EVERGLADES PROGRAM
Chapter 40E-63, F.A.C.

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BMP Training September 26, 2013
Everglades Research and Education Center
Outline

- The Everglades Agricultural Area (EAA)
- Why was the BMP program created?
- What is the BMP program?
- What are the BMPs?
- What are the requirements of the BMP program?
- How is the EAA annual P load calculated?
- How has the BMP program performed?
- BMP program incentives
- Promising new research
The EAA is a highly productive agricultural area comprised of muck/peat soils. This area has 430,000 acres of sugarcane harvested annually and about 70,000 acres of sod, rice and vegetables. The EAA is considered one of Florida's most important agricultural regions.

The major sources of water for the EAA are rainfall and Lake Okeechobee.

The area is drained and irrigated by a canal network and a system of structures and pumps. Canals and flooded fields serve as habitat for wading birds and various biota, including endangered species.
EAA Drainage

- The drainage of the EAA caused decomposition of organic soil (subsidence), which continues today at a slower rate. Soil loss impacts the hydrology and ecology of the Everglades.

- The loss of elevation has meant a loss of the hydraulic head that once drove water south. Pumping is now required to move water southward.

- Soil loss has also meant a loss of water storage capacity, which has meant a reduction in the ability of the area to hold water and mediate seasonal and long-term variations in rainfall.
Organic Soil Oxidation

1973
- Torry >51 in
- Terra Cela >51 in
- Pahokee 36-51 in

1988
- Torry >51 in
- Terra Cela >51 in
- Pahokee 36-51 in
- Lauderhill 20-36 in
- Dania <20 in
Why was the EAA BMP program created?

- The EAA was the single largest source of phosphorus loads to the Everglades. A 47 percent contribution of the historical phosphorus load to the Everglades for the 1979-1988 baseline period represents the largest single source of this nutrient to the ecosystem. Lesser amounts come from Lake Okeechobee, other agricultural and urban basins, and from rainfall.
Why was the BMP program created?
Why was the EAA BMP program created?

Ecosystem Disruption: Cattail Encroachment


Time series trend analysis of cattail (Typha spp.) within Water Conservation Area 2A (WCA-2A) was performed utilizing 1:24,000 scale color infrared aerial photography captured in 1991, 1995, and 2000. Each cattail map was generated utilizing stereo photogrammetric techniques. The 1991 and 1995 cattail maps were demarcated using a vector system with a minimum mapping unit of 0.09 hectares (0.053 acres). The 1995 cattail map was generated and vector-processed using the 2000 aerial photography, resulting in 175,000 individual grid cells covering all of WCA-2A. Vegetation within each individual grid cell was observed utilizing a Zeiss 570 stereoscopic plotter. Cattail cover was estimated for each grid cell and assigned one of four possible categories. The categories of this classification are: "cattail monotypy" (greater than or equal to 90% cattail), "cattail-dominant mix (90% - 80% cattail), "cattail-sparse mix" (15% - 40% cattail), or "other" (less than 15% cattail). For ground-truthing, seven hundred and forty-two square kilometers within WCA-2A were visited using 28 different locations, where cattail coverage was determined to be areas in question or "unknown" during the photogrammetric process.

Advantages of the grid system mapping include greater time and cost efficiency and the unique ability to classify vegetation within the same quarter-acre grid cells from this analysis during future mapping efforts. This allows for the past, present, and future analysis of each individual quarter-acre of the entire area under study. In addition, the grid system more accurately depicts the overall heterogeneity of Everglades vegetation.

Results show that cattail continues to spread throughout WCA-2A, with monotypic cattail patches expanding throughout the eastern portion of the impoundment and along the southwestern boundary. In addition, sparse cattail continue to spread along distinct cattail-exgress boundaries and throughout the southern region of WCA-2A. The rate of spread appears to be slowing down. A major reduction in annual total phosphorus leads to WCA-2A during the 1991 to 2000 period. Decrease in nutrient, hydrologic alterations, invasive species extirpation, and the threat of acid rain influence successful establishment of cattail in the Everglades. The relative importance of these factors influencing cattail coverage in WCA-2A from 1990 to 2000 will need to be determined. A small area in the northern tip of WCA-2A shows a decrease in cattail coverage. It is hypothesized that the loss of cattail in this area is due to a combination of events including the reduction in phosphorus loading and water levels with the closing of structure S106 in 1994. Structure S106 regulates water flow from the Hillsboro Canal into northern WCA-2A.

For additional information contact Ken Rutchey at (561) 682-6163 or email at krutchey@fwmd.gov.


What is the EAA BMP Program?

- 1994 Everglades Forever Act
- Regulatory program goal: reduce EAA P loads by 25%
- EAA BMPs in place by February 1, 1995
- Master and individual BMP permits
- Compliance and enforcement procedures
- EAA load calculation methods
- STA creation and management
## What are the BMPs?

<table>
<thead>
<tr>
<th>BMP</th>
<th>PTS</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NUTRIENT CONTROL: MINIMIZE MOVEMENT OF NUTRIENTS OFF-SITE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nutrient Application Control</td>
<td>2½</td>
<td>Controlled application of nutrients; banding, controlled application</td>
</tr>
<tr>
<td>Nutrient Spill Prevention</td>
<td>2½</td>
<td>Formal spill protocols: storage, handling, transfer, and education/instruction</td>
</tr>
<tr>
<td>Rotational Vegetable Planting</td>
<td>2½</td>
<td>Rotation planting of high P/low P demand crops to avoid P build up</td>
</tr>
<tr>
<td>Plant Tissue Analysis</td>
<td>2½</td>
<td>Determines plant nutrient requirements via tissue testing</td>
</tr>
<tr>
<td>Soil Test Based Fertilization</td>
<td>5</td>
<td>Determine soil P requirements and follow standard recommendations</td>
</tr>
<tr>
<td>Split Nutrient Application</td>
<td>5</td>
<td>Applying split P without exceeding total recommendation</td>
</tr>
<tr>
<td>Slow Release P Fertilizer</td>
<td>5</td>
<td>Specially treated fertilizer</td>
</tr>
<tr>
<td>Reduced P Fertilization</td>
<td>5</td>
<td>P application rate is at least 30% below recommendation</td>
</tr>
<tr>
<td><strong>WATER MANAGEMENT: MINIMIZE THE VOLUME OF OFF-SITE DRAINAGE DISCHARGE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>½ Inch Detained</td>
<td>5</td>
<td>Delay discharge: based on measuring daily rain events using a rain gauge</td>
</tr>
<tr>
<td>1 Inch Detained</td>
<td>10</td>
<td>Delay discharge: based on measuring daily rain events using a rain gauge</td>
</tr>
<tr>
<td>Improved Infrastructure</td>
<td>5</td>
<td>Re-circulate water; fallow field flood; increase water detention; booster pumps</td>
</tr>
<tr>
<td>Water Table Management</td>
<td>5</td>
<td>Optimizing drainage and irrigation schedules to decrease discharge</td>
</tr>
<tr>
<td><strong>PP AND SEDIMENTS: MINIMIZE MOVEMENT OF PARTICULATE MATTER AND CANAL SEDIMENTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any 2</td>
<td>2½</td>
<td>• Leveling fields • Slow drainage velocity near pumps • Grassed swales/field ditch connections • Ditch bank berms • Canal cleaning program • Aquatic weed control • Field ditch drainage sumps • Barriers at discharge locations • Ditch bank stabilization • Sediment sump/trap in canals • Soil stabilization through infrastructure improvements • Cover crops • Culvert bottoms above ditch bottoms • Vegetated ditch banks</td>
</tr>
<tr>
<td>Any 4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Any 6</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Any 8</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Other BMPs</td>
<td>TBD</td>
<td>BMPs proposed by permittee and accepted by SFWMD</td>
</tr>
</tbody>
</table>
### What are the BMPs?

#### Example: Sugarcane Farm - Shallow Soil

<table>
<thead>
<tr>
<th>BMP</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2” Rainfall detention</td>
<td>5</td>
</tr>
<tr>
<td>Controlled fertilizer application</td>
<td>2.5</td>
</tr>
<tr>
<td>Fertilizer spill prevention</td>
<td>2.5</td>
</tr>
<tr>
<td>Soil testing program</td>
<td>5</td>
</tr>
<tr>
<td>Sediment controls (6)</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional BMPs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Level fields</td>
<td></td>
</tr>
<tr>
<td>Field ditch sumps</td>
<td></td>
</tr>
<tr>
<td>Ditch bank berms</td>
<td></td>
</tr>
<tr>
<td>Raised culverts</td>
<td></td>
</tr>
<tr>
<td>Main canal sump</td>
<td></td>
</tr>
<tr>
<td>Riser boards</td>
<td></td>
</tr>
</tbody>
</table>

**Total**                                           **25**
What are the requirements of the EAA BMP Program?

Conditions for Permit Issuance/Renewal

- Submit BMP Plan—description, rationale, explanation, fertilization and water management for each crop, water management design, monitoring, education and training, schedule for implementation

- Submit WQ Plan—description of WQ monitoring program, map of locations, description of sample collection methods, flow calculation methods, QA/QC, data mgt, data submittal
BMP Program Incentives

- Agricultural Privilege Tax
- Farm basin level P load monitoring
- Shining example for CERP
- Coexistence of Agriculture and Environment
How has the program performed?
Promising New Research

Anaerobic:
P flux 10X+
Max Detritus

Aerobic:
Min Flux
Min Detritus

P flux from sediment
FAV Project Update

Objectives

1. Evaluate FAV management practices in the EAA farm canals for impact on
   a) farm drainage water phosphorus (P) load
   b) P speciation of farm drainage water
   c) canal sediment properties

2. Use research results to develop a BMP for managing FAV in farm canals that further lowers farm P loads.

The goal is to provide growers an additional tool in their efforts to reduce off-farm P loading in the Everglades Agricultural Area.
Paired farms study (4 pairs)

- Two pairs each in S-5A and S-6 sub basins
- 2-yr calibration and 3-yr treatment periods
- Calculate changes after initiation of practices
- Improved vs. typical FAV control practices
Example: Farm Pair Aerial View
FAV Project Update
Comparative Regression Analysis For P Load

Treated\(_i\) = b_0 + b_1 (Control\(_i\)) + e

- Calibration Period
- After Treatment
Calibration Period

- Collected two full water year data:
  - May 1, 2011 – April 30, 2013
- Conducted regression analysis on P loads between farm pairs to determine if the relationship is significant
Calibration Period Regression Load Graphs

Regression Plot for Site 0401 vs 2501 Daily Load Relationship

Regression Plot for Site 3103 vs 3102 Weekly Load Relationship

Regression Plot for Site 6117 vs 1813 Weekly Load Relationship

Regression Plot for Site 4702 vs 4701 Weekly Load Relationship
Calibration Period Regression Equations

Weekly P Load 6117 vs 1813:
\[ P_{Load1813} = -6.464 + 0.430 \times P_{Load6117} + 6.02 \times Rain_{6117} \]
Observations = 44, \( Adj \, R^2 = 0.955 \), RMSE = 8.52

Weekly P Load 3102 vs 3103:
\[ P_{Load3102} = -68.85 + 1.45 \times P_{Load3103} + 68.2 \times Rain_{3102} \]
Observations = 41, \( Adj \, R^2 = 0.838 \), RMSE = 81.52

Daily P Load 0401 vs 2501:
\[ P_{Load0401} = 0.1821 + 1.42 \times P_{Load2501} + 2.00 \times Rain_{2501} \]
Observations = 110, \( Adj \, R^2 = 0.877 \), RMSE = 4.44

Weekly P Load 4701 vs 4702:
\[ P_{Load4701} = 3.072 + 0.432 \times P_{Load4702} \]
Observations = 19, \( Adj \, R^2 = 0.488 \), RMSE = 5.59
FAV Research Project
Farm Drainage Water

- 0401
- 2501
- 1813
- 6117
- 3102
- 3103
- 4701
- 4702

TP (mg L$^{-1}$)
FAV Research Project
Farm Drainage Water

Drainage water samples from Feb 2011 thru Apr 2013
FAV Project Status

- Treatment Farms: 3103 0401 6117
- Control Farms: 3102 2501 1813
- Continued Baseline Monitoring (one yr): 4701 and 4702
- Treatment Initiation: May 1, 2013 for 3 farm pairs
  - Monitoring of FAV growth
  - Spot spraying with approved Aquatic herbicide
- Treatment Initiation: May 1, 2014 for farm pair 4
BMP Program Conclusions

As a result of 100% participation by EAA growers:

- The EAA achieved an estimated 71 percent [63 mt] TP load reduction for WY2012.
- The average annual reduction in TP loads due to BMP implementation since WY1996 has been 55%.

Efforts to improve BMP performance and implementation through research, extension, and training continue.

The success of the EAA BMP program is the result of a group effort; all involved need to continue to be diligent and conscientious implementing BMPs.
Thank you for your participation and attention. Any questions?