Water Quality Monitoring to Assess a Regional Approach to Treat Agricultural Runoff

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Pam Livingston Way
Lori McCloud

Environmental Scientist
St. Johns River Water Management District
Palatka, Florida
Florida's Five Water Management Districts
Mission of the District

Manage water resources to ensure their continued availability while maximizing both environmental and economic benefits.

Responsibilities

- Water supply
- Flood protection and floodplain management
- Water quality
- Natural systems
The St. Johns River

• St. Johns River is the longest river in Florida stretching 310 miles in length

• St. Johns River is one of few rivers in the United States that flows north

• St. Johns River elevation change is less than 30 feet from headwaters to the inlet, or one inch per mile
Lower St. Johns River

- Receives drainage from 12 major tributary watersheds

- Land use is primarily rural, agricultural, and undeveloped lands to the south; urbanized lands to the north near Jacksonville
• The Tri-County Agricultural Area is comprised of watersheds with a significant amount of agricultural land use, much of which is in close proximity to the St. Johns River.

• Approximately 31,000 acres is irrigated vegetable cropland; predominantly potato, cabbage and sod.
A three year (1991-93) diagnostic project quantified and qualified nutrient loading from 10 representative area farms and results indicated

1) N and P loading is primarily associated with storm events.

2) Nitrogen loading occurred mostly during the growing season, P loading had no seasonal trend.
Total Nitrogen for 61 streams in the Lower St. Johns River Basin

Major Land Use
- Forested
- Urban
- Dairy/Livestock
- Row Crop

Mean Total Nitrogen, mg/L

Total Phosphorus for 61 Streams in the Lower St. Johns Basin

Major Land Use
- Forested
- Urban
- Dairy/Livestock
- Row Crop

Mean Total Phosphorus, μg/L
TMDL Reductions Required for the TCAA

- 37% Nitrogen Load Reduction
- 15% Phosphorus Load Reduction
I. All agricultural commodities must implement in-field BMPs

II. Construction of four Regional Stormwater Treatment (RST) Facilities to achieve the remaining agricultural reductions

Expected RST TMDL Nutrient Reduction:

- TN - 2,409 kg/yr
- TP - 1,091 kg/yr
Dog Branch Regional Stormwater Treatment

- Regional stormwater treatment implemented as secondary treatment for Dog Branch Basin
- Watershed modeling identified Dog Branch watershed as priority basin
- Basin area – 2000 acres - 65% agricultural
- Former agronomic field
Dog Branch RST – BMP Treatment Train

11 hectare wet detention pond + 23 hectare constructed treatment wetland
System Performance Monitoring

- RST - Water Quality (base flow and storm water samples)
- RST - Water levels and pumped inflow (cfs) measured
- RST - Rainfall
- Analyze water samples for total suspended solids, nitrate-nitrite, ammonium, total kjeldahl nitrogen, total nitrogen, orthophosphate, total phosphorus, various metals

Canal Inflow (pump station)

Pond Inflow
Water Volume
Nutrient Conc.

Interior
Rainfall
Evapotranspiration
Berm runoff

Wetland Inflow
Pond Outflow
Volume
Nutrient Conc.

Pond Outflow

Wetland Inflow

Interior
Rainfall
Evapotranspiration
Berm runoff

Pond mass of nutrient removal
Pond percent nutrient removed

Wetland mass of nutrient removal
Wetland percent nutrient removed

RST System mass of nutrient removal
RST System percent nutrient removed
Perform long-term water quality analysis and hydrologic monitoring to assess performance of the treatment system.
Dog Branch System Performance

Total Phosphorus (kg)

Total Nitrogen (kg)

Canal inflow
Pond out
Wetland out
RAIN
### Dog Branch System Performance

<table>
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<tr>
<th>Year</th>
<th>TN IN (kg)</th>
<th>TN Out (kg)</th>
<th>TN Red (kg)</th>
<th>%Reduction TN</th>
<th>TP IN (kg)</th>
<th>TP Out (kg)</th>
<th>TP Red (kg)</th>
<th>%Reduction TP</th>
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<tbody>
<tr>
<td>2009</td>
<td>13227</td>
<td>2747</td>
<td>10479</td>
<td>79%</td>
<td>5771</td>
<td>1255</td>
<td>4515</td>
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<tr>
<td>2010</td>
<td>3849</td>
<td>1722</td>
<td>2127</td>
<td>55%</td>
<td>1518</td>
<td>379</td>
<td>1138</td>
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<td>2011</td>
<td>7691</td>
<td>2966</td>
<td>4724</td>
<td>61%</td>
<td>3036</td>
<td>744</td>
<td>2291</td>
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<td>2012</td>
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<td>5063</td>
<td>8852</td>
<td>64%</td>
<td>6071</td>
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<td>3310</td>
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<td>2013</td>
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<td>4451</td>
<td>8103</td>
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<td>6278</td>
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<td>5012</td>
<td>11765</td>
<td>70%</td>
<td>6237</td>
<td>2206</td>
<td>4030</td>
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### Annual Average Reduction

<table>
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<th>TN</th>
<th>TP</th>
</tr>
</thead>
<tbody>
<tr>
<td>66%</td>
<td>67%</td>
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</tbody>
</table>

### Total Nitrogen In vs. TN Reduced

The linear equation is $y = 1E-05x + 0.5171$ with $R^2 = 0.5025$.

### Total Phosphorus In vs. TP Reduced

The linear equation is $y = -3E-05x + 0.8248$ with $R^2 = 0.3838$. 
Dog Branch Regional Stormwater Treatment
Conclusions

- Performance monitoring is required to understand RST system delivery, behavior and performance.

- DBR BMP treatment train design is effective in treating both nitrogen (wetland) and phosphorus (pond) loads entering the system.

- RST treatment removal is greater during years with more rainfall compared to years with less rainfall.
The DBR RST annual average reduction exceeds the estimated TN (2,409 kg/yr) and TP load reductions (1,091 kg/yr) required by LSJR Main Stem TMDL.

DBR RST is effective in treating agricultural discharges in the Dog Branch Watershed.
Questions?
Property Acquisition

• A 20-year dream of the previous property owner’s was to see the “Edgefield” parcel of land turned into a public facility that could preserve the aesthetics of the area for the public.

• The District worked with the couple and was able to purchase the 230 acre property (including the residence) in 2001 with Florida Forever Funds.

• The facility was completed in 2007, with a total cost of 3.4 million dollars (incl. purchase price). Construction of the project was completed with funds from the National Oceanic and Atmospheric Administration’s Coastal Impact Assistance Program, Florida Department of Transportation mitigation funds, and special legislative appropriations.