Davis Pond River Diversion Project: Pre- and Post-Diversion Trends for Salinity Intrusion and Nutrient Removal

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New Orleans, LA

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Outline

• Louisiana Nutrient Management Strategy
• Davis Pond Diversion
• Data Sources and Methodology
• Pre- and Post-Diversion Trends
• Removal Efficiency
• Summary and Recommendations
Nutrient Management Strategy

- Improve management of Nonpoint Sources (BMPs, Incentives)
- Improve management of Point Sources (Monitoring, TMDLs, Permits, Enforcement)
- Leverage capacity of river diversions to reduce nutrient load to Gulf of Mexico
Davis Pond Freshwater Diversion

- Diversion authorized by Flood Control Act of 1965
- Constructed by USACE, 1997-2002
- Located ~15 miles upstream of New Orleans
- St. Charles Parish, near River Mile 118

- Max Capacity: 10,650 cfs
- 9,300 acres Ponding Area
- Fully operational in 2007
Davis Pond Diversion Objectives

- Reintroduce river flow of water, nutrients, sediments to coastal wetlands of Barataria Basin
- Reduce marsh loss; enhance marsh vegetation
- Improve fish and wildlife productivity
- Control salinity intrusion
- Removal of nutrients
- Removal of sediments
Performance Analysis of Diversion

- Jun-Nov: high biological productivity; operations based on 5 ppt salinity target in mid-basin
- River: Low/High
- Diversion: Low/High
- Pre-Diversion: (1997-2002)
- Post-Diversion (2003-2012)
- Data Sources: USACE, USGS, WQPORTAL, CPRA, NOAA NODC

- Salinity intrusion
- Nutrient removal
- Sediment removal
Mississippi River and Diversion
Median Flow (Jun-Nov)

River: Low/High

Mississippi River, 1997-2012
Tarbert Landing

Pre-Diversion 2 Cases

325,000 cfs

Diversion: Low/High

Davis Pond, 2002-2012

Post-Diversion 2x2 Cases

1,260 cfs
Salinity
Salinity, River Flow/Low

Range for oysters 5-15 ppt

Barataria Basin
- Salinity (ppt)
  Pre- and Post-Diversion
  June - November
  Low River Flow
  Low Diversion Flow

5 ppt Pre-Diversion
5 ppt Post-Diversion
5 ppt Post Project Target
15 ppt Pre-Diversion
15 ppt Post-Diversion
15 ppt Post Project Target
Salinity, Grand Bayou, 5 ppt Line

River(Low) Pre-Diversion (1999,2000)
Nutrients
NO$_3$NO$_2$, River Flow/High


- **RIVER/HIGH (PRE_DIVERSION)**
- **RIVER/HIGH (POST_DIVERSION/LOW)**
- **RIVER/HIGH (POST_DIVERSION/HIGH)**

<table>
<thead>
<tr>
<th>NO$_3$NO$_2$</th>
<th>Removal Efficiency (%)</th>
<th>Mass Removal (g m$^{-2}$ yr$^{-1}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diversion/Low</td>
<td>Diversion/High</td>
<td>Diversion/Low</td>
</tr>
<tr>
<td>River/Low</td>
<td>97%</td>
<td>89%</td>
</tr>
<tr>
<td>River/High</td>
<td>93%</td>
<td>93%</td>
</tr>
</tbody>
</table>

- Lake Cataouatche
- Lake Salvador
- Little Lake
- Grand Bayou
- Barataria Pass

20 m isobath
TOTAL-N, River Flow/High


<table>
<thead>
<tr>
<th>Location</th>
<th>Total-N</th>
<th>Removal Efficiency (%)</th>
<th>Mass Removal (g m⁻² yr⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Diversion/Low</td>
<td>Diversion/High</td>
</tr>
<tr>
<td>River/Low</td>
<td></td>
<td>50%</td>
<td>27%</td>
</tr>
<tr>
<td>River/High</td>
<td></td>
<td>45%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Distance from Davis Pond Diversion (meters)

Lake Catahouache
Lake Salvador
Little Lake
Grand Bayou
Barataria Pass

20 m isobath
## Removal Efficiency

<table>
<thead>
<tr>
<th>Study Area</th>
<th>Citation</th>
<th>Season</th>
<th>Total-N RE(%)</th>
<th>Total-P RE(%)</th>
<th>NO3NO2 RE(%)</th>
<th>TSS RE(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fourleagule Bay</td>
<td>Perez et al. 2011</td>
<td>Winter/Spr</td>
<td>43%</td>
<td>20%</td>
<td>51%</td>
<td></td>
</tr>
<tr>
<td>Caernarvon</td>
<td>Day et al. 2009</td>
<td>Annual</td>
<td>44%</td>
<td>62%</td>
<td>57%</td>
<td></td>
</tr>
<tr>
<td>Caernarvon</td>
<td>Lundberg et al 2014</td>
<td>Summer/Fall</td>
<td>no data</td>
<td>no data</td>
<td>95%</td>
<td></td>
</tr>
<tr>
<td>Davis Pond</td>
<td>CH2M Hill 2013</td>
<td>P-k-C* Avg Ops</td>
<td>42%</td>
<td>38%</td>
<td>65%</td>
<td></td>
</tr>
</tbody>
</table>

The table above presents removal efficiency data for different studies and seasons. The data includes the removal efficiency for Total-N, Total-P, NO3NO2, and TSS.
Summary
Summary & Recommendations

- **Salinity Intrusion Diversion** is most effective at reducing salinity near 5 ppt line at low river flow. Little effect of diversion at high river flow.
- Little effect of diversion near 15 ppt line. Salinity controlled by river and Gulf of Mexico.
- **Removal Efficiency**: Low diversion flow achieves higher removal efficiency for Nitrogen and TSS.

- **Confounding effects of physical forcing** (e.g., wind, rain, storm events, river flow; Gulf circulation) make it difficult to isolate effect of diversion on mid-basin salinity.
- **Recommendation**: Develop methodology to separate out effects of diversion and physical forcing in Barataria Basin on salinity during May-December higher diversion period.
Questions?

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Slides in Back Pocket
Sediments (TSS)
TSS, River Flow/Low


- ▲ RIVER/LOW (PRE_DIVERSION)
- ● RIVER/LOW (POST_DIVERSION/LOW)
- ▲ RIVER/LOW (POST_DIVERSION/HIGH)

<table>
<thead>
<tr>
<th>TSS</th>
<th>Removal Efficiency (%)</th>
<th>Mass Removal g m⁻² yr⁻¹</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Diversion/Low</td>
<td>Diversion/High</td>
</tr>
<tr>
<td>River/Low</td>
<td>94%</td>
<td>77%</td>
</tr>
<tr>
<td>River/High</td>
<td>77%</td>
<td>44%</td>
</tr>
</tbody>
</table>

20 m isobath

Distance from Davis Pond Diversion (meters)

Lake Cataouatche, Lake Salvador, Little Lake, Grand Bayou, Barataria Pass
TOTAL-P, River Flow/Low


<table>
<thead>
<tr>
<th>Location</th>
<th>Total-P</th>
<th>Removal Efficiency (%)</th>
<th>Mass Removal g m⁻² yr⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Diversion/Low Diversion/High</td>
<td>Diversion/Low Diversion/High</td>
</tr>
<tr>
<td>River/Low</td>
<td></td>
<td>28% 43%</td>
<td>1.1 2.7</td>
</tr>
<tr>
<td>River/High</td>
<td></td>
<td>14% 10%</td>
<td>0.3 1.1</td>
</tr>
</tbody>
</table>

20 m isobath

Distance from Davis Pond Diversion (meters)

Lake Cataouatche
Lake Salvador
Little Lake
Grand Bayou
Barataria Pass

Dynamic Solutions LLC
PO4T, River Flow/Low


<table>
<thead>
<tr>
<th>Total-P</th>
<th>Removal Efficiency (%)</th>
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20 m isobath
Salinity, Wilkinson Canal
Salinity, Wilkinson Canal

River(Low) Pre-Diversion (1999,2000)
Salinity, Lac des Allemandes
Salinity, Lac des Allemandes

River(Low) Pre-Diversion (1999, 2000)
Monthly Salinity, 5 ppt Line

Grand Bayou

Salinity Target Range
Pre-Diversion (Riv9)
Post-Diversion (Riv9)

SALINTY (ppt)

Month

0 1 2 3 4 5 6 7 8 9 10 11 12

5 ppt

15 ppt
Salinity Mixing Diagram
Davis Pond and Barataria Basin
Strong sink for NO3NO2
Salinity, Barataria Bay, 15 ppt Line

River(Low) Pre-Diversion (no data, 1999, 2000)
Salinity Mixing Diagram
Davis Pond and Barataria Basin
Strong sink for NO3NO2
Denitrification key process