
</tbody>
</table>

*NOTES: The information provided above is based on the sound and information presented by the participants at the event.*
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Gerardo de la Peña</td>
<td>Samuel Huntz</td>
<td>305-601-2540</td>
<td><a href="mailto:SHA9H21@outlook.com">SHA9H21@outlook.com</a></td>
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<td>Eduardo Yepes</td>
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<td>(3) 542-7282</td>
<td><a href="mailto:edye666@arcte.com">edye666@arcte.com</a></td>
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<td>Josephine Baynes</td>
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</tr>
<tr>
<td>Mauricio del Valle</td>
<td>Jacksonville</td>
<td>305-407-8168</td>
<td></td>
</tr>
<tr>
<td>Luis Bonete</td>
<td>Self</td>
<td>-</td>
<td>lr האוונז@mymail.com</td>
</tr>
<tr>
<td>Beatrice Machalaby</td>
<td>Self</td>
<td>(3) 804-9191</td>
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<tr>
<td>Avel Jimenez</td>
<td>Self</td>
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<td>alec@<a href="mailto:jimenez@gmail.com">jimenez@gmail.com</a></td>
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<td>Kick Kendall</td>
<td>Nobe News</td>
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<td><a href="mailto:TAX122@me.com">TAX122@me.com</a></td>
</tr>
</tbody>
</table>
# RESILIENCE CONVERSATION SERIES
## Blue Green Infrastructure Discussion

**Date:** Tuesday, September 17, 2019 | **Time:** 6:30 PM  
**Location:** City Hall Commission Chambers  
1200 Convention Center Drive, Third Floor

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<tbody>
<tr>
<td>Donna Hack</td>
<td>President</td>
<td>305-864-8098</td>
<td></td>
</tr>
<tr>
<td>M. Soto</td>
<td>Resident</td>
<td></td>
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</tr>
<tr>
<td>Erick Cioles</td>
<td>CMB</td>
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<tr>
<td>Benjamn Enfield</td>
<td>Self</td>
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**NOTE:** The information presented above is subject to verification by the City of Miami Beach.
# RESILIENCE CONVERSATION SERIES

**Blue Green Infrastructure Discussion**

**Tuesday, September 17, 2019 | 6:30 PM**

City Hall Commission Chambers
1700 Convention Center Drive, Third Floor

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<tbody>
<tr>
<td>Bob Kust</td>
<td>Live Love Lakeview Inc.</td>
<td>305-864-5110</td>
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# Resilience Conversation Series

## Blue Green Infrastructure Discussion

Tuesday, September 17, 2019 | 6:30 PM  
City Hall Commission Chambers  
1700 Convention Center Drive, Third Floor

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<tbody>
<tr>
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<td>571-236-4473</td>
<td><a href="mailto:tylburn@jacobs.com">tylburn@jacobs.com</a></td>
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<td>Andy Potts</td>
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</tr>
<tr>
<td>Roy Coley</td>
<td>CMB Public</td>
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<tr>
<td>Nelson Perez</td>
<td>CMB PPD</td>
<td></td>
<td></td>
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<tr>
<td>Gary Martinez</td>
<td>CM - PWD</td>
<td>(818) 347-8942</td>
<td><a href="mailto:yonside@msn.com">yonside@msn.com</a></td>
</tr>
<tr>
<td>Andy de la Torre</td>
<td>CM - PWD</td>
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</tr>
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# RESILIENCE CONVERSATION SERIES

## Blue Green Infrastructure Discussion

**Tuesday, September 17, 2019 | 6:30 PM**

**City Hall Commission Chambers**

**1700 Convention Center Drive, Third Floor**

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<tr>
<td>Ines Noto</td>
<td>Miami Beach</td>
<td></td>
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</tr>
<tr>
<td>Melissa Berthold</td>
<td>CMB</td>
<td></td>
<td><a href="mailto:melissa@beachmi.gov">melissa@beachmi.gov</a></td>
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<td>Elizabeth Wheeler</td>
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<tr>
<td>Vanessa Vázquez</td>
<td>CMB - CLP</td>
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<tr>
<td>Margarita Kuyff</td>
<td>CMB Environmental</td>
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<tr>
<td>Mitchell Calberstine</td>
<td>CMB Environmental</td>
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</table>

**NOTICE:** This information is included above to confirm that the board adopted the resolution by the process in the presented order.
COMMENT CARD

Name/Nombre: ___________________________ Date/Fecha: ___________________________
Address/Dirección: ___________________________ E-mail/Correo Electrónico: ___________________________
Phone/Teléfono: ___________________________ E-mail/Correo Electrónico: ___________________________

Questions or Comments / Preguntas o Comentarios:

FPL storing nuclear waste under "bins" under Biscayne Bay. Approved by local & federal?
Potential spill risk?

Would you like to receive email communications from the City of Miami Beach?  YES  NO

COMMENT CARD

Name/Nombre: Chi Chi Truong  Date/Fecha: 9/17/19
Address/Dirección: 14050 Biscayne Blvd #916
Phone/Teléfono: ___________________________ E-mail/Correo Electrónico: ___________________________

Questions or Comments / Preguntas o Comentarios:

strategy to maximize storage potential; Is it given the dependence on permeable sands and berms and etc. on flood protection?

Would you like to receive email communications from the City of Miami Beach?  YES  NO
Name/Nombre: Lisa Erist Date/Fecha: Sept 17, 2019
Address/Dirección: 900 Lakeview Dr.
Phone/Telefónoa: (305) 519-1415 E-mail/Correo Electrónico: LOFISTACOOL.COM

We kept hearing about the BOSI and the reduction of heat island effect - but all I see is a lot of more buildings. How does one accommodate this?

Q: Where is the balance? How does one accomplish your reduction in heat island effect?
Comment Card

Patrick Shearer
2016 Bay Dr, 207
786-517-2632
pshearer@desclinesinc.com
9/17/19

Are any of the Jacobs folks local?!

What about Previous Paver Roads / raised w/ storage in roadside and infiltrate into subsalt, create head & face water down w/ underground cutoff walls so water doesn't bubble up around ground in surrounding lower areas. Hickory Dr. in Melvina is a complete pervious street using PaveDrain. Miami Beach should do this.

Would you like to receive email communications from the City of Miami Beach? [YES [ ] NO

Sort of failed to mention we need to create depressed areas for all storms to drain to - Regardless of size.

Walter - I'm service they need to dig in MB HOA meetings & Levels said living here line could tolerate 1 foot of water 25% of time small projects. MB needs get on Short's flood insurance not for St. Roys - previous raised streets & food storage in roadway.

Flood insurance - good direction.

Jacks Love for current - they need to redesign eveyr necessarily renovate or cut "cutting edge" I think.

Love for current - biggest "storm" around 1/5 of total. 8" 5" = good direction.

Walter, Matt Alvarez, Blue Green Teams. Plenty of current w/ design standards, what local community live well with.

I think there is a total of 56 - mix. Good direction.
Comment Card

Name: Nancy Bernstein
Address: 40th N. Bay Rd
Phone: 305-490-9175
E-mail: nanycb+nyc

Questions or Comments:

there is a little green area about an acre big. So far I have not seen any plans for this area. Will this become a blue space? I don't understand why you would lose 59th St. & N Bay for all the renovations and neglect 63rd & N Bay. Also will you be raising the streets to abrown into the blue areas or leaving how the grey blue and green on the streets integrate.

Comment Card

Name: Nancy Bernstein
Address: 40th N. Bay Rd
Phone: 305-490-9175
E-mail: nanycb+nyc

Questions or Comments:

NO MORE ASPHALT PLEASE!!
GO BIG ON BLUE/GREEN.

Would you like to receive email communications from the City of Miami Beach? [x] YES [ ] NO
**COMMENT CARD**

**IN-PERSON**  **FACEBOOK LIVE**  **E-MAIL**

Name/Nombre: **DAVE OUELLET**  Date/Fecha: 

Address/Dirección: 

Phone/Teléfono: 

E-mail/Correo Electrónico: 

Questions or Comments / Preguntas o Comentarios: 

Would you like to receive email communications from the City of Miami Beach? [ ] YES [ ] NO

---

**COMMENT CARD**

**IN-PERSON**  **FACEBOOK LIVE**  **E-MAIL**

Name/Nombre: **FRANCOIS MONOT**  Date/Fecha: 9/17

Address/Dirección: **777 LAKE VIEW DR**

Phone/Teléfono: **786.212.7631**  E-mail/Correo Electrónico: FRANCOISMONOT@YAHOO.FR

Questions or Comments / Preguntas o Comentarios:

WHEN ARE WE GOING TO BE CONSULTED NEIGHBOR TO SEE IF THE STREETS HAVE TO BE CARED UP LAKEVIEW OR IF A CHEAPER SOLUTION ECOLOGICALLY AND ECONOMICALLY CAN BE IMPLEMENTED INSTEAD.

Would you like to receive email communications from the City of Miami Beach? [ ] YES [ ] NO
Resilience Conversation Series
Blue Green Infrastructure

Phone: 954-723-5817  E-mail/Correo Electrónico: VoteJonWeish@gmail.com

Comment Card

Would you like to receive email communications from the City of Miami Beach? | YES | NO

Comment Card

Would you like to receive email communications from the City of Miami Beach? | YES | NO
Resilience Conversation Series
Blue Green Infrastructure

NAME: ALEJANDRO GONZALES
ADDRESS: 5100 Laguna Drive
DATE: 9/17/19

Would you like to receive email communications from the City of Miami Beach? [ ] YES [ ] NO

Questions or Comments / Preguntas o Comentarios:

I'm a 4th grader and I'm keeping an eye out for what's going to happen.

NAME: Chi Chi Truong

Comments or Suggestions:

With your underground solution to the high ground water table, this is a temporary solution, but do you envision a more permanent ground water management system will be necessary and what might that entail?

Many of the design storms from South Florida will not be over the 20-year rainfall, but I've heard some consideration of per centimetric storms. What are those storms and how are they?
Resilience Conversation Series
Blue Green Infrastructure

MIAMI BEACH

Resilience Conversation Series
Blue Green Infrastructure
MIAMI BEACH

Resilience Conversation Series
Blue Green Infrastructure

(1) Our city founders created big swales 60+ years ago. We already have swales/rain gardens but they have been filled in. Where is the SWALE Mgmt Plan that we prepared 10 yrs ago?

(2) Why is a big swale $5M+ estimating #850K for 4 of cost per ft or 4x 'swales'?

Resilience Conversation Series
Blue Green Infrastructure

MIAMI BEACH

Resilience Conversation Series
Blue Green Infrastructure

PUBLIC OUTREACH REPORT

COMMENT CARD
IN-PERSON FACEBOOK LIVE E-MAIL

Name/Nombre: Rick Kendle Date/Tiempo: 9/17/19
Address/Dirección: 99 Bay Dr.
Phone/Telefonía: 305-772-6681 E-mail/Correo Electrónico: rax123@me.com

(1) Our city founders created big swales 60+ years ago. We already have swales/rain gardens but they have been filled in. Where is the SWALE Mgmt Plan that we prepared 10 yrs ago?

(2) Why is a big swale $5M+ estimating #850K for 4 of cost per ft or 4x 'swales'?

Resilience Conversation Series
Blue Green Infrastructure

MIAMI BEACH

Resilience Conversation Series
Blue Green Infrastructure

PUBLIC OUTREACH REPORT

COMMENT CARD
IN-PERSON FACEBOOK LIVE E-MAIL

Name/Nombre: ALEC JIMENEZ Date/Tiempo: 9/17
Address/Dirección: 1520 Meridian Ave Apt 257
Phone/Telefonía: 305-815-0140 E-mail/Correo Electrónico: alecjimenez@gmail.com

Questions or Comments / Preguntas o Comentarios:
HOW POSSIBLE IS A CF-3 MIAMI BEACH OR LARGE BLUE/GREEN INFRASTRUCTURE OPTION?
CAN THIS BE DONE BEFORE 2030/2050?

Would you like to receive email communications from the City of Miami Beach? [ ] YES [ ] NO
COMMENT CARD

IN-PERSON   FACEBOOK LIVE   E-MAIL

Name/Nombre: Alexander Zasteva
Address/Dirección: 900 North St., Apt. 207
Phone/Telefónía: 
E-mail/Correo Electrónico: zasteva@gmail.com

Question or Comments / Preguntas a Comentarios:

Reminder of future generations

Would you like to receive email communications from the City of Miami Beach? [ ] YES [ ] NO

COMMENT CARD

IN-PERSON   FACEBOOK LIVE   E-MAIL

Name/Nombre: Jennifer Kaiser
Address/Dirección: 1400 N. Hibiscus Dr., Miami Beach, 33139
Phone/Telefónía: 760-252-4631
E-mail/Correo Electrónico: jkmrae@gmail.com

Questions or Comments / Preguntas a Comentarios:

- Overall Cost?
- Long term maintenance costs?
- Tax increase?
- How long from start to finish?

Would you like to receive email communications from the City of Miami Beach? [ ] YES [ ] NO
Resilience Conversation Series
Blue Green Infrastructure

COMMENT CARD

Name/Nombre: Bob Mosthoff
Address/Dirección: 4600 Lakeview Drive

Date/Téca: 9/17/2019

MIAMI BEACH IS SETTING THE NEW STANDARDS
RELEASE OF STORM WATER INTO BISCAYNE BAY

Would you like to receive email communications from the City of Miami Beach? | YES | NO

COMMENT CARD

Name/Nombre: Peter Luria
Address/Dirección: 1800 W 23 Street

Date/Téca: 9/17/19

I would like to make a few comments after the presentation

Would you like to receive email communications from the City of Miami Beach? | YES | NO

+ Already do receive city communications
COMMENT CARD

Name/Nombre: Michael Laas

Date/Fecha: 9/1/19

Address/Dirección:

Phone/Teléfono: Michael.Laas@email.com

Email/Correo Electrónico:

Questions or Comments / Preguntas a Comentarios:

- How will BGI adapt to rising sea levels and the base elevation will need to be raised frequently.
- How does BGI interact with the built environment, meaning water management from buildings, run off.

Would you like to receive email communications from the City of Miami Beach? [ ] YES [ ] NO

COMMENT CARD

Name/Nombre: Glenn Norton

Date/Fecha: 9/17/19

Address/Dirección: 5242 North Bay Road

Phone/Telefon: glenn.norton@email.com

Email/Correo Electrónico:

Questions or Comments / Preguntas a Comentarios:

1. Must residential streets be wide enough for cleaner traffic.
2. Does this vegetation encourage mosquito and algae growth?
3. How do we control mosquitoes? Who is responsible?
4. What is the life span of paving roads?
5. Collins Canal—when does the water diminish?
6. Can we change to more green?
Name/Nombre: GARY MARTINEZ
Date/Fecha: 09/17/2019
Address/Dirección: 1061 EUCLID AVE # 102
Phone/Teléfono: (305) 347-8942 Email/Correo Electrónico: vonsider@msn.com

Would you like to receive email communications from the City of Miami Beach? [ ] YES [ ] NO

Name/Nombre: LILY FISST
Date/Fecha: 09/17/19
Address/Dirección: 800 LAKEVIEW PIVE
Phone/Teléfono: (305) 519-1415 Email/Correo Electrónico: LOP1st@AOL.com

Q. How will you maintain these public landscaping and streets?
Q. How will you get developers to implement these heartful - green roofs and all these devices in that project (all these planting you showed on the streets)?
Q. What flooding (Haiti). What is your strategy for the public park?
Resilience Conversation Series
Blue Green Infrastructure

**COMMENT CARD**

**IN-PERSON**  **FACEBOOK LIVE**  **E-MAIL**

Name/Nombre: **JEFF GALE**  Date/Fecha: **9/17/19**
Address/Dirección: **4360 Royal Palm Avenue, MB 33140**
Phone/Teléfono: **305/884-5637**  E-mail/Correo Electrónico: **JEFF.GALELAW@BELLSON.COM**

Questions or Comments / Preguntas o Comentarios:

Would you like to receive email communications from the City of Miami Beach? [ ] YES [ ] NO

---

**COMMENT CARD**

**IN-PERSON**  **FACEBOOK LIVE**  **E-MAIL**

Name/Nombre: **LIZ LATORRE**  Date/Fecha: **9/17/19**
Address/Dirección:
Phone/Teléfono: **415/232-2621**  E-mail/Correo Electrónico: **LIZA@GMAIL.COM**

Questions or Comments / Preguntas o Comentarios:

"With so much money being spent to improve our city parks, are canopy trees planned to shade whole parks?"  "Re: Golf Course - garden center a new Marlin/Convention Center park only a few blocks away, why take away the golf course?"

Would you like to receive email communications from the City of Miami Beach? [ ] YES [ ] NO
Social Media Posts

Posted on September 17, 2019 - Facebook

City of Miami Beach Retweeted
Commissioner Eileen Higgins @CommHogan - Sep 17
The MDS team joined a packed house at @MiamiBeachNews for the first of their Resilience Conversation Series on blue and green stormwater infrastructure. I’m inspired by #MiamiBeach’s innovative, solution-driven thinking when it comes to our changing environment #MBRaingAbove

Posted on September 17, 2019 - Twitter

City of Miami Beach @MiamiBeachNews | Sep 17
Preview blue & green infrastructure concepts being developed for Miami Beach tonight during the first of our Resilience Conversation series!

We begin at 6:30 PM at 1700 Convention Center, Biscayne, 3rd floor.

Stream online: miami(beach)/government/rb... #MBRaingAbove - at Miami Beach City Hall

Posted on September 17, 2019 - Facebook

City of Miami Beach Government
17 on September a las 18:45

“We need to hear from the residents who will be living with these solutions so tonight is very important for our team.”

Full house tonight in Commission Chambers as the Jacobs Engineering team explains how over the past few months they have evaluated all the different blue-green infrastructure options. Specifically what is and is not applicable in Miami Beach.

Stream online here: https://www.miami(beach)/government/rb... Ver más

Posted on September 17, 2019 - Facebook

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Resilience Conversation Series
Blue Green Infrastructure

City of Miami Beach Government.
17 on September 17, 17:58
Preview blue & green infrastructure concepts being developed for Miami Beach tonight during the first of our Resilience Conversation series! We begin at 6:30 PM inside Commission Chambers located on the 3rd floor of City Hall (1700 Convention Center Drive).
Can’t make it? Watch live on MBTV or stream online here https://www.miamibeach3.gov/government/mbtv

Posted on September 17, 2019 - Facebook

City of Miami Beach @MiamiBeachNews - Sep 17
The City retained Jacobs Engineering to evaluate our programs because we want to get it right.

Today’s meeting is about ‘the water and the grass’. There will be other opportunities to talk about the engineering such as the road raising...
@MayorDarGelber

#MBRisingAbove

Posted on September 17, 2019 - Twitter
<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matt Alvarez</td>
<td>Project Manager</td>
<td>25</td>
</tr>
<tr>
<td>Tom Ryburn</td>
<td>Deputy Project Manager/Implementation Task Lead</td>
<td>30</td>
</tr>
<tr>
<td>Laurens van der Tak</td>
<td>Climate Adaptation Advisory Panel</td>
<td>30</td>
</tr>
<tr>
<td>Jason Bird</td>
<td>Planning Task Lead</td>
<td>19</td>
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<tr>
<td>Andy Potts</td>
<td>Blue-Green Infrastructure Task Lead</td>
<td>19</td>
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<tr>
<td>Joe Rozza</td>
<td>Blue-Green &amp; Sustainability</td>
<td>25</td>
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<tr>
<td>Monica Diaz</td>
<td>Public Outreach</td>
<td>15</td>
</tr>
<tr>
<td>Matt Friesen</td>
<td>Urban Design</td>
<td>13</td>
</tr>
<tr>
<td>Jade Paul</td>
<td>Urban Design</td>
<td>19</td>
</tr>
</tbody>
</table>
REMINDER – PLEASE SUBMIT QUESTIONS AND COMMENTS TONIGHT!

• Submit Question Card
• Online viewers email questions to: MBRisingAbove@miamibeachfl.gov
• Open comment period through September 24, 2019

Questions on Citywide Stormwater Management? Please contact:
Liz Bello-Matthews
Public Information Officer – Public Works Department
305-673-7000 ext. 6902
E-mail: LizBello-Matthews@miamibeachfl.gov
AGENDA

• What is BGSI? Why is it used?
• Where can it be used?
• How does it impact:
  – Parking?
  – Mosquitoes?
• How can the public get involved?
• What are the next steps?
• Questions and Answers
WHAT IS BGSI?

• **Green stormwater infrastructure** typically uses vegetation and/or soils to treat and reduce stormwater flows

• **Blue stormwater infrastructure** temporarily stores and treats stormwater

• BGSI is typically designed and sized to capture more frequent storm events

• Different from coastal strategies, such as living shorelines, dunes, mangrove plantings, and oyster or artificial reefs
WHY SHOULD WE USE BGSI?

• **Stormwater benefits**
  – Water quality (WQ)
  – Groundwater recharge
  – Some detention/flood mitigation

• **Community benefits**
  – Urban heat island mitigation
  – Air quality
  – Climate resiliency
  – Ecosystem health/biodiversity
WHAT ARE THE WATER QUALITY BENEFITS?

• BGSI can **reduce pollutants** that threaten the Bay, such as metals, nutrients, sediment, and pathogens

• By retaining rainfall, BGSI **reduces stormwater discharges** and pollutant loads

• BGSI can also **filter stormwater** that is not retained
BY RECHARGING THE FRESHWATER LENS, BGSI CAN HELP KEEP SALT WATER AT BAY TO PROTECT OUR TREES

Source: ULI Advisory Services Panel Report on Miami Beach, 2018 (adapted)
HOW WILL BGSI FIT INTO THE CITY’S FLOOD MITIGATION STRATEGIES?

• Complements “grey” infrastructure

• Provides some detention/flood mitigation, but alone will provide little or no benefit for:
  – “sunny day” flooding
  – flooding from major rainfall
  – storm surge

• Designed for storms 2 inches or less, which is about 25% of the much larger storms typically used for flood control
COMMUNITY (CO-BENEFITS) OF BGSI

BGSI CAN HELP MITIGATE THE URBAN HEAT ISLAND IN THE CITY

Heat Island Effect: higher temperatures in developed areas

Map source: Davey Resource Group
WHAT BGSI PRACTICES ARE LESS APPLICABLE TO MIAMI BEACH?

• Although **not as readily applicable** to Miami Beach, these might still prove beneficial in certain settings:

<table>
<thead>
<tr>
<th>BGSI Practice</th>
<th>Why Less Applicable to Miami Beach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detention Tanks</td>
<td>limited water quality benefit, relatively high costs, lower effectiveness with sea level rise and high tides, proprietary, limited applicability, limited storage capacity</td>
</tr>
<tr>
<td>Exfiltration Trenches</td>
<td></td>
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<tr>
<td>High-Flow Media Filters</td>
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<tr>
<td>Living/Green Walls</td>
<td></td>
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<tr>
<td>Gravity Wells</td>
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<tr>
<td>Subsurface Flow Wetlands</td>
<td></td>
</tr>
</tbody>
</table>
WHAT BGSI PRACTICES ARE MOST APPLICABLE TO MIAMI BEACH?

- Bioretention/Bioswales/Rain Gardens
- Blue and Green Roofs
- Constructed Wetlands/Floating Wetland Islands
- Detention Basins/Surface Storage
- Enhanced Tree Pits/Trenches
- Low Volume Injection Wells (Pumped)
- Permeable Pavement
- Rainwater Harvesting (Cisterns, Rain Barrels)
- Stormwater Planters
- Subsurface Infiltration/Storage
- Tree Canopy
- Wet Ponds

Note: The City is developing an Urban Forestry Master Plan.
WHAT DOES BGSI LOOK LIKE?

- Takes many different forms, from landscaping elements to permeable pavements to ponds to green roofs
- Can vary greatly in appearance, from high-profile features to those that blend in
- Vegetation requires time to get established
Bioretention (Rain Garden)
Stormwater Planters
Vegetated ("Green") Roof
Residential Rain Garden

Residential Rain Barrel
Floating wetland islands in Florida and similar settings
WHERE CAN BGSİ BE USED?

• In a variety of locations:
  – Roads
  – Parks and other open spaces
  – Schools/public facilities
  – On rooftops
  – Residential and commercial properties

• Miami Beach is approximately 40% impervious area

• Goal is to preserve and increase pervious (“green”) area
WHERE IS THE CITY PLANNING TO IMPLEMENT BGSI?

• Roads, parks/open spaces, public facilities; integrated with other planned improvements

• City projects with BGSI under design:
  – Community Park (former Par 3)
  – Maurice Gibbs Park
  – 59th Street Bioswale
  – 1st Street Stormwater Improvements

• Preliminary concepts for:
  – Residential and commercial streets
  – Neighborhood parks
  – Golf Courses
  – Collins Canal

• There is an opportunity to make policy/code changes to further encourage/require private BGSI implementation
Note: all concepts are preliminary and subject to change during budgeting, design, permitting, etc.
COLLINS CANAL

BIKE & PEDESTRIAN LAKES

OLD ROADWAY ELEVATION

SUBSURFACE INFILTRATION TRENCH
SUBSURFACE INFILTRATION WITH SUSPENDED PAVEMENT FOR TREE GROWTH

NEIGHBORHOOD LANDING PARK

FLOATING BOARDWALK

MANGROVE PLANTINGS

PASSIVE RECREATION

FLOATING WETLANDS

NEIGHBORHOOD ACCESS

OVER FLOW THROUGH BULKHEAD WALL BEFORE AND BEYOND LANDINGS

NATIVE STREET TREES
COMMERCIAL STREET
RESIDENTIAL STREET
NEIGHBORHOOD PARK
MIAMI BEACH GOLF COURSE
THE ART OF THE POSSIBLE
MIAMI BEACH GOLF COURSE

The Art of the Possible
Scenario 1 – Retrofit

- Bioswales
- Detention Basins
- Wet Ponds
- Permeable Pavement
- Rainwater Harvesting
- 18 Holes of Golf
MIAMI BEACH GOLF COURSE

The Art of the Possible
Scenario 2 – Repurpose
• Bioretention Edges
• Detention Basin
• “Green” Recreation Center
• Wet Ponds
• Constructed Wetlands
• 9 Holes of Golf
MIAMI BEACH GOLF COURSE

The Art of the Possible
Scenario 3 – Reimagine
• Wetland Park
• “Green” Edges
• “Green” Recreation Hub
• Living Machine Gardens
• “Living with Water” Eco-District
For implementing blue-green infrastructure across Miami Beach, Florida-friendly plants are the perfect choice as they are climate-adapted, excel at ecosystem services, and enhance sense of place.

Species such as mangroves will be used for living shoreline environments.

Species such as duck potato, Fakahatchee grass, and red maple will be used from the Florida wetland plant community.

Species such as South Florida slash pine and saw palmetto will be used from South Florida pine flatwood plant community.
Note: suggestions are subject to budgetary and other constraints.
WILL BGSI REDUCE PARKING?

• Parking will be evaluated and discussed with stakeholders on a project-by-project basis

• BGSI is often strategically located in areas where parking is already not permitted to minimize impacts
• Some BGSI may reduce parking along streets and in parking lots if vegetated BGSI is used
• In most cases there are options that do not reduce parking
WILL BGSI PROMOTE MOSQUITO BREEDING?

- No, if properly designed, constructed, and maintained
- BGSI that is typically dry should empty within 3 days, and should be checked frequently
- BGSI that holds water over 7 days must use other methods to prevent mosquito growth
  - Screening
  - Natural predator populations
  - Mosquito-specific larvicides

Note: Appropriate precautions against mosquitoes should be taken whether there are BGSI practices present or not.
WHAT CAN THE PUBLIC DO TO PROMOTE BGSI IN MIAMI BEACH?

• Advocate for it
• Implement/maintain it on your property:
  – Roadside swales
  – Rain barrels
  – Rain gardens
  – Trees
• Help protect and maintain public BGSI (once it is constructed) through grassroots adoption programs
• Residents and businesses will be a key partner for BGSI
Residential Rain Garden
Existing Grass Swales and Trees in Neighborhoods are Important to Stormwater Management
WHAT ARE THE NEXT STEPS?

• Compile and incorporate public input
• Additional opportunities for input:
  – Public comment period (9/17 - 9/24)
  – Sustainability & Resiliency Committee (9/25)
  – Commission meeting (10/16)
  – Future neighborhood meetings for specific projects
  – Grassroots efforts neighborhood by neighborhood
  – Website updates - www.MBrisingAbove.com

Questions on BGSI? Please contact:
Monica R. Diaz
Infinite Source Communications Group
305-573-0089
E-mail: Monica@iscprgroup.com

Questions on Citywide Stormwater Management? Please contact:
Liz Bello-Matthews
Public Information Officer – Public Works Department
305-673-7000 ext. 6902
E-mail: LizBello-Matthews@miamibeachfl.gov
RESILIENCE CONVERSATION SERIES: BLUE-GREEN INFRASTRUCTURE

September 17, 2019
ADDITIONAL SLIDES FOR Q&A
SHALLOW GROUNDWATER ELEVATIONS MAY LIMIT USE OF SOME BGSI PRACTICES

Source: Groundwater Elevation Monitoring and Mapping (E Sciences, 2014)
OUTLINE OF BGSI CONCEPT PLAN

• Introduction (Objectives, User’s Guide)
• Miami Beach Context (land use, hydrology, topography, etc.)
• Blue-Green Infrastructure Practices and Strategies
  – 1-page Fact Sheets of Practices
  – 2-page Fact Sheets of Strategies/Scenarios
• Site Concepts and Renderings
• Recommendations

Meant for a Wide Range of Users

Intended to inform Master Planning, CIP Planning, Design Criteria Packages (DCPs), New Development and Other Policies
Residential Rain Garden
Garden Apartments
ADDITIONAL BGSI FAQs

• How does BGSI get maintained?
• Will BGSI reduce recreational space?
• Where can I find more information on BGSI?
• How much will BGSI cost?
• What other City projects might incorporate BGSI?
How does BGSI get maintained?

- BGSI practices require a variety of maintenance activities depending on the type of BGSI and site-specific factors.

- Landscaped BGSI require maintenance typical of other landscaped areas, potentially including trash removal, pruning, weeding, and erosion repair.

- Many BGSI practices include devices for pretreatment of runoff that require periodic sediment and debris removal.

- Permeable pavements require the surface to be cleaned to prevent clogging.
WILL BGSI REDUCE RECREATIONAL SPACE?

- Locations for BGSI in parks and other open spaces will be carefully considered to minimize impacts to the usage of the sites.

- In many cases, BGSI may serve both recreational and stormwater purposes (for example, a permeable pavement basketball or tennis court).

- BGSI can also enhance recreational spaces by providing additional landscape features.
HOW MUCH WILL BGSI COST?

• BGSI is about **value**
• Specific BGSI project costs will be determined in future phases
• Costs vary greatly based on practice type, site conditions, sizing, type of site, etc.
• BGSI is less expensive when part of development/redevelopment vs. retrofitted in later
• Potential cost reduction strategies include:
  – Integrate with other infrastructure projects/planned improvements
  – Standardize designs and streamline implementation
  – Seek economies of scale through
    ▪ Practices that hold a greater volume or manage larger drainage areas
    ▪ By bundling projects
    ▪ Through neighborhood-scale projects
## ADDITIONAL INFORMATION

<table>
<thead>
<tr>
<th>Resource</th>
<th>Source/Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rising Above web site</td>
<td><a href="http://www.mbrisingabove.com/climate-adaptation/">http://www.mbrisingabove.com/climate-adaptation/</a></td>
</tr>
<tr>
<td>Sarasota County Low Impact Development Guidance Document</td>
<td><a href="https://www.scgov.net/home/showdocument?id=33258">https://www.scgov.net/home/showdocument?id=33258</a></td>
</tr>
<tr>
<td>University of Florida Soil and Water Sciences Video Topics: Green Stormwater Infrastructure</td>
<td><a href="https://soils.ifas.ufl.edu/extension/videos/low-impact-development/">https://soils.ifas.ufl.edu/extension/videos/low-impact-development/</a></td>
</tr>
<tr>
<td>Constructed Floating Wetlands: A review of research, design, operation and management aspects, and data meta-analysis</td>
<td><a href="https://apirs.plants.ifas.ufl.edu/site/assets/files/372369/372369.pdf">https://apirs.plants.ifas.ufl.edu/site/assets/files/372369/372369.pdf</a></td>
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</table>

Note that the City and Jacobs are not specifically endorsing all of the information provided in these sources but is providing them for general information to be used with discretion.
POTENTIAL BGSI (INTEGRATED W/ PLANNED CITY PROJECTS)
ADDITIONAL POTENTIAL BGSI
(INTEGRATED W/PLANNED TRANSPORTATION IMPROVEMENTS AND TRIANGULAR OPEN SPACES)
Tell us what you think of the draft concept for... WELCOME TO THE CITY OF MIAMI BEACH’S RESILIENCE CONVERSATION SERIES ON BLUE GREEN INFRASTRUCTURE

Did you know Miami Beach is implementing creative infrastructure techniques to mitigate flooding and improve our water quality as part of our Integrated Water Management Strategy? Tonight, you’ll get a sneak peek at the overall approach and draft concepts for specific projects.

Join us for a presentation to discuss the proposed approach to blue green infrastructure and the potential co-benefits for recreation and social spaces.

Following the presentation there are displays of proposed concepts that could help our city live with water, including:

- Typical interventions that will be recommended in the City’s upcoming Blue Green Infrastructure Concept Plan
- Alternative conceptual designs for transformative, city-scale, blue green infrastructure projects.

Share your thoughts by voting with dot stickers and writing your comments on the boards.
FLORIDA-FRIENDLY PLANTS FOR BIORETENTION + BIOSWALE APPLICATIONS

- Conoclinium coelestinum
  Blue Mistflower
- Stachyophyta jamaicensis
  Blue Porterweed
- Erythrina herbacea
  Coralbean
- Heliotropium angiospermum
  Scorpion Tail
- Tripsacum dactyloides
  Fakahatchee Grass
- Tripsacum floridanum
  Florida Gamagrass
- Muhlenbergia capillaris
  Muhly Grass
- Serenoa repens
  Saw Palmetto
- Eleocharis cellulosa
  Spikerush
- Stachytarpheta jamaicensis
  Blue Porterweed
- Tripsacum dactyloides
  Fakahatchee Grass
- Tripsacum floridanum
  Florida Gamagrass
- Muhlenbergia capillaris
  Muhly Grass
- Serenoa repens
  Saw Palmetto

FLORIDA-FRIENDLY PLANTS FOR CONSTRUCTED WETLANDS

- Ilex cassine
  Dahoon Holly
- Cocothrinax argentata
  Silver Palm
- Thrinax morrisii
  Key Thatch Palm
- Lysiloma latifolium
  Wild Tamarind
- Quercus virginiana
  Live oak
- Pontederia cordata
  Pickerelweed
- Nymphaea odorata
  Fragrant Water Lily
- Sagittaria latifolia
  Arrowhead
- Crinum americanum
  Swamp Lily
- Sagittaria lancifolia
  Spikerush
- Eleocharis recurvata
  Knotted Spikerush
- Iris virginica
  Blue Flag Iris
- Canna flaccida
  Golden Canna
- Spartina alterniflora
  Sand Cord Grass
- Taxodium ascendans
  Pond Cypress
- Ilex cassine
  Dahoon Holly
- Cocothrinax argentata
  Silver Palm
- Thrinax morrisii
  Key Thatch Palm
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  Sand Cord Grass
- Taxodium ascendans
  Pond Cypress

South Florida is home to a diverse and vibrant tapestry of plant communities and ecosystems. For implementing blue green infrastructure across Miami Beach, Florida-friendly plants are the perfect choice as they are climate adapted, excel at ecosystem services and enhance sense of place. The list below is a summary of species that may be used in the BGI program.
South Florida is home to a diverse and vibrant tapestry of plant communities and ecosystems. For implementing blue green infrastructure across Miami Beach, Florida-friendly plants are the perfect choice as they are **climate adapted**, excel at **ecosystem services** and enhance **sense of place**. The list below is a **summary of species** that may be used in the BGI program.

**FLORIDA-FRIENDLY PLANTS FOR CONSTRUCTED SALT MARSHES AND MANGROVES**

- Borrichia arborescens
- Helianthus debilis
- Heliotropium curassavicum
- Portulaca pilosa
- Salicornia bigelovii
- Strumphia maritima
- Juncus roemerianus
- Spartina patens

- Coccoloba uvifera
- Avicennia germinans
- Helianthus debilis
- Portulaca pilosa
- Salicornia bigelovii
- Strumphia maritima
- Juncus roemerianus
- Spartina patens

- Conocarpus erectus
- Conocarpus erectus var. sericeus
- Coccoloba uvifera
- Coccoloba diversifolia

- Beach Sunflower
- White Mangrove
- Silver Buttonwood
- Pigeon plum

**FLORIDA-FRIENDLY TREES FOR URBAN CANOPY RESTORATION**

- Acer rubrum
- Codiaeum variegatum
- Quercus laurifolia
- Pinus elliottii var. densa
- Bursera simaruba
- Ocotea coriacea
- Knudodendron ferreum
- Swietenia mahagoni

- Red Maple
- Geiger Tree
- Laurel Oak
- South Florida Slash Pine
- Gumbo Limbo Tree
- Lancewood
- Black Ironwood
- American Mahogany

---

**BGI PLANT MATRIX**

**FLORIDA-FRIENDLY PLANTS FOR CONSTRUCTED SALT MARSHES AND MANGROVES**

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- Gumbo Limbo Tree
- Lancewood
- Black Ironwood
- American Mahogany

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**BLUE GREEN INFRASTRUCTURE PILOT PROJECT CONCEPT**
The Collins Canal is an existing, man-made channel that runs parallel to Dade Boulevard, connecting Indian Creek to Biscayne Bay. By adding constructed wetlands, enhanced tree pits and trenches, and permeable pavement to its design, we can increase the amount of water that is absorbed and treated.

**How it Works**

1. **Managed Aquatic Plant Systems**
   Managed Aquatic Plant Systems (MAPS) provide habitat, enhance aesthetics, and improve water quality in the canal by reducing common pollutants such as nitrogen, phosphorus, and suspended solids. MAPS will be anchored into the canal bottom, allowing them to rise during flood/high-tide conditions and remain functional and resilient.

2. **Enhanced Tree Pits/Trenches**
   Filters and stores stormwater flows to improve water quality prior to discharging into the canal, while providing significant rooting volume for street trees.

3. **Permeable Pavement**
   Stormwater from Dade Boulevard will flow onto bike and pedestrian lanes constructed of permeable pavement, which looks similar to standard pavement but allows water to drain through its openings and into an underlying infiltration/storage trench. Permeable pavement will reduce the amount of stormwater flowing into the canal.

**Water Management Benefits**
- Capture of roadway runoff helps to reduce peak flows (during high frequency events)
- Treatment of roadway runoff reduces hydrocarbons and heavy metal pollution
- Treatment uptakes nitrogen and phosphorus, reducing likelihood of algae blooms

**Additional Benefits**
- Neighborhood Beautification
- Walking and biking paths
- Waterfront Seating
- Kayak drop-in points

**Collins Canal**

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2. **Enhanced Tree Pits/Trenches**
   Filters and stores stormwater flows to improve water quality prior to discharging into the canal, while providing significant rooting volume for street trees.

3. **Permeable Pavement**
   Stormwater from Dade Boulevard will flow onto bike and pedestrian lanes constructed of permeable pavement, which looks similar to standard pavement but allows water to drain through its openings and into an underlying infiltration/storage trench. Permeable pavement will reduce the amount of stormwater flowing into the canal.

**Water Management Benefits**
- Capture of roadway runoff helps to reduce peak flows (during high frequency events)
- Treatment of roadway runoff reduces hydrocarbons and heavy metal pollution
- Treatment uptakes nitrogen and phosphorus, reducing likelihood of algae blooms

**Additional Benefits**
- Neighborhood Beautification
- Walking and biking paths
- Waterfront Seating
- Kayak drop-in points

**Collins Canal**

**Collins Canal is an existing, man-made channel that runs parallel to Dade Boulevard, connecting Indian Creek to Biscayne Bay.** By adding constructed wetlands, enhanced tree pits and trenches, and permeable pavement to its design, we can increase the amount of water that is absorbed and treated.

**How it Works**

1. **Managed Aquatic Plant Systems**
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In Miami Beach residential streets vary in whether they include on-street parking, curbs, sidewalks, and other improvements, while often accommodating numerous driveways, alleys, and roadway intersections. Permeable pavement, enhanced tree pits, traffic chicanes, and other drainage features such as trench drains can be incorporated within varying residential roadway conditions to **improve water quality, calm traffic**, and **reduce flows to private property**.

**HOW IT WORKS**

1. **PERMEABLE PAVEMENT / DELINEATED ON-STREET PARKING**
   - Stormwater will discharge in defined permeable pavement parking areas. Permeable pavement looks like standard pavement but allows water to drain into an underlying infiltration trench. Permeable pavement will reduce stormwater flowing into private property, minimize soil compaction from parked vehicles on lawns, recharge groundwater, and filter stormwater.

2. **ENHANCED TREE PITS / TRAFFIC CHICANES**
   - Enhanced tree pits located in traffic chicanes will provide shade for residents, reduce traffic speeds on local roads, reduce stormwater discharges, and improve water quality. Enhanced tree pits will also provide significant rooting volume for trees and contribute to a healthier native South Florida ecosystem.

3. **TRENCH DRAINS**
   - Trench drains are depressed linear troughs which manage stormwater flows within the public roadway and allow stormwater to drain through into an underlying infiltration trench. Along with valley curbs, enhanced tree pits, and permeable pavement, trench drains can maintain stormwater flows within a raised public roadway and out of private property.

**ADDITIONAL BENEFITS**
- **Neighborhood beautification**
- **Additional shade for walking and biking**
- **Increased biodiversity**
- **Traffic calming**
- **Reduced heat island effect**

**WATER MANAGEMENT BENEFITS**
- **Capture of roadway runoff helps to reduce peak flows (during high frequency events)**
- **Treatment of roadway runoff reduces hydrocarbons and heavy metal pollution**
- **Treatment and infiltration of stormwater to recharge groundwater supplies and replenish freshwater lens**
**WATER MANAGEMENT BENEFITS**

- Capture of roadway runoff helps to reduce peak flows (during high frequency events).
- Treatment of roadway runoff reduces hydrocarbons and heavy metal pollution.
- Treatment and infiltration of stormwater to recharge groundwater supplies and replenish the freshwater lens.

**ADDITIONAL BENEFITS**

- Neighborhood Beautification
- Increased walking and biking opportunities
- Traffic calming
- Improved sidewalk seating opportunities

Commercial streets often accommodate on-street parking, curbs, and sidewalks serving varying land uses. Lessened driveway conflicts within these corridors provide opportunities for longer segments of permeable pavement, trees, infiltration and storage trenches to improve water quality.
Water Management Benefits:
- Capture of roadway runoff helps to reduce peak flows (during high frequency events)
- Treatment of roadway runoff reduces hydrocarbons and heavy metal pollution
- Treatment and infiltration of stormwater to recharge groundwater supplies

Additional Benefits:
- Neighborhood Beautification
- Walking and biking paths
- Additional shade along park perimeter
- Enhanced biodiversity

Parks provide a great opportunity to collect, infiltrate, and store stormwater during smaller, more frequent rain events. Permeable pavement, enhanced tree pits, bioswales and infiltration trenches may be used near park perimeters and access points. Rain gardens and constructed wetlands can be utilized within parks to reduce stormwater quantities, improve water and air quality, and enhance gathering spaces.
The Art of the Possible - below are three high-level scenarios exploring the redevelopment of the Miami Beach Golf Club into a blue green infrastructure asset: 1) a retrofit scenario - keeping all eighteen holes; 2) a repurpose scenario - converting the back nine holes into a signature park; and 3) a reimagine scenario - converting the club into a central park with potential development opportunities.
Scenario 1 retrofits the Miami Beach Golf Club with tactical blue green infrastructure interventions to reduce stormwater volumes and improve water quality. The existing water hazards and edges of the golf club would be enhanced and redesigned with blue green practices. All eighteen holes and golf facilities would be maintained more or less as they are today.
Scenario 2 repurposes the back nine holes of the Miami Beach Golf Club to create a new signature park focused on integrating passive and active recreation with a robust blue green infrastructure program to mitigate stormwater volumes and improve water quality. In this high-level concept the front nine holes of the Golf Club remain intact as an executive course.

**1. Golf Club Front Nine Stays As-Is**
The land area of the front nine of the golf club is kept intact and reconfigured as necessary for an executive course.

**2. Repurpose the Back Nine**
Consider repurposing the 65 acres comprising the back nine to accommodate BGI interventions and the potential for a substantial open space improvement.

**3. Create a Signature Park Space**
Repurposing the back nine into a signature modern park space. A park which balances environmental, social and economic considerations and provides a framework for district-wide resiliency.

**4. Link BGI Systems in Park to the Neighborhood**
Stormwater storage and water quality measures may be designed to accept and integrate with adjacent BGI improvements, such as Collins Canal.

**How It Works**

- Bioretention Edges
- Detention Basin
- "Green" Recreation Center
- Wet Ponds
- Constructed Wetlands
Scenario 3 reimagines the entire Miami Beach Golf Club to establish a 21st century “Central Park” for Miami Beach. This initial concept sketch explores the potential of a new neighborhood predicated on a Living with Water theme, a recreation hub, and a signature wetland park with hiking and biking trails and passive and active recreation opportunities.

REIMAGINE ALL 145 ACRES
The entire publicly-owned golf club may be transformed into an amenity for all Miami Beach residents. One that responds to a holistic view of sustainability.

MIAMI BEACH’S CENTRAL PARK
Reimagining the golf club as a new central park for Miami Beach. A 21st century open space working to bring people together while improving the city’s resiliency.

A POSTCARD DESTINATION
The potential is to create a new postcard moment for Miami Beach – one that advertises its proactive approach to mitigating climate change impacts and understanding urban placemaking.

LIVING WITH WATER
Additional potential opportunities may include leveraging a portion of the land for public and private development, such as a mixed-use eco-district working to fulfill the City’s objectives on sustainability, social equity and environmental justice.

HOW IT WORKS
MIAMI BEACH GOLF CLUB

1. REIMAGINE ALL 145 ACRES
   The entire publicly-owned golf club may be transformed into an amenity for all Miami Beach residents. One that responds to a holistic view of sustainability.

2. MIAMI BEACH’S CENTRAL PARK
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4. LIVING WITH WATER
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   Additional potential opportunities may include leveraging a portion of the land for public and private development, such as a mixed-use eco-district working to fulfill the City’s objectives on sustainability, social equity and environmental justice.
Garden apartments as well as other private properties can be important partners in augmenting comprehensive blue-green infrastructure systems in Miami Beach. Property owners can make a difference citywide taking simple steps such as incorporating downspout disconnections, rain barrels, and tree plantings on their properties. Other BGSI BMPs, such as permeable pavement for parking spaces, can be used to manage stormwater on private property.
Often located at waterfront locations, street ends provide opportunities to incorporate BGSI which absorb and filter stormwater prior to discharging into canals, the Biscayne Bay, and the ocean, while incorporating and enhancing habitat for land and aquatic species, and providing flexible parking and play spaces for residents.

1. **Rain Gardens**
   Rain gardens generally reduce stormwater discharges by absorbing storm water runoff from impervious areas such as walkways, parking lots, hard sports courts, and compacted lawn areas.

2. **Enhanced Tree Pits**
   Enhanced tree pits and biofiltration trenches will provide increased shade for residents, reduce stormwater discharges, and improve water quality. Enhanced tree pits will also provide significant rooting volume for trees and a diverse understory to contribute to a healthier native South Florida ecosystem.

3. **Enhanced Tree Pits**
   Enhanced tree pits and biofiltration trenches will provide increased shade for residents, reduce stormwater discharges, and improve water quality. Enhanced tree pits will also provide significant rooting volume for trees and a diverse understory to contribute to a healthier native South Florida ecosystem.

4. **Living Shoreline**
   Improves water and soil quality in water bodies, reduces wave action during severe storms, and provides habitat for wildlife.

**HOW IT WORKS**

**WATER MANAGEMENT BENEFITS**
- Capture of roadway runoff helps to reduce peak flows (during high frequency events)
- Treatment of roadway runoff reduces hydrocarbons and heavy metal pollution
- Treatment uptakes nitrogen and phosphorus reducing likelihood of algae blooms

**ADDITIONAL BENEFITS**
- Neighborhood Beautification
- Walking and biking paths
- Waterfront Seating
- Kayak drop in points
# Contents

What is blue-green stormwater infrastructure? ................................................................. 1  
Why should we use BGSI? .................................................................................................. 1  
What are the water quality benefits of BGSI? ................................................................. 1  
How will BGSI fit into the city’s flood mitigation strategies? ........................................ 2  
What community benefits can BGSI potentially provide? ............................................... 2  
What BGSI practices are most applicable to Miami Beach? .......................................... 3  
What BGSI practices are less applicable to Miami Beach? ............................................. 3  
What does BGSI look like? ............................................................................................... 4  
Where can BGSI be used? ................................................................................................. 4  
Where is the City planning to implement BGSI? ........................................................... 6  
How will BGSI function with rising sea levels and shallow groundwater? ................... 6  
How does BGSI get maintained? ...................................................................................... 6  
Who will do the maintenance for BGSI? ........................................................................ 6  
Will BGSI promote mosquito breeding and the spread of disease? .............................. 6  
Will BGSI reduce parking? ............................................................................................... 7  
Will BGSI reduce recreational space? ............................................................................. 7  
What can the public do to promote BGSI in Miami Beach? .......................................... 7  
Where can I find more information on BGSI? .............................................................. 8
Frequently Asked Questions Concerning Blue-Green Stormwater Infrastructure

What is blue-green stormwater infrastructure?

Green stormwater infrastructure typically uses rainwater harvesting, vegetation, and/or soils to treat and reduce stormwater flows. Examples include bioretention (rain gardens) and permeable pavement.

Blue stormwater infrastructure temporarily stores and treats stormwater without significant reliance on vegetation. Examples are wet ponds and detention basins.

Blue-green stormwater infrastructure (BGSI) encompasses both green and blue stormwater infrastructure practices. Phrases like low-impact development techniques, sustainable site design, and stormwater best management practices have also been used to describe BGSI.

BGSI is typically designed and sized to capture the frequent storm events that make up most of the total rainfall in an average year (storms of up to 1.5 or 2 inches of rain). Extreme events that happen less frequently are often associated with flooding and will require larger stormwater infrastructure such as stormwater pump stations and conveyance systems to address them.

The focus of BGSI is the treatment and capture of stormwater runoff, therefore BGSI is different from coastal strategies (for example, living shorelines, dunes, mangrove plantings, and oyster or artificial reefs) that target coastal stressors like wave energy, sea level rise, and storm surges.

Why should we use BGSI?

BGSI can provide a range of both stormwater-related benefits as well as other community benefits. Stormwater benefits can include:

- Water quality improvement (more details under the next frequently asked question [FAQ])
- Groundwater recharge and replenishment of the freshwater lens under Miami Beach, helping to reduce saltwater intrusion and protect soils and tree roots from salt damage
- Some detention and flood mitigation benefits (particularly for thunderstorm-type nuisance flooding, more information follows under the FAQ “How will BGSI fit into the city's flood mitigation strategies?”)

Other community benefits (also known as “co-benefits”) can include:

- Urban heat island mitigation
- Air quality improvement
- Climate resiliency
- Habitat creation and improvement
- Multiple other community benefits, including job creation, improved urban aesthetics, increased property values, improved pedestrian safety, and enhanced recreational spaces.

More details on the stormwater and community benefits are included in the next three (3) FAQs.

What are the water quality benefits of BGSI?

Protecting water quality for Miami Beach’s beaches and waterways is a priority as they provide habitat, a great quality of life, and opportunities for tourism. Stormwater runoff from urban areas can deliver pollutants—including bacteria/pathogens, nutrients (such as nitrogen and phosphorus), sediment, and
heavy metals—to waterways and beaches. Where these pollutants are present, BGSI can play an important role in partially removing them from the runoff.

BGSI reduces stormwater discharges by retaining rainfall. Lower discharge volumes translate into reduced pollutant loads. BGSI also treats stormwater that is not retained. 1 It should be noted that BGSI can only improve the quality of the water that it receives (that is, the runoff from the drainage area that it serves) and has the capacity to treat. Therefore, extensive BGSI coverage would typically be required to have significant overall pollutant load reductions.

Like all infrastructure, BGSI must be designed, constructed, and maintained to function properly over the long term (for more on maintenance, see the FAQ “How does BGSI get maintained?”).

**How will BGSI fit into the city’s flood mitigation strategies?**

BGSI can complement “grey” infrastructure such as pipes and pumps. BGSI can provide some detention and flood mitigation benefits (particularly for thunderstorm-type nuisance flooding). Alone, BGSI will provide little or no benefit for “sunny day” flooding resulting from king tides, flooding from major rainfall events, or flooding caused by storm surge from the Atlantic Ocean or Biscayne Bay. BGSI is typically designed for storms of 2 inches or less (for the drainage area it serves), which is approximately 25 percent of the much larger storms typically used to size flood control systems, such as pipes and pumps.

**What community benefits can BGSI potentially provide?**

BGSI can potentially provide a suite of community benefits, as shown below in the graphic from the U.S. Environmental Protection Agency. The benefits vary significantly depending on the project location and setting, BGSI practice type(s), level of implementation, maintenance practices, etc.

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**Potential Environmental, Social, Economic, and Public Health Benefits of Green Infrastructure**


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What BGSI practices are most applicable to Miami Beach?

A wide range of BGSI practice types were evaluated based on city/regional/national experience, stormwater performance, ease of implementation/maintenance, community/environmental benefits, cost efficiency, and climate change resilience. The recommended practices were determined to perform well across these areas and have potential applicability in Miami Beach given the local context (soil and groundwater conditions, land uses, development patterns, climate, etc.).

The most applicable BGSI practices are:
- Bioretention/Bioswales/Rain Gardens
- Blue and Green Roofs
- Constructed Wetlands/Floating Wetland Islands
- Detention Basins/Surface Storage
- Enhanced Tree Pits/Trenches
- Injection Wells (Pumped)
- Permeable Pavement
- Rainwater Harvesting (Cisterns, Rain Barrels)
- Stormwater Planters
- Subsurface Infiltration and Storage
- Tree Canopy
- Wet Ponds

When and where to use each recommended BGSI practice depends on a variety of site-specific factors, such as land use, location, topography, groundwater elevation, soil conditions, and existing infrastructure.

What BGSI practices are less applicable to Miami Beach?

The following BGSI practices are less applicable to or less effective in Miami Beach due to their reduced water quality benefits, higher costs, lack of scalability, lower effectiveness when dealing with sea level rise and high tides, proprietary designs, limited applicability, or low storage capacities:
- Detention Tanks
- Exfiltration Trenches
- High-Flow Media Filters
- Living/Green Walls
- Gravity Wells
- Subsurface Flow Wetlands

Although not as readily applicable to Miami Beach, the above BGSI practices might still prove beneficial in certain settings.

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2 Although not typically thought of as BGSI, injection wells are included here as they reduce the volume of stormwater discharged, and with proper pretreatment/filtration can provide water quality benefits.

3 Trees are a key component of BGSI, and the City is developing an Urban Forest Master Plan to provide a strategic framework to guide the City in managing, maintaining, planting, and preserving its urban forest. See www.mbris ingabove.com/climate-mitigation/urban-canopy-2/urban-forestry-master-plan/.
What does BGSI look like?

BGSI can take many different forms, from landscaping elements such as rain gardens to permeable pavements that can look like normal pavements to wet ponds to blue and green roofs atop buildings. BGSI practices can vary from being dominant, high-profile features to blending in seamlessly with the surroundings. Some example images with established vegetation are provided on the next page (vegetated BGSI, like other landscaping, requires time to get established).

Where can BGSI be used?

BGSI can be used on and along roads, in parks and other open spaces, at schools and other public facilities, on rooftops, and on residential and commercial properties. Approximately 40% of Miami Beach is covered by impervious surfaces (buildings and pavements) that prevent water from percolating into the ground. BGSI should be employed to treat runoff from these impervious surfaces and help preserve, enhance, and increase the City’s remaining pervious or “green” areas.

When choosing where to place BGSI practices, the following factors should be considered:

- Depending on the BGSI practice type, offsets from utilities, buildings, and other structures may be required to protect those features from water damage.
- Factors such as budget, permitting, site conditions, neighborhood preferences, and ownership will influence the location and types of BGSI.

A rendering of bioretention and permeable pavement on a typical residential street in Miami Beach
Examples of BGSI Applications

- Pervious Concrete Parking Lot
  Source: Jacobs

- Wet Pond
  Source: Southwest Florida Water Management District

- Rain Garden
  Source: Jacobs

- Normal (left) and Porous Asphalt (Right)
  Source: Jacobs

- Infiltration Trench
  Source: Jacobs

- Blue-Green Roof Plaza
  Source: Jacobs

- Green Roof (in foreground) Adjacent to Marina
  Source: Jacobs

- Residential Rain Barrel
  Source: Jacobs

- Residential Rain Garden
  Source: Jacobs

- Floating Wetland Islands
  Source: Jacobs

- Stormwater Planter
  Source: Jacobs

- Permeable Paver Driveway
  Source: Jacobs
**Where is the City planning to implement BGSI?**

The City is planning to implement BGSI along roads, in parks and other open spaces, and at public facilities. City projects currently under design with BGSI components include Maurice Gibbs Park, Community Park (former par 3 golf course), 59th Street bioswale, and 1st Street stormwater improvements. In addition, preliminary concept renderings have been developed for the following:

- Residential street
- Commercial street
- Neighborhood park
- Miami Beach Golf Course (three scenarios)
- Collins Canal
- Street end (where a street dead ends at a waterbody)
- Garden apartments

There is also an opportunity to make policy and code changes to further encourage and/or require public and private BGSI implementation.

**How will BGSI function with rising sea levels and shallow groundwater?**

Shallow and increasing groundwater elevations in portions of the City limit the soil storage capacity and infiltration required for some BGSI practices to function effectively. However, such limitations might potentially be overcome with underdrains, fill, and/or pumping. Other practices, such as wet ponds and constructed wetlands, can continue to function with shallow groundwater although their storage capacity may be reduced as groundwater levels increase. Blue and green roofs, rainwater harvesting, and floating wetland islands would typically not be impacted by rising groundwater.

**How does BGSI get maintained?**

BGSI practices require a variety of maintenance activities depending on the type of BGSI and site-specific factors. Landscaped BGSI requires maintenance typical of other landscaped areas, potentially including: debris and trash removal, pruning, weeding, replanting, erosion repair, and mulching. Many BGSI practices include devices for pretreatment of runoff that require periodic sediment and debris removal. Permeable pavements require the surface to be periodically cleaned (for example, with a street cleaning vehicle) to prevent clogging.

**Who will do the maintenance for BGSI?**

A variety of entities may be involved in BGSI maintenance depending on the situation. In parks and at other City-owned properties, the City would likely lead the maintenance activities (either with City staff or contractors) although they may be supported by residents and businesses through volunteer efforts, “Friends of” groups, “adopt-a-BGSI” programs, neighborhood associations, etc. Along commercial streets, business improvement districts and similar groups may lead maintenance activities. On private property, BGSI maintenance would be the responsibility of the property owner/manager. Maintenance procedures and responsibilities for BGSI on residential roads are still being formulated.

**Will BGSI promote mosquito breeding and the spread of disease?**

If properly designed, constructed, and maintained, BGSI should not promote mosquito breeding. BGSI systems that are not intended to have prolonged ponding should typically empty within 3 days (mosquitoes require standing water to be present for more than 7 days to grow). BGSI systems should be checked frequently to ensure they are emptying as expected. Systems that hold water for prolonged periods (for example, wet ponds, wetlands, and cisterns) must use other methods to prevent mosquito
growth, such as screening, establishing a natural predator population, and/or appropriate mosquito specific larvicides.

*It should be noted that mosquitos are present in Miami Beach regardless of BGSI. Residents and visitors should take appropriate precautions to prevent getting bitten (for information from Miami-Dade County, see [www8.miamidade.gov/global/solidwaste/mosquito/home.page]).*

**Will BGSI reduce parking?**

Impacts to parking will be evaluated and discussed with stakeholders on a project-by-project basis. However, BGSI is often strategically located in areas where parking is not permitted (for example, in swale areas, near fire hydrants and close to intersections). In many cases there are BGSI options that can be implemented (for example permeable pavements) that do not affect parking. Some BGSI systems may reduce parking along streets and in parking lots if areas along them are used for vegetated BGSI.

**Will BGSI reduce recreational space?**

Locations for BGSI in parks and other open spaces will be carefully considered to minimize impacts to the usage of the sites. In many cases, BGSI may serve both recreational and stormwater retention purposes (for example, a permeable pavement basketball or tennis court). BGSI can also enhance recreational spaces by providing additional landscape features.

**What can the public do to promote BGSI in Miami Beach?**

Private properties will be a key partner in the successful implementation of BGSI in Miami Beach. Residents and businesses can implement several types of relatively low-cost, low-maintenance BGSI practices on their properties, including rain gardens, trees, cisterns, and rain barrels. Property owners can maintain, preserve, and enhance their existing green space, trees, and roadside swales. In addition, the public may be able to volunteer to help protect and maintain City-installed BGSI practices through grassroots adoption programs, if those programs are developed.
Where can I find more information on BGSI?

More information can be found at the following links/sources.

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<th>Resource</th>
<th>Source/Location</th>
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<tbody>
<tr>
<td>MB Rising Above Website</td>
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<tr>
<td>Florida Department of Transportation Drainage Design Guide (Injection Wells covered in Chapter 7)</td>
<td>fdotwww.blob.core.windows.net/sitefinity/docs/default-source/roadway/drainage/files/drainagedesignguide.pdf</td>
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<td>Sarasota County Low Impact Development Guidance Document</td>
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<tr>
<td>University of Florida Soil and Water Sciences Video Topics: Green Stormwater Infrastructure</td>
<td>soils.ifas.ufl.edu/extension/videos/low-impact-development/</td>
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<tr>
<td>Constructed Floating Wetlands: A review of research, design, operation and management aspects, and data meta-analysis</td>
<td>apirs.plants.ifas.ufl.edu/site/assets/files/372369/372369.pdf</td>
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Note that the City is not specifically endorsing the information provided in these sources but is providing them for general information to be used with discretion.
Appendix C
BGSI Practices and Strategies
Fact Sheets
Bioretention/Bioswales/Rain Gardens

Bioretention facilities are sunken landscape beds containing plants in a special soil mix (called *engineered soil*) that sits above a gravel drainage layer. They replicate the natural water cycle by allowing water to enter the soil (*infiltration*), evaporate to the air (*evapotranspiration*), or be ponded for up to 2 to 3 days. Bioretention facilities use Florida-friendly plants that can withstand both occasional dry periods and flooding. Combined with engineered soil, these plants also provide natural filtration and treatment of stormwater runoff, removing many pollutants often found in stormwater runoff. Bioretention can take many forms including bioretention basins, bioswales (or bioretention swales), rain gardens, vegetated curb extensions, etc. and work well with infiltration/storage facilities below the ground.

**Advantages**
- Excellent water quality and freshwater lens recharge capabilities
- Versatile, with broad applicability
- Enhanced site aesthetics, tree canopy, biodiversity, and wildlife habitat

**Potential Limitations**
- 6 to 18 inches of separation to groundwater recommended
- Higher maintenance until plants are established
- If not designed, installed, and maintained correctly, can promote mosquito breeding

**Applicability**
Bioretention is highly adaptable to most site types and conditions—from large and heavily landscaped features in parks, schools, and other public facilities to small and simple rain gardens at residences. Bioretention can also be implemented along roadways and in medians and parking lots.

**Potential Enhancements for Increased Performance**
- Real-time controls: dynamic, predictive technology that controls flows in/out of system, improving storage efficiency
- Modular/high-porosity media: increases storage capacity
- Engineered soil enhancements: improve pollutant removal
- High-flow filter media: allows rapid surface infiltration/treatment in tight spaces
- Underdrains (if needed): allow systems to drain within 72 hours

![Bioretention facility at the University of Florida Southwest Recreation Center (Source: Stephen Hofstetter, Alachua Co. Env.Protection Dept.)](image)

![Typical bioretention cross-section with surface depression, Florida-friendly plants, engineered soil, and gravel layer](image)

<table>
<thead>
<tr>
<th>Performance</th>
<th>Implementation</th>
<th>Community/Environmental</th>
<th>Other</th>
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<tr>
<td>Water Quality</td>
<td>Capital Cost</td>
<td>Improved Aesthetics</td>
<td>Climate Change Resilience</td>
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<td>Freshwater Lens Recharge</td>
<td>Maintenance Cost</td>
<td>Dual Use</td>
<td>Mosquito Vector Resistance</td>
</tr>
<tr>
<td>Flood Mitigation</td>
<td>Scalability</td>
<td>Habitat Creation</td>
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<td>Constructability</td>
<td>Urban Heat Island Reduction</td>
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Blue and Green Roofs

Blue and green roofs provide stormwater storage on flat roofs or those with up to 30-degree slopes. If feasible, they can be especially useful in the areas of Miami Beach where ground-level BGSI practices are not feasible because of limited space, utility conflicts, and/or high groundwater. Blue and green roofs typically only capture direct rainfall and not runoff diverted from other areas but can still provide meaningful water quality and runoff reduction benefits. Blue roofs store water either directly on the roof or in chambers beneath raised decking. Green roofs (or vegetated roofs) consist of vegetation on top of several other layers (growing, drainage, and storage media) and are divided into three types, varying in their complexity and thickness: extensive, semi-intensive, and intensive. Extensive roofs are the lightest, simplest, and thinnest type of green roof, while intensive roofs are the most elaborately vegetated, attractive, and thickest type. Semi-intensive green roofs fall between extensive and intensive types.

Advantages
- Use a generally otherwise unused space with fewer conflicts than may be on the ground
- Reduce urban heat island and noise levels and provide potential energy savings for the building
- Provide enhanced site aesthetics, biodiversity, and wildlife habitat

Potential Limitations
- Roof must be capable of supporting additional weight, therefore it may be difficult to implement on existing buildings
- Reduced stormwater capture potential compared to other BGSI practices, as drainage area is limited to the roof area
- Potentially high maintenance needs until vegetation is established

Applicability
Blue and green roofs can be adapted to fit many different roof sizes, shapes, slopes (up to 30 degrees), weight limitations, and levels of wind exposure. Extensive systems can be used on roofs with more limited structural capacities, while intensive ones can be used on roofs capable of supporting more weight.

Potential Enhancements for Increased Performance
- Use a wide variety of different plants
- Modular/high-porosity media: increases storage capacity
- Integrating with rainwater harvesting to increase effectiveness and have a source of irrigation during dry periods

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## Constructed Wetlands/Floating Wetland Islands

Constructed wetlands are shallow marshes planted with native vegetation that improve water quality through plants absorbing pollutants in their roots (called uptake) and water evaporating to the atmosphere (called evapotranspiration). Constructed wetlands maintain a permanent water surface using flow control structures that regulate stormwater runoff discharges from the wetland. They remain constantly wet and are planted with Florida-friendly plants that thrive in such conditions. The plants provide natural filtration and treatment of stormwater runoff, removing many common pollutants like phosphorous and nitrogen that can degrade water bodies like Biscayne Bay. **Floating wetland islands** (FWI) are a type of constructed wetland that mimics natural aquatic ecosystems where emergent plants grow on the surface in floating mats. Over time, the plant roots grow beneath the mats in the water and improve water quality through biofilms that attach to the roots and through plant uptake. Wetlands are Florida’s “original stormwater treatment systems” and both constructed wetlands and FWI have moderate to high applicability in Miami Beach.

### Advantages
- Good water quality improvement benefits
- Enhanced aesthetics, biodiversity, and wildlife habitat
- Wetlands are good for sites with high groundwater; FWI provides treatment in without additional land areas (since they are located in the ponds or channels)

### Potential Limitations
- Higher maintenance until plants are established
- Requires larger land area than other BGSI practices (or an open waterbody or channel for FWI systems)
- If not designed, installed, and maintained correctly, can promote mosquito breeding

### Applicability
Constructed wetlands are best suited for locations that have lots of land, a relatively large contributing drainage area, and high groundwater. Soil type will also impact applicability, with loamy and silty soils typically being the most ideal for establishing wetland vegetation.

### Potential Enhancements for Increased Performance
- Real-time controls: dynamic, predictive technology that controls flows in/out of system, improving storage efficiency
- Can be designed with additional storage capacity to aid with flood reduction
- Consider the use of an iron enhanced sand filter for additional nutrient removal

### Performance

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Detention Basins/Surface Storage

Detention basins are dry ponds that fill up with stormwater runoff during rain events. Stormwater is then slowly released (over 2 to 3 days) to minimize downstream flooding. They’re typically geared more towards flood control than improved water quality. However, they can be enhanced with native vegetation and configured as “infiltration basins”, if conditions allow. Surface storage facilities, like detention basins, can provide some flood protection benefits, especially in the low-lying areas of Miami Beach where working below ground is challenging due to high groundwater conditions. Through subtle integration into the existing landscape, especially at parks/open spaces, surface storage can be blended into the site, appearing as dry and usable space most times and filling up during rain or high water events. By directing stormwater to sites with detention basins or surface storage, other parts of the City could experience reduced flooding.

Advantages
- Potentially significant flood control benefits
- Typically less costly to construct compared to other BGSI practices
- Potentially allows for the “dual use” of stormwater capture and recreation

Potential Limitations
- Larger storage volumes for flood control require more land area
- Provides less freshwater lens recharge and low water quality improvements
- Since it involves temporarily flooding public land, requires community acceptance and education

Applicability
Detention basins are best suited for locations with lots of open land and a relatively large contributing drainage area (at least 10 acres). Surface storage facilities are most applicable where it is acceptable to construct perimeter earthen berms (or similar structures) for temporary surface inundation.

Potential Enhancements for Increased Performance
- Real-time controls: dynamic, predictive technology that controls flows in/out of system, improving storage efficiency
- Can be designed as “infiltration basins”, as well as vegetated with Florida-friendly plants to improve water quality

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Enhanced Tree Pits/Trenches

Enhanced tree pits/trenches combine the stormwater capture benefits of subsurface infiltration/storage systems with the water and air quality benefits of trees. This BGSI practice can be subtly integrated into most sites, appearing as either a single tree (pit) or a row of trees (trench) in pavement, lawn, or landscaping. These structures typically capture stormwater runoff that is piped in from street or parking lot drains or runoff that flows through permeable pavement. The runoff then slowly enters the underlying soil (called infiltration) or drains into the City’s drainage system within 2 to 3 days. Trees selected for these systems are hardy Florida-friendly species that can withstand both extended dry and wet conditions. Tree pits/trenches are well suited to the look and feel of Miami Beach because they can help maintain a high visual appeal.

Advantages

- Increased tree canopy, evapotranspiration (water evaporating into the air), and site aesthetics, as well as reduced urban heat island
- Flexibility to be configured and sized for a variety of specific site conditions
- Can be integrated with planned streetscape or utility improvements to reduce construction cost

Potential Limitations

- 6 to 18 inches of separation to groundwater recommended
- Utilities in sidewalks should be avoided/protected
- Regular watering required until trees are well rooted and established

Applicability

Enhanced tree pits/trenches are applicable on most streets, commercial/public facilities, parking lots, and open spaces in Miami Beach where their use would not hinder vehicular or pedestrian circulation. They are often most effective when seamlessly integrated into streetscapes or within parking lot islands and can also work well with road raising, which creates the opportunity for greater stormwater storage capacity above groundwater.

Potential Enhancements for Increased Performance

- Sand-based structural soil or suspended pavement system with modular soil cells: increases rooting volume and enhances tree health/longevity
- Modular/high-porosity media: increases storage capacity
- Underdrains (if needed): allow systems to drain and minimize the time tree roots are kept saturated (overly wet)

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Example of an enhanced tree trench with permeable pavers

Typical enhanced tree trench section using suspended pavement system/modular soil cells (Source: Viridian Landscape Studio)
Rainwater harvesting involves capturing rainwater from roofs or other surfaces and reusing it as an alternative or supplement to *potable water* (water that is safe to drink/use). Rainwater harvesting systems intercept water, typically from roof drains, before it drains to municipal stormwater pipes and store it in either rain barrels (above ground) or in *cisterns* (water storage tanks above or below the ground). Rain barrels and cisterns are made from a variety of materials (wood, concrete, plastic, fiberglass, etc.) and the water they store can be reused for non-potable applications, such as landscape irrigation or toilet flushing. Although stormwater benefits can be limited when the systems are partially full, they also can reduce potable water use, which lowers both individual water bills and the demand on the public water system.

**Advantages**

- Wide applicability with respect to different types of roofs and storage options (type, size, shape, and location – above or below ground, inside or outside)
- Can be integrated with site features, such as artwork, stairs, and benches
- Less impacted by high groundwater in Miami Beach

**Potential Limitations**

- Requires space to install storage system and a use for the captured rainwater
- Typically sized for smaller rainfall events (to refill often) and therefore may need to be coupled with other BGSI practices
- Depending on the anticipated use of rainwater (for example, toilet flushing) and/or the source of runoff (whether roof or other surface), enhanced treatment, permitting, or additional maintenance may be required

**Applicability**

With its ability to fit many shapes, sizes, and aesthetic standards, rainwater harvesting has wide applicability in Miami Beach. Implementation can range from small aboveground rain barrels used for landscape irrigation at homes to larger above/belowground cisterns used for toilet flushing or other non-potable uses at commercial or public facilities. Many other factors influence applicability and feasibility, including accessibility of roof drains, demand for harvested rainwater, and size of the area generating runoff.

**Potential Enhancements for Increased Performance**

- Water treatment systems (filtration and/or disinfection) or “first flush” diverters: improve pollutant removal and allow more applications for water re-use (toilet flushing)
- Real-time controls: dynamic, predictive technology that controls flows in/out of system, improving system efficiency

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*This cistern at a restaurant reuses roof runoff to irrigate a vegetable garden in a raised planter (also shown)*

1) Rainwater enters the cistern from the rooftop runoff.

2) Stormwater is stored inside the blocks.

3) A hose is attached to the nozzle and stored rainwater is used for irrigation.

*Schematic/photo of an artistic cistern at a library used for landscape irrigation*
Subsurface Infiltration/Storage

Subsurface infiltration/storage systems temporarily hold stormwater runoff underground in material like gravel, high-strength plastic boxes/arches, large-diameter pipes, and concrete chambers. This allows the stormwater to be detained until it either infiltrates into the soil or drains into Miami Beach’s existing drainage system, emptying within 2 to 3 days. The systems can be placed under almost any type of finished surface, whether pavement, grass, landscaping, or other material and are often “fed” by surface drains and pipes or potentially by pumping from other (lower) areas.

Advantages

• Depending on the storage media, potential to capture large volumes of stormwater runoff and thus reduce localized flooding (caused by rainfall)
• Freshwater lens recharge
• Allows for the “dual use” of stormwater capture and a variety of surface treatments such as pavement (including raised roads), lawn, and landscaping

Potential Limitations

• 6 to 18 inches of separation to groundwater recommended for infiltration (from bottom of system)
• Given the high groundwater conditions common in Miami Beach, these systems would typically need to be constructed near or above the existing ground elevation, which could limit the amount of water they capture without pumping
• Depending on site conditions, pretreatment structures (filters, sediment storage chambers, etc.) intended to capture trash, sediment, and other materials with high clogging potential may require frequent maintenance

Applicability

These practices are applicable to locations in Miami Beach with adequate separation between their lowest elevations and groundwater, or in those areas where such separation could be achieved by raising the ground surface and installing them at or above the existing ground surface. These practices can be readily combined with other BGSI practices, such as permeable pavement, bioretention, and rainwater harvesting.

Potential Enhancements for Increased Performance

• Real-time controls: dynamic, predictive technology that controls flows in/out of system, improving storage efficiency
• Modular/high-porosity media: increase storage capacity
• Sand (or other media) filter layer at bottom to enhance pollutant removal, especially when close to groundwater

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Stormwater Injection Wells (Pumped)

Stormwater injection well systems collect stormwater runoff in an underground tank or basin and pump the water to one or several shallow injection wells. The systems don’t treat stormwater before it enters the aquifer but often contain baffles or other devices that settle debris and grit before pumping. In the City of Miami Beach, most injection wells consist of a 24-inch-diameter steel casing set to a depth between 60 and 100 ft below the ground, with the open space around the casing grouted to the land surface. Injection wells in the City typically feature open-hole construction in the Biscayne Aquifer, drilled to depths of 80 to 200 ft. In southern and central portions of the City, the aquifer is composed of coralline limestone that receives water at rates over 1,000 gallons per minute (gpm). While injection wells don’t provide all the stormwater and community benefits of the other recommended BGSI practices, they can still prove beneficial in the City.

Advantages
- Can help manage flooding during moderate storms or during the rainy season
- Where the capacity to absorb is high, gets rid of stormwater runoff rapidly
- Occupy little space, once wells and collection systems installed
- May help recharge the freshwater lens from below in areas where present

Potential Limitations
- Sea level rise makes stormwater injection more difficult/less effective
- The ability to absorb water (called permeability) of the Biscayne Aquifer declines in northern portions of the City, limiting injection to about 50 gpm
- May require annual maintenance to remove debris and prevent clogging
- Reliance on collection and pumping systems to deliver water to wells

Applicability
Injection well systems work most effectively in the southern and central portions of the City, where the aquifer is highly absorbent. Injection wells offer an alternative method of disposing stormwater runoff from roofs, parking lots, streets, and other non-porous (impermeable) surfaces.

Potential Enhancements for Increased Performance
- Enhanced pretreatment and storage before injection reduces chances of clogging in injection wells
- Maximizing the length of the open interval increases potential disposal rates
- Regular well rehabilitation can restore injection well performance to near-new levels

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Permeable Pavement

Permeable pavement often looks like ordinary pavement but allows stormwater to drain through it and into an underlying storage system (or reservoir). The storage reservoir under the permeable pavement provides a place for the stormwater to be retained until it can infiltrate into the soil, filtering out pollutants in the process. The storage reservoir typically consists of clean and evenly sized stone that can store water in its gaps (typically 40 percent of its volume), though pipes or different types of chambers (plastic or concrete) can also be used to increase storage capacity. A variety of permeable pavement types can used depending on the specific characteristics of a site including concrete, asphalt, paver blocks, and reinforced turf or gravel systems, among others. Permeable pavement has high applicability in Miami Beach, where it can reduce stormwater that would otherwise run off pavement surfaces and into streets, private properties, or receiving waters like Biscayne Bay.

Advantages

- Stormwater runoff capture and freshwater lens recharge
- Versatile, with broad applicability
- Allows for “dual use” of hard surface and stormwater capture

Potential Limitations

- 6 to 18 inches of separation to groundwater recommended (from bottom of stone subbase)
- Careful design, construction, and maintenance necessary to ensure long-term performance
- Permeable pavements not suitable for all sites (for example, high-speed roadways or certain land uses with high potential pollutant loads like gas stations)

Applicability

Permeable pavement provides stable and reliable surfaces for vehicles and pedestrians, while providing freshwater lens recharge, water quality benefits, and even localized flood reduction. Permeable pavement is well suited for parking lots (especially the parking spaces), bike/walking paths, sidewalks, playgrounds, plazas, tennis or basketball courts, and other similar uses. It can also be used on low-volume (minimally used) residential roadways and/or parking lanes.

Potential Enhancements for Increased Performance

- Real-time controls: dynamic, predictive technology that controls flows in/out of system, improving storage efficiency
- Underdrains (if needed): allow systems to drain within 72 hours

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Stormwater Planters

Stormwater planters are similar to bioretention facilities; both are sunken landscape beds containing Florida-friendly plants in a special soil mix (called engineered soil) that sit above a gravel drainage layer. But unlike bioretention facilities, stormwater planters are enclosed by concrete, brick, wood, or other materials, and can be placed either above or below the ground elevation. Depending on the specific site conditions, they can be either flow-through or infiltration planters. **Flow-through planters** typically have sealed bottoms to detain water for up to 3 days. **Infiltration planters** have open bottoms to allow water to enter (or infiltrate) the soil beneath the planter. Both provide filtration and treatment of stormwater runoff, which flows into them from nearby paved areas, such as sidewalks or roadways, or is piped in from roof downspouts. Because stormwater planters are irrigated by rainfall, they can provide a more sustainable alternative to traditional landscaping that uses potable water (water that’s safe to drink).

**Advantages**
- Flow-through planters can be placed in areas of the City with high groundwater
- Flexible design allows them to be elevated and/or configured to fit in tight spaces
- Increased water quality, as well as enhanced site aesthetics and biodiversity

**Potential Limitations**
- 6 to 18 inches of separation to groundwater recommended for infiltration planters
- Higher maintenance until plants are established, and regular maintenance after
- Utilities in roadway and sidewalks should be considered

**Applicability**
Stormwater planters are highly applicable throughout Miami Beach as they can be placed along many roadways, sidewalks, and parking lots, as well as adjacent to buildings where they can capture roof runoff. Planters can often be installed in conjunction with planned sidewalk or roadway improvements, including road raising.

**Potential Enhancements for Increased Performance**
- Modular/high-porosity media: increases storage capacity
- Engineered soil enhancements/high-flow filter media: improve pollutant removal, increase surface infiltration rates
- Underdrains: allow systems to drain within 72 hours
- Enhanced pretreatment (for example, screens/filters to pretreat roof runoff)
- If possible, elevate planters in areas with high groundwater

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**Wet Ponds**

Wet ponds are among the most recognizable BGSI practices in Florida. They accept and hold stormwater runoff long enough to allow pollutants to settle out, resulting in cleaner water. Wet ponds are designed to maintain a permanent water surface (or permanent pool) through flow control structures that regulate discharge from the pond. Aeration systems are often installed in wet ponds to introduce oxygen into the water, which encourages growth of beneficial aerobic bacteria that consume nutrients and improve water quality. Water quality can also be improved by placing aquatic and wetland plants around the pond perimeter or on floating wetland islands. Vegetation filters runoff and helps reoxygenate the water, which further improves water quality. Vegetation also provides habitat for fish and other aquatic organisms.

**Advantages**
- Good water quality improvement benefits
- Good option for sites with high groundwater
- Potential for enhanced site aesthetics, biodiversity, and wildlife habitat opportunities

**Potential Limitations**
- Larger storage volumes for the permanent pool and flood control require more land area.
- Infiltration and freshwater lens recharge are minimal, and so runoff volume reduction is minimal.
- Invasive species and vector control are often necessary.

**Applicability**
Wet ponds are best suited for locations with large open areas, a relatively large contributing drainage area, and high groundwater conditions. They are generally implemented in residential, commercial, or open space areas. Some of the existing water features at golf courses may function as, or could potentially be converted to, wet ponds. Ponds can be lined to help address soil/groundwater contamination concerns.

**Potential Enhancements for Increased Performance**
- Real-time controls: dynamic, predictive technology that controls flows in/out of system, improving storage efficiency
- Can be designed with additional storage volume to help reduce flooding (often called an extended-detention wet pond)

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![Wet pond in Naples, Florida](image)

Rendering of a wet pond in a Miami Beach park that will capture and store neighborhood stormwater (Source: Savino & Miller Design Studio)
Commercial and Public Facilities

BGSI has wide applicability at Miami Beach’s many commercial and public facilities, whether they are sites dominated by buildings, sites that balance buildings with other needs (such as parking and landscaping), schools and other educational facilities, parking garages, or other facilities. These locations range from highly visible and visited (schools, apartment buildings, and restaurants) to more utilitarian (storage/maintenance yards and police/fire stations).

Various BGSI practices can be applied at these facilities, with careful consideration given to their specific opportunities and constraints. While some facilities may only be able to capture their own stormwater runoff, other facilities—especially larger public ones—may be able to capture significant volumes from adjacent areas.

Advantages

- Improved commercial or public spaces through aesthetics, amenities, site restoration, and/or increased tree canopy
- Improved water quality, reduced stormwater runoff volume, and increased freshwater lens recharge
- Reduction of urban heat island
- Potential to capture large volumes of stormwater and thus reduce localized flooding
- High visibility/educational value
- Dual-use opportunities (for example, permeable pavement parking areas)
- Other potential advantages for BGSI at buildings: reduced potable water use (water that’s safe to drink) and reduced need for cooling (less energy use)

Potential Limitations

- Accessibility and public safety concerns, especially at schools
- Cost of implementation
- Due to flat topography, directing runoff into public facilities can be challenging
- Capturing roof drainage might be challenging due to inaccessible downspouts
- Limited maintenance capabilities (budget, experience, and/or resources) depending on owner
- Construction and maintenance activities might need to be scheduled around operating hours, especially at schools
- Other limitations: building utilities, structural loading capacity (for blue or green roofs), limited ground space (for other types of BGSI practices), future expansion/redevelopment plans, etc.

Applicable Practices

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Bioswale adjacent to a public library
Fact Sheet Commercial and Public Facilities

Facilities with Building Coverage Greater Than 90% of the Site

Many commercial and public facilities with large building footprints and thus limited ground space present unique challenges for BGSI. BGSI practice feasibility generally depends on the type of building, the accessibility of its roof drains (whether they are internal or external to the building), and even its water demand (if considering rainwater harvesting and reuse). Blue and green roofs can be well suited to these sites if the roof is able to support them. Stormwater planters can be placed against exterior building walls if there is space and roof drains are external or can be re-directed. Cisterns (water storage tanks) can also be placed next to buildings or even in unused spaces inside them to allow rainwater to be harvested for non-potable uses like toilet flushing and/or landscape irrigation. In some cases, opportunities for managing runoff outside the parcel (for example, in the right-of-way) should be explored.

Facilities with Building Coverage Less Than 90% of the Site

Commercial and public facilities with a smaller percentage of building space and larger areas for parking, walkways, landscaping, courtyards, or other uses provide many opportunities to integrate BGSI and enhance their use and aesthetics. Existing green spaces at such sites may be well suited to BGSI practices, such as bioretention/bioswales, enhanced tree trenches, stormwater planters, subsurface infiltration/storage, and constructed wetlands (though on a much more limited basis). Parking lots—especially relatively large ones, those with minimal underground utilities, and those without significant landscaping or trees—are ideal candidates for BGSI implementation and for maximizing capture of stormwater runoff generated both within and potentially outside the site. Permeable pavement and subsurface infiltration/storage systems can be cost-effectively coupled with parking lot repaving or reconstruction efforts. Bioswales and enhanced tree trenches can be incorporated into islands, no parking zones, or in paved areas slated for removal (based on a reduced need for parking). In some cases, parking lots (or portions of them) can be allowed to temporarily pond, providing surface storage.
Schools

Miami Beach's schools and other educational institutions provide many compelling opportunities for BGSI in ways that potentially enhance their value. Such sites typically have ample areas for recreation and/or parking. These sites can typically be feasibly, safely, and cost-effectively adapted for a variety of BGSI practices, especially bioretention, permeable pavement, and subsurface infiltration/storage. In addition to managing stormwater generated onsite, BGSI at schools can often be made large enough to capture stormwater runoff from adjacent areas. These sites can also provide unique opportunities to educate students and the public about BGSI (for example, educational signage and observation platforms) and to demonstrate different BGSI technologies and variations (for example, interactive rainwater cisterns). Such demonstrations can give the City useful and practical information that yields more streamlined and cost-effective BGSI projects in the future.

Parking Garages

Similar to locations dominated by buildings, Miami Beach's parking garages provide both significant challenges to BGSI implementation and also unique opportunities to use practices with more limited applicability at other sites. In general, if there is sufficient space (especially landscaping) next to parking garages, the most suitable (and cost-effective) BGSI practices are bioretention/bioswales or stormwater planters. For sites that are more constrained (and more likely in Miami Beach), exterior practices such as permeable pavement or subsurface infiltration/storage may prove feasible if roof drains are accessible. Otherwise, practices such as blue roofs (possibly on the upper-most parking level), green roofs (on non-parking areas or canopies on the upper-most parking level), or rainwater harvesting cisterns (placed in unused space and assuming there is a demand for such water) could be further explored.
Parks and Open Spaces

Miami Beach contains a variety of recreational areas, including golf courses, open spaces, parks, and pocket parks/plazas. These facilities are generally excellent opportunities to implement many types of BGSI practices. Parks can offer more significant water quality, flood mitigation, and freshwater lens recharge benefits by capturing runoff from adjacent areas through gravity drainage or pumping.

Successfully implementing BGSI at parks often involves a balancing act between preserving or enhancing existing recreational uses and providing the space required for BGSI. Given the challenges of Miami Beach (flat topography, high groundwater, etc.), BGSI practices at recreational sites should ideally entail temporarily storing water on the surface and/or raising the ground elevation and storing water underground.

Advantages
- Improved public spaces through aesthetics, amenities, and site restoration
- Increased tree canopy
- Natural source of irrigation for Florida-friendly landscaping
- Less restrictive with respect to existing utilities or other infrastructure
- Potential to capture large volumes of stormwater
- High visibility/educational value
- Dual-use opportunities (e.g., permeable pavement play surfaces)

Potential Limitations
- Accessibility and public safety concerns
- Sediment and trash may impact aesthetics and functionality, especially in dense urban areas and sites with large drainage areas
- Diverse and sometimes unpredictable usage and preferred pathways for park visitors
- Due to flat topography, directing runoff into parks can be challenging
- Working around public art/monuments and existing vegetation, especially trees

Applicable Practices

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Fact Sheet Parks and Open Spaces

Golf Courses
By their size and open nature, Miami Beach’s two public golf courses (Miami Beach and Normandy Shores Golf Courses) offer unique opportunities to capture large volumes of water. Larger BGSI practices that have limited applicability at most other sites (i.e., detention basins/surface storage, wet ponds, and constructed wetlands) can be readily integrated into golf courses, especially those that can be reconfigured or repurposed. Fairways provide locations for extensive temporary surface storage surrounded by perimeter earthen berms. Wet ponds can store and treat water before it is used for irrigation.

Open Spaces
Miami Beach has a variety of triangular or similarly shaped open spaces that appear to have no defined usage or formal programming. These spaces provide opportunities to implement smaller-scaled BGSI practices, such as bioretention/bioswales, enhanced tree pits/trenches, and subsurface infiltration/storage. These practices can be seamlessly integrated into the landscape, replacing unused lawn areas and avoiding impacts to existing trees and vegetation. In general, these sites are best suited to capturing stormwater runoff from adjacent streets, though some may be able to store additional runoff.
Fact Sheet Parks and Open Spaces

Parks

Miami Beach's larger parks provide a wide variety of opportunities for virtually all types of BGSI practices. BGSI can be integrated into the corners, edges, and other underutilized areas of parks to both enhance and avoid disrupting existing uses—from larger practices like wet ponds and constructed wetlands to smaller practices like bioretention and bioswales. Permeable pavements can provide dual-use benefits by creating stable surfaces for basketball courts, tennis courts, and walkways, while also capturing stormwater. Detention basins/surface storage can also allow dual use by temporarily storing water on depressed athletic fields or those enclosed by perimeter earthen berms. Some parks can be raised off the ground to create significant underground storage of water that is piped in from outside the site.

Pocket Parks/Plazas

By definition pocket parks and plazas are the most space-limited recreational areas. However, Miami Beach’s pocket parks and plazas provide ample opportunities for BGSI. For pocket parks with little green space and dominated by hardscape surfaces, such as pavement or pavers, BGSI practices such as permeable pavement and subsurface infiltration/storage facilities are most applicable. Another option for such sites is to turn them into “water plazas” that temporarily store stormwater on the surface during rain events. Such sites may also serve as “floating parks” that have platforms and other features that rise and fall with changing water elevations. Other types of pocket parks may be well-suited to BGSI practices such as bioretention, enhanced tree pits/trenches, and stormwater planters.
Right-of-Way/Streets and Alleys

Miami Beach’s right-of-way (ROW) takes many forms (commercial and residential streets, street ends, pedestrian streets [also called non-motorized streets], alleys, etc.) and is vital to its economy, quality of life, and unique nature. The City’s ROW offers many opportunities to implement BGSI to enhance usage, improve aesthetics, and integrate with existing and planned drainage infrastructure. BGSI practices provide many stormwater benefits when placed in the ROW, which is among the City’s largest sources of stormwater runoff.

While the ROW contains numerous challenges to BGSI implementation (see Potential Limitations), several practices can often be seamlessly located in or along ROW shoulders, grass strips and swales, sidewalks, no parking zones, landscaped or paved islands, and medians. BGSI can also be integrated with roadway improvements, including potential road raising. Practices employing Florida-friendly vegetation such as bioretention/bioswales, stormwater planters, and enhanced tree pits/trenches, as well as permeable pavements, are often the most effective BGSI in the ROW. Such practices can potentially be implemented at lower overall costs when they are incorporated into other capital improvements, such as road repaving/reconstruction, utility work, or other streetscape improvements.

**Potential Advantages**

- Improved water quality, reduced stormwater runoff volume, and increased freshwater lens recharge
- Improved streetscape aesthetics
- Increased tree canopy, as well as enhanced tree health/longevity; potential to align with City’s Urban Forest Master Plan
- Compatible with various road improvements, such as road width reductions, 1- to 2-way conversions, road raising, etc.
- High visibility/educational value
- Opportunity to help reduce nuisance street flooding
- Improved safety resulting from traffic calming and increased pedestrian buffers
- Reduction of urban heat island
- Opportunity to reduce impervious (non-porous) cover by converting pavement (no parking zones, paved medians, etc.) to landscaped areas or using permeable pavement

**Potential Limitations**

- Competing with other demands, such as pedestrian accessibility, bicycling, parking, bus stops, loading zones, etc.
- Working around existing features, such as utilities, trees, signs, benches, mailboxes, etc.
- Conventional standards for roadway materials, construction, compaction, etc., which may reduce BGSI effectiveness
- Limited ROW width
- Vehicular mobility, especially with respect to turning radii, emergency vehicle access, and sight clearances at corners
- Increased maintenance requirements
Applicable Practices

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<td>Subsurface Infiltration/Storage (in areas with higher elevations or integrated with road raising)</td>
<td>Blue &amp; Green Roofs</td>
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<td>Enhanced Tree Pits/Trenches (not in alleys)</td>
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<td>Constructed Wetlands (applicable to street ends only)</td>
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<td>Permeable Pavement (parking and bike lanes, sidewalks)</td>
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<td>Rainwater Harvesting</td>
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Commercial Streets

Miami Beach’s commercial streets, which encompass its avenues, boulevards, and main streets, are some of the City’s most visible and heavily traveled. While perhaps the most challenging of the City’s ROW with respect to BGSI, they also provide rich BGSI opportunities. Bioretention/bioswales and stormwater planters can be carefully located in “underused” ROW spaces, where they can effectively treat stormwater runoff and also create visual interest through an attractive, layered planting scheme. Subsurface infiltration/storage systems, especially when integrated with road raising, can store and infiltrate runoff to help reduce localized flooding. Enhanced tree pits/trenches, when coupled with suspended pavement systems or structural soil, can greatly increase urban canopy and tree health. Permeable pavements can be used in many ways, whether in sidewalks, around tree pits, or in parking lanes, but their selection and design must appropriately consider the anticipated vehicular use, loading, and frequency, as well as the City’s unique aesthetic character. In general, implementing BGSI in commercial streets has great potential, and should maintain or even enhance existing public uses, safety, and accessibility.

Residential Streets

Compared to Miami Beach’s commercial streets, the City’s residential streets generally have more space and less utility and other constraints for BGSI. Their grass strips and swales, as well as landscaped or paved islands, represent good opportunities for BGSI practices, such as bioswales, rain gardens, and stormwater planters. Subsurface infiltration/storage systems may also be viable, especially when integrated with road raising. Vegetated BGSI practices would likely be
focused in locations where parking is not currently permitted to minimize parking impacts for residents. Permeable pavements can provide the “dual use” benefits of a stabilized parking surface and stormwater capture. In general, implementing BGSI in residential streets can have a variety of stormwater quality and volume benefits, while being seamlessly integrated into the landscape, enhancing streetscape aesthetics, and potentially increasing property values.

Street Ends

Typically located at waterfront locations, Miami Beach’s numerous street ends provide unique opportunities to incorporate BGSI that absorbs and filters stormwater immediately prior to discharging into Indian Creek, canals, and Biscayne Bay. At the same time, such locations have the potential for incorporating and enhancing habitat for land and aquatic species, as well as providing flexible parking and active or passive recreational spaces for residents. BGSI practices, such as bioretention/bioswales/rain gardens, constructed wetlands, enhanced tree pits/trenches, permeable pavement, and stormwater planters, can all be implemented at street ends, but their use will depend on the size, location, and intended purpose of the street ends.
Non-motorized Street

Non-motorized streets, also known as pedestrian malls or pedestrian streets, are not very common in Miami Beach. However, the non-motorized streets that do exist in the City, most notably Lincoln Road, are important cultural landmarks, as well as key shopping, dining, and strolling destinations. Bioretention/bioswales, stormwater planters, enhanced tree pits/trenches, and permeable pavement can be implemented in such streets, but their placement and sizing must balance stormwater improvements with high aesthetic standards and passive recreational needs. In addition, such practices must consider existing trees and vegetation, public artwork, water features, and the many other amenities often found on these streets.

Lincoln Road in Miami Beach (Source: Kevin Sprague, Lincoln Road Business Improvement District)  
Bioretention, permeable pavers, and stormwater planters in non-motorized ROW

Alleys

Compared to the City’s other ROWs, Miami Beach’s alleys offer more limited opportunities for BGSI. However, implementing BGSI practices, such as permeable pavement and subsurface infiltration/storage systems, especially when integrated with road raising, can still provide meaningful stormwater runoff improvements, as well as improved alley aesthetics and resilience. The proximity of alleys to buildings can pose challenges to BGSI implementation, both during construction and with respect to long-term foundation impacts. However, such constraints can often be overcome by waterproofing the sides of BGSI installations and being extra careful when they’re installed. As with other ROW areas, permeable pavements must carefully consider the anticipated vehicular use, loading, and frequency, as well as fit within the City’s unique aesthetic character.

Typical alley in downtown Miami Beach  
Permeable pavers above an infiltration trench in an urban alley
Single-Family Residential Parcels

Miami Beach’s single-family residential parcels provide unique opportunities to directly engage and educate the public on BGSI practices. Single-family residential parcels have more limited space for BGSI practices, but implementing BGSI in residential locations can still provide meaningful improvements to stormwater quality and freshwater lens recharge, especially if widely employed across neighborhoods.

The most applicable BGSI practices at single-family residential parcels are vegetated systems (rain gardens and bioswales) planted with Florida-friendly plants, rainwater harvesting with rain barrels, and permeable pavements. BGSI practices in these settings are usually simpler and easier to maintain than those implemented in public or commercial sites. What these relatively low-tech practices may lack in storage capacity, they can make up for in aesthetic beauty and educational value. Ultimately, significant stormwater improvements in Miami Beach will require public engagement and adoption of BGSI practices on residential parcels.

Advantages

- Improved water quality and increased freshwater lens recharge
- Improved aesthetics and potentially increased property values
- Reduced localized flooding
- Reduced potable water use, especially when rain barrels are used to harvest rainwater for landscape irrigation, downspouts are directed into landscaped areas, and when Florida-friendly plants are used
- Multiple public resources available, including Miami-Dade County’s free Adopt-a-Tree program and Rain Barrel Workshops

Potential Limitations

- Cost of installation
- Lack of experience with design and/or installation
- Lack of existing drainage infrastructure to connect overflow or underdrain pipes from BGSI practices
- Limited stormwater storage capacity, as well as smaller contributing drainage areas
- Routine and/or restorative maintenance needs

Applicable Practices

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1 Information about these programs can be found on Miami-Dade County’s web site at [www.miamidade.gov](http://www.miamidade.gov)
Fact Sheet Single-Family Residential Parcels

Front yard rain garden

Downspout that has been disconnected from a stormwater pipe and directed toward landscaped area (Source: Wisconsin Department of Natural Resources)

Rain barrel connected to residential downspout

Permeable pavement driveway
Appendix D

BGSI Plant Matrices/Plant Palette Boards
South Florida is home to a diverse and vibrant tapestry of plant communities and ecosystems. For implementing blue green infrastructure across Miami Beach, Florida-friendly plants are the perfect choice as they are climate adapted, excel at ecosystem services and enhance sense of place. The list below is a summary of species that may be used in the BGI program.
South Florida is home to a diverse and vibrant tapestry of plant communities and ecosystems. For implementing blue green infrastructure across Miami Beach, Florida-friendly plants are the perfect choice as they are climate adapted, excel at ecosystem services and enhance sense of place. The list below is a summary of species that may be used in the BGI program.
The Collins Canal is an existing, man-made channel that runs parallel to Dade Boulevard, connecting Indian Creek to Biscayne Bay. By adding constructed wetlands, enhanced tree pits and trenches, and permeable pavement to its design, we can increase the amount of water that is absorbed and treated.

**HOW IT WORKS**

1. **MANAGED AQUATIC PLANT SYSTEMS**
   Managed Aquatic Plant Systems (MAPS) provide habitat, enhance aesthetics, and improve water quality in the canal by reducing common pollutants such as nitrogen, phosphorus, and suspended solids. MAPS will be anchored into the canal bottom, allowing them to rise during flood/high-tide conditions and remain functional and resilient.

2. **ENHANCED TREE PITS/TRENCHES**
   Filters and stores stormwater flows to improve water quality prior to discharging into the canal, while providing significant rooting volume for street trees.

3. **PERMEABLE PAVEMENT**
   Stormwater from Dade Boulevard will flow onto bike and pedestrian lanes constructed of permeable pavement, which looks similar to standard pavement but allows water to drain through its openings and into an underlying infiltration / storage trench. Permeable pavement will reduce the amount of stormwater flowing into the canal.

### WATER MANAGEMENT BENEFITS
- Capture of roadway runoff helps to reduce peak flows (during high frequency events).
- Treatment of roadway runoff reduces hydrocarbons and heavy metal pollution.
- Treatment uptake nitrogen and phosphorus, reducing likelihood of algae blooms.

### ADDITIONAL BENEFITS
- Neighborhood Beautification
- Walking and biking paths
- Waterfront Seating
- Kayak drop-in points

**STRATEGIC VALUE**

**COLLINS CANAL**

**BLUE GREEN INFRASTRUCTURE PILOT PROJECT CONCEPT**
In Miami Beach residential streets vary in whether they include on-street parking, curbs, sidewalks, and other improvements, while often accommodating numerous driveways, alleys, and roadway intersections. Permeable pavement, enhanced tree pits, traffic chicanes, and other drainage features such as trench drains can be incorporated within varying residential roadway conditions to improve water quality, calm traffic, and reduce flows to private property.

**BLUE GREEN INFRASTRUCTURE PILOT PROJECT CONCEPT**

**RESIDENTIAL STREET**

**HOW IT WORKS**

1. **PERMEABLE PAVEMENT / DELINEATED ON-STREET PARKING**
   Stormwater will discharge in defined permeable pavement parking areas. Permeable pavement looks like standard pavement but allows water to drain into an underlying infiltration trench. Permeable pavement will reduce stormwater flowing into private property, minimize soil compaction from parked vehicles on lawns, recharge groundwater, and filter stormwater.

2. **ENHANCED TREE PITS / TRAFFIC CHICANES**
   Enhanced tree pits located in traffic chicanes will provide shade for residents, reduce traffic speeds on local roads, reduce stormwater discharges, and improve water quality. Enhanced tree pits will also provide significant rooting volume for trees and a diverse understorey to contribute to a healthier native South Florida ecosystem.

3. **TRENCH DRAINS**
   Trench drains are depressed linear troughs which manage stormwater flows within the public roadway and allow stormwater to drain through an underlying infiltration trench. Along with valley curbs, enhanced tree pits, and permeable pavement, trench drains can maintain stormwater flows within a raised public roadway and out of private property.

**WATER MANAGEMENT BENEFITS**

Capture of roadway runoff helps to reduce peak flows (during high frequency events). Treatment of roadway runoff reduces hydrocarbons and heavy metal pollution. Treatment and infiltration of stormwater to recharge groundwater supplies and replenish freshwater lens.

**ADDITIONAL BENEFITS**

Neighborhood beautification, additional shade for walking and biking, increased biodiversity, traffic calming, reduced heat island effect.
Commercial streets often **accommodate on-street parking**, curbs, and sidewalks serving varying land uses. Lessened driveway conflicts within these corridors provide opportunities for longer segments of **permeable pavement, trees, infiltration and storage trenches** to improve water quality.

**PERMEABLE PAVEMENT**
Stormwater will discharge in defined permeable pavement parking areas. Permeable pavement looks like standard pavement but allows water to drain into an underlying infiltration trench. Permeable pavement will reduce stormwater flowing into private property, minimize soil compaction from parked vehicles on lawns, recharge groundwater, and filter stormwater.

**ENHANCED TREE PITS/BUMP-OUTS**
Enhanced tree pits located in bump-outs will provide increased shade for residents, reduce traffic speeds on local roads, reduce stormwater discharges, and improve water quality. Enhanced tree pits will also provide significant root volume for trees and a diverse understory to contribute to a healthier native South Florida ecosystem.

**BALANCED ON-STREET PARKING**
On-street parking will serve various modes of transportation and be enhanced with bump-outs and sidewalks accommodating lush plants to mitigate elevated surface temperatures, manage stormwater, enhance walkability, and improve aesthetics for neighborhood.

**GREEN ROOFS**
Green roofs accept stormwater to filter and absorb flows, as well as cool urban heat islands and provide habitat.

**WATER MANAGEMENT BENEFITS**
- Capture of roadway runoff helps to reduce peak flows (during high frequency events)
- Treatment of roadway runoff reduces hydrocarbons and heavy metal pollution
- Treatment and infiltration of stormwater to recharge groundwater supplies and replenish the freshwater lens

**ADDITIONAL BENEFITS**
- Neighborhood beautification
- Increased walking and biking opportunities
- Traffic calming
- Improved sidewalk seating opportunities
PERMEABLE PAVERS
Stormwater will discharge in defined permeable pavement areas. Permeable pavement looks like standard pavement but allows water to drain into an underlying infiltration trench. Permeable pavement will reduce stormwater flowing into private property or streets, minimize soil compaction from parked vehicles on lawns, recharge groundwater, and filter stormwater.

ENHANCED TREE PITS
Enhanced tree pits and biofiltration trenches will provide increased shade for residents, reduce stormwater discharges, and improve water quality. Enhanced tree pits will also provide significant rooting volume for trees and a diverse understory to contribute to a healthier native South Florida ecosystem.

RAIN GARDENS AND BIOSWALES
Rain gardens generally reduce stormwater discharges by absorbing stormwater runoff from impervious areas such as walkways, parking lots, hard sports courts, and compacted lawn areas. Bioswales generally reduce stormwater discharges and recharge groundwater by intercepting, diverting, and absorbing stormwater runoff from impervious areas such as walkways, parking lots, hard sports courts, and compacted lawn areas.

CONSTRUCTED WETLANDS
Constructed wetlands mimic natural wetlands by retaining and filtering water, cycling nutrients, while supporting habitat for a diverse range of species. They are designed to continually hold water, either at the surface or just below the soil surface.

HOW IT WORKS
Parks provide a great opportunity to collect, infiltrate, and store stormwater during smaller, more frequent rain events. Permeable pavement, enhanced tree pits, bioswales and infiltration trenches may be used near park perimeters and access points. Rain gardens and constructed wetlands can be utilized within parks to reduce stormwater quantities, improve water and air quality, and enhance gathering spaces.

WATER MANAGEMENT BENEFITS
- Capture of roadway runoff helps to reduce peak flows (during high frequency events)
- Treatment of roadway runoff reduces hydrocarbons and heavy metal pollution
- Treatment and infiltration of stormwater to recharge groundwater supplies

ADDITIONAL BENEFITS
- Neighborhood Beautification
- Walking and biking paths
- Additional shade along park perimeter
- Enhanced biodiversity

BLUE GREEN INFRASTRUCTURE PILOT PROJECT CONCEPT
NEIGHBORHOOD PARK
The Art of the Possible - below are three high-level scenarios exploring the redevelopment of the Miami Beach Golf Club into a blue green infrastructure asset: 1) a retrofit scenario - keeping all eighteen holes; 2) a repurpose scenario - converting the back nine holes into a signature park; and 3) a reimagine scenario - converting the club into a central park with potential development opportunities.
Scenario 1 retrofits the Miami Beach Golf Club with tactical blue green infrastructure interventions to reduce stormwater volumes and improve water quality. The existing water hazards and edges of the golf club would be enhanced and redesigned with blue green practices. **All eighteen holes and golf facilities would be maintained** more or less as they are today.

**HOW IT WORKS**

1. **Golf Club Remains Intact**
   The existing eighteen hole golf course remains largely intact and functioning much the same as it does today.

2. **Retrofit the Water Hazards**
   The water hazards and out of bounds areas are redesigned to include BGI interventions such as stormwater detention, wet ponds and bioswales.

3. **Transform the Edges to BGI**
   The edges of the golf club will be redesigned to include bioretention zones, pervious pavement and facilities may be retrofitted to include rainwater harvesting features.

4. **Connect to District Systems**
   The increased stormwater capacity and water quality treatment facilities may allow for networking the interventions to other BGI projects, such as Collins Canal.
Scenario 2 repurposes the back nine holes of the Miami Beach Golf Club to create a new signature park focused on integrating passive and active recreation with a robust blue green infrastructure program to mitigate stormwater volumes and improve water quality. In this high-level concept, the front nine holes of the Golf Club remain intact as an executive course.

**How It Works**

1. **Golf Club Front Nine Stays As-IS**
   - The land area of the front nine of the golf club is kept intact and reconfigured as necessary for an executive course.

2. **Repurpose the Back Nine**
   - Consider repurposing the 65 acres comprising the back nine to accommodate BGI interventions and the potential for a substantial open space improvement.

3. **Create a Signature Park Space**
   - Repurposing the back nine into a signature modern park space. A park which balances environmental, social and economic considerations and provides a framework for district-wide resiliency.

4. **Link BGI Systems in Park to the Neighborhood**
   - Stormwater storage and water quality measures may be designed to accept and integrate with adjacent BGI improvements, such as Collins Canal.
Scenario 3 reimagines the entire Miami Beach Golf Club to establish a 21st century “Central Park” for Miami Beach. This initial concept sketch explores the potential of a new neighborhood predicated on a Living with Water theme, a recreation hub, and a signature wetland park with hiking and biking trails and passive and active recreation opportunities.
**BLUE GREEN INFRASTRUCTURE PILOT PROJECT CONCEPT**

**GARDEN APARTMENTS**

Garden apartments as well as other **private properties** can be important partners in augmenting a comprehensive blue-green infrastructure system in Miami Beach. **Property owners can make a difference** citywide taking simple steps such as incorporating downspout disconnections, rain barrels, and tree plantings on their properties. Other BGSI BMPs such as permeable pavement for parking spaces, rain gardens, green roofs, and enhanced tree pits can be used to manage stormwater on private property.

**HOW IT WORKS**

1. **PERMEABLE PAVEMENT**
   Stormwater will discharge in defined permeable pavement parking areas. Permeable pavement looks like standard pavement but allows water to drain into an underlying infiltration trench. Permeable pavement can manage and filter stormwater, minimize soil compaction from parked vehicles on lawns and recharge groundwater.

2. **ENHANCED TREE PITS**
   Enhanced tree pits and biofiltration trenches will provide increased shade for residents, reduce stormwater discharges, and improve water quality. Enhanced tree pits will also provide significant root zone volume for trees and a diverse understory to contribute to a healthier native South Florida ecosystem.

3. **RAIN GARDENS**
   Rain gardens generally reduce stormwater discharges by absorbing stormwater runoff from impervious areas such as walkways, parking lots, hard sports courts, and compacted lawn areas.

4. **GREEN & BLUE ROOFS**
   Green roofs filter and absorb stormwater flows, as well as cool urban heat islands and provide habitat. Blue roofs can be used in conjunction with green roofs to store water volumes on building roofs when the structure allows.

5. **DOWNSPOUT DISCONNECTS**
   Downspout disconnects take roofwater that would otherwise enter the storm sewer and route it into permeable/retains for storage and/or stormwater BMPs for treatment.

**WATER MANAGEMENT BENEFITS**

- Capture of driveway and roof runoff helps to reduce peak flows (during high frequency events).
- Treatment uptake nitrogen and phosphorus reducing likelihood of algae blooms.
- Treatment of residential runoff reduces sediment transfer, as well as fertilizer, pesticides, bacteria, and hydrocarbon pollution.

**ADDITIONAL BENEFITS**

- Neighborhood Beautification
- Reduction in urban heat island effect / cooler ambient temperatures
- Enhanced biodiversity and habitat
- Increased shade from trees plantings
Often located at waterfront locations, street ends provide opportunities to incorporate BGSI which absorb and filter stormwater prior to discharging into canals, the Biscayne Bay, and the ocean, while incorporating and enhancing habitat for land and aquatic species, and providing flexible parking and play spaces for residents.

**HOW IT WORKS**

1. **RAIN GARDENS**
   - Rain gardens generally reduce stormwater discharges by absorbing stormwater runoff from impervious areas such as walkways, parking lots, hard sports courts, and compacted lawn areas.

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4. **LIVING SHORELINE**
   - Improves water and soil quality in water bodies, reduces wave action during severe storms, and provides habitat for wildlife.

**WATER MANAGEMENT BENEFITS**

- Capture of roadway runoff helps to reduce peak flows (during high frequency events)
- Treatment of roadway runoff reduces hydrocarbons and heavy metal pollution
- Treatment uptakes nitrogen and phosphorus reducing likelihood of algae blooms

**ADDITIONAL BENEFITS**

- Walking and biking paths
- Waterfront Seating
- Kayak drop-in points
- Street ends
- Living shoreline
- Rain gardens
- Enhanced tree pits
- Florida friendly vegetation
- Bioswale
- Permeable pavement
- Filtered stormwater overflows into natural water bodies
Appendix F
Potential Project Location Maps
Legend

- Transportation Management Plan Projects
- Triangular Open Spaces
- Canal
- Miami Beach City Limits
- Building Footprints
- Parcels
- Parks

Triangular Open Spaces

<table>
<thead>
<tr>
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Transportation Master Plan Projects

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Data Sources:
ESRI, City of Miami Beach
October 2019
Transportation Master Plan Projects

131 Drexel Avenue Neighborhood Greenway
130 Purdy Avenue Neighborhood Greenway
127 20 Street Neighborhood Greenway
126 15th Street Neighborhood Greenway
125 SR A1A/Indian Creek Drive Protected Bicycle Lanes
124 SR 112/Julia Tuttle Cswy Exclusive Transit Lane/Shared-Use Path
122 Pine Tree Drive Protected Bicycle Lanes
117 Flamingo Drive Protected/buffered bicycle lanes
116 24th Street / Liberty Avenue Protected/buffered bicycle lanes
114 Venetian Causeway Conventional Bike Lanes
113 Washington Avenue Exclusive transit and protected/buffered bicycle lanes
112 Alton Road Exclusive transit and protected/buffered bicycle lanes
111 South Pointe Drive Protected/buffered bicycle lanes
106 SR A1A Collins Ave/Indian Creek Dr Exclusive transit and protected/buffered bicycle lanes
105 SR A1A Collins Avenue Exclusive transit lanes
104 Prairie Avenue Neighborhood Greenway
103 SR A1A/Indian Creek Drive Protected/buffered bicycle lanes
101 Lincoln Lane North Bicycle Connection/ Neighborhood Greenway
100 Lincoln Road Shared Space
98 44th St and SR A1A/Collins Ave Safety Feasibility Study
97 SR 112/41st St and Pine Tree Dr Safety Feasibility Study
96 SR 907/Alton Rd and SR 112/41st St Safety Feasibility Study
93 21st Street and 22nd Street/Park Avenue Protected Bicycle Lanes Feasibility Study
91 Meridian Avenue Protected/buffered bicycle lanes
90 SR A1A/Collins Ave/Indian Creek Dr Exclusive transit and protected/buffered bicycle lanes
89 17th Street Exclusive transit and protected/buffered bicycle lanes
88 South Beach Pedestrian Priority Zones
85 42nd St Enhanced Bicycle Lanes
83 16th St Bicycle Facilities Improvements
82 Alton Rd and North Bay Rd Intersection Bicycle Improvements
81 Chase Avenue Shared-Use Path Feasibility Study
76 SR A1A/Collins Ave/Indian Creek Dr and SR 112/41st St Intersection Safety Study and Improvements
75 Middle Beach Recreational Corridor
74 SR 907/Alton Rd and Michigan Ave Intersection Improvements
73 10th Street Neighborhood Greenway
72 11th Street Neighborhood Greenway
71 SR 112/Julia Tuttle Causeway Westbound Ramp
70 SR 112/41st Street and SR 907/Alton Road Auxiliary Turn/Shoulder Lane Study
67 Trolley Route: SR 907/Alton Rd SR 112/41st St SR A1A/Indian Creek Dr/Collins Ave Dade Blvd Prop MB
65 SR 112/Julia Tuttle Causeway Feasibility Study
63 Intersection of 907/Alton Road and 43rd St/Ed Sullivan Rd
61 SR A1A/Indian Creek Drive Bicycle/Pedestrian Safety Improvements
60 23rd Street Complete Streets Feasibility Study
58 SR A1A/MacArthur Causeway and SR A1A/5th St Feasibility Study of Adaptive Signal Controls
56 SR A1A/5th St and SR 907/Alton Rd Intersection Improvements
55 6th St and Michigan Ave Bicycle Facilities Analysis
53 Meridian Avenue and 28th Street Shared Use Path
52 Meridian Avenue Bicycle Facilities
50 Dade Blvd Shared Use Path and Road Diet
49 SR 907 Bicycle Alternatives Analysis and Implementation
46 SR 907/Alton St and 17th St Intersection Improvements
45 SR 907 Bicycle Alternatives Analysis and Implementation
44 Introduction of 5th Avenue Road and 4th Dade Collins Road
43 Triangle at Sunset Dr and SR A1A/Indian Creek Dr
42 Triangle at Alton Rd and Alton Rd
41 Triangle at Sunset Dr and Alton Rd
40 SR A1A/MacArthur Causeway Complete Streets Feasibility Study
39 Triangle at Alton Rd and Alton Rd
38 Triangle at Alton Rd and West 34th St
37 Triangle at Sunset Dr and West 21st St
36 Triangle at Lake Ave and Sunset Dr
35 Triangle at Indian Creek Dr and West 41st St
34 Triangle at Sunset Dr and W 21st St
33 Triangle at Alton Rd and W 34th St
32 Triangle at Alton Rd and Alton Rd
31 Triangle at West 35th St and Flamingo Dr
30 Triangle at Prairie Ave and W 28th St
29 Triangle at W 35th St and Flamengo Dr
28 Triangle at Flamingo Dr and Pine Tree Dr
27 Triangle at W 33rd St and Flamengo Dr
26 Triangle at Dade Blvd and Washington Ave
25 Triangle at 1st St and Jefferson Ave
24 Triangle at Sunset Dr and Alton Rd
23 Triangle at Dade Blvd and Washington Ave
22 Triangle at Park Ave and W 28th St
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20 Triangle at West 33rd St and Flamengo Dr
19 Triangle at Alton Rd and Alton Rd
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City of Miami Beach Potential Locations for BGSIs in Transportation Master Plan Projects and in Triangular Open Spaces

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