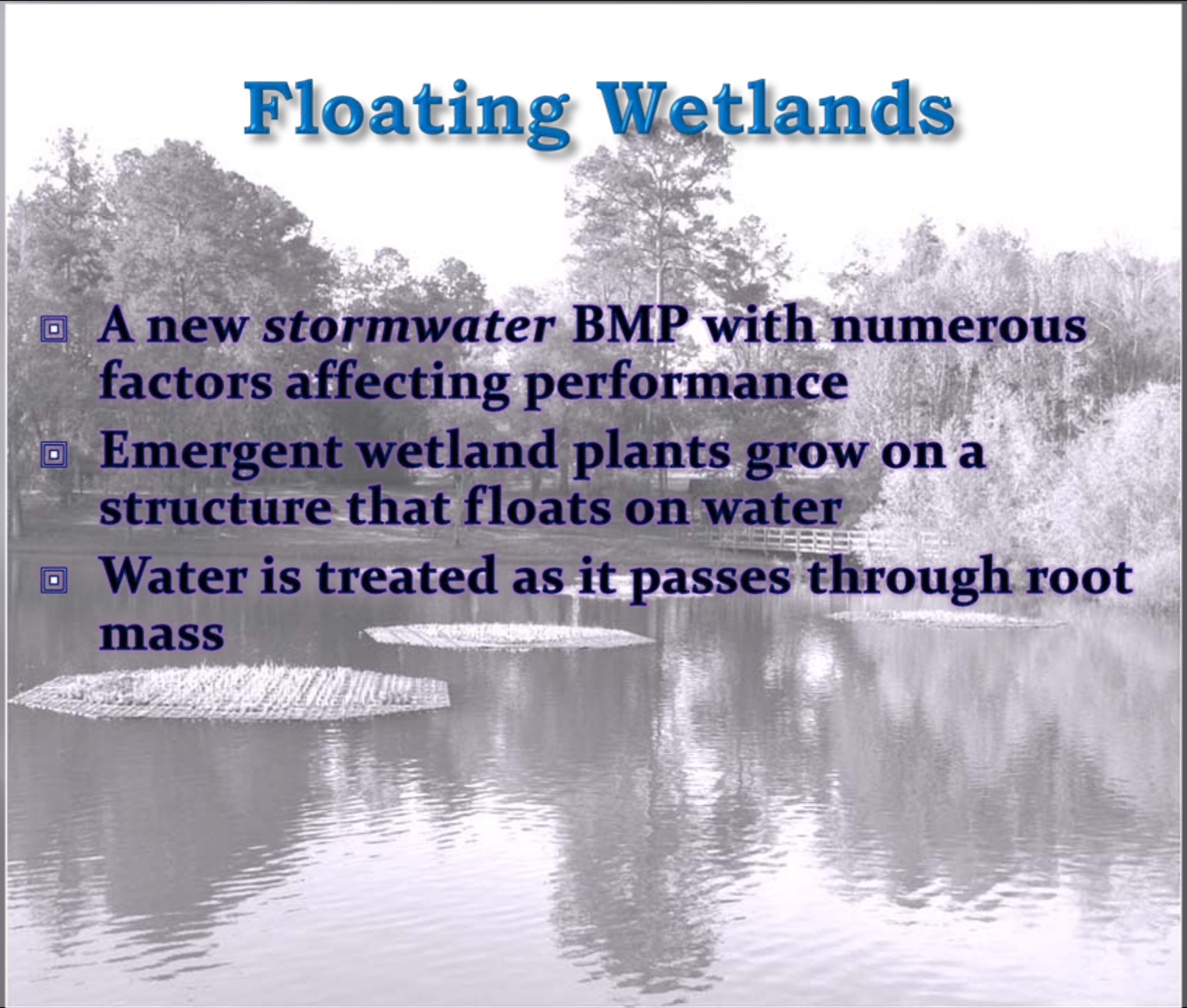
FLOATING WETLAND ISLANDS

a.k.a.
Floating Wetlands
Floating Plant Treatment Systems
Artificial Floating Meadows
Managed Aquatic Plant Systems (MAPS)
Floating Island Treatment System (FITS)*

Floating Wetlands



- A new *stormwater* BMP with numerous factors affecting performance
- Emergent wetland plants grow on a structure that floats on water
- Water is treated as it passes through root mass

Littoral Wetlands vs. Floating Wetlands

319-funded Stormwater Pond – Photo altered for color & size

MAPS @ Deer Creek – Photo altered for color & size

Littoral Wetlands vs. Floating Wetlands

Littoral Zones	Floating Wetlands
• Do not require harvesting • Requires reliable inflow/volume to maintain wetland vegetation • May be considered inappropriate for neighborhood settings • Requires larger parcel of land • May be necessary in some permitting situations	• Should be harvested for max nutrient removal • Survives with variable water depths • May be considered aesthetically pleasing • Plant root mat likely has a much greater potential for interaction with water column • Sunlight may be blocked thereby limiting the potential for algae growth

FOUR FLORIDA STUDIES

This presentation will present four studies performed across Florida that have variable results as to the removal efficiencies of MAPS.

Evaluation of a Floating Wetland for Improving Water Quality in an Urban Lake

Thomas A. DeBusk, Rick Baird, David Haselow and Tom Goffinet

Location: Rockledge
Lake Size: 3.95 ac.
Watershed Size: 91 ac.
Depth: 2 m
Littoral Zone: Yes

An Assessment of Floating Vegetated Mats to Reduce Nutrients in an Urban Lake

Geoffrey Watts, Mark Heidecker, Ken Espy, Catherine Bray, Sarah Keith Valentine

Location: Tallahassee
Lake Size: 4.38 ac.
Watershed Size: 180 ac.
Depth: 1.8 m
Littoral Zone: No

An Evaluation of Beemat Floating Mats to Improve Water Quality Performance in the Deep Creek West Regional Stormwater Treatment Facility

Pam Livingston Way, Steve Beeman, Lori McCloud

Location: St. Johns County
Tri-County Agricultural Area
Treatment Train Size: 15 ac.
Watershed Size: 1,196 ac.
Depth: 0.8 m
Littoral Zone: No

Managed Aquatic Plant System Performance Monitoring at the Upper Deer Creek Regional Stormwater Facility

CDM

Location: Jacksonville
Pond Size: 7 ac.
Watershed Size: 512 ac.
Depth: ukn
Littoral Zone: No

Evaluation of a Floating Wetland for Improving Water Quality in an Urban Lake

Thomas A. DeBusk, *Rick Baird*, *David Haselow* and *Tom Goffinet*

Rockledge

18 m diameter circle inside a boom with solar pump

Rockledge/*DeBusk*

- Utilized an 18 m diameter circle inside a boom (1.6% surface area of lake)
- Plants: water hyacinth, *Hydrocotyle*, *Bidens*, *Sagittaria*, and *Pontederia*
- Did not perform harvesting
- Deployed: August 2003
- Completed study: October 2004
- Utilized solar pump to provide water exchange (100m3/day)
- Utilized alum injection to stabilize P

Rockledge/DeBusk

Pre

- TN concentration: 1.80 mg/L
- TP concentration: 0.168 mg/L
- chlorophyll-a concentration: 78 mg/m^3
- Total coliform: 339 CFU
- DO concentration: 9.6 mg/L

Total Percentage efficiency reported:
TN: avg. 40%
TP: avg. 50%
Ch-a: 65%

Post

- TN concentration: 1.08 mg/L
- TP concentration: 0.084 mg/L
- chlorophyll-a concentration: 26 mg/m^3
- Total coliform: 3057CFU
- Mass removals of 25.6 kg N and 2.81 kg P/yr
- DO concentration: 1.2 mg/L

"Data from this, and prior studies, suggest that the floating wetland can be an effective nutrient control technology, particularly for small urban lakes, wet detention ponds and agricultural impoundments with water column TP concentrations in excess of approximately 0.100 mg/L."

An Assessment of Floating Vegetated Mats to Reduce Nutrients in an Urban Lake

Geoffrey Watts, Mark Heidecker, Ken Espy, Catherine Bray, Sarah Keith Valentine

Floating mats as initially installed

Red top bent grass harvested after 8 months of growth

Tallahassee/Watts

- Utilized 9 octagon-shaped floating mats: 6 at inflow; 3 at outflow covering 4500 sq. ft. (2.4%)
- 400 pound concrete anchor
- Plants: Redtop, Juncus, Canna, Impatiens, Pontederia
- Performed harvesting
- Deployed: March 2009
- Completed study: September 2010
- Turtle nets installed 12 months and noted increase in growth

Tallahassee/Watts

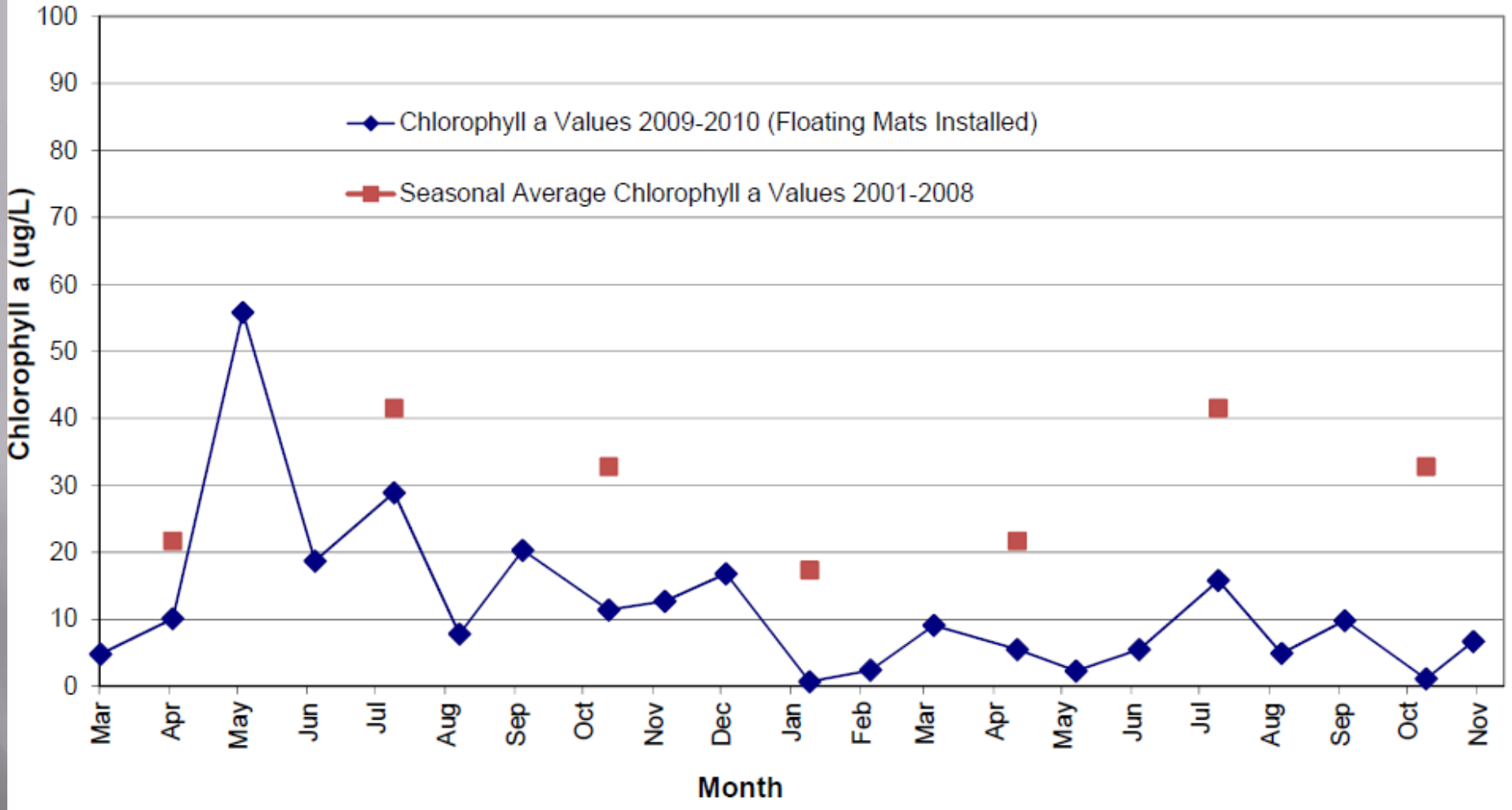
Pre

- TN concentration: 0.57 mg/L
- TP concentration: 0.045 mg/L
- Chlorophyll-a concentration: 20 ug/L

Post

- TN concentration: 0.70 mg/L
- TP concentration: 0.05 mg/L
- Only Juncus and Pontederia recorded a net positive TP uptake.
- Approximately 4100 grams of TKN was sequestered by the aquatic plants over the study period.
- Chlorophyll *a* showed improvement relative to the long-term seasonal average.

Figure 23. Lake Leon Chlorophyll a Concentration vs Time



An Evaluation of Beemat Floating Mats to Improve Water Quality Performance in the Deep Creek West Regional Stormwater Treatment Facility

Pam Livingston Way, Steve Beeman, Lori McCloud

Tri-County Agricultural Area/*Livingston*

- Watershed was 93% agriculture
- Five floating mats tethered in ditch at 10 ft x 20 ft ea. (1000 sq. ft. total)
- Plants: *Canna flaccida* and *Juncus effusus*

Mats as first installed in ditch.

Pond outfall and floating wetland systems appear in ditch.

Growth of Canna flaccida and Juncus effusus as seen on July 8, 2009.

Tri-County Agricultural Area/*Livingston*

Pre (upstream/downstream)

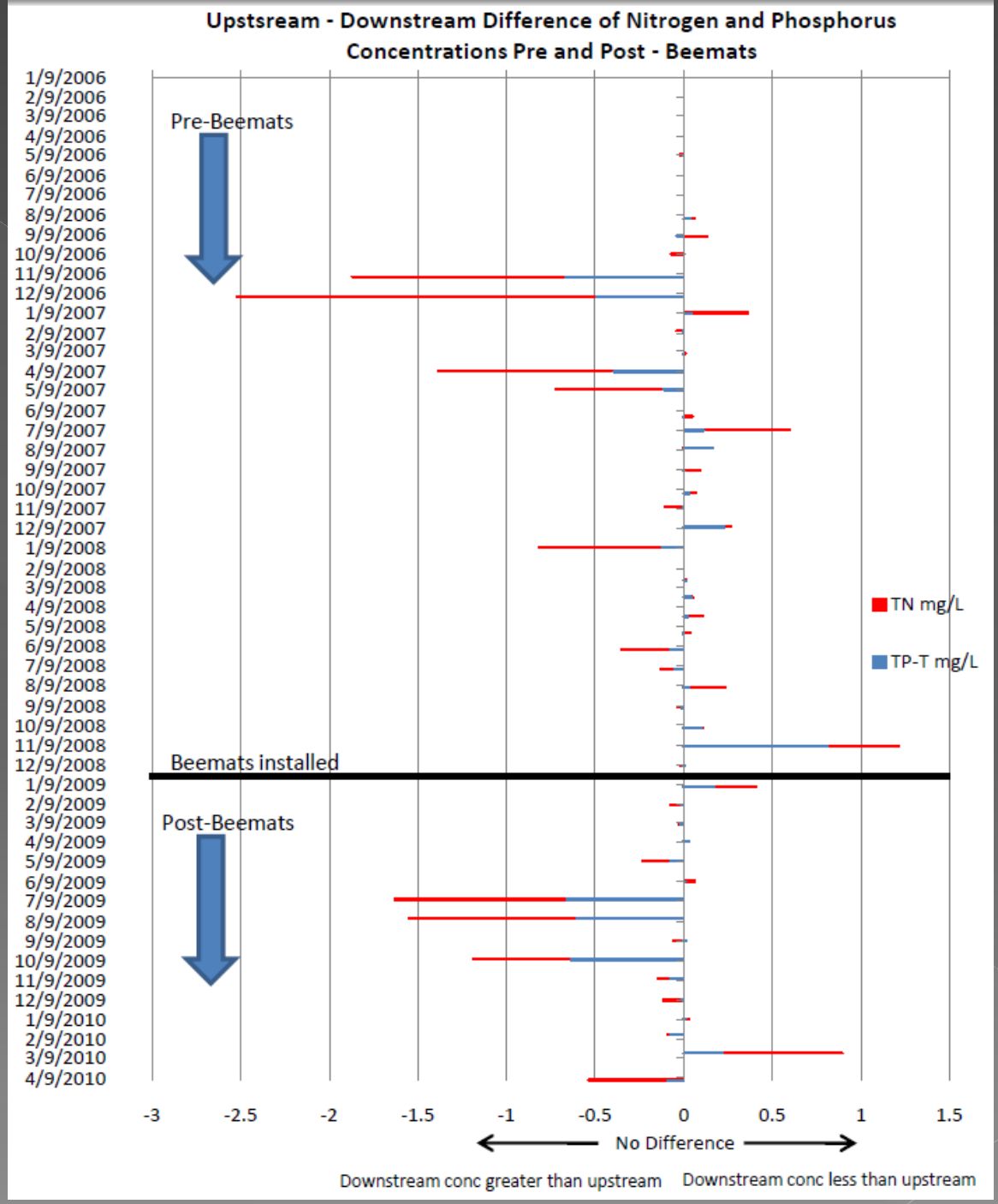
- TN concentration: 1.43 mg/L and 1.67 mg/L
- TP concentration: 0.60 mg/L and 0.68 mg/L

Potential Causes of Results

- Nitrogen and phosphorus cycling
- Phytoplankton decomposition and recycling of nutrients
- Nutrient flux

Post (upstream/downstream)

- TN concentration: 1.37 mg/L and 1.64 mg/L
- TP concentration: 0.49 mg/L and 0.60 mg/L
- Results indicated no significant differences (p=0.05) between the pre- Beemat and post-Beemat water quality conditions
- At 12 months, nitrogen uptake for Canna was 170 g/m2 while Juncus was 91 g/m2.


Upstsream - Downstream Difference of Nitrogen and Phosphorus Concentrations Pre and Post - Beemats
1/9/2006
2/9/2006
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11/9/2009
12/9/2009
1/9/2010
2/9/2010
3/9/2010
4/9/2010
Pre-Beemats
Beemats installed
Post-Beemats
TN mg/L
TP-T mg/L
-3
-2.5
-2
-1.5
-1
-0.5
0
0.5
1
1.5
No Difference
Downstream conc greater than upstream
Downstream conc less than upstream

Managed Aquatic Plant System Performance Monitoring at the Upper Deer Creek Regional Stormwater Facility

CDM

JACKSONVILLE/*CDM*

- Began with abnormally high nitrogen levels in the groundwater
- U-shaped island at inflow and isolated islands at center covering 12,000 sq. ft. (5%)
- Plants: *Juncus effusus* and *Canna flaccida*
- Deployed: June 2010
- Completed Study: November 2010

Vegetation growing on floating mat

Planted cups and roots

Jacksonville/CDM

Inflow

- TN concentration: 1.330 mg/L
- TP concentration: 0.246 mg/L

Outflow

- TN concentration: 1.112 mg/L
  - -0.01% difference
- TP concentration: 0.110 mg/L
  - -0.46% difference
- Did see larger mass loading removals, but saw increase in mass loading for TKN.

Plant Uptake

- TN: 168.6 lbs
- TP: 4.82 lbs

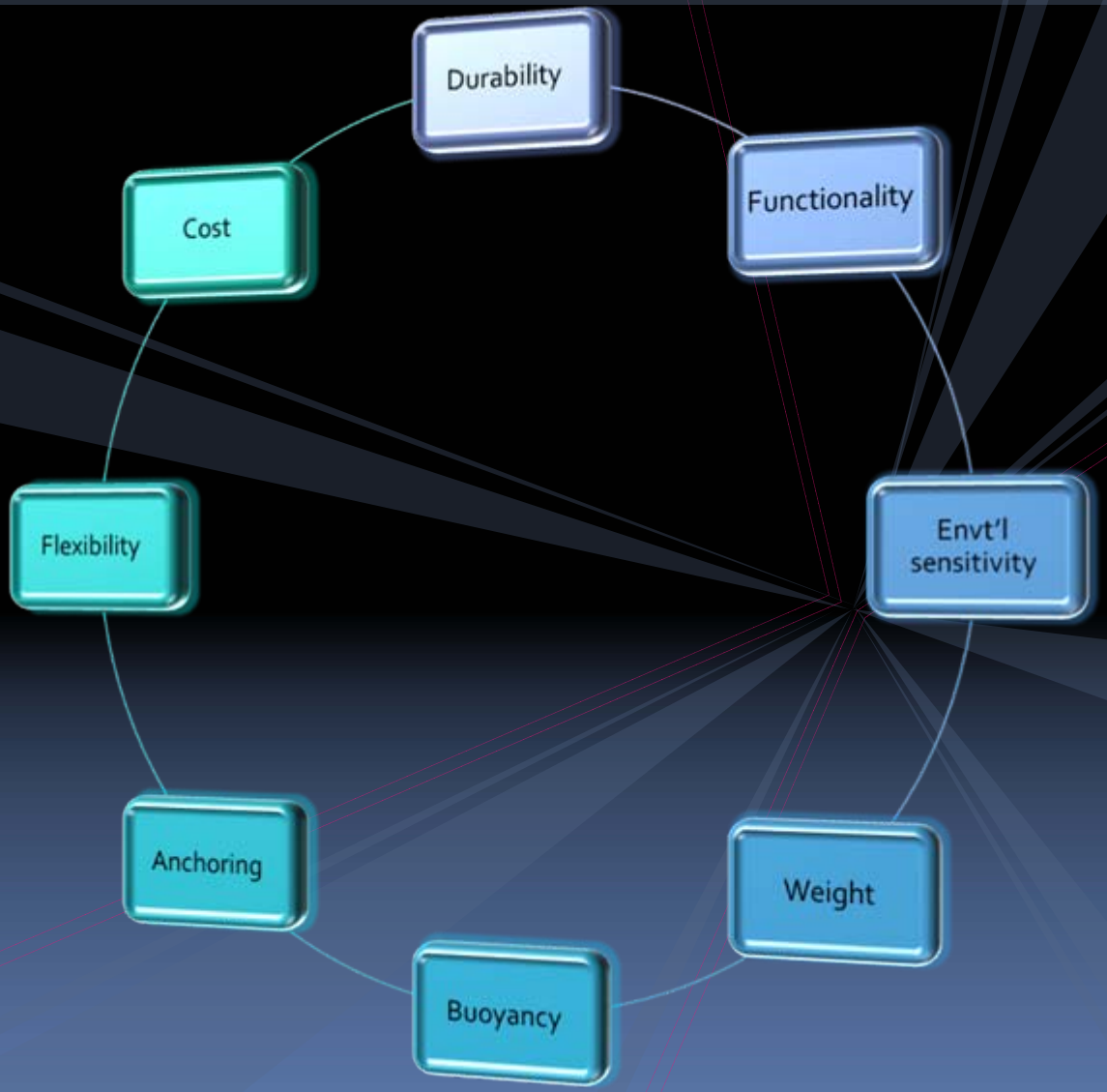
Causes of Results

- Construction related activities
- Low rainfall
- Predatation
- Late planting

Lessons Learned

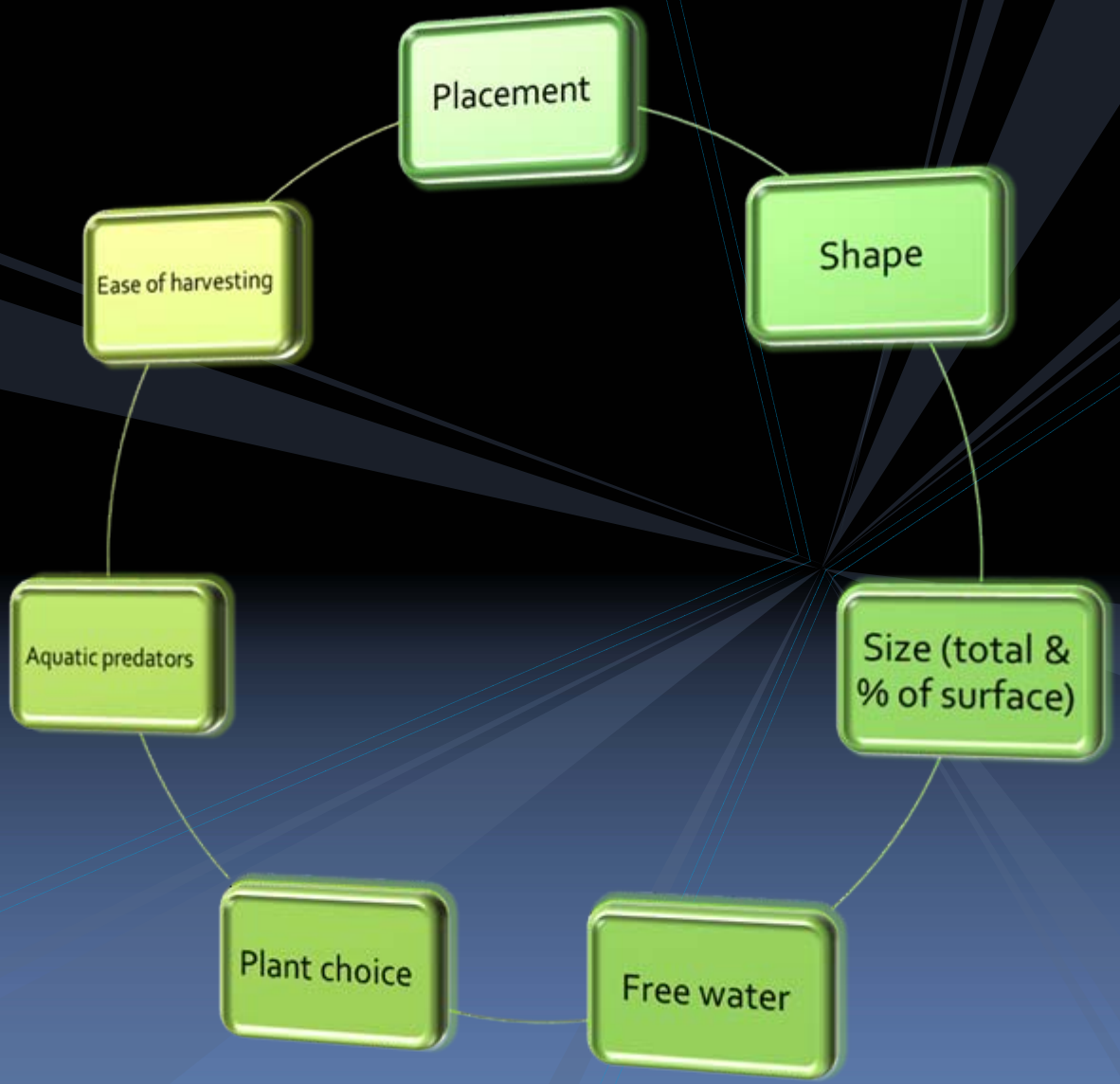
- On the Rockledge pond, alum injection believed to have been responsible for the TP removal
- Pumped water exchange may have had positive impact on positive TN and Ch-a removals
- Rockledge's increase in total coliform, likely resulting from birds, should encourage the use of bird exclusion devices
- Tallahassee found that turtle excluding nets positively affected the nutrient uptake
- Tallahassee also found that Juncus and Pontederia maximized TKN removals
- Summer months provide greatest uptake; beware winter die-back (harvesting considered essential maintenance)
- Dissolved Oxygen may be lowered by mats. Open water between mat and outfall or between a series of mats may help.

Considerations in “Mat” Construction



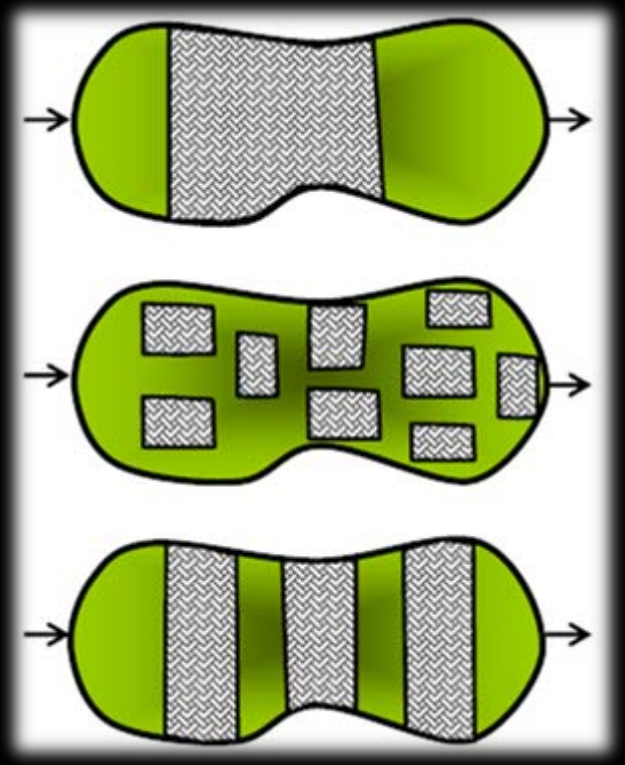
These factors were outlined by T.R. Headley and C.C. Tanner in Application of Floating Wetlands for Enhanced Stormwater Treatment: A Review, 2006.

Considerations in Configuration



Placement, Shape & Size

- Consider your inflow and outflow locations
- Beware bypassing the system.
- What percentage of the surface area do you want to cover? This is largely unknown.
  - Littoral zones 20-30%
- Look at the flow rates of the pond:
  - too high may result in negative consequences;
  - too low may not move water through the root structures efficiently
  - Pumping may be needed
- How much sunlight penetration do you want?
- Free water (btw 1-2 m) should occur between mat and pond bottom.
- To combat low DO, consider open water zones.



Application of Floating Wetlands for Enhanced Stormwater Treatment: A Review, T.R. Headley & C.C. Tanner, Nov 2006

Tallahassee Project: An Assessment of Floating Vegetated Mats to Reduce Nutrients in an Urban Lake, March 2011, Geoffrey Watts, Mark Heidecker, Ken Espy, Catherine Bray, Sarah Keith Valentine Picture altered for color

Jacksonville Project: Managed Aquatic Plant System Performance Monitoring at the Upper Deer Creek Regional Stormwater Facility Final Report, April 2011 Picture altered for color

Aquatic Plants

In choosing your plants, consider the root percentage vs. organic matter percentage (this will affect the weight and buoyancy of your mat as well as the nutrient uptake).

Predators & Harvest

- Consider utilizing both turtle exclusion netting and wading bird deterrents.
  - Turtles and other aquatic life may eat the root systems, reducing their effectiveness
  - Wading birds may find refuge on the islands and increase fecal bacteria counts
- Ensure that you harvest as needed. The mineralization and dissolution of the organic floating substrate and underlying sludge sediments will likely increase nutrients in your system.

Lake Jesup Total Phosphorus Removal Treatment Technologies Floating Island Pilot Project

Mark T. Brown and
Treavor H. Boyer

Floating Island Treatment Systems—a different kind of system

FITS System on first deployment

Solar panels drive the pumps, which move water through the horizontal and vertical columns

FITS system on second deployment

Picture taken 7/09/10

What is FITS?

- UF Center for Wetlands tested configurations and materials in mesocosms and laboratory experiments prior to Lake Alice deployment.
- Deployed a two-unit process that used plant and biofilter uptake first, followed by phosphorus adsorption using Phos-X™.

GAINESVILLE/*BROWN*

- Lake Alice: 82 acre open water/marsh (vast majority is the marsh) with a 1,140 ac. watershed
- Project designed for PO_4 removal with the intention of benefiting Lake Jesup
- Deployed: September 2009
- Study Complete: March 24, 2010
- Incl. pumps w/ flow rate maintained at ~3.8 L/min
- Utilized FITS: Floating Island Treatment Systems
- Found that estimated costs are within the average costs of other technologies for TP removal

Gainesville/Brown

Biological efficiencies

- TP reduction efficiencies btw 10-80%
- PO_4 reduction efficiencies btw 5-82%

Adsorptive media efficiencies

- TP reduction efficiencies btw 0-78%
- PO_4 reduction efficiencies btw 0-82%

TOTALS for FITS system

- TP reduction efficiencies btw 35-93%
- PO_4 reduction efficiencies btw 25-97%


QUESTIONS?