



Blue-Green Stormwater Infrastructure Practices

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 a period of time. 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 that threaten Biscayne Bay. Bioretention can take many forms including bioretention basins, bioswales, 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

- 2 ft 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



Typical bioretention cross-section with surface depression, Florida-friendly plants, engineered soil, and gravel layer

Performance		Implementation		Community/Environmental		Other	
Water Quality	🌿🌿🌿	Capital Cost	🌿🌿🌿	Improved Aesthetics	🌿🌿🌿	Climate Change Resilience	🌿
Freshwater Lens Recharge	🌿🌿	Maintenance Cost	🌿🌿	Dual Use	🌿	Mosquito Vector Resistance	🌿🌿
Flood Mitigation	🌿	Scalability	🌿🌿🌿	Habitat Creation	🌿🌿		
		Constructability	🌿🌿🌿	Urban Heat Island Reduction	🌿🌿		

🌿 = low 🌿🌿 = medium 🌿🌿🌿 = high

Blue Green Stormwater Infrastructure Integrated Into All Relevant Planning

- **Recommended practices:**
 - Bioretention (ponds/swales)/Rain Gardens
 - Blue-green roofs
 - Constructed/floating wetlands
 - Detention basins
 - Enhanced tree planters
 - Pumped injection
 - Permeable pavement
 - Rainwater Harvesting
 - Stormwater planters
 - Subsurface infiltration/storage
 - Wet ponds
 - Tree canopy
- **Implementation scenarios: residential, commercial, transportation & public spaces**



RESIDENTIAL STREET

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.**

STRATEGIC VALUE

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 understory 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 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.

DEEP ROOTING FLORIDA-FRIENDLY VEGETATION TO FILTER STORMWATER AND MAINTAIN CLEAR SIGHT LINES FOR ROADWAY USERS

PROTECTION OF EXISTING CANOPY TREES

INCREASED CANOPY TO MITIGATE HEAT ISLAND EFFECT

**TODAY
→
ENHANCED**



DELINEATED ON-STREET PARKING WITH PERMEABLE PAVEMENT

TRAFFIC CHICANES WITH BIORETENTION

TRENCH DRAINS

MODIFIED VALLEY CURBS TO CONVEY STORMWATER TO GREEN INFRASTRUCTURE

BIOFILTRATION

STORAGE

INFILTRATION

**OVERFLOWS TO
STORM SEWER**

STORAGE

INFILTRATION



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 STREET

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**.

STRATEGIC VALUE

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 will reduce stormwater flowing into private property, minimize soil compaction from parked vehicles on lawns, recharge groundwater, and filter stormwater.
- 2 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 rooting volume for trees and a diverse understory to contribute to a healthier native South Florida ecosystem.
- 3 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.
- 4 GREEN ROOFS**
Green Roofs accept stormwater to filter and absorb flows, as well as cool urban heat islands and provide habitat.



TODAY

ENHANCED



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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

NEIGHBORHOOD PARK

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.

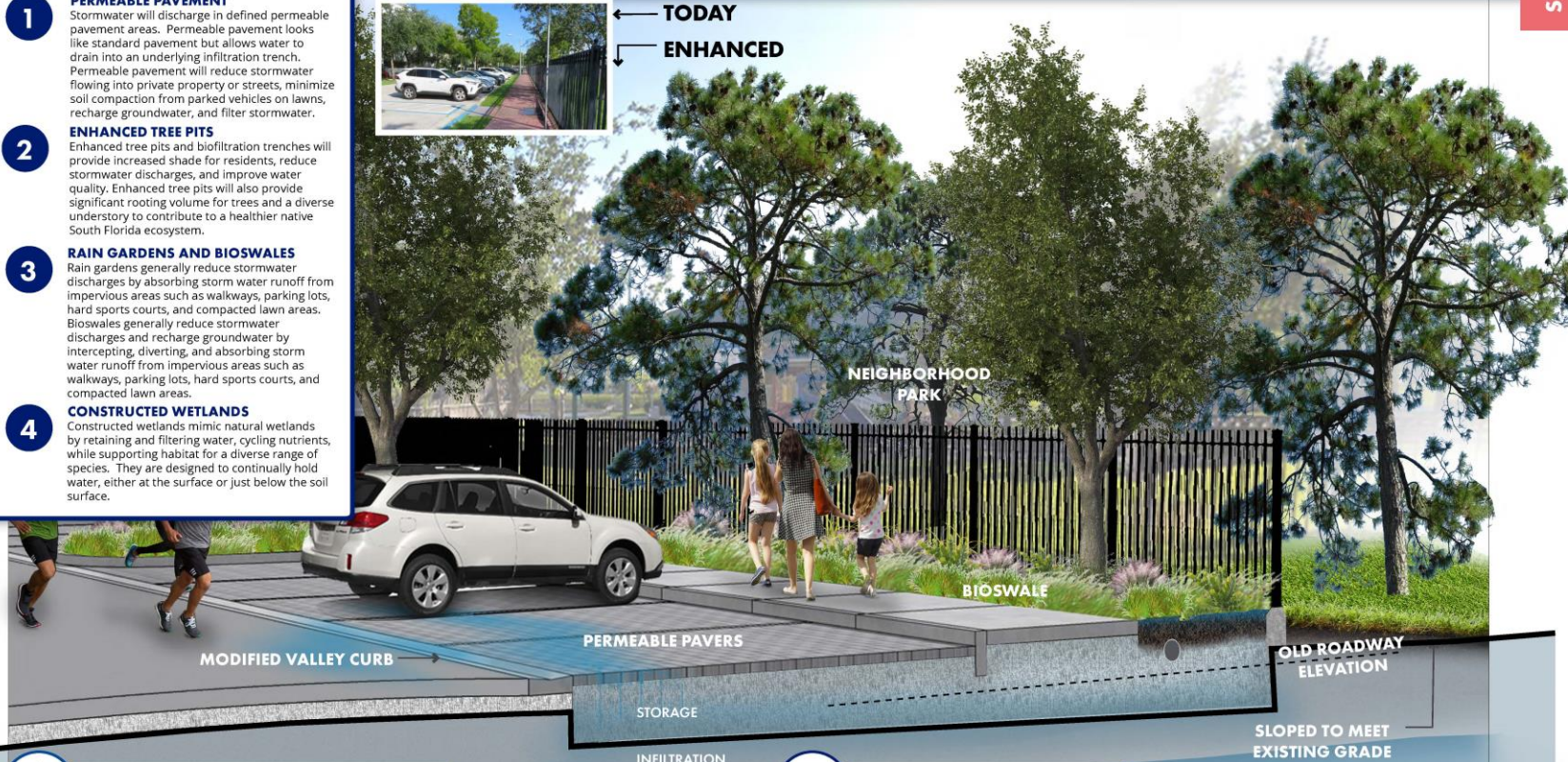
STRATEGIC VALUE

HOW IT WORKS

- 1 PERMEABLE PAVEMENT**
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.
- 2 ENHANCED TREE PITS**
Enhanced tree pits and bioinfiltration 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 RAIN GARDENS AND BIOSWALES**
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. Bioswales generally reduce stormwater discharges and recharge groundwater by intercepting, diverting, and absorbing storm water runoff from impervious areas such as walkways, parking lots, hard sports courts, and compacted lawn areas.
- 4 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.



← **TODAY**
← **ENHANCED**



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