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Miami Beach Integrated Water Management

Blue-Green Stormwater Infrastructure
Frequently Asked Questions

Document Version 3

City of Miami Beach

Contents

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.

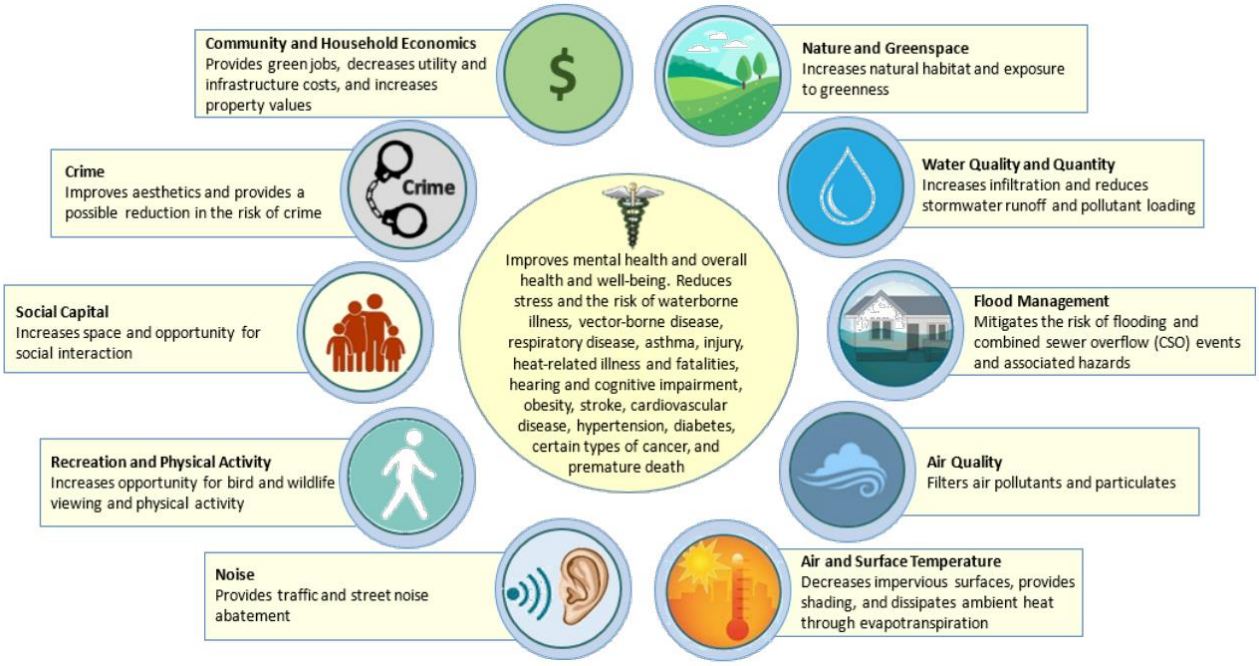
Like all infrastructure, BGSI must be designed, constructed, and maintained to function properly over the long term (for more on maintenance, see the FAQ "How does BGSI get maintained?").

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.



Potential Environmental, Social, Economic, and Public Health Benefits of Green Infrastructure
Source: https://www.epa.gov/sites/production/files/2017-11/documents/greeninfrastructure_healthy_communities_factsheet.pdf

[1] U.S. Environmental Protection Agency. Benefits of Green Infrastructure. Accessed August 16, 2019. https://www.epa.gov/green-infrastructure/benefits-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.

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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.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 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

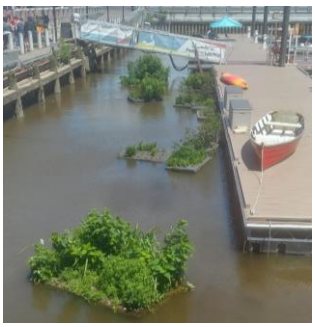
Infiltration Trench
Source: Jacobs

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.

Resource	Source/Location
MB Rising Above Website	www.mbrisingabove.com
Best Management Practices for South Florida Urban Stormwater Management Systems	www.sfwmd.gov/sites/default/files/documents/bmp_manual.pdf
Florida Field Guide to Low Impact Development: Bioretention Basins/Rain Gardens	buildgreen.ufl.edu/Fact_sheet_Bioretention_Basins_Rain_Gardens.pdf
Florida Field Guide to Low Impact Development: Green Roofs/Eco-roofs	www.buildgreen.ufl.edu/Fact_sheet_Green_Roofs_Eco_roofs.pdf
Florida Department of Transportation Drainage Design Guide (Injection Wells covered in Chapter 7)	fdotwww.blob.core.windows.net/sitefinity/docs/default-source/roadway/drainage/files/drainagedesignguide.pdf
Sarasota County Low Impact Development Guidance Document	www.scgov.net/home/showdocument?id=33258
University of Florida Soil and Water Sciences Video Topics: Green Stormwater Infrastructure	soils.ifas.ufl.edu/extension/videos/low-impact-development/
Constructed Floating Wetlands: A review of research, design, operation and management aspects, and data meta-analysis	apirs.plants.ifas.ufl.edu/site/assets/files/372369/372369.pdf

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.