Internal Loading of TP and Other Constituents in the L-7 Canal Using a Simple Mixing Model

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BACKGROUND

The Arthur R. Marshall Loxahatchee National Wildlife Refuge includes one of three areas in South Florida designated to maintain water storage, provide flood control, and provide a refuge for the remnant Everglades ecosystem. In the 1950s and 1960s the refuge was surrounded by perimeter canals and hydrologically isolated from its watershed by levees. Stormwater runoff, primarily from the Everglades Agricultural Area, is pumped into the perimeter canal where it may flow to discharge structures or mix into the rainwater-dominated interior wetland. The pumped stormwater has elevated concentrations of both Cl and P. Data collected primarily by the South Florida Water Management District were analyzed in this study using a simple mixing model to provide a qualitative graphical assessment of P internal loading or loss within the perimeter canal. This graphical assessment is analogous to the use of mixing plots or concentration-salinity diagrams in estuarine systems to identify presence of sources and sinks of constituents during seaward mixing. Rather than salinity, Cl is here used to estimate the fraction of each water sample originating in pumped inflow to the canal. This analysis supports the hypothesis that there is an internal P loading source within the canal. It is conjectured that the internal canal P source results from groundwater advection of re-mineralized P in sediment pore water. Recent studies have documented a large pool of P in the highly organic sediments deposited in the perimeter canal since construction. Relationship of internal loading to canal stage and discharge are examined.

Characterization of water quality parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Canal</th>
<th>Interior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Calcium</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Sulfate</td>
<td>C</td>
<td>-</td>
</tr>
<tr>
<td>Potassium</td>
<td>+</td>
<td>C</td>
</tr>
<tr>
<td>Silica</td>
<td>+/-</td>
<td>+/-</td>
</tr>
<tr>
<td>Algal Growth Potential</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Total Nitrogen</td>
<td>C</td>
<td>-</td>
</tr>
<tr>
<td>Total Phosphorus</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

Conservative = C, source = +, sink = -

Conclusions

+ The mixing plot method classifies source/sink
+ Mixing plot lacks time-of-travel estimate
+ Multi-constituent analysis increases insight into underlying processes
+ In the Canal
  – No sinks identified
  – Source of TP, AGP, and Ca

MIXING PLOTS FOR SELECTED PARAMETERS

- Sodium
- Total Nitrogen, TN
- Total Phosphorus, TP
- TN to TP Ratio – Solid line is ratio of mixing lines