Low Impact, High Rewards: Using LID to Foster Growth and Meet ERP Requirements

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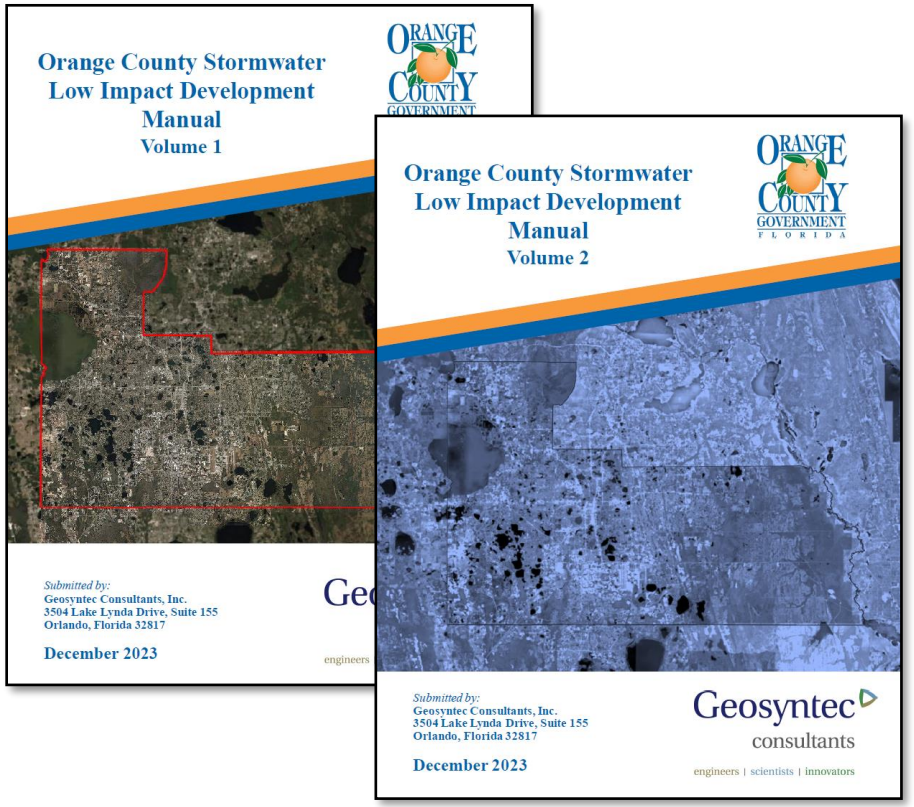
Presentation Outline

- Introduction
- Purpose of the LID Manual
- Overview of Volume 1
- Overview of Volume 2
- What's Next



Introduction

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Introduction

County goals

- Provide additional guidance on innovative stormwater management practices
  - Meet new regulatory requirements (updated statewide stormwater rule)
  - Provide guidance and training for county staff
- More sustainable growth
  - Protect natural resources
  - Improve quality of life
  - Major changes in comprehensive plan and zoning code, protection areas
- Leverage nature-based solutions for stormwater management → Low Impact Development (LID)/Green Stormwater Infrastructure (GSI)
  - Improve water quality
  - Help reduce flooding and stress on secondary drainage infrastructure

Introduction: Goals of the Manual

- Goals:
  - Support Orange County's Stormwater Management Program
  - Update guidance for stormwater design to incorporate new LID and GSI principles
  - Enhance water quality of County's stormwater and by extension, surface waterbodies
  - Promote stormwater treatment, volume reduction methods, and increasing tools in the toolbox for designers to meet water quality requirements

Introduction: LID

- LID = Low Impact Development:
  - An approach to land development (or redevelopment) that works with nature to manage stormwater as close to its source as possible. LID employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that treat stormwater as a resource rather than a waste product.
  - LID can include both structural and non-structural practices

Introduction: Types of LID

- Non-structural vs structural practices
  - Non-structural practices:
    - Often referred to as source control practices
    - Typically leveraged as early as the planning phase
    - Examples: preserving open space, minimizing soil compaction, cluster development, use of Florida Friendly Landscaping, street sweeping
  - Structural practices:
    - Physical structures used to mitigate the changes in stormwater caused by urban development
    - Can be further organized based on their primary treatment mechanism

Introduction: Intended Users

- Intended Users:

  Professionals engaged in planning, designing, constructing, operating, and maintaining development projects in Orange County.

Introduction: Organization of Manual

LID Manual divided into two volumes

- Volume 1
  Provides overview / big picture information
  - Introduces LID
  - Discusses County characteristics
  - Assesses the site and site constraints
  - Reviews LID practices applicable in Florida
- Volume 2
  Provides more specific info on individual practices
  - Design details
  - Example calculations
  - Operation and maintenance guidelines
  - Monitoring guidance

Purpose of the LID Manual

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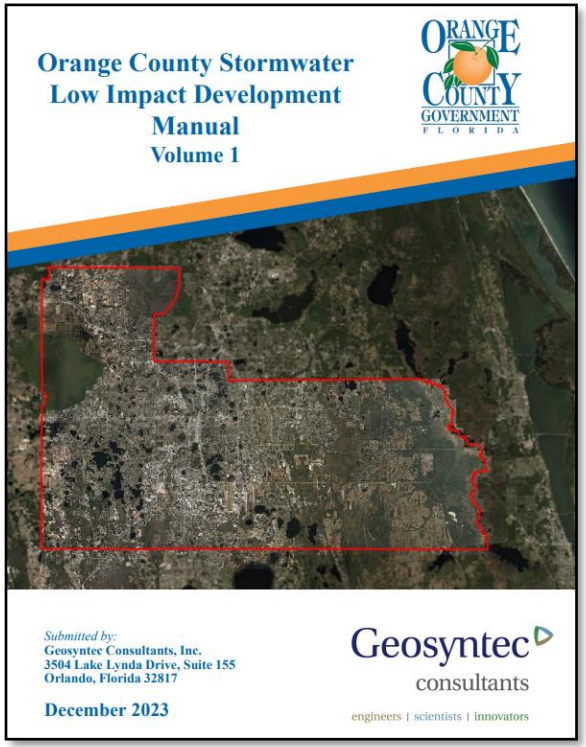
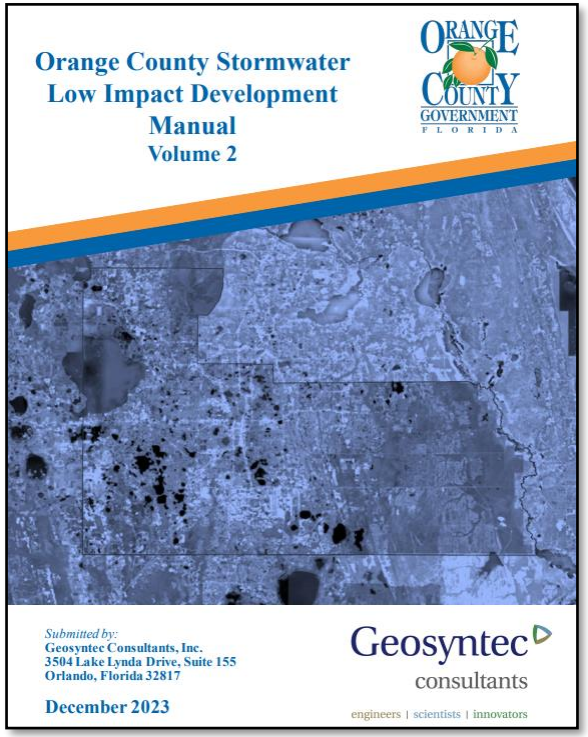
Purpose of Volume 1

- Promote and provide uniform guidance on LID across Orange County
  - Local jurisdictions, developers, staff and property owners
- Identify problems of urban stormwater runoff
  - Flooding and water quality impairment or waters not attaining standards (WNAS)
- Discuss constraints typically seen with using LID practices compared to conventional stormwater management approaches
  - Site, cost, operation and maintenance
- Provide overview of regulations applicable to Orange County
  - State, local, water management districts (WMD)
- Statewide stormwater rule – future update



Purpose of Volume 2

- Provide technical guidance and design specifications for LID practices
  - Design specifications and details
  - Relevant calculations
  - Nutrient removals, underdrain flow
  - Operation, maintenance, and monitoring guidance
  - Modifications (acceptable vs unacceptable)
- LID practices covered in Volume 2:
  - Bioretention systems
  - BAM enhancements
  - Tree box filters
  - Infiltration planters



Overview of Volume 1

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Overview of Volume 1: Key Strategies and Practices

- Stormwater is challenging to treat… Especially to the levels required by new Statewide Stormwater / ERP rules:

Project Scenario	TN	TP	Additional Criteria
All sites	**55%**	**80%**	Or post ≤ pre, whichever is more stringent
OFWs	**80%**	**90%**	Or post ≤ pre, whichever is more stringent
Impaired waters	**80%**	**80%**	And post ≤ pre
Impaired waters + OFW	**95%**	**95%**	And post ≤ pre
Redevelopment	**45%**	**80%**	N/A
Redevelopment + OFW	**60%**	**90%**	N/A
Redevelopment + Impaired waters	**45%**	**80%**	And net improvement for pollutant of concern

Overview of Volume 1: Key Strategies and Practices

- Stormwater generates large volumes of water quickly
- Different characteristics in different parts of the County will change how water should be managed
- Different regulatory requirements associated with waterbody impairments, TMDLs, BMAPs, and OFWs will impact the level of treatment required

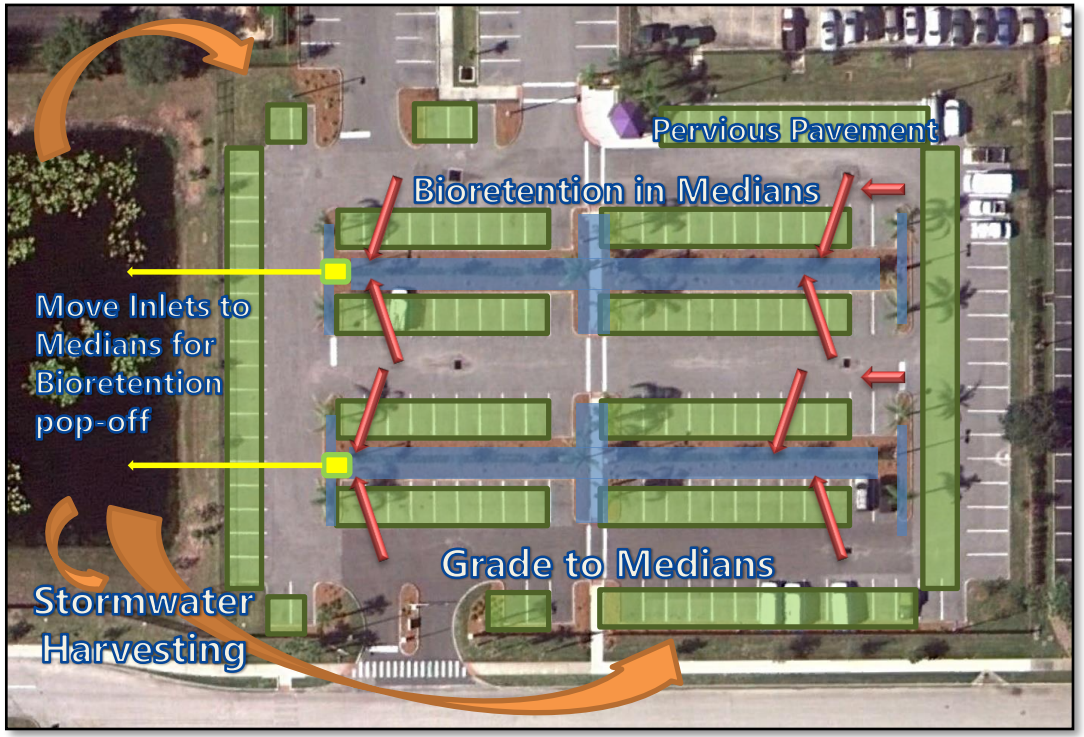
Overview of Volume 1: Key Strategies and Practices

- Traditional stormwater practices will not be sufficient to meet these requirements
- Incorporation of LID will be necessary
- Using multiple practices working in conjunction will be necessary
  - Treatment train approach
  - Important to understand the different removal mechanisms

Overview of Volume 1: Defining Treatment Trains

- Defines Treatment Train:
  - Multiple treatment practices that incorporate multiple removal mechanisms that are implemented in series with each other to increase the water quality treatment achieved
  - Water flows from one practice to the next
  - Slow, Spread, Sink

Conceptual design



Geosyntec, 2018

Overview of Volume 1: Defining treatment trains

Treatment trains can be a combination of:

- Non-structural BMPs
  - Preserving natural drainage patterns
  - Preventing pollution
- Structural BMPs
  - Bioretention systems
  - BAM enhanced systems
  - Tree box filters
  - Infiltration planters

Minnesota Stormwater Manual, 2015

Overview of Volume 1: Nutrient Removal Mechanisms

- Mechanisms of structural practices
  - Retention (infiltration)
    - Enters the ground, pollutants removed via biological processes as water passes through soil and goes into groundwater
    - Most effective practice
  - Dry Detention (filtration)
    - Enters the ground, pollutants removed via filter media before water is discharged through underdrain that connects to downstream infrastructure
    - Less effective and should have upstream control of particles that could clog media layers
  - Source control
    - Minimizes the amount of stormwater generated or the amount of pollutants entering the stormwater
    - Highly effective and should be most upstream practice
  - Vegetative uptake
    - Plants taking up dissolved nutrients through root systems
    - Effective, need to consider the form that nutrients are in to make sure available for uptake

BMP Summary – Non-structural

Practice Type	Principles and Practices						
	Preserve Natural Drainage Patterns	Minimize Impervious Area	Disconnect Impervious Area	Integrate Open Space and Urban Development	Street Sweeping	Florida-Friendly Landscaping	Interceptor Trees
LID Principles	X	X	X	X			
Non-Structural Practices					X	X	X

BMP Summary – Structural

Practice Type	LID Practices														
	Green Roof	Storm-water and Rain-water Harvest-ing	Under-ground Storage and Exfiltration	Pervious Pave-ment	Bio-retention Swales	Vegetated Buffer Strips	Tree Box Filter	Infil-tration Planter Boxes	Rain Garden	Filtration with BAM	NSBB	Dry Retention	Wet Det-ention	MAPS	Constructed Wetlands
Infiltration		X	X	X	X	X		X	X			X			
Filtration	X			X	X	X	X	X	X	X			X		
Source Control											X				
Vegetative Uptake	X				X	X	X	X	X					X	X
Settling	X										X		X		X

Overview of Volume 2

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Overview of Volume 2

- LID practices included
  - Bioretention Systems
  - BAM Enhancements
  - Tree Box Filters
  - Infiltration Planter Boxes

Fergusonss.com, 2024

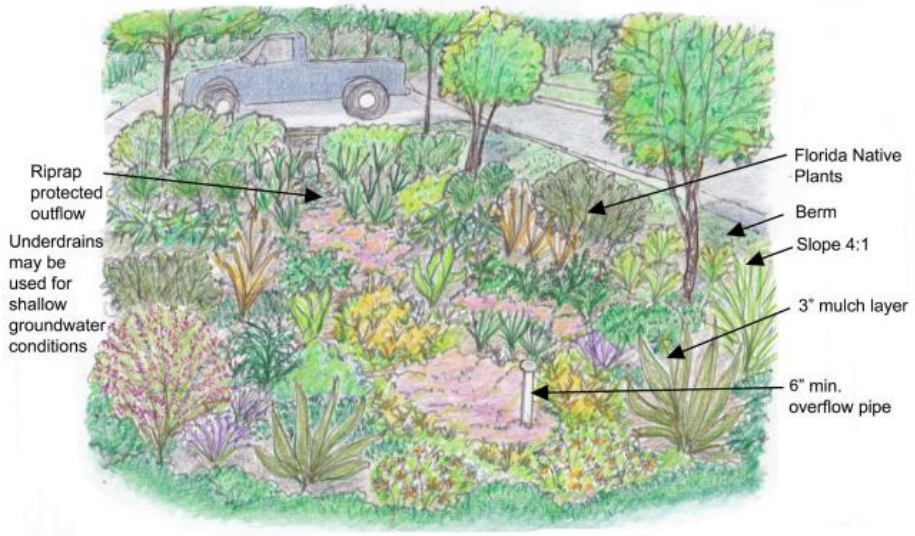
Orange County LID Manual, 2023

Geosyntec, n.d.

Orange County LID Manual, 2023

Overview of Volume 2

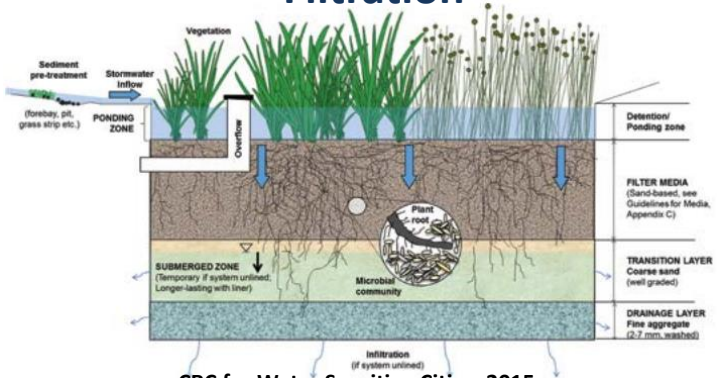
- For each practice, the following information is presented:
  - Introduction to practice
  - Practice/system components
  - Description of the mechanisms responsible for flood and water quality mitigation
    - Includes with and without underdrains
  - Media components and purpose



Overview of Volume 2

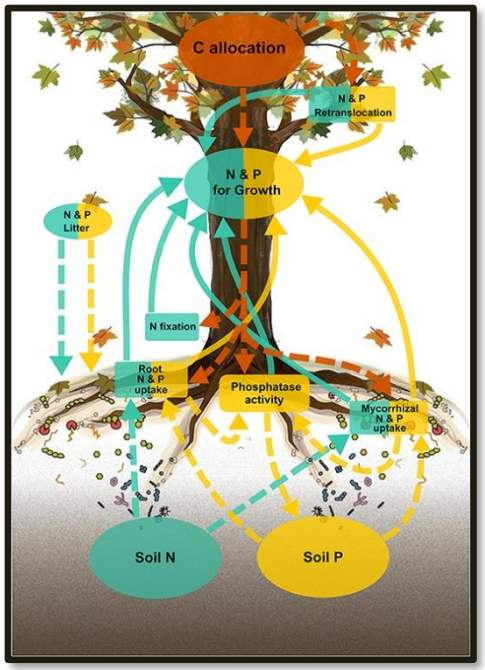
- Function of different practice features/elements
- Site suitability considerations

Filtration



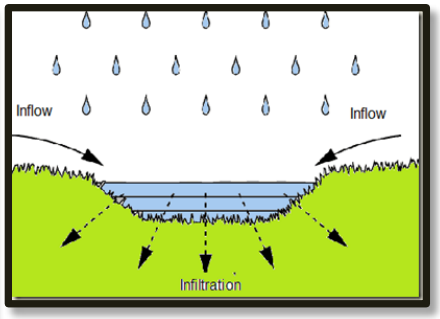
CRC for Water Sensitive Cities, 2015

Vegetative Uptake



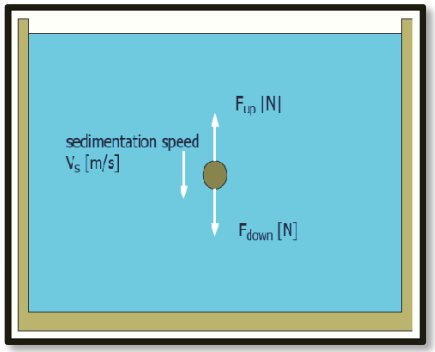
Frontiers in Forests and Global Change, 2020

Infiltration



online civil engineering, 2012

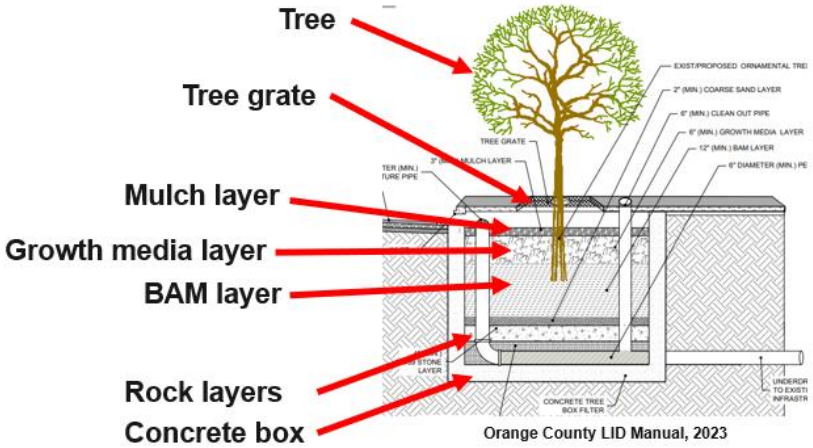
Settling



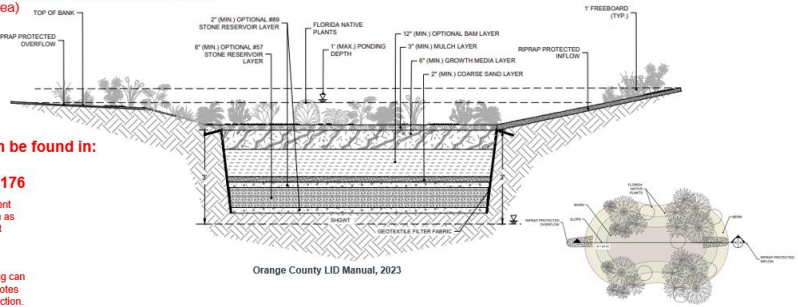
Hydraulic Transport of Sand/Shell Mixtures, 2011

Overview of Volume 2

- Design details and specifications
- Construction considerations
- Example Calculations



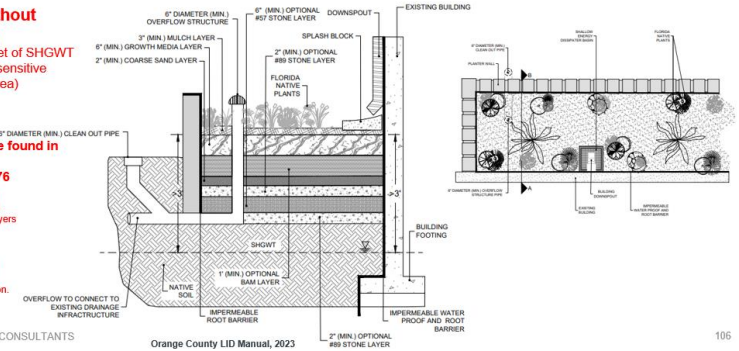
System without underdrain
(not within 3 feet of SHGWT and not within sensitive groundwater area)



Section can be found in:
Volume 2
Page 27 of 176

Additional pertinent information, such as what the different layers are for, contacting utility companies, and soft/hard armoring can be found in the notes portion of this Section.

System without underdrain
(not within 3 feet of SHGWT and not within sensitive groundwater area)



Section can be found in Volume 2
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Additional pertinent information, such as what the different layers are for, overflow information, and contacting utility companies, can be found in the notes portion of this Section.

Overview of Volume 2: Operation and Maintenance

- Regular inspections are required to ensure performance
  - Surface
    - Monthly
  - Vegetation
    - Quarterly
  - System
    - Monthly
- Maintenance checklist submitted yearly to the County by the maintenance personnel
- Minimum 5 representative pictures of system
  - Inflow & outflow points, vegetation
- Every 5 years a Professional Engineer to check system and ensure functionality
- Once the new stormwater rule is finalized, the inspection criteria/frequency is subject to change

Inspection and Maintenance Checklist for Bioretention without Underdrains			
Facility Name and Address:			
Date of Inspection:			
Site Conditions:	Excellent ☐	Good ☐	Adequate ☐ Poor ☐
Date of Last Rain Event:			
Inspection Frequency Type:	Monthly ☐	Quarterly ☐	Annual ☐
Inspection Activities Visual inspections are an integral part of system maintenance. Inspection includes monitoring for drainage, debris and sediment accumulation, vegetation health and coverage, and surface deterioration.			
Inspection Item	**Checked (Y/N)**	**Maintenance Needed (Y/N)**	**Corrective Action/Comments**
BIORETENTION SURFACE (Frequency – Monthly)			
BS1. Evidence of erosion (i.e., visible rills or gullies or sediment accumulation)			
BS2. Mulch layer is still in place (depth of at least 3 in)			
BS3. Inflow and overflow points in working order			

Overview of Volume 2: Operation and Maintenance

Inspection Item	Checked (Y/N)	Maintenance Needed (Y/N)	Corrective Action/Comments
VEGETATION MANAGEMENT (Frequency – Quarterly)			
VM1. Evidence of dead or unhealthy plants			
VM2. Is plant community composition still according to approved plans?			
VM3. Do plants appear well maintained/manicured			
Inspection Item	**Checked (Y/N)**	**Maintenance Needed (Y/N)**	**Corrective Action/Comments**
SYSTEM PERFORMANCE (Frequency – Monthly)			
SP1. Evidence of standing water			
SP2. Debris and sediment accumulation			

OVERALL CONDITION OF FACILITY	
In accordance with approved design plans? (Y/N)	
Maintenance required as result of deficiencies detailed above? (Y/N)	
Date by which maintenance must be completed: (Y/N)	
NOTES	
CERTIFICATION SIGNATURE	
Company Name:	
Company email, address, and phone number:	
Name of Inspector:	
Inspector Signature:	

Overview of Volume 2: Water Quality Performance Monitoring

- Water quality monitoring guidance
  - To determine if the system is performing as intended, water quality monitoring is necessary
    - Identify pollutant flow path, removal mechanisms, and downstream waterbody of interest (surface discharge or groundwater?)
  - If surface discharge:
    - Monitor inflow and overflow with autosamplers
    - Assess mass of pollutants associated with accumulated sediment, debris, and removed vegetation
      - Measure weight, bulk density, water content, and nutrient content
  - If groundwater:
    - Monitor inflows(s), overflow, and control structure
    - Install a lysimeter to collect water that would infiltrate into the ground
    - Mass of pollutants associated with accumulated sediment and debris

Geosyntec, 2024

Radovanovic (UF/IFAS), 2024

Overview of Volume 2: Water Quality Performance Monitoring

- Flow monitoring
  - Using area-velocity probe (or equivalent – must be appropriate for continuous estimation of flow, such as ISCO 2150)
  - Can be from inflow pipe or may need to create a small weir to facilitate flow measurement
- Stormwater sampling
  - Auto-sampler to collect time- or flow-weighted composite samples (such as ISCO 6712)
  - Storm events typical to Central Florida.
  - Rain gauge to be installed on-site
- System performance = $1-((mass\ entering\ system-mass\ leaving\ system)/(mass\ entering\ system))$
  - Entering: autosampler (collect runoff)
  - Leaving to surface waterbody (underdrain): autosampler (only runoff, not coarser material), debris, sediment, vegetation
    - Debris, sediment, and vegetation will need to be added to both mass entering and mass leaving, as autosamplers are not effective at collecting this.
  - Leaving by infiltration into ground (no underdrain): lysimeter

Teledyne ISCO, 2024

What's Next

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What's Next?

- Additional practices
  - Permeable/Pervious Pavements
  - Stormwater Harvesting/Reuse
  - Vegetative Buffer Strips
  - Interceptor Trees
  - Constructed Wetlands
  - Nutrient Separating Baffle Boxes (NSBBs) and Cyclone Separators
  - Modular Wetlands
  - Exfiltration
- Regulatory Update
- Cost Guidance
  - Establish cost of pollution, i.e., cost to remediate waterbodies
  - Develop cost estimate methodology
- Case Studies
- Incorporation into drainage manual
  - Identify additional incentives

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- Geosyntec Consultants
  - Jovana Radovanovic
  - Eric Davis

Questions?

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