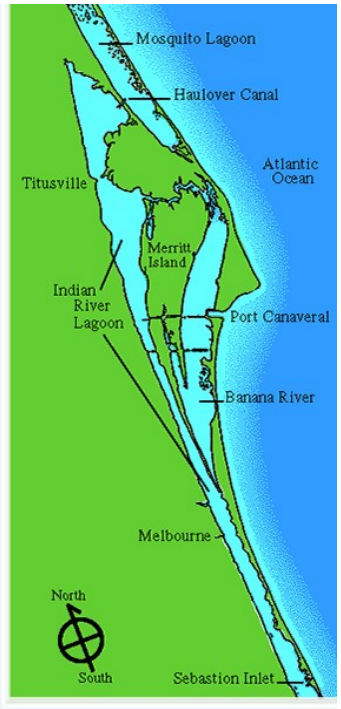
Indian River Lagoon
Basin Management Action Plan Meeting

University of Central Florida

Innovative Stormwater Management for Nutrient Reduction

Success Stories and Design Suggestions

Marty Wanielista
Stormwater Management Academy
May 13, 2014 Cocoa Beach
www.stormwater.ucf.edu



Why and What Innovative Techniques

- Why: IRL reacts in a negative way to excess nutrients and fresh water inputs.
- What Techniques:
  - Regional basis: fertilizer regulations, stormwater parks (South Brevard and Indian Hills), chemical treatment, stormwater reuse, IRL muck removal.
  - Source controls: such as, nutrient removal from OSTDS, and Stormwater LID methods.

Source controls or LID Methods

take no additional land, reduce runoff volume and mass loadings, can save money in the long run

- **Less Impervious Area** Reduce Impervious Surfaces
- **Green Roofs** Reduce runoff volume and rate.
- **Pervious Pavement (retention)** Pavers and pervious concrete
- **Stormwater Harvesting** Reuse to reduce surface discharges.
- **Floating Wetlands** Improve nutrient removal in wet ponds.
- **On-Site Retention, such as, swales, reverse berms, rain gardens, tree wells, retention basins and exfiltration pipes.**
- **BAM (Bio-sorption Activated Media)** retention system and OSTDS.
- **Detention/BAM Filter** underground in high or low water tables.
- **Inter-event Treatment** use BAM during non-runoff conditions.
- **Treatment Trains** A series of LID and regional practices.

Seal of Approval

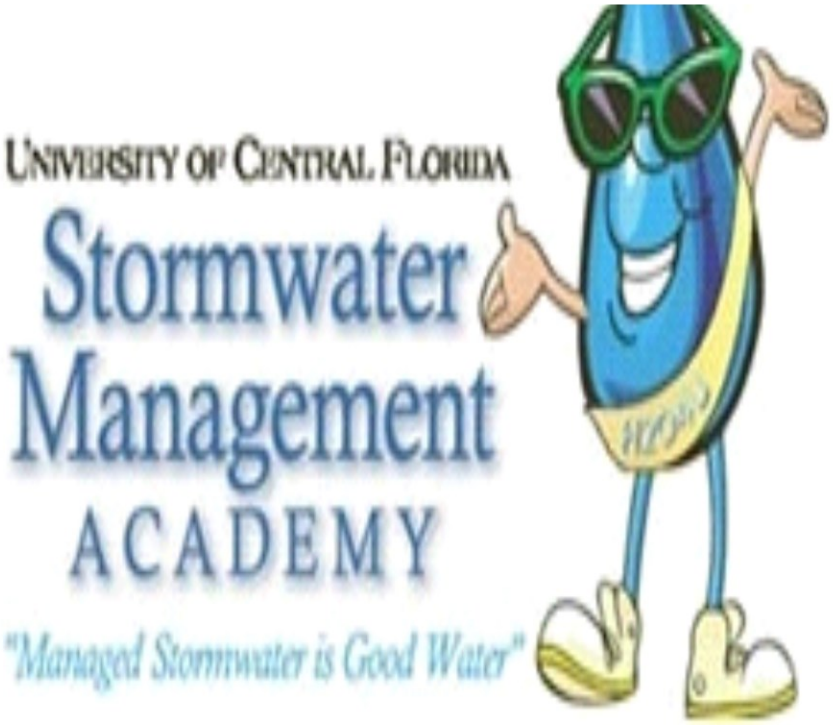
BMPTRAINS Nutrient Model

DRAFT BEST MANAGEMENT PRACTICE ANALYSIS AID:	CLICK HERE TO START

INTRODUCTION PAGE

This program is compiled from stormwater management publications and deliberations during a two year review of the stormwater rule in the State of Florida.
Input from the members of the Florida Department of Environmental Protection Stormwater Review Technical Advisory Committee and the staff and consultants from the State Water Management Districts is appreciated.

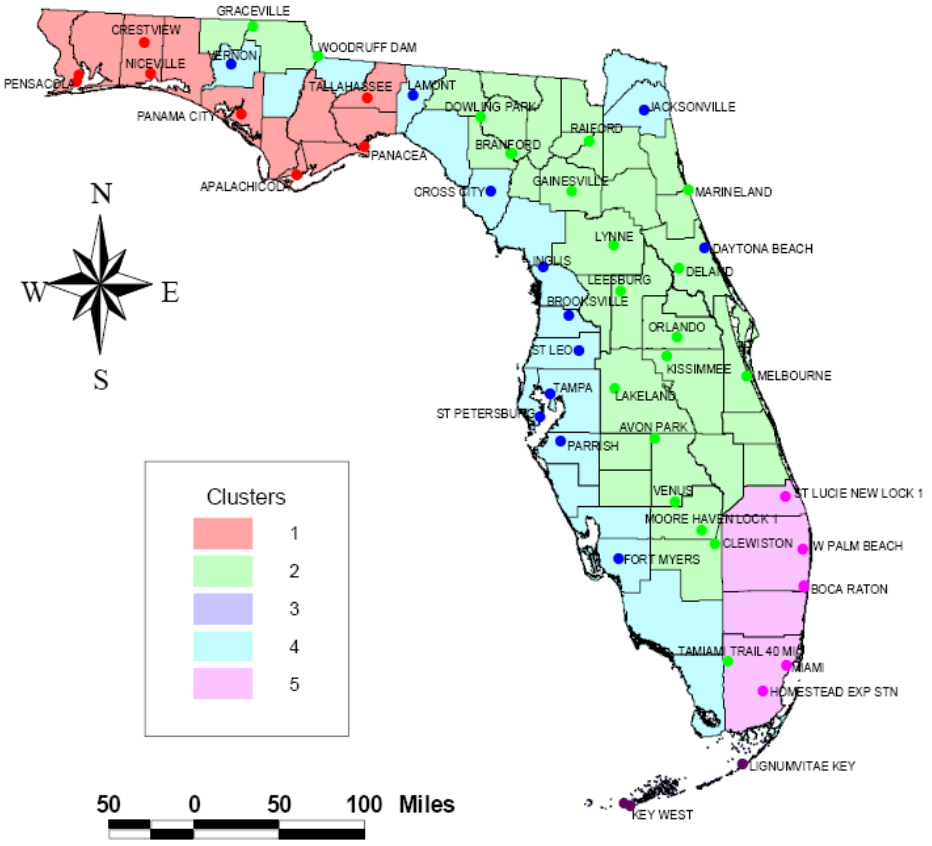
The State Department of Transportation provided guidance and resources to compile this program. The Stormwater Management Academy is responsible for the content of this program.



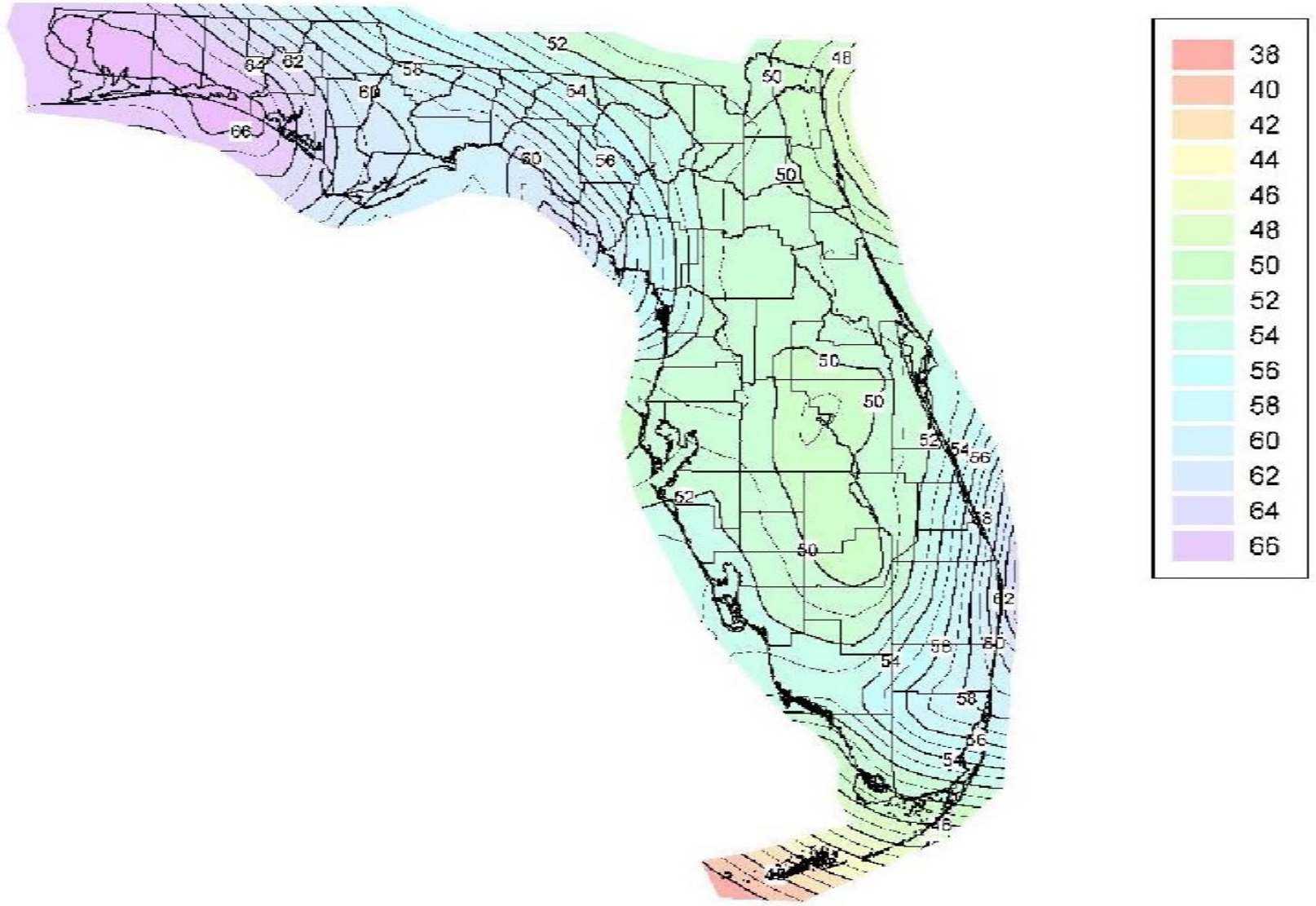
Available from www.stormwater.ucf.edu (no charge)

Rainfall Zones

- Average Annual Removal is the target.
- Varies with rainfall patterns across the State



Annual rainfall averages (inches)

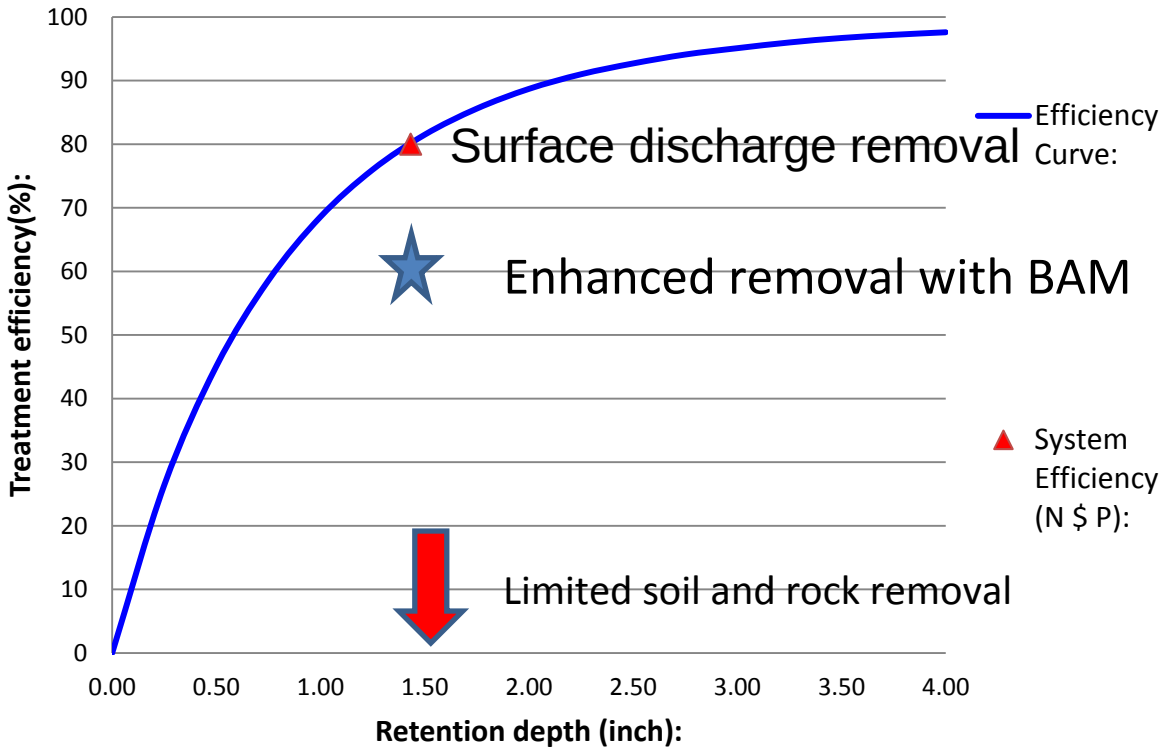


BMP Treatment Options

RETENTION BASIN	WET DETENTION	EXFILTRATION TRENCH	RAIN (BIO) GARDEN	SWALE	USER DEFINED BMP
PERVIOUS PAVEMENT	STORMWATER HARVESTING	FILTRATION including BIOFILTRATION	LINED REUSE POND & UNDERDRAIN INPUT	NOTE !!!: All individual system must be sized prior to being analyzed in conjunction with other systems. Please read instructions in the CATCHMENT AND TREATMENT SUMMARY RESULTS tab for more information.	
GREENROOF	RAINWATER HARVESTING	FLOATING ISLANDS WITH WET DETENTION			
VEGETATED NATURAL BUFFER	VEGETATED FILTER STRIP	VEGETATED AREA Example tree well	CATCHMENT AND TREATMENT SUMMARY RESULTS		

Example Output Retention Basin Design

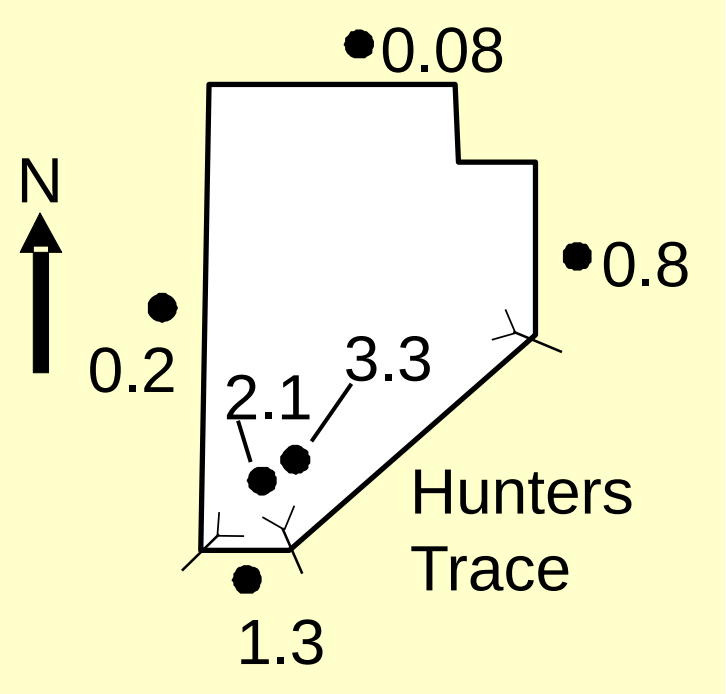
Assumes water entering ground has no “immediate” surface discharge

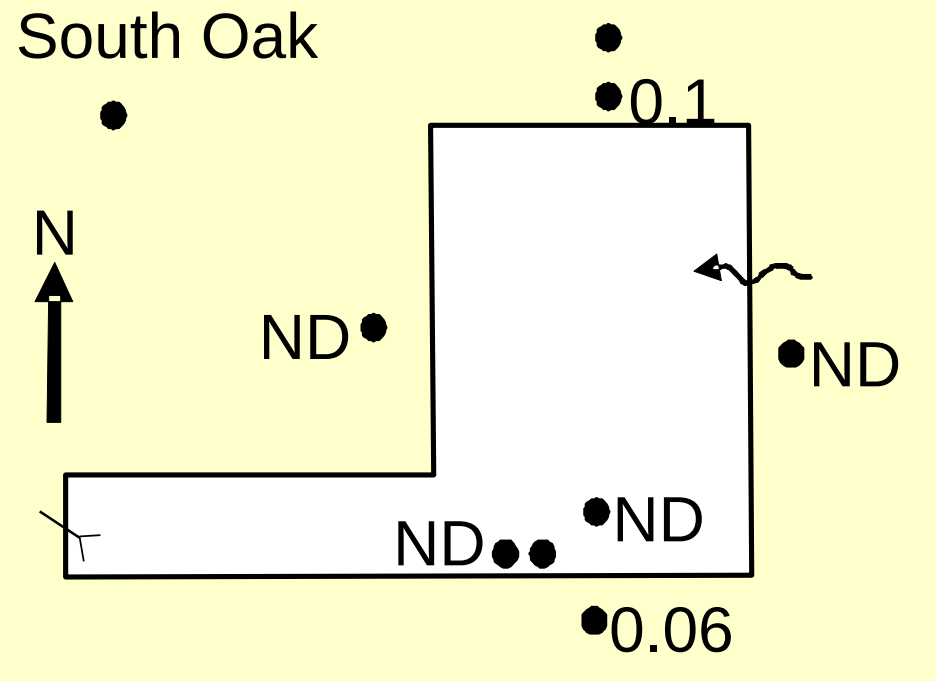


Retention depth over the equivalent impervious area is 1.43 inches and note a recovery time of 24 hours was used.

NITRATE LEVELS

- Nitrate concentrations (mg/L) higher at Hunters Trace than South Oak



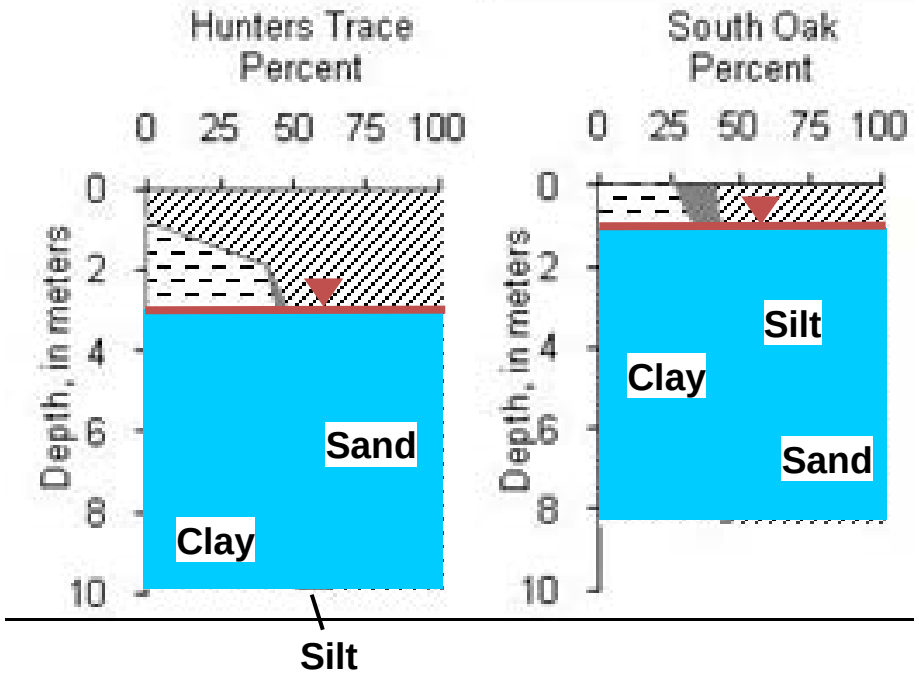


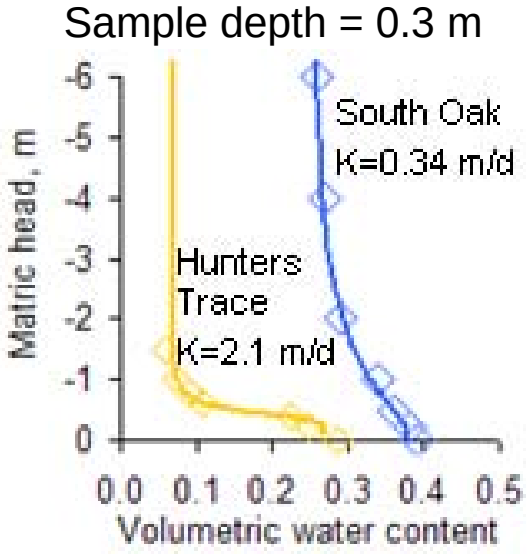
No Bio-sorption Activated Media (BAM)

YES. BAM soil materials

SOIL CHARACTERISTICS

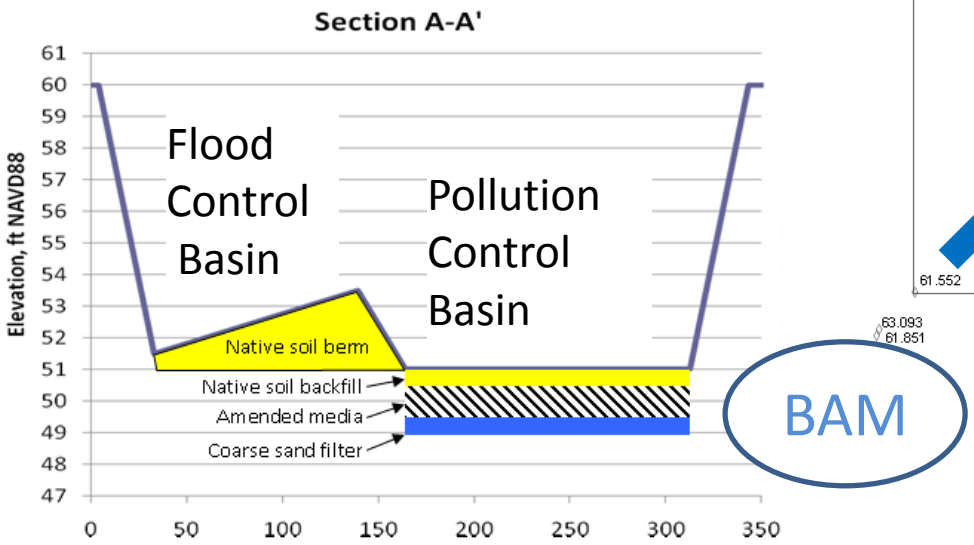
- Textural differences contributed to large differences in the soil moisture retention curves.
- Soil moisture is important because O_2 diffusion through water is 10,000 times less than through air.

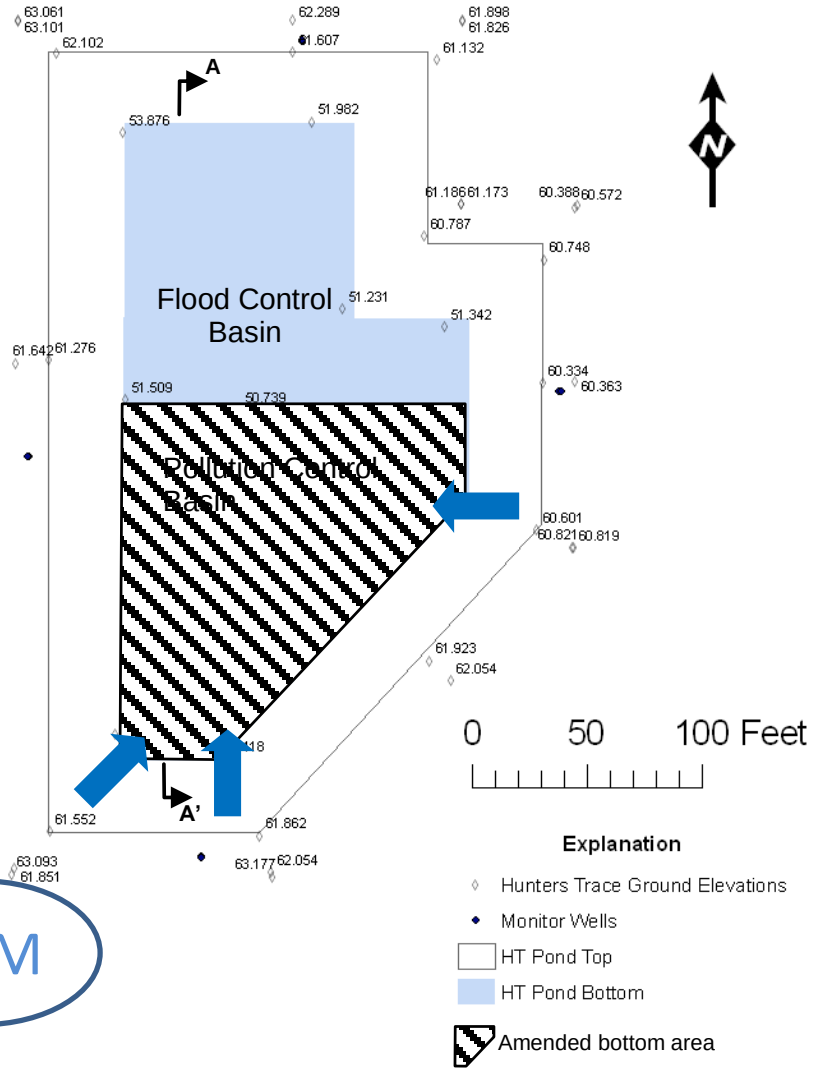




HUNTERS TRACE – USE BAM

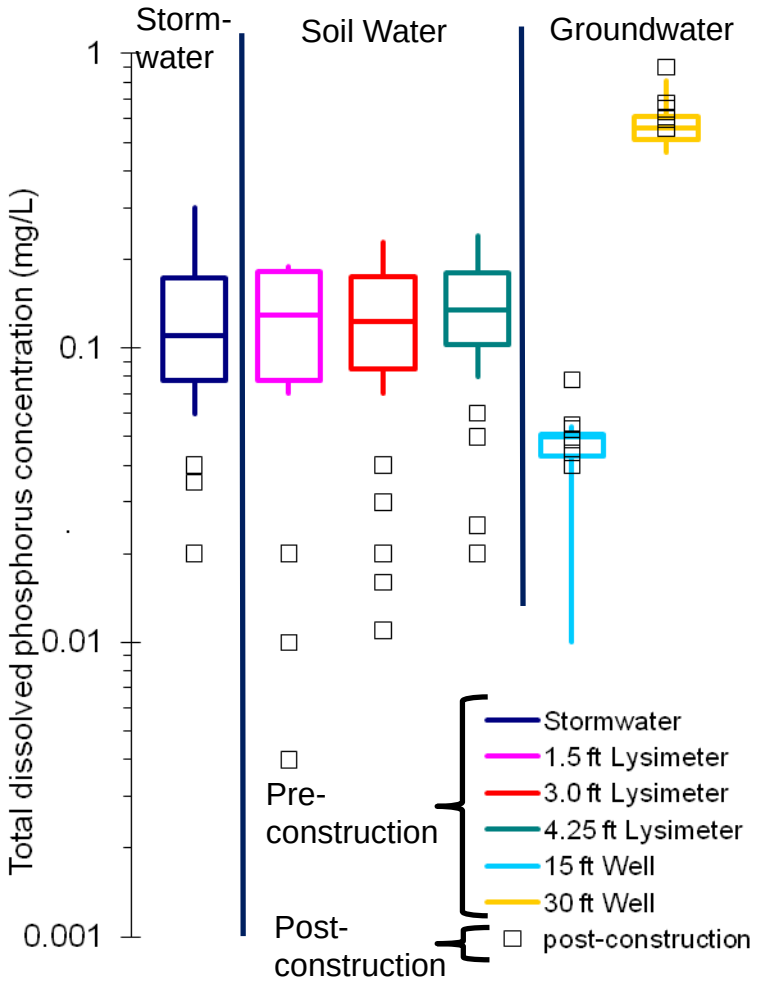
- Reproduce soil conditions that exist at the SO basin by using an amended soil layer:
  - Increase soil moisture
  - Reduce oxygen transport
  - Increase sorption capacity





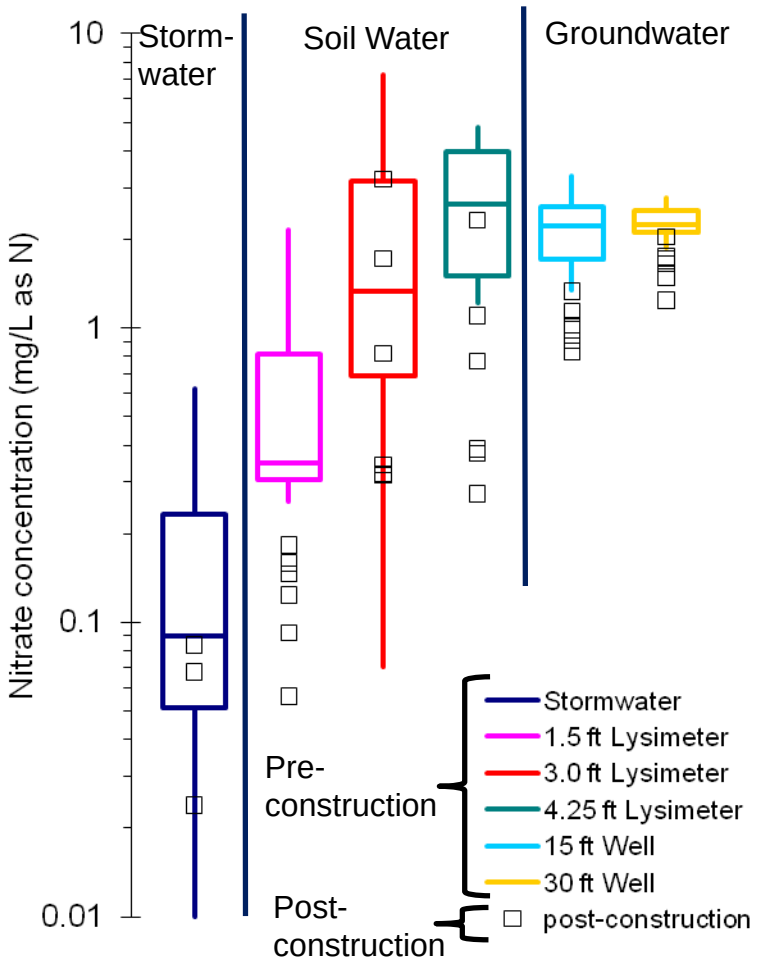
After BAM– Phosphorus

- 70–90% reductions in total dissolved phosphorus (TDP) from pre-construction (2007–2009) to post-construction (2009–2010) median concentrations in soil water
- No change in TDP at water table.
- TDP decreases may be due to dilution, sorption, precipitation, microbial assimilation, or some combination of these processes
- ortho-P > 80% TDP, total P (unfiltered) is ~1–10x TDP

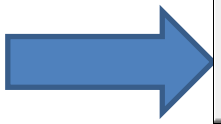


After BAM – Nitrate

- 50-80% reductions in nitrate from pre-construction (2007-2009) to post-construction (2009-2010) median concentrations in soil water and at the water table.
- Nitrate decreases most likely due to dilution, sorption, reduced nitrification, denitrification, anammox, or some combination of these processes.



BMP Treatment Options



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What is a Green Roof?

- Vegetated Roof Cover
- Active (Intensive): Deep Media, Intended for Public Access
- Passive (Extensive): Shallow Media, Intended for Maintenance Access Only, Designed for Aesthetics

What is a Green Roof?

(Must structurally support the media 25 lbs/SF up)

Up to 70

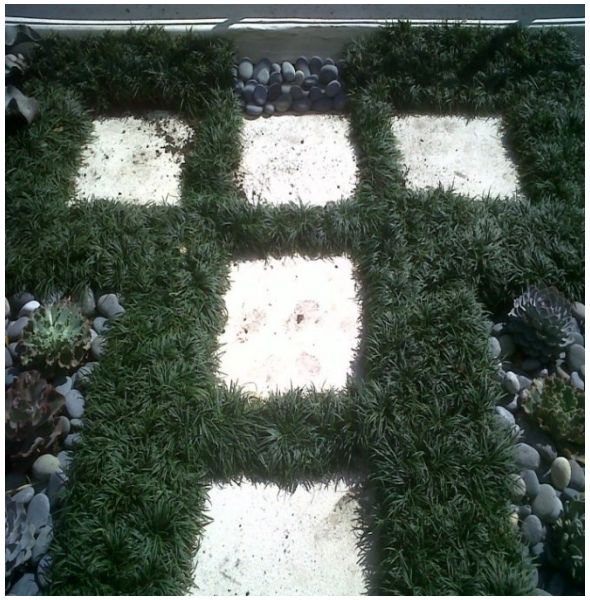
Up to 35

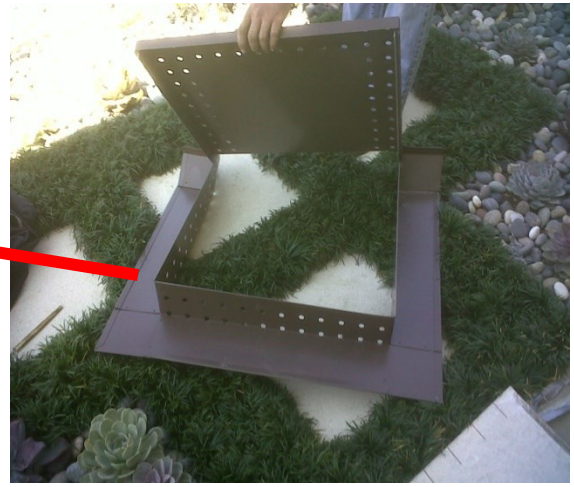
Up to 50

Up to 25


Honda Headquarters 4 months after installation Clermont Florida

West Coast Home (near Sarasota)





Mondo, Muhly, Coontie,
And “specimen” plants
In a bed of rounded rock
Over B&G media

John Wheeler
Landscaping

Green Roof and Solar Panels

UCF Student Union Green Roof

- Green roof was installed in March 2005
- Full coverage achieved in about one year
- Office space with view of green roof had rent increased by $8 per square foot
- Energy benefits were analyzed by FSEC heat reduction of about 45% in a year [www.stormwater.ucf.edu]

ESCAMBIA COUNTY CENTRAL OFFICE LARGEST IN FLORIDA ~ 33,000 SF

Thanks to: County, Bay Design Arch, AENew Jr., FDEP, and IFAS
Photo Credits to Escambia County.

What plants are on our roof?

- Mimosa

- Muhly Grass

- Black-eyed Susan

- Blanket Flower

What plants are on our roofs?

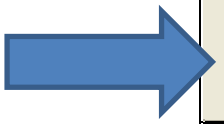
- Sand cord grass

- Upright Rosemary

- Red Basil

- Dune Sunflower

Treatment Options



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MULTIPLE WATERSHEDS AND TREATMENT SYSTEMS ANALYSIS

LID Method
Porous Pavements

- Pervious Concrete
- Flexi-pave™
- Permeable Pavers
- Pervious Asphalt
- Others

Pervious Pavement Research and Development: Setting the standard

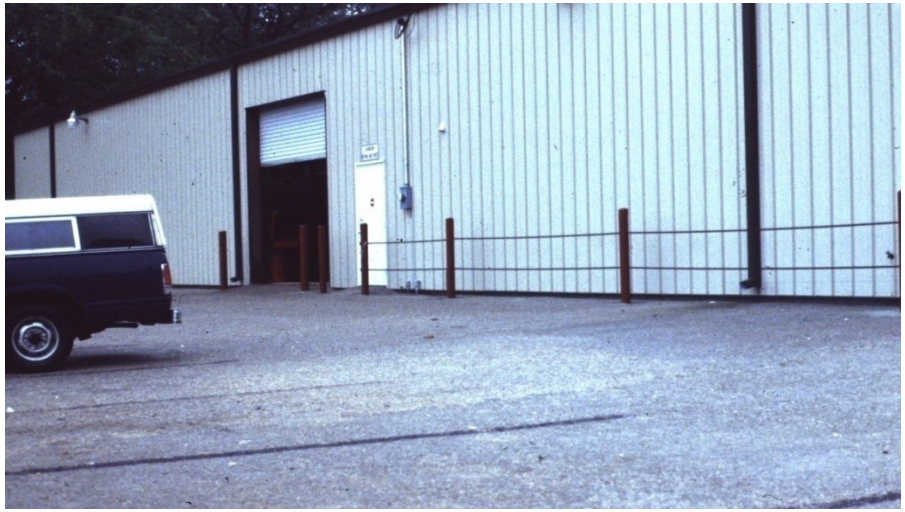
Indialantic

Indialantic

Placement, Striking, Pizza Cutter and 7 day Curing


ESCAMBIA COUNTY
CENTRAL OFFICE COMPLEX

Vacuum Sweeping - SAND



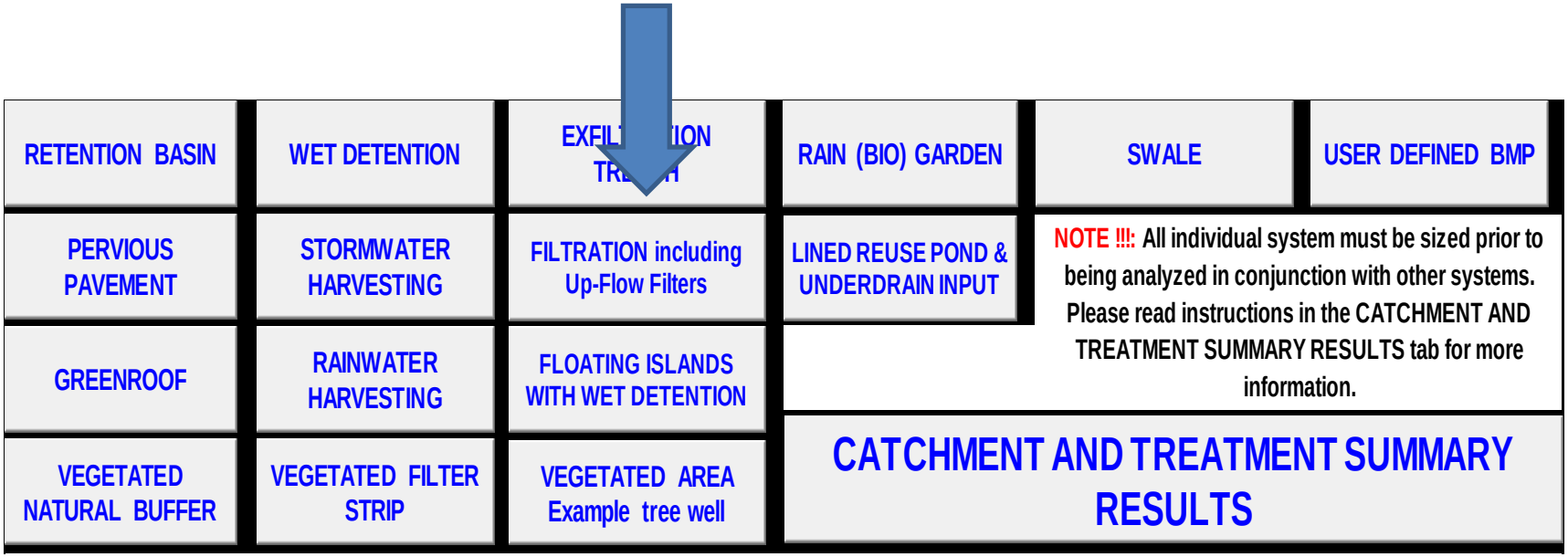

ELGIN

SEDIMENTS REMOVED

SANDY SEDIMENTS

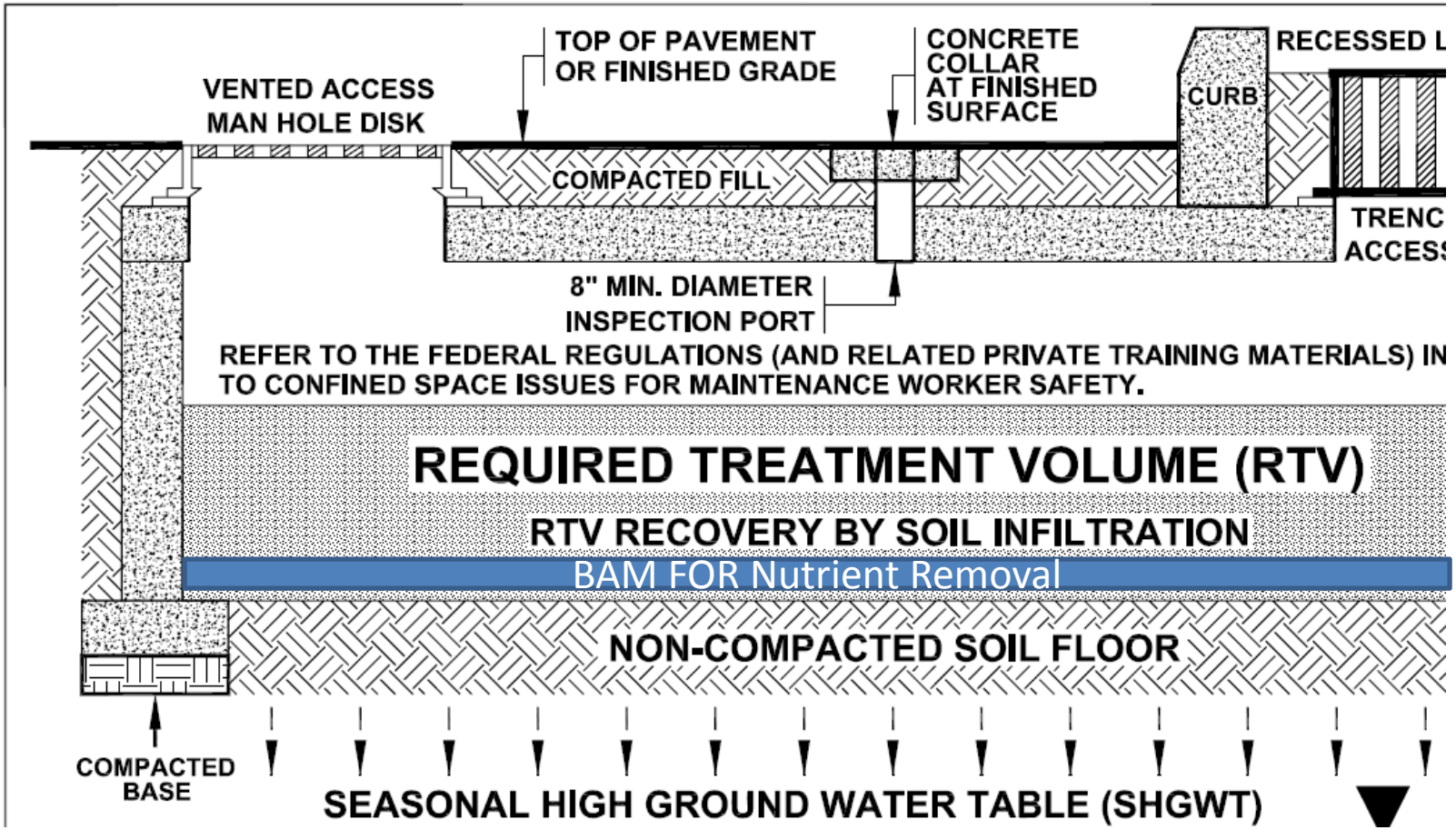
FINE GRAINED SEDIMENTS

In-Line or Off-Line Filters

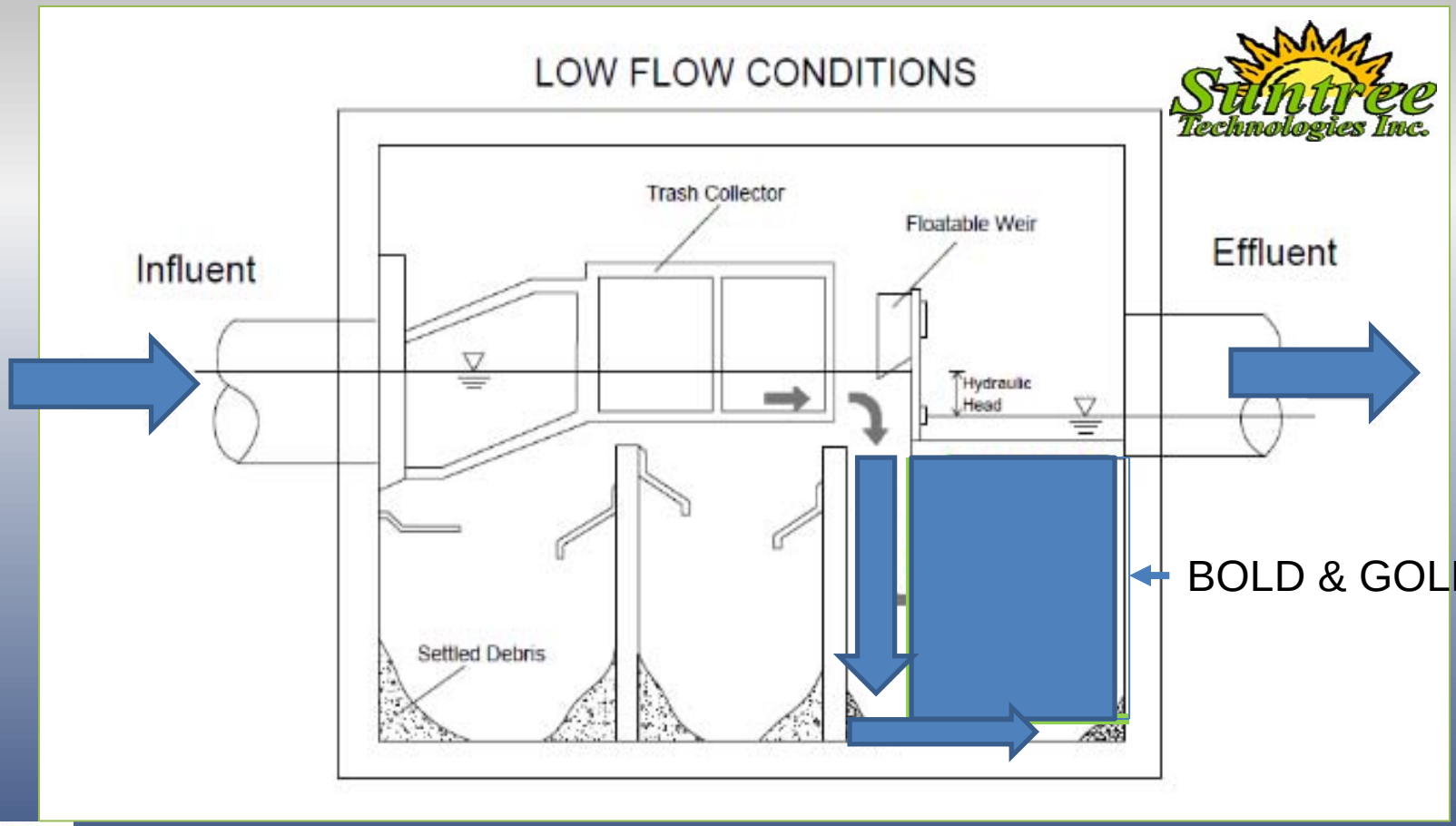


Underground locations, thus do not take land

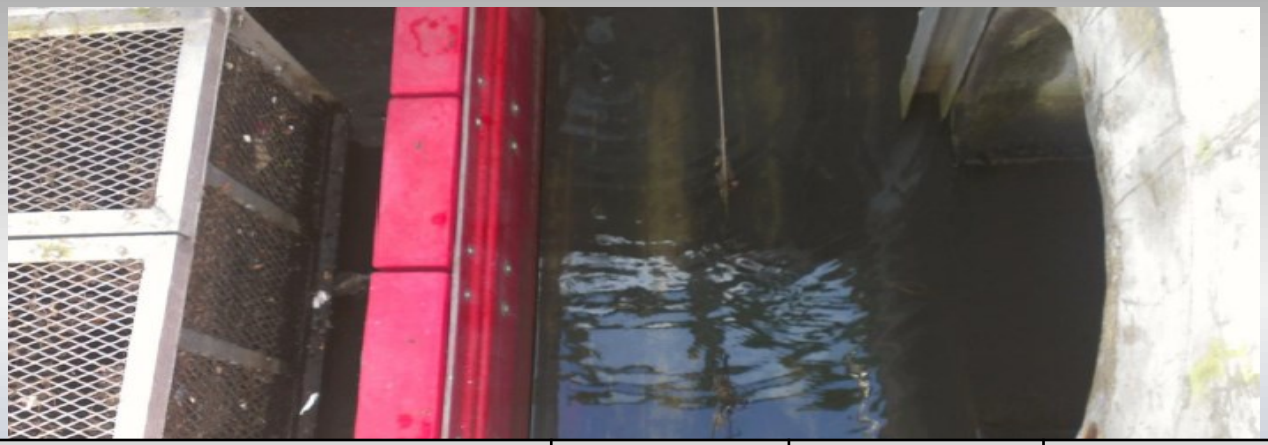
Underground Vaults in Low Water Table Areas



Designed and Installed by SunTree for High Water Table Areas



Sampling Results (estimated 70% of flow through filter)

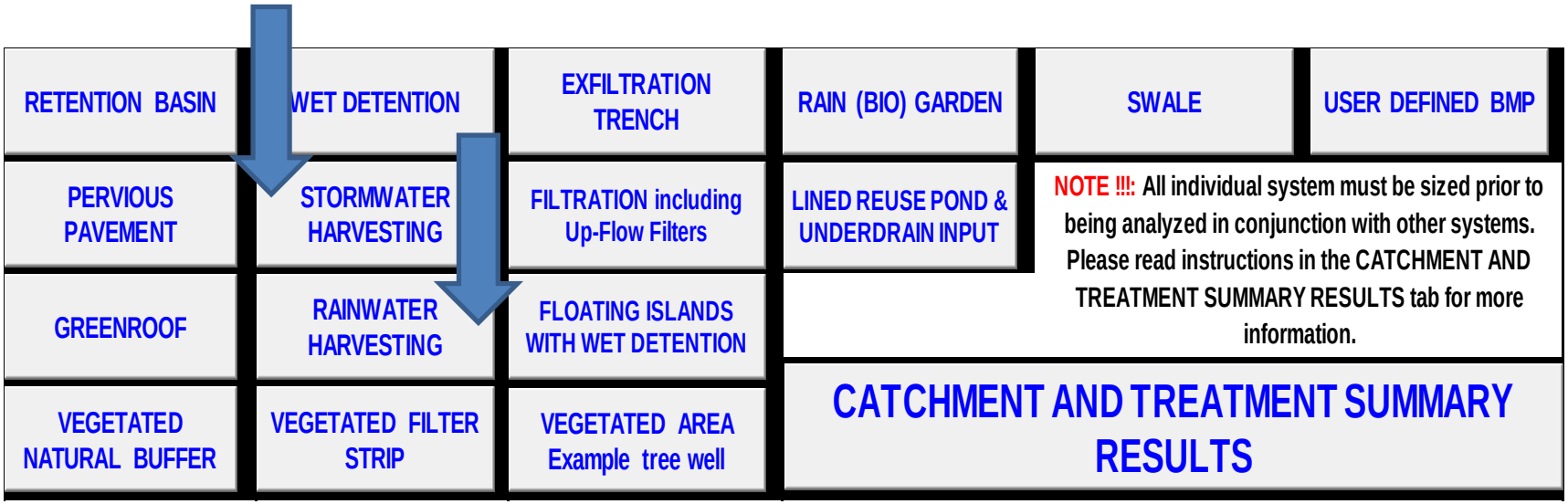


Parameter	Total Nitrogen	Total Phosphorus	Total Suspended Solids
Average Influent Concentration (mg/L)	1.87	0.281	105
Average Filter Removal (%)	45	58	40
Average System Removal (%)	67	79	81
Average Annual Removal (%)	54	67	70

UCF STORMWATER MANAGEMENT ACADEMY

WATERMARK ENGINEERING GROUP, INC.

Harvesting (reuse of the Water)



Stormwater (regional) & Rainwater Harvesting (LID)

Rainwater Harvesting from roof tops

WHAT? Detained stormwater for non-potable uses, such as irrigation, car washing, toilet flushing, wet-land enhancement, make-up wcloths washing, etc.

WHY? (some reasons)

1. To lower the cost of water supply.
2. Reduce stormwater pollution into surface waters.
3. Save and maintain ground water.
4. Save and enhance vegetation
5. Reduction of salt water intrusion.

H2O4U

Examples: Over 300 in Florida

Sources: Horizontal Subsurface Systems and G. Hartman

www.stormwater.ucf.edu

1. South Bay Utilities

- Upscale residential irrigation demand
- No CUP
- No FPSC
- No FDEP

- 50¢/1,000 gallons
- Shallow wells
- Customer agreements 900 homes - HOA
- Coastal / fragile resource

2. Winter Park Florida (retrofit)

Regional Pond Serving roadway and commercial property

COLLECTS RUNOFF WATER

CONTROLS POLLUTION

AND REUSES THE WATER

Water harvesting for irrigation of lawns
Community saved potable water
as well as money.

3. East Central Florida

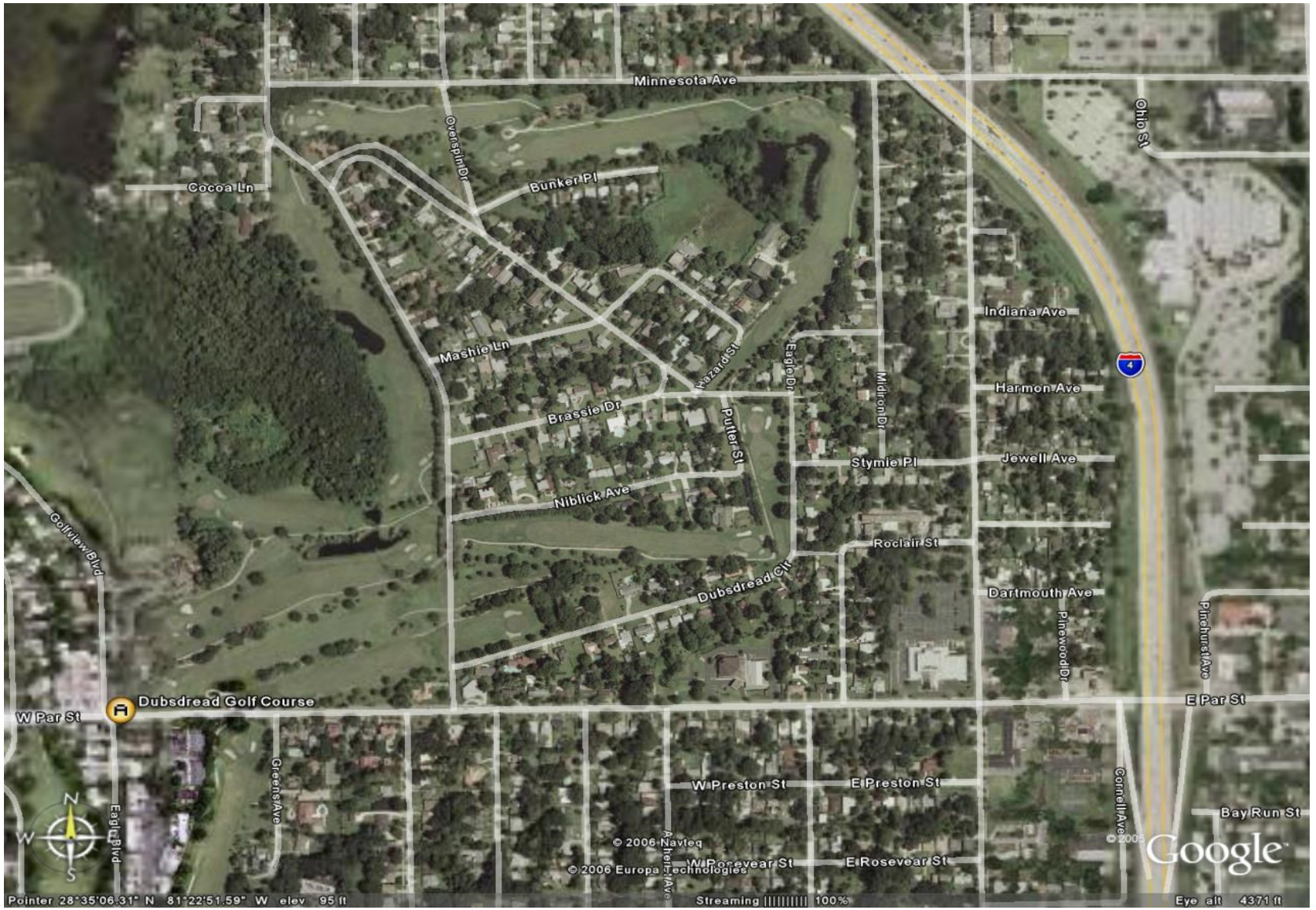
- Approximately 550,000 acres
- FPSC (Exclusive)

- 19.2¢/1,000 gallons (2004)
- Canals, Ponds and wells
- 20 MGD
- Expandable

4. Golf Course and I-4 Stormwater Management Plan

- Plan – Provide water on golf course to improve the play and image of the course.
- FDOT – We got the water for you.
- WIN WIN FDOT and a high school gets stormwater plans, citizens get a real golf course.
- All get stormwater treatment and saving of potable water that would otherwise be used for irrigation.
- And oh yes, Wekiva is protected.

District Signature Project



City of Miramar – Broward County

- Source Estimated Capital Cost - $1.3 Million
- Capacity – 1 MGD
- Cost per 1,000 gallons (Reclaimed & Harvested IQ) - $0.80/1,000 gallons
  - Original estimates

Hartman Consulting & Design
301 E. Pine Street - Suite 1020 - Orlando, Florida 32801
Phone 407-447-9095 - Fax 407-447-9406

CITY OF MIRAMAR
PROPOSED STORMWATER SUPPLY SYSTEM
PLAN VIEW

FIGURE 1-2

Cocoa Village Harvesting and Reuse area

Treatment Options

RETENTION BASIN	WET DETENTION	EXFILTRATION TRENCH
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MULTIPLE WATERSHEDS AND TREATMENT SYSTEMS ANALYSIS

Floating Islands (5% coverage)

Must be maintained
At least once per year

Plant Selections

Canna

Juncus

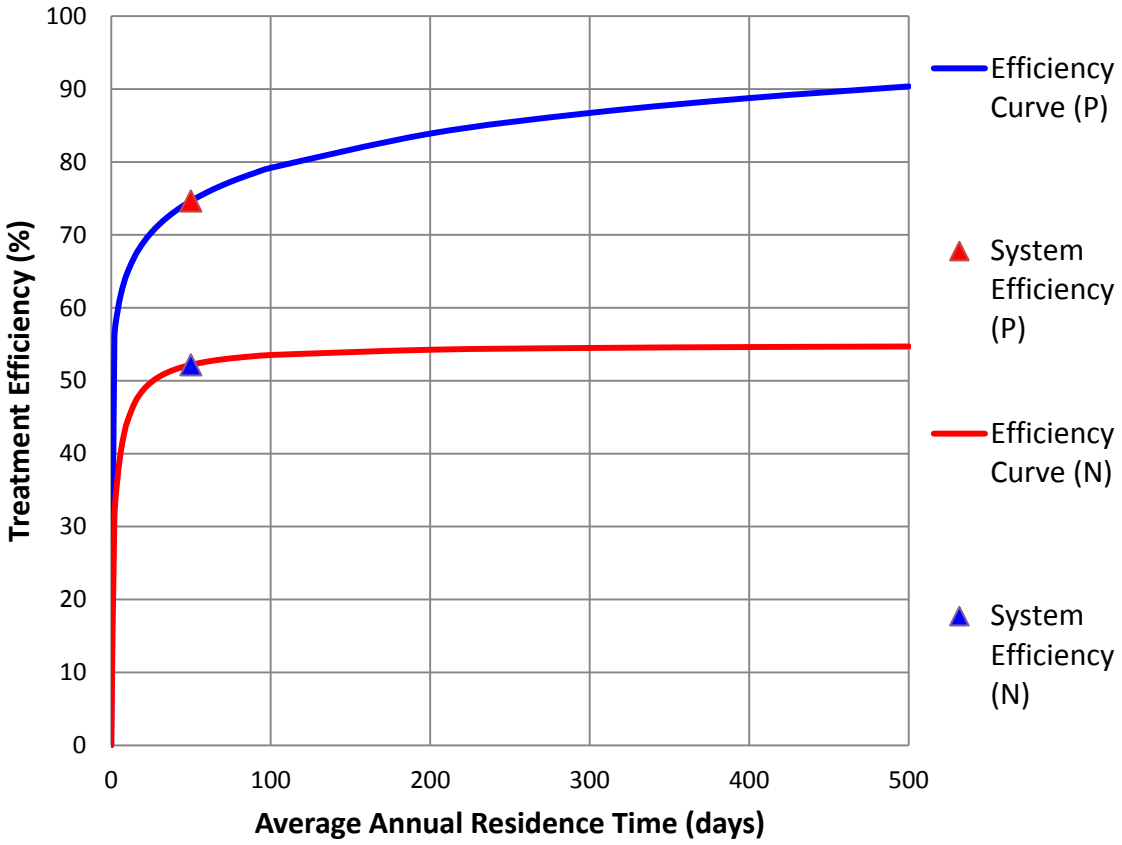
Flower

Grass

Vegetation used on interlocking foam FTWs

Example Efficiencies
Output Wet Detention Design with Floating Islands

Maximum 10% credit for floating wetlands



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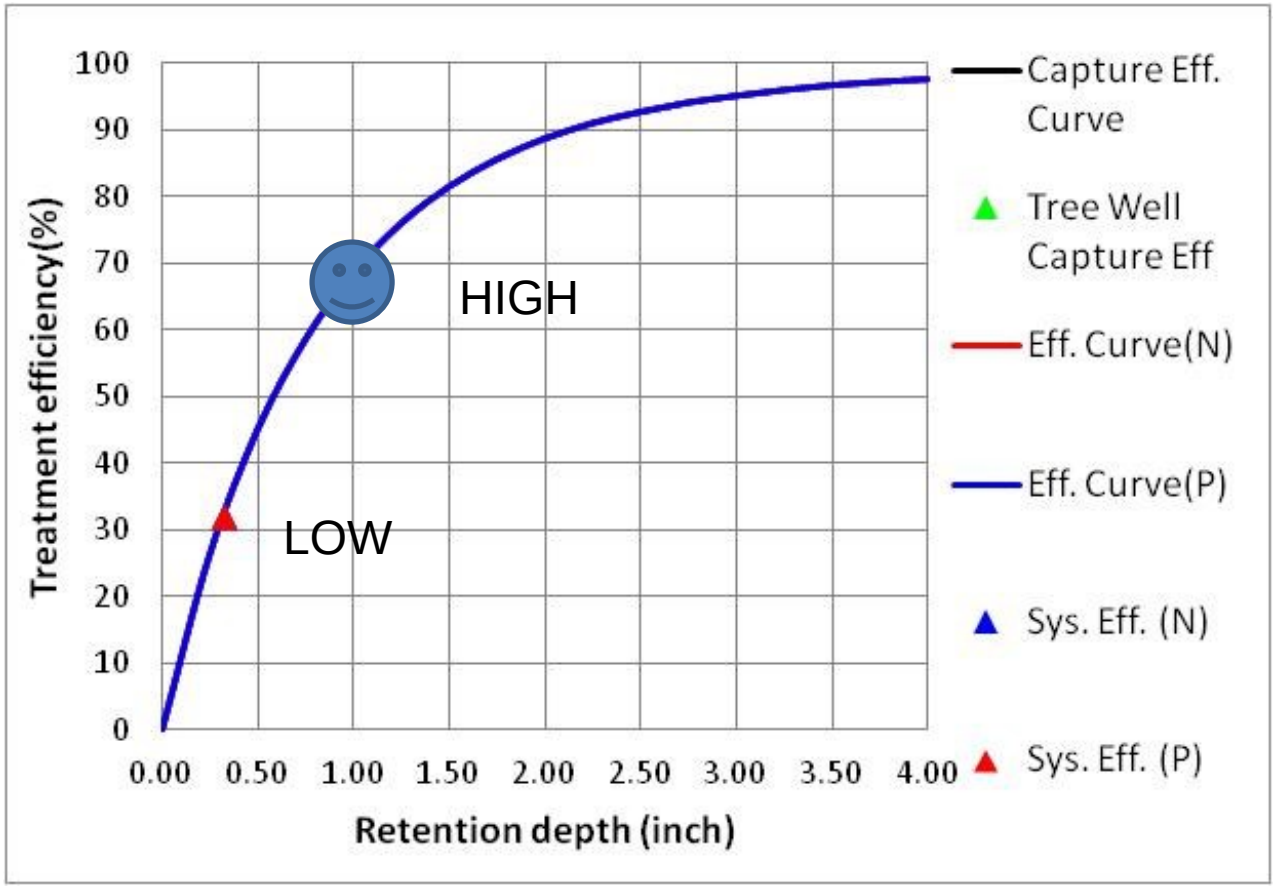
MULTIPLE WATERSHEDS AND TREATMENT SYSTEMS ANALYSIS

On-Site Retention BMPs

Exfiltration, Swales,

Exfiltration and SWALES Typical Effectiveness



Note: following is a detention option with soil augmentation that will produce two separate removal curves.

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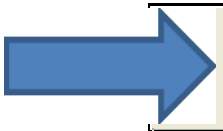

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MULTIPLE WATERSHEDS AND TREATMENT SYSTEMS ANALYSIS


Parking Lot
RAIN GARDEN
BAM

Treatment Options

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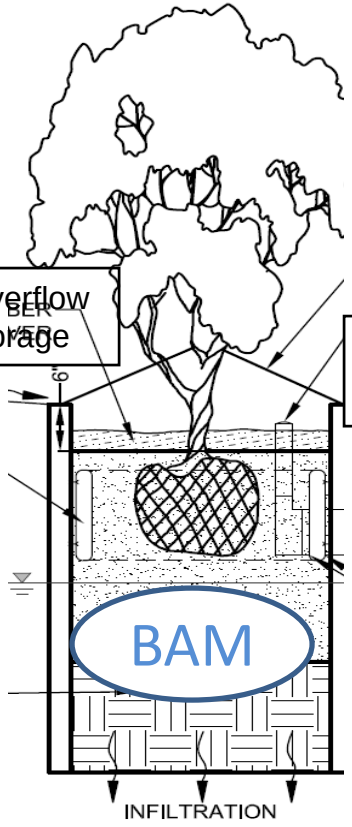
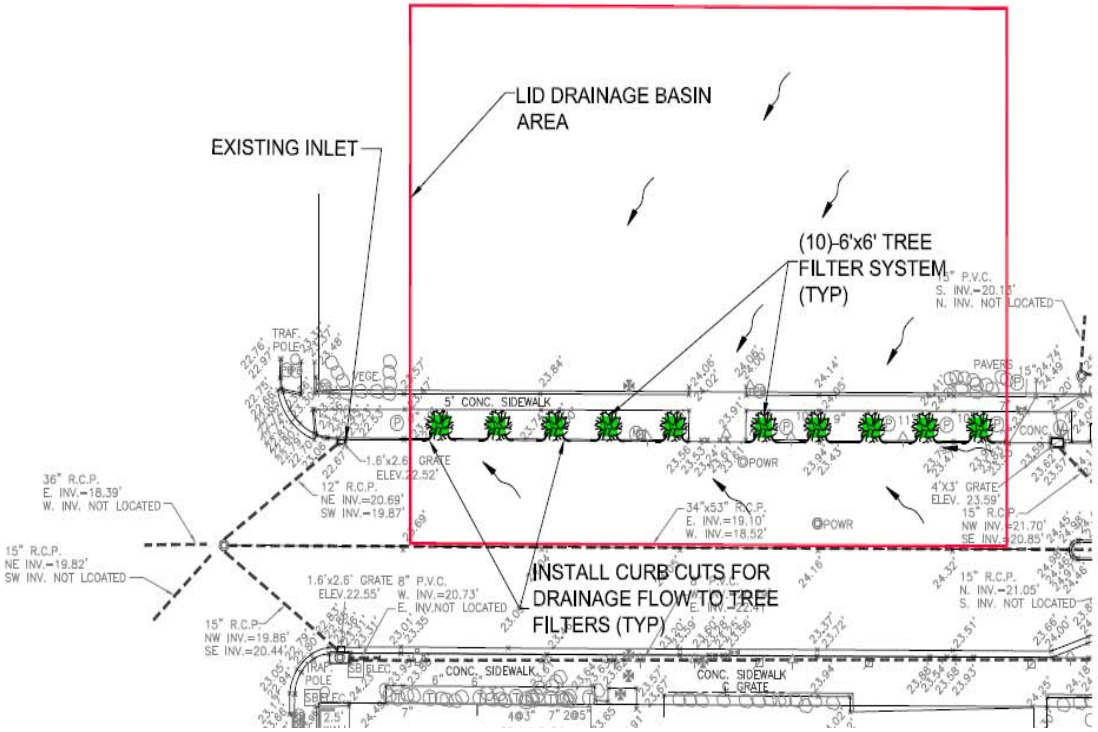
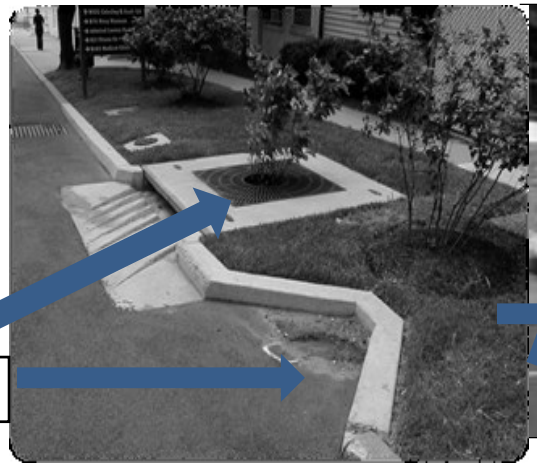
Tree Box Filter Retention Design







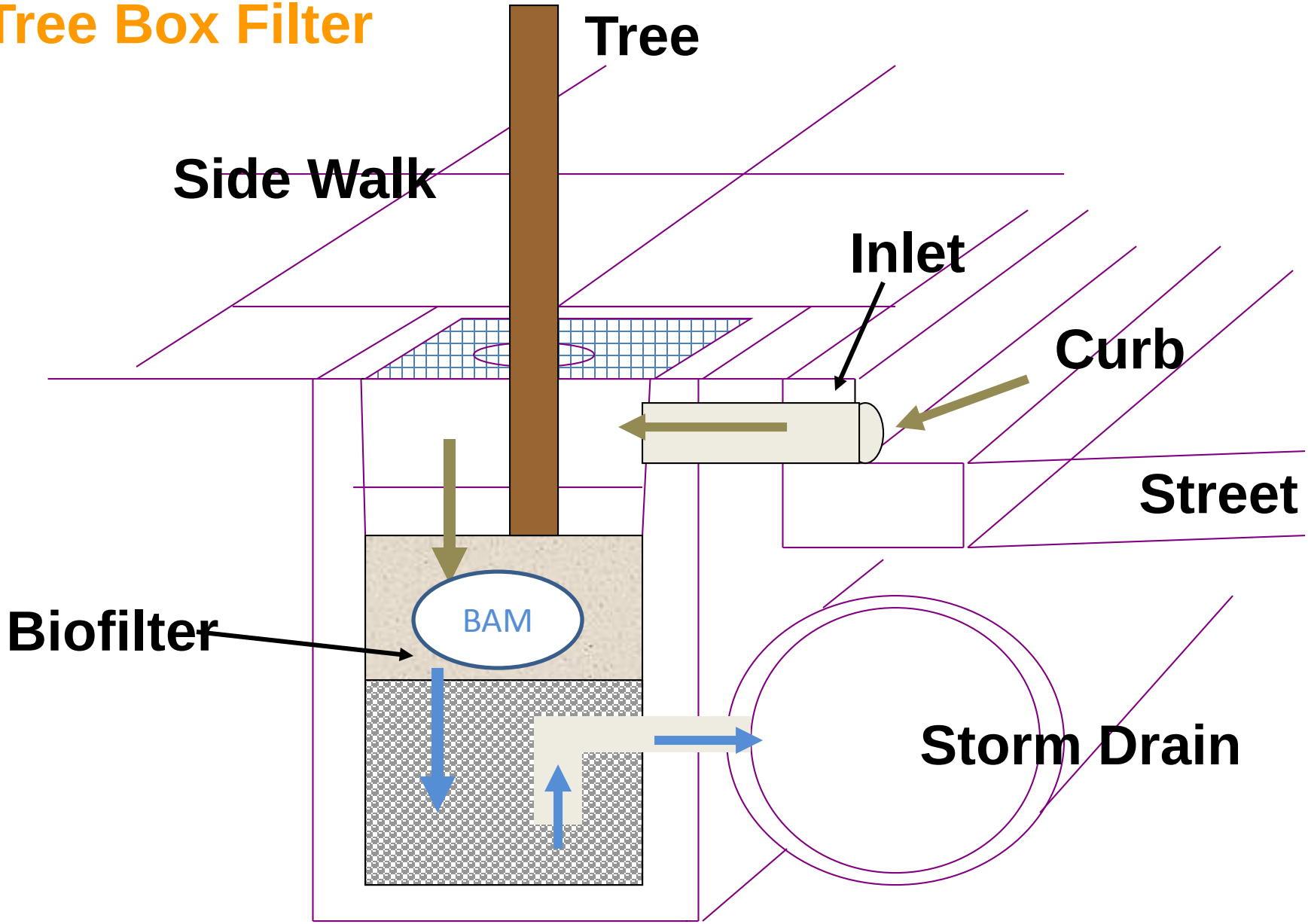
Overflow

Flow to Tree Wells

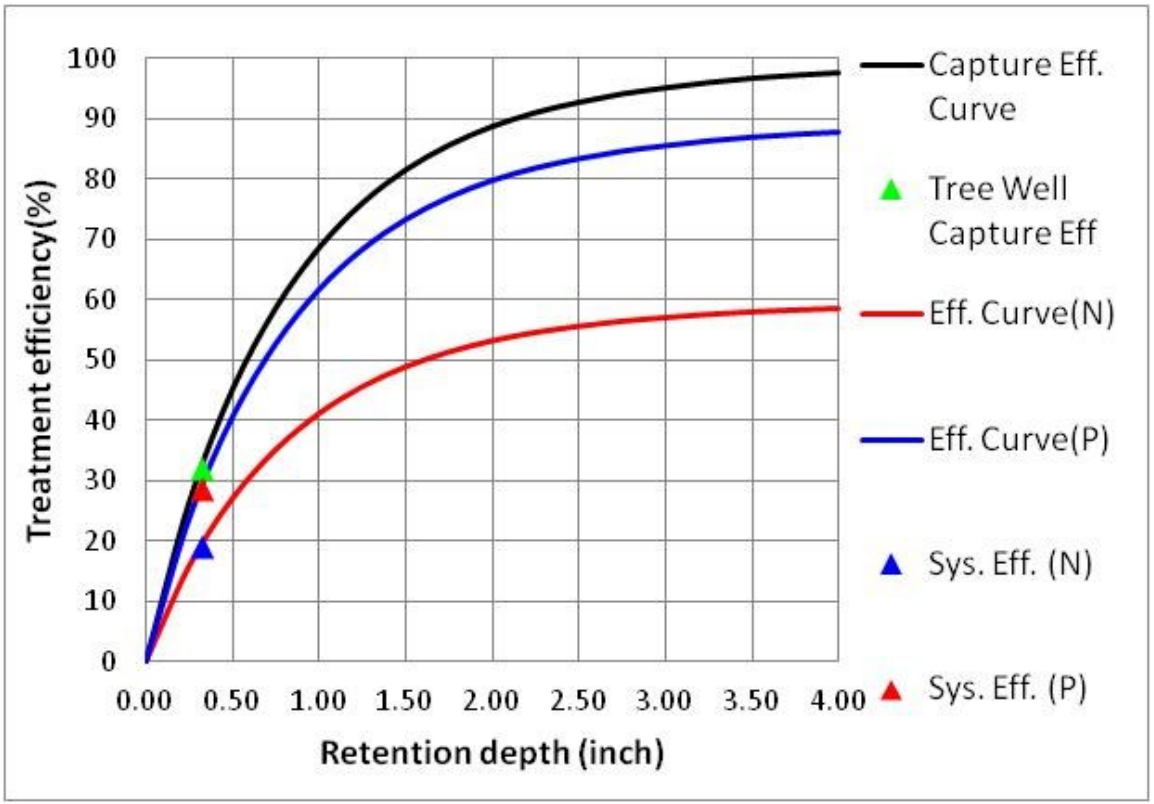
Flow to Tree Well

Overflow

Tree Box Filter

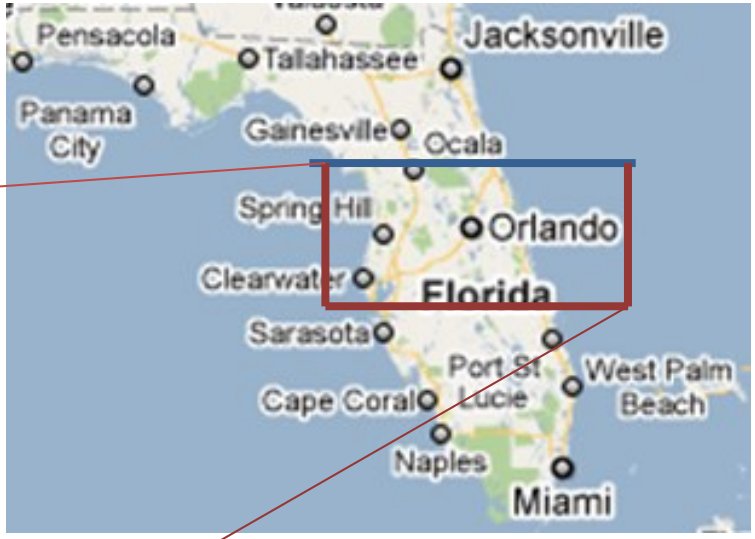


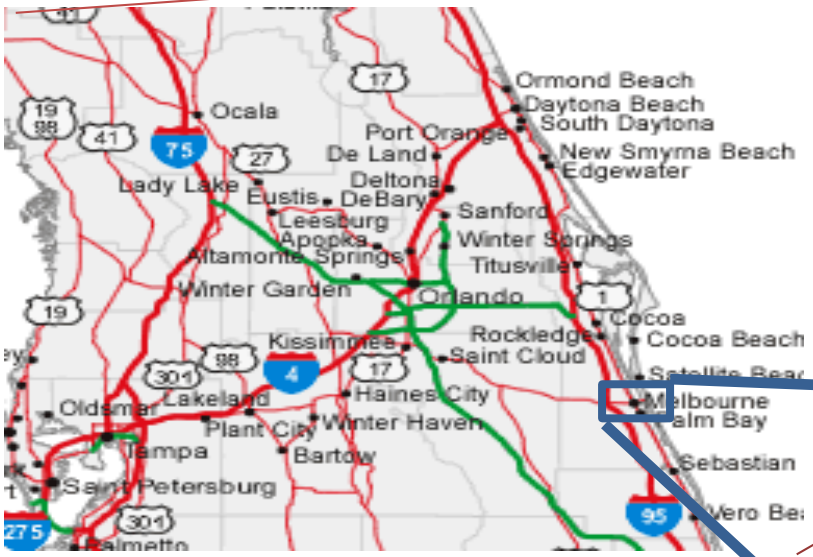
Tree Well and Rain Garden Typical Effectiveness

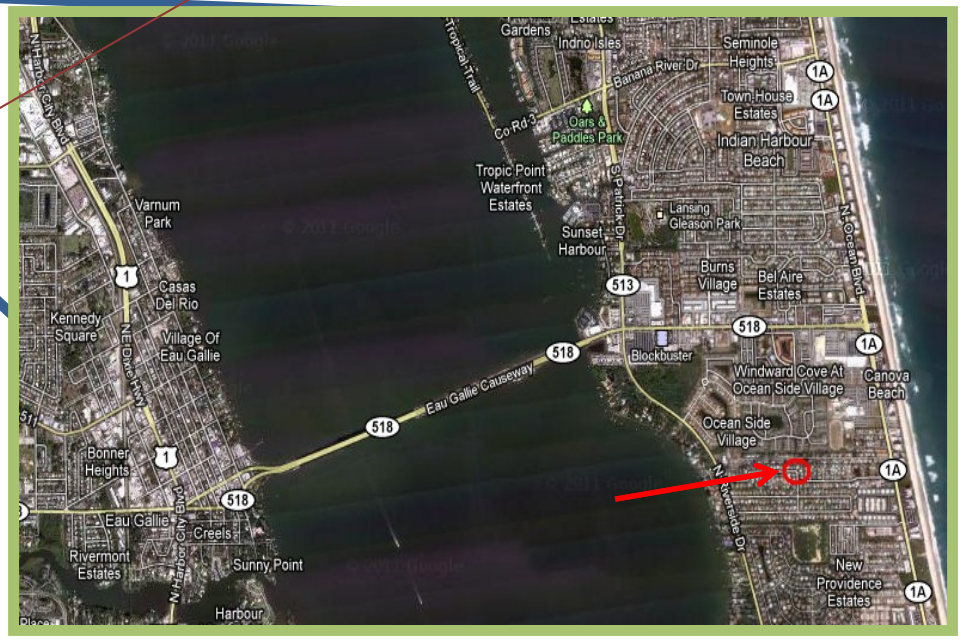


Effectiveness if a Bio-sorption Activated Media (BAM) can be used

Florida's Showcase Green Envirohome (FSGE)







Indialantic , Florida

(East Coast - Florida)

Brevard County

Green roof project of the year

Florida's Showcase Green Envirohome (FSGE)

Indialantic , Florida
(East Coast Florida)
Brevard County

FSGE Test Field

Bold n' Gold septic & Sand area

Geotextile over Infiltrator chambers

Sampling ports

Test Field

Control Field

Pictures provided by www.FSGE.net

Removal

- 99% BOD
- 97% SS
- 78% TN
- 70% TP

University of Central Florida
Stormwater Management Academy
"Managed Stormwater is Good Water"

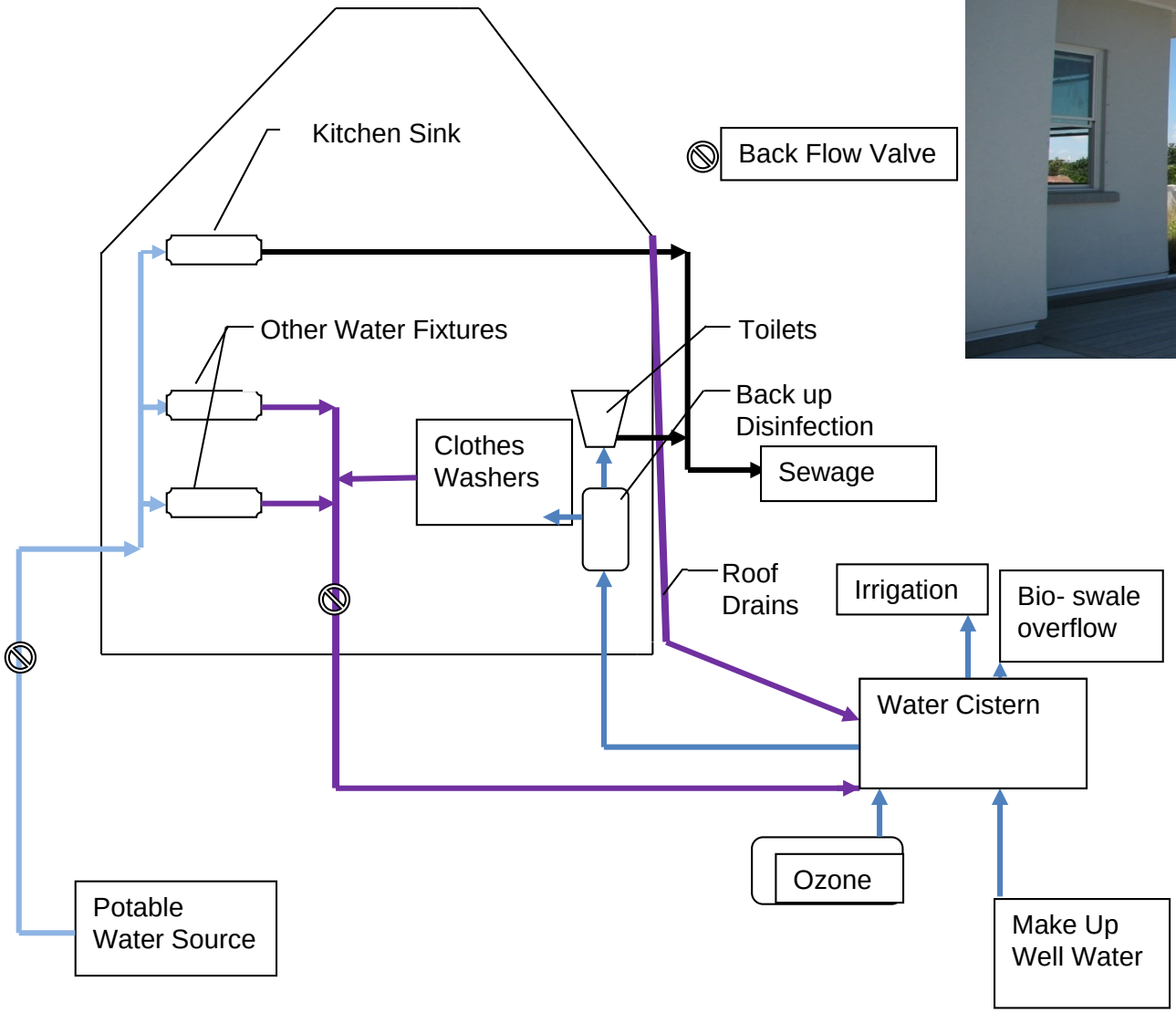
FSGE Integrated Site Design
For Nutrient Removal using Stormwater BMPs

H2O4U

- 4500+ gallons

Green Roofs, Pervious Pavements and Bioswale for overflow from Cistern

CISTERN SOLUTION
BIOSWALE FOR OVERFLOW



Gray Water

Black Water

Integrated Gray and Stormwater Harvesting Reducing Potable Water Use

Conclusions: Water

Water Use – Reduced Average Daily Flow (ADF) for FSGE:

Date	Volume Change (G)	Flow rate gpd	GPCD
4/4/11 to 8/3/11	10,727	88	**29.3**
	National Average = 69.3		

Savings return on investment is 7 years.
Insurance cost decrease and water cost.
Workable systems that perform.
Water Quality – Exceeds standards
Discharge – none from a 24 inch rain

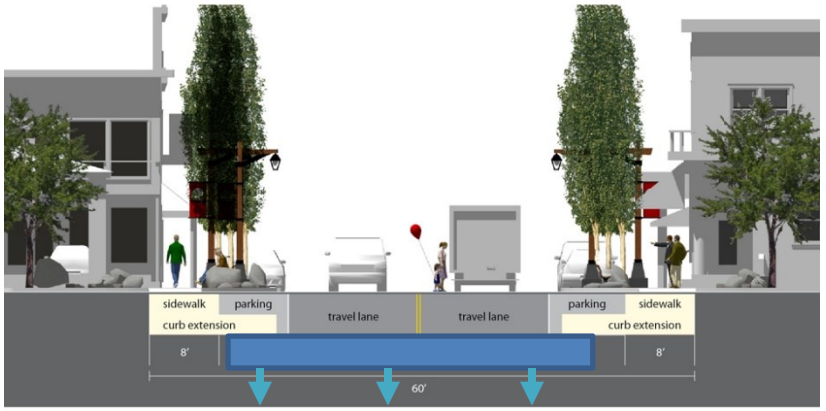
University of Central Florida

Innovation
- City of Cocoa Beach

- Objective: Remove nutrients before they reach the IRL.
- LID methods
  - Use BAM material for nutrient removal
  - Underground vaults
  - Pervious pavers, thus reducing the impervious area
  - Vegetated areas to include Tree Planters

MILLER LEGG
Improving Communities. Creating Environments.

Minutemen Street Cocoa Beach

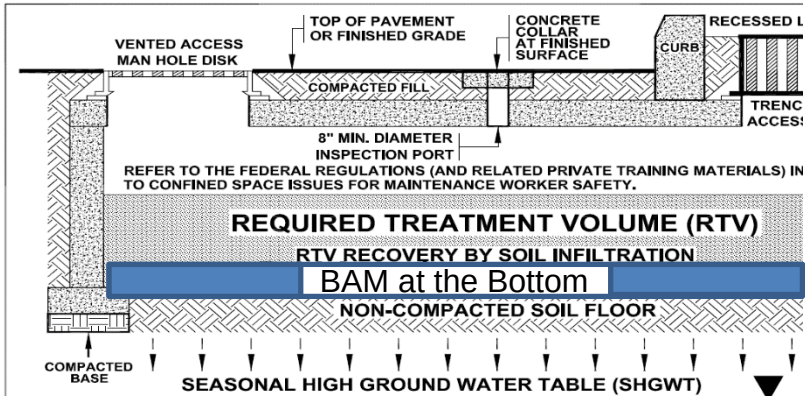


Above Ground Source Treatment

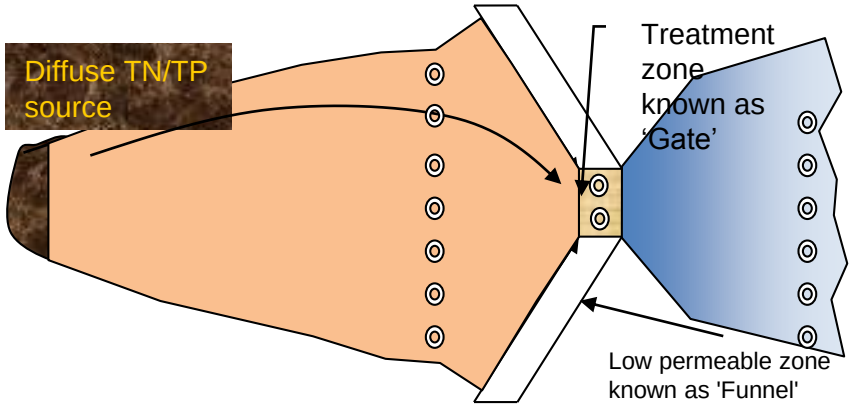
Pervious Pavements and Vegetated Areas

Under Ground Retention with BAM

SOURCE Treatment



Regional Treatment



Dry Period Treatment

- During non runoff conditions, use the BAM for removal of nutrients in the IRL.
- Pump water back from the IRL to the location for which there is BAM and let the discharge return to the IRL.
- An example of Sarasota County with FDEP and other funding follows:

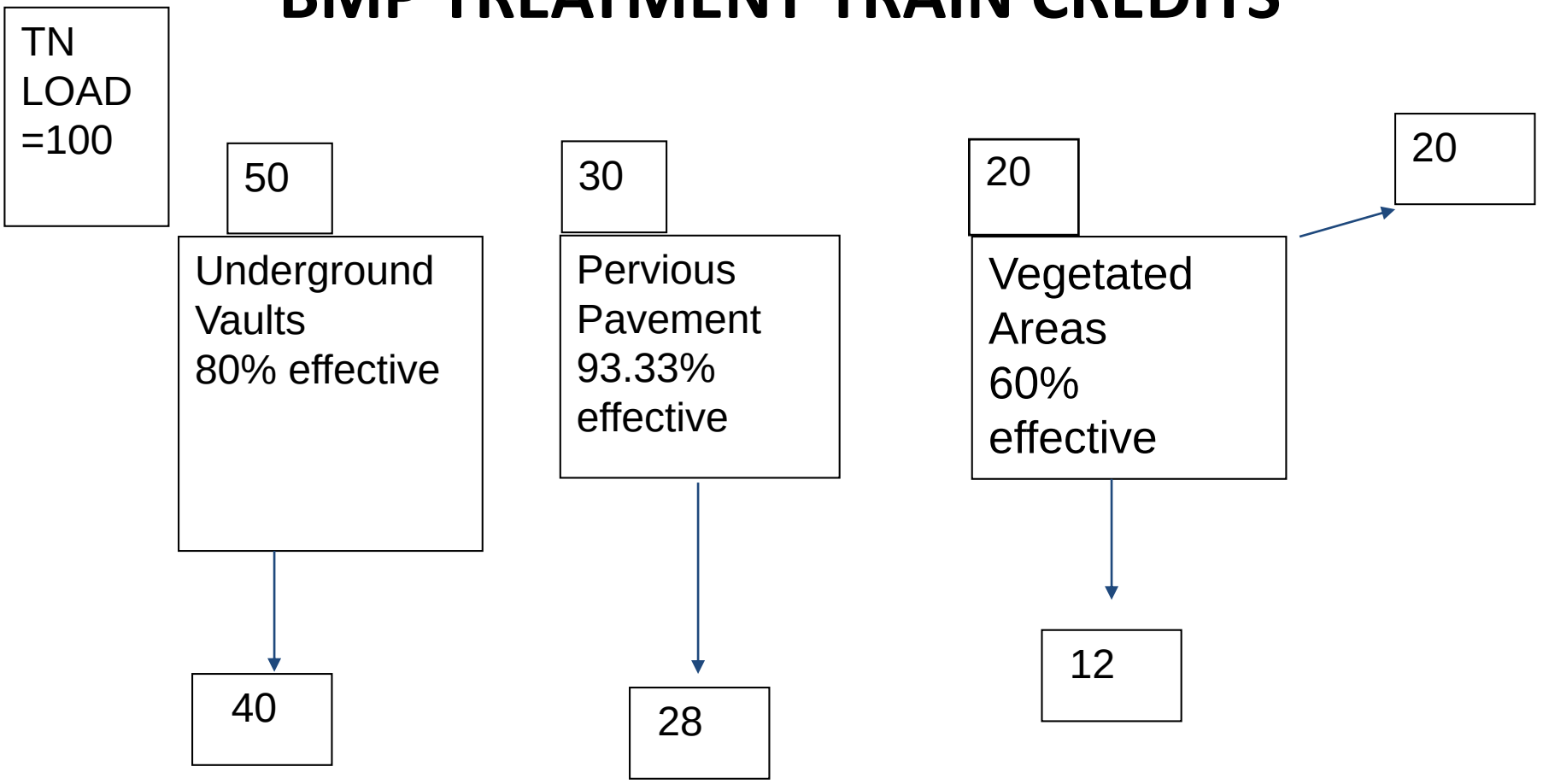
Briarwoods Inter-event Up-flow Filters

- Four 160 LF by 5 FT diameter parallel upflow filters
- 8 Ft Deep anaerobic rock zone with BAM
- Integrated wetland treatment
- Two pump stations that continuously treat 2 MGD

UCF
STORMWATER MANAGEMENT ACADEMY

WATERMARK
ENGINEERING GROUP, INC.

BMP TREATMENT TRAIN CREDITS



Most likely will not achieve 20% level of removal because of site and budget constraints, but it can be done and is being done.

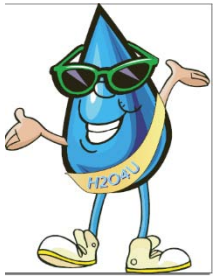
H2O4U

Seal of Approval

Indian River Lagoon: LID options

CONCLUSIONS

1. To reduce nutrients into the IRL, consider reduced impervious areas, Green roofs, Pervious pavements, Retention systems, Floating Wetlands, BAM with retention and on-site wastewater treatment, Dry period treatment, and Harvesting as LID options.
2. All these LID are available now and are being used in Florida.
3. They provide control for surface and ground water pollution.
4. Over a life cycle, they cost less, and they may have a lower first cost also.



Indian River Lagoon
Nutrient Reductions Meeting

Nutrient Reduction Using Low Impact Development

Success Stories and Design Suggestions

Marty Wanielista

Questions and Discussion

Thank You…

www.stormwater.ucf.edu