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

Restore America's Estuaries 2014 Washington DC

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Outline

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

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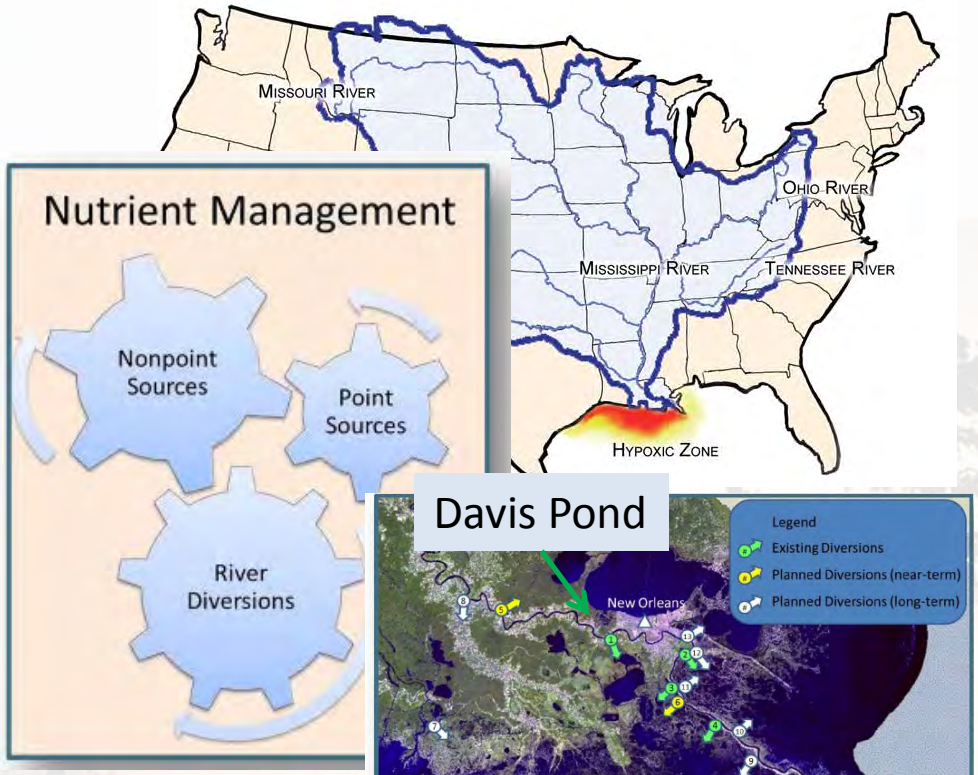
Nutrient Management Strategy



- 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; hypoxia

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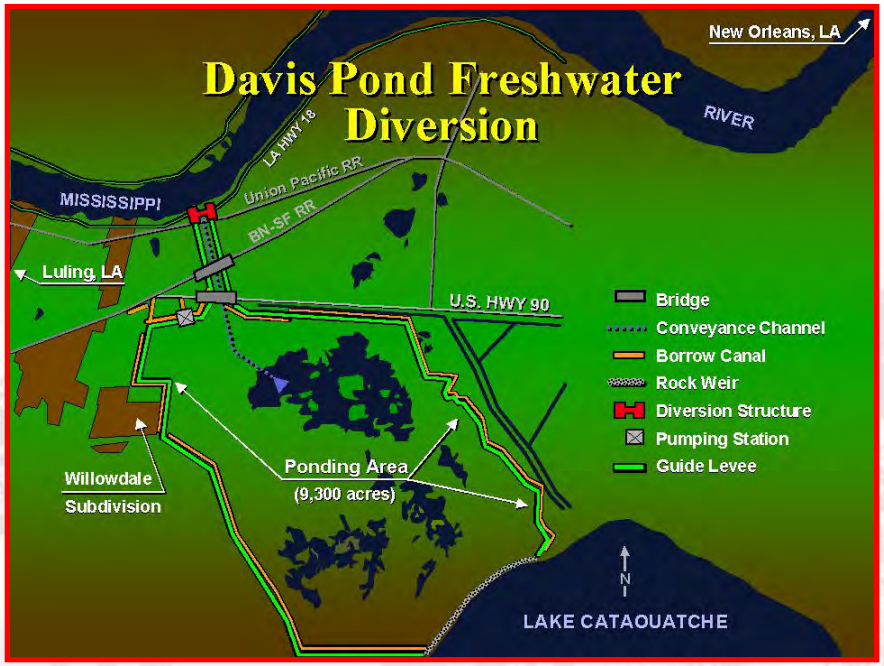
Davis Pond Freshwater Diversion



- RM 118: ~15 miles upriver, NO
- Maximum Capacity: 10,650 cfs
- Ponding Area: 9,300 acres
- USACE: Fully operational in 2007

- Objectives
- Reintroduce river flow, nutrients, sediments to Barataria Basin wetlands
- Reduce marsh loss; enhance marsh vegetation
- Improve fish & wildlife productivity
- Control salinity intrusion
- Remove nutrients & sediments

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Performance Analysis of Diversion

- Jun-Nov: high biological productivity; operations based on 5 ppt salinity target in mid-basin
- Mississippi 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 & sediment removal
- Phytoplankton

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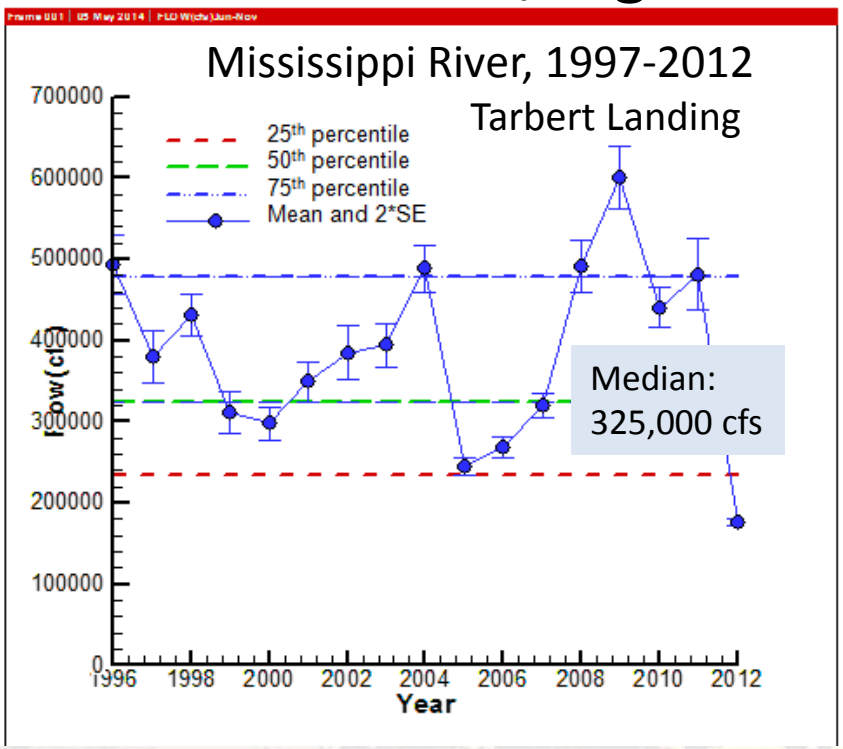
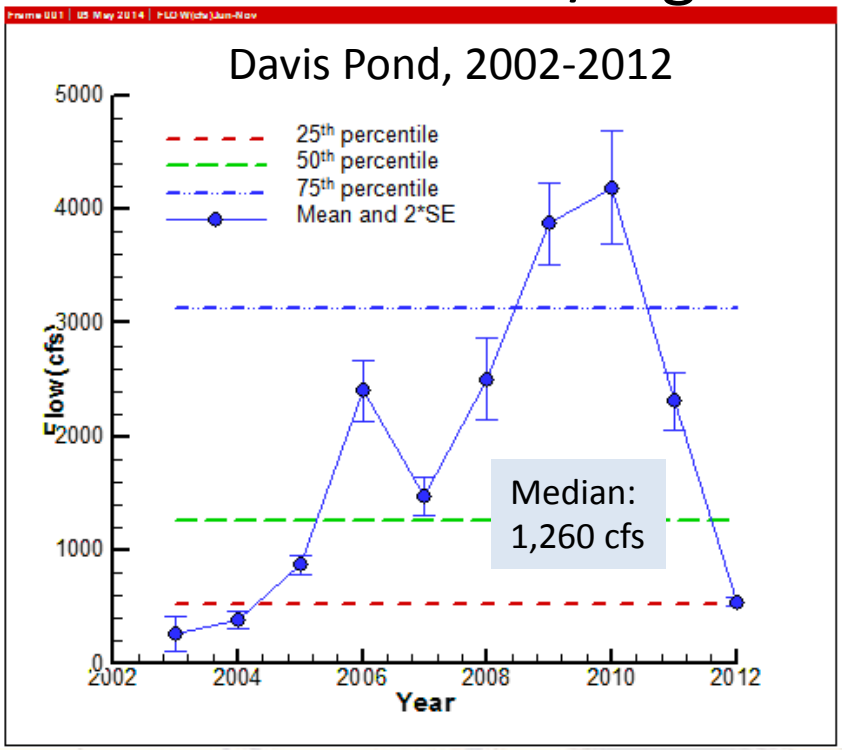
Mississippi River and Diversion Median Flow (Jun-Nov)

River: Low/High



Diversion: Low/High



Pre-Diversion 2 Cases

Post-Diversion 2x2 Cases

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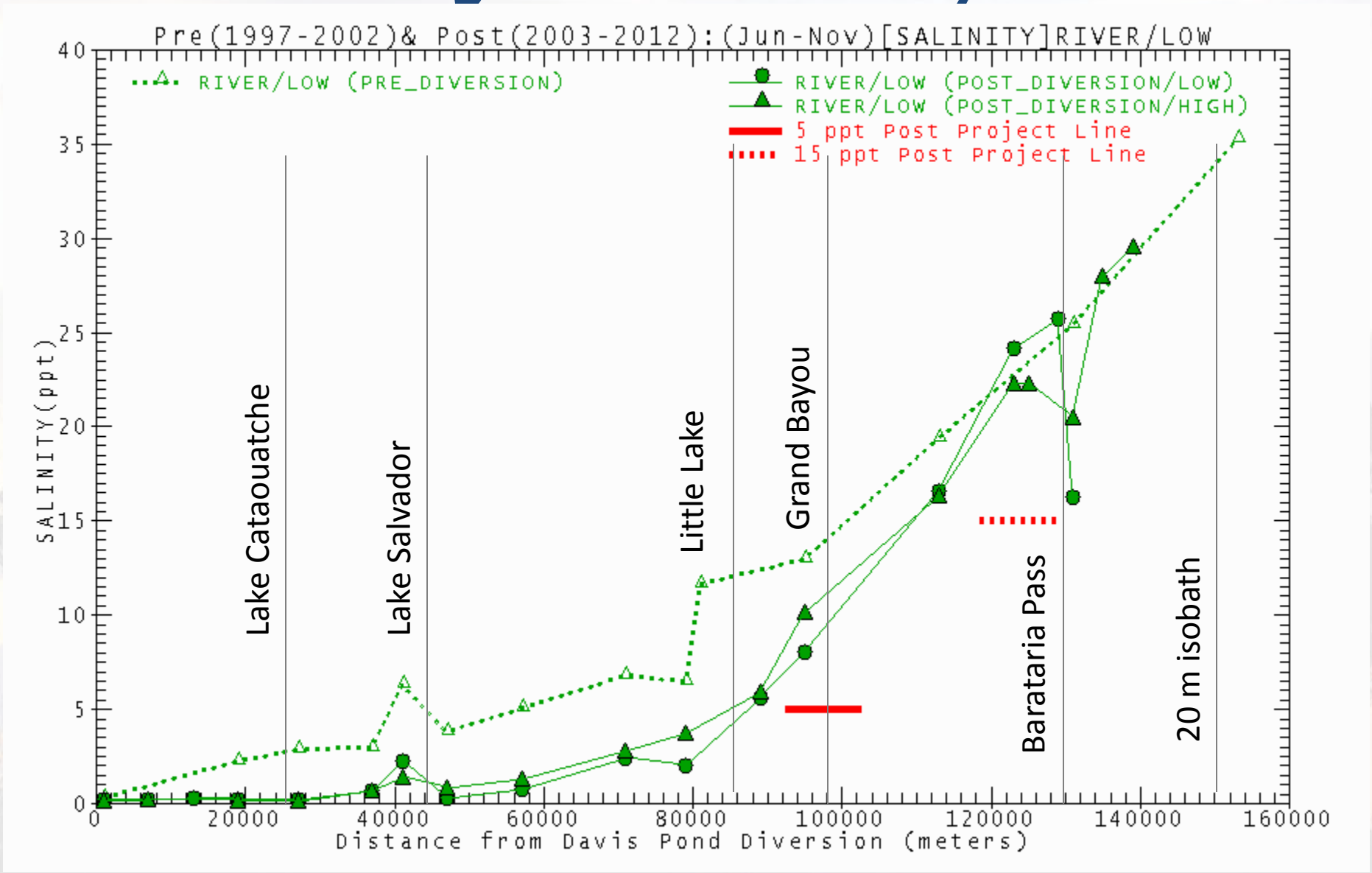
Salinity


Orleans
N
W
E
S
Barataria Basin
1-D Grid
Lake Salvador
Black Bay
Mississippi River
Barataria Bay
Timbalier Bay
5
15
25
35
45
55
65
75
85
95
105
115
125
135
145
155
40
One-Dimensional
Data Extraction Path
(Points are km along path)
0 2.5 5 10
Miles

Salinity, River Flow/Low



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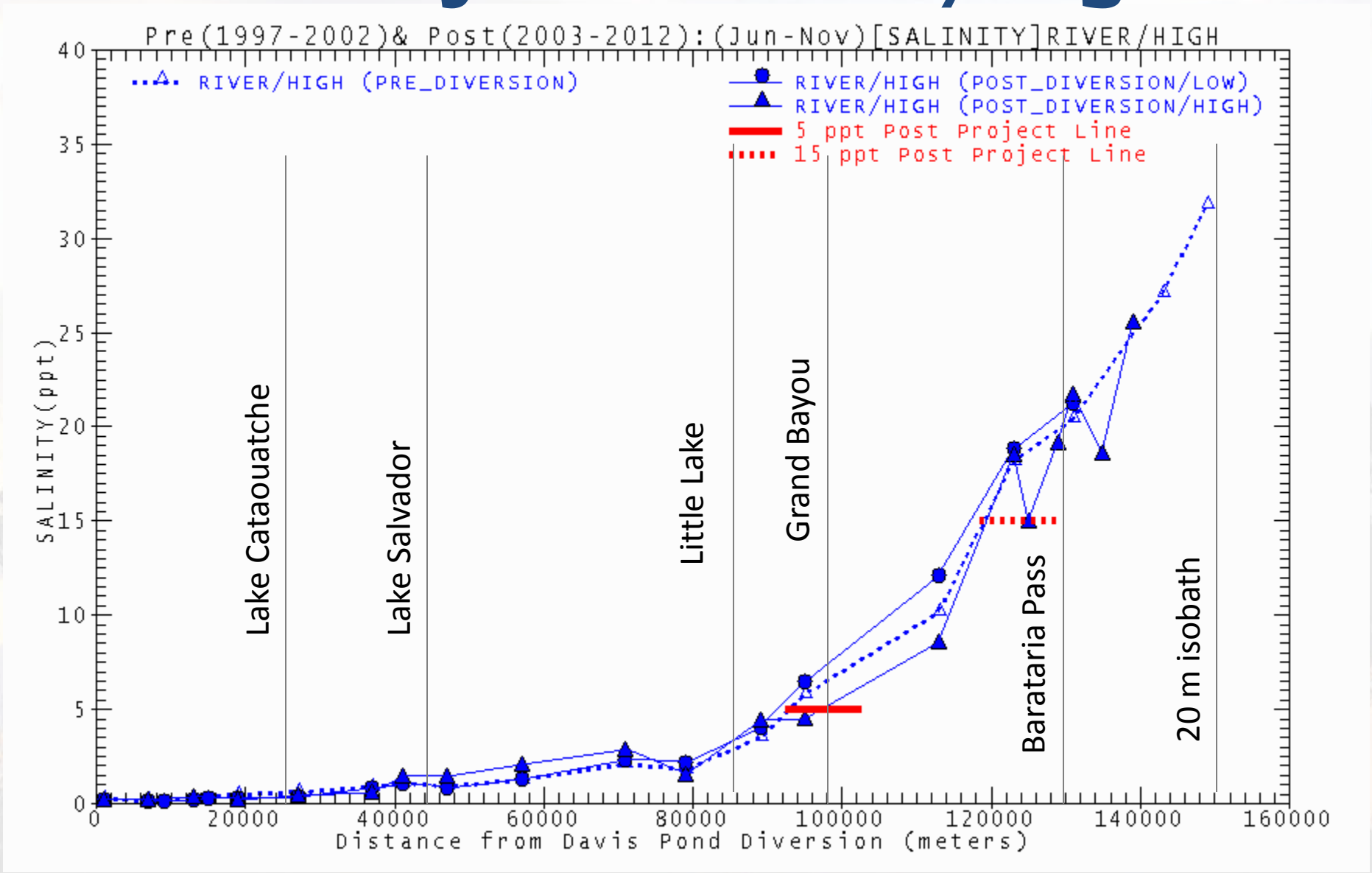
Salinity, River Flow/High



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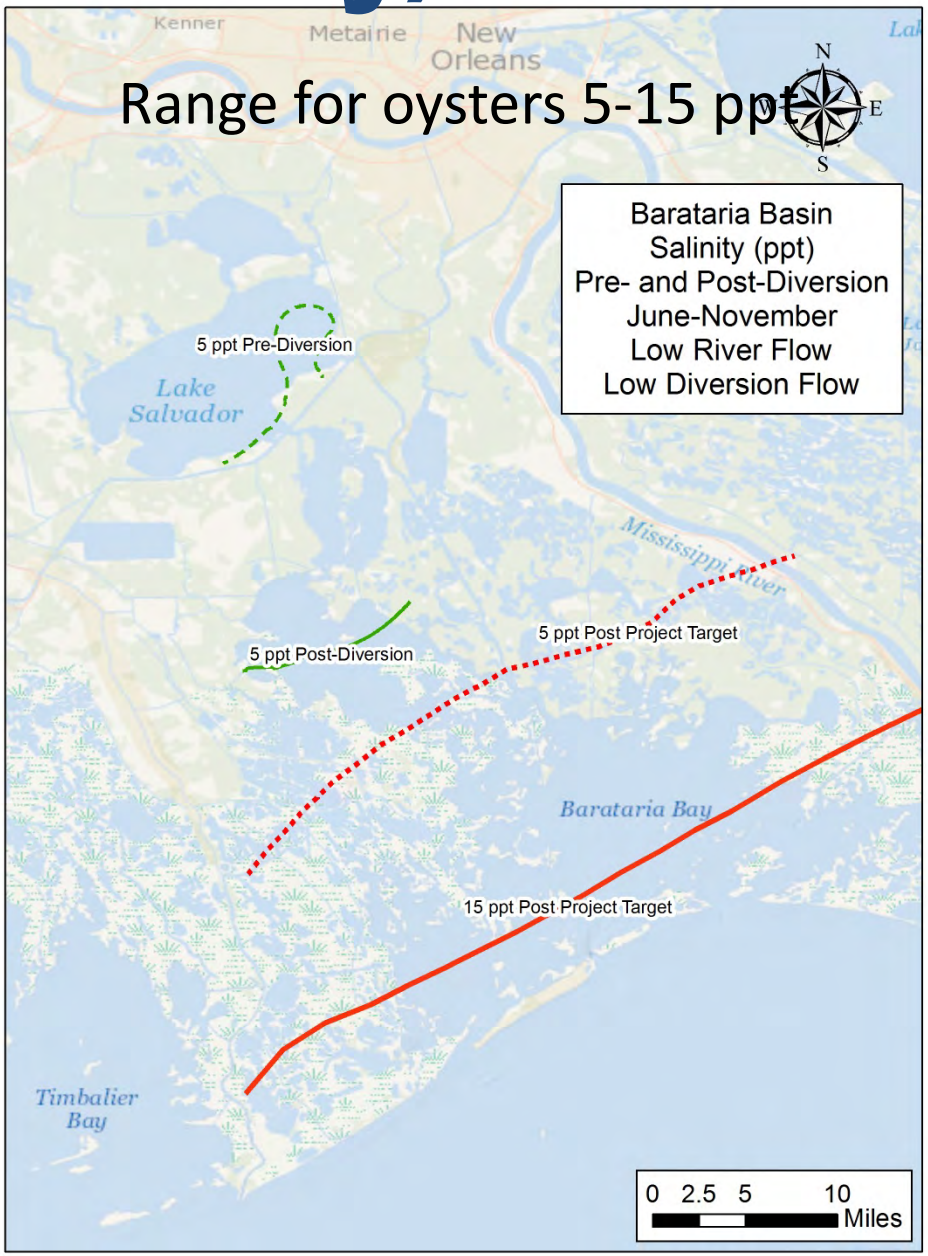
Salinity, River Flow/Low



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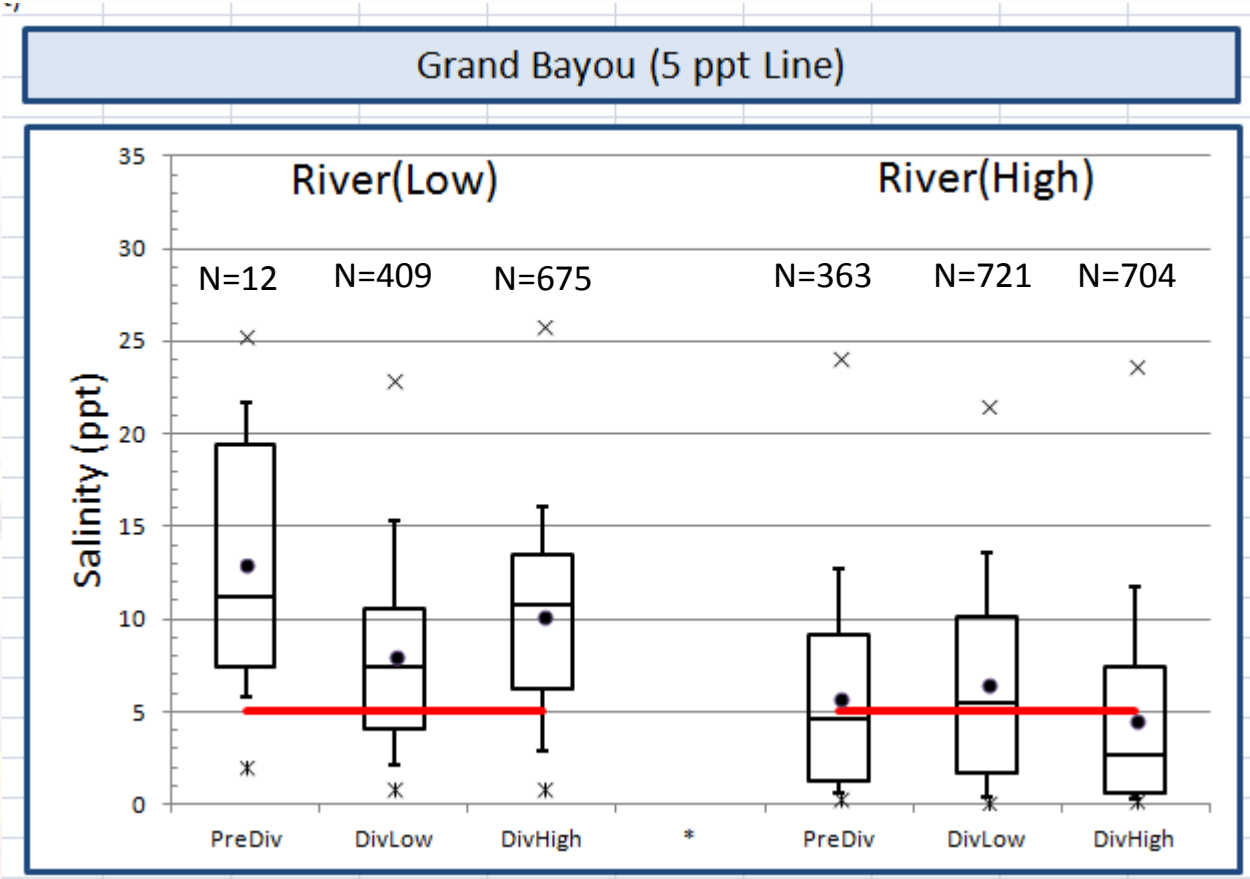
Salinity, Grand Bayou, 5 ppt Line



River(Low) Pre-Diversion (1999,2000)

River(High) Pre-Diversion (1997,1998,2001,2002)

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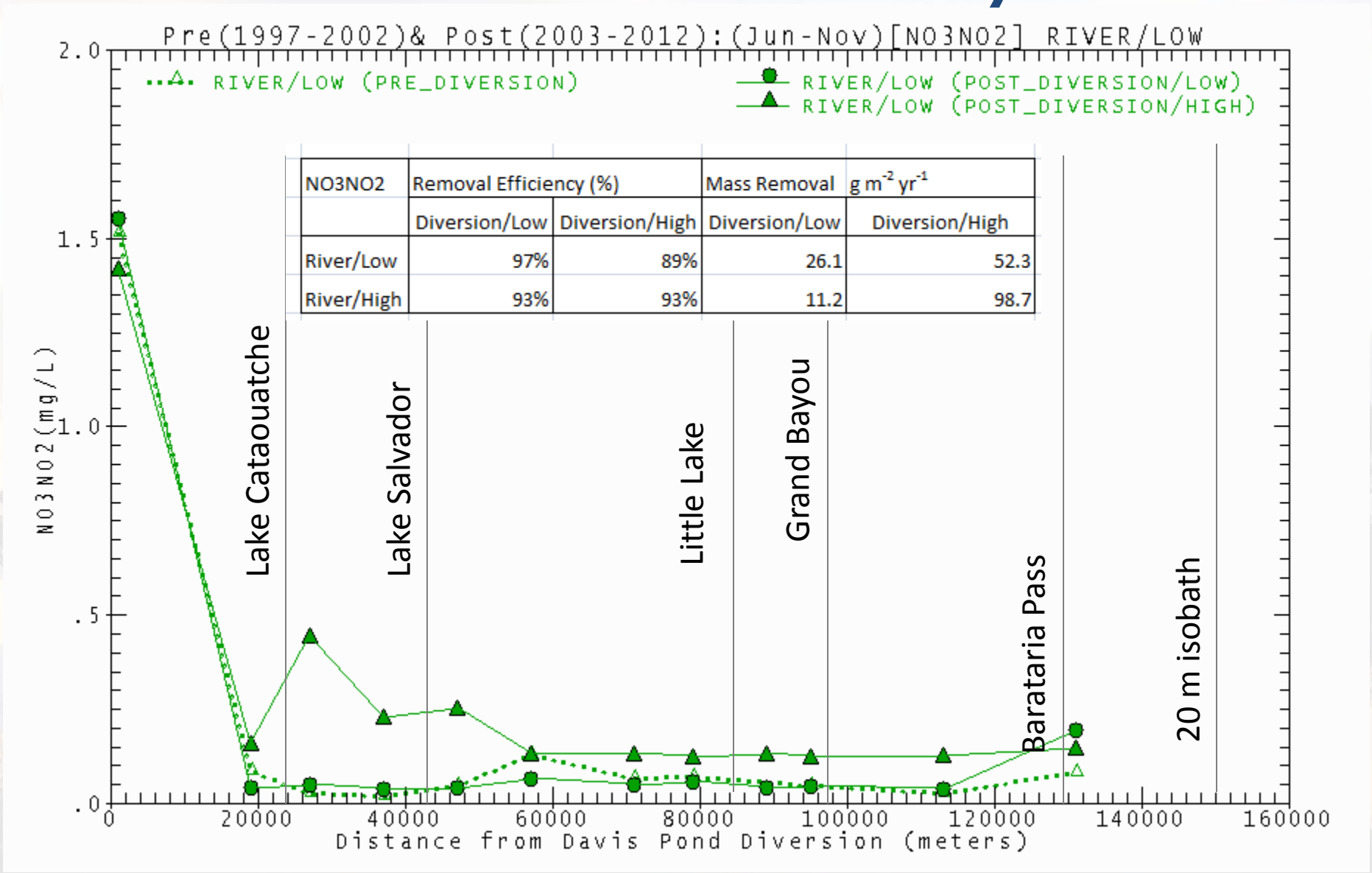
Nutrients & Sediment (TSS)

NO3NO2, River Flow/Low



NO3NO2	Removal Efficiency (%)		Mass Removal $g\ m^{-2}\ yr^{-1}$	
	Diversion/Low	Diversion/High	Diversion/Low	Diversion/High
River/Low	97%	89%	26.1	52.3
River/High	93%	93%	11.2	98.7

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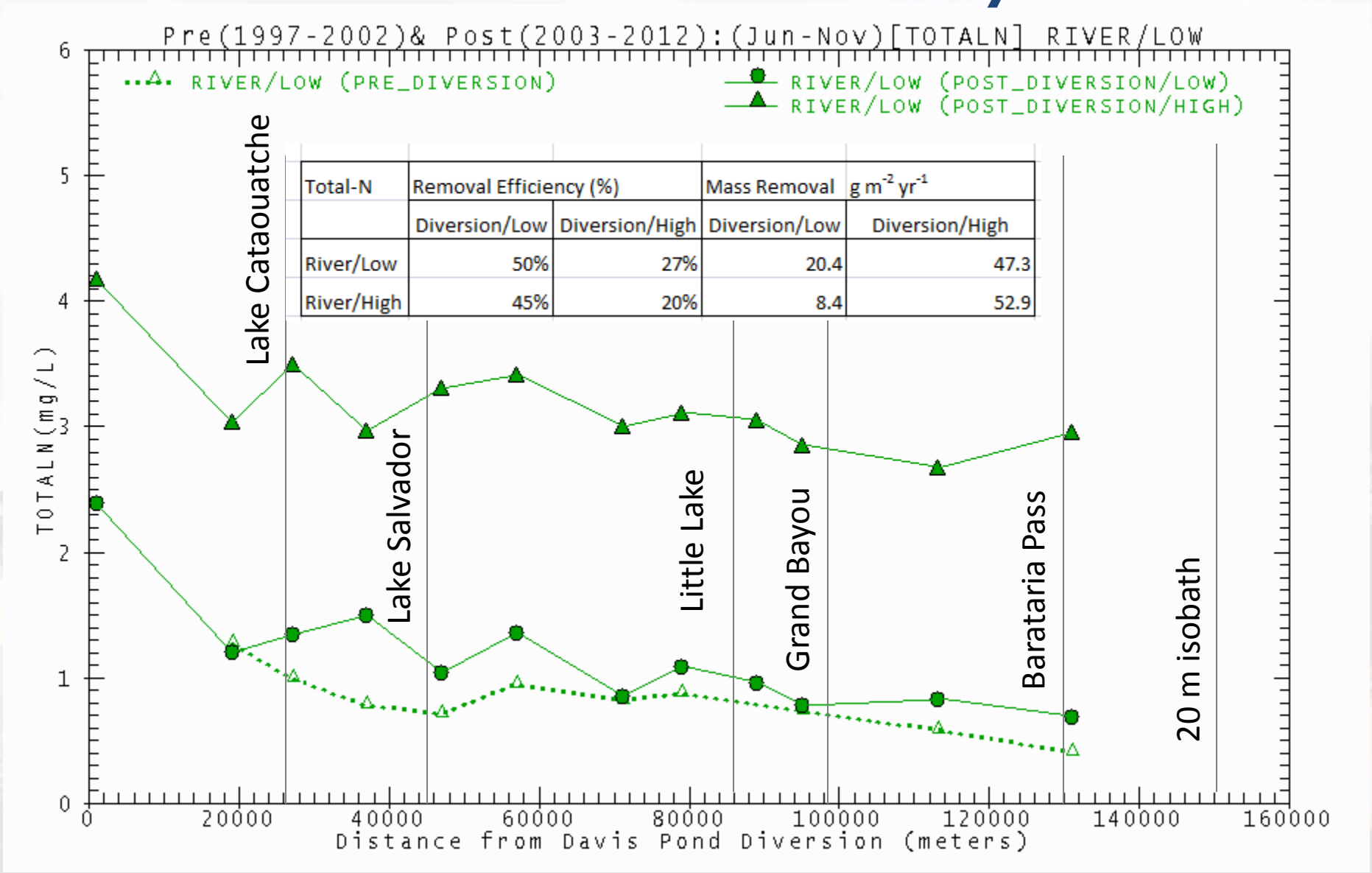
TOTAL-N, River Flow/Low



Total-N	Removal Efficiency (%)		Mass Removal $g\ m^{-2}\ yr^{-1}$	
	Diversion/Low	Diversion/High	Diversion/Low	Diversion/High
River/Low	50%	27%	20.4	47.3
River/High	45%	20%	8.4	52.9

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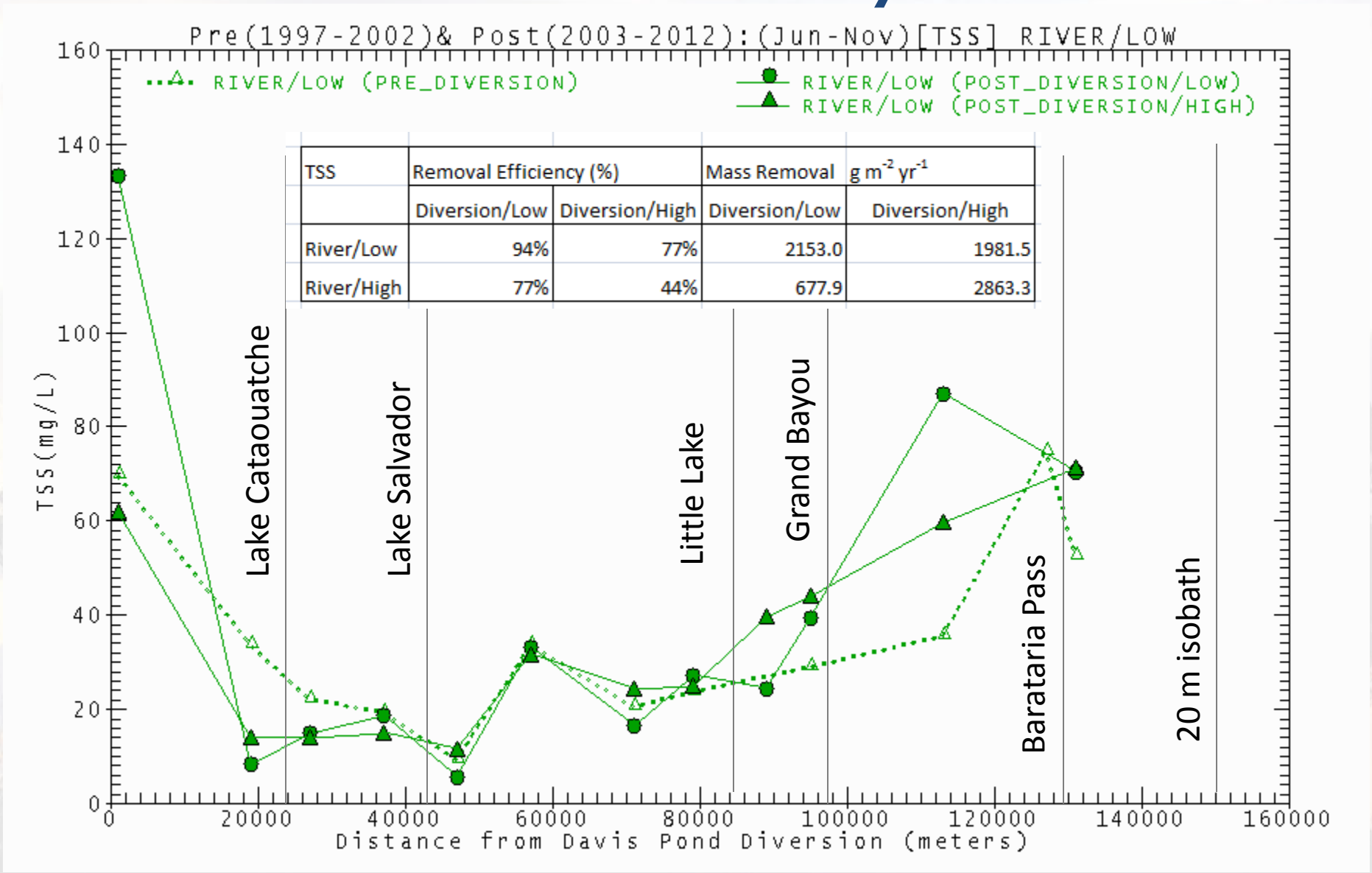
TSS, River Flow/Low



TSS	Removal Efficiency (%)		Mass Removal $g\ m^{-2}\ yr^{-1}$	
	Diversion/Low	Diversion/High	Diversion/Low	Diversion/High
River/Low	94%	77%	2153.0	1981.5
River/High	77%	44%	677.9	2863.3

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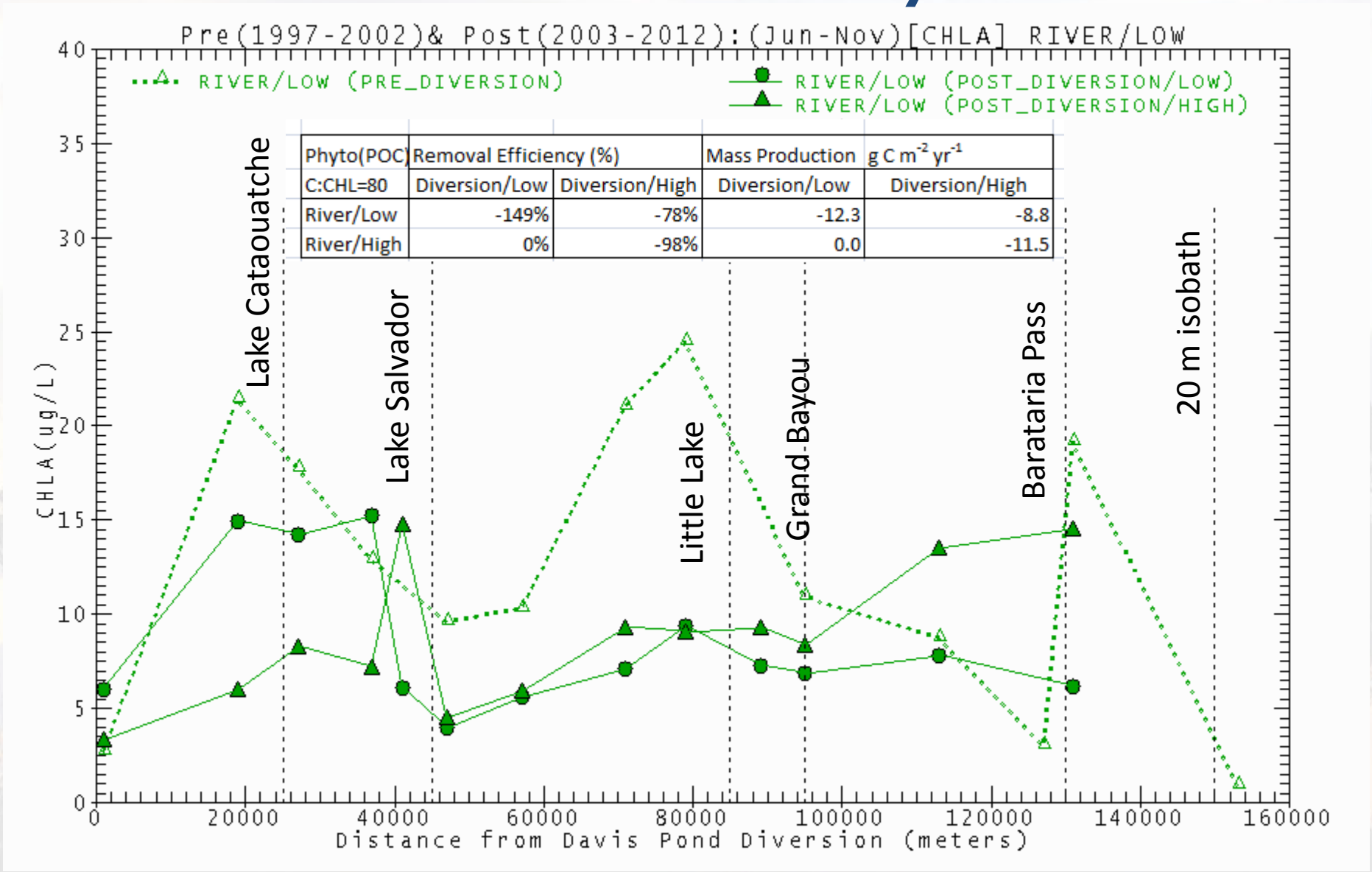
Phytoplankton (Chlorophyll-a)

Chl-a, River Flow/Low



Phyto(POC)	Removal Efficiency (%)		Mass Production g C m^{-2} yr^{-1}	
C:CHL=80	Diversion/Low	Diversion/High	Diversion/Low	Diversion/High
River/Low	-149%	-78%	-12.3	-8.8
River/High	0%	-98%	0.0	-11.5

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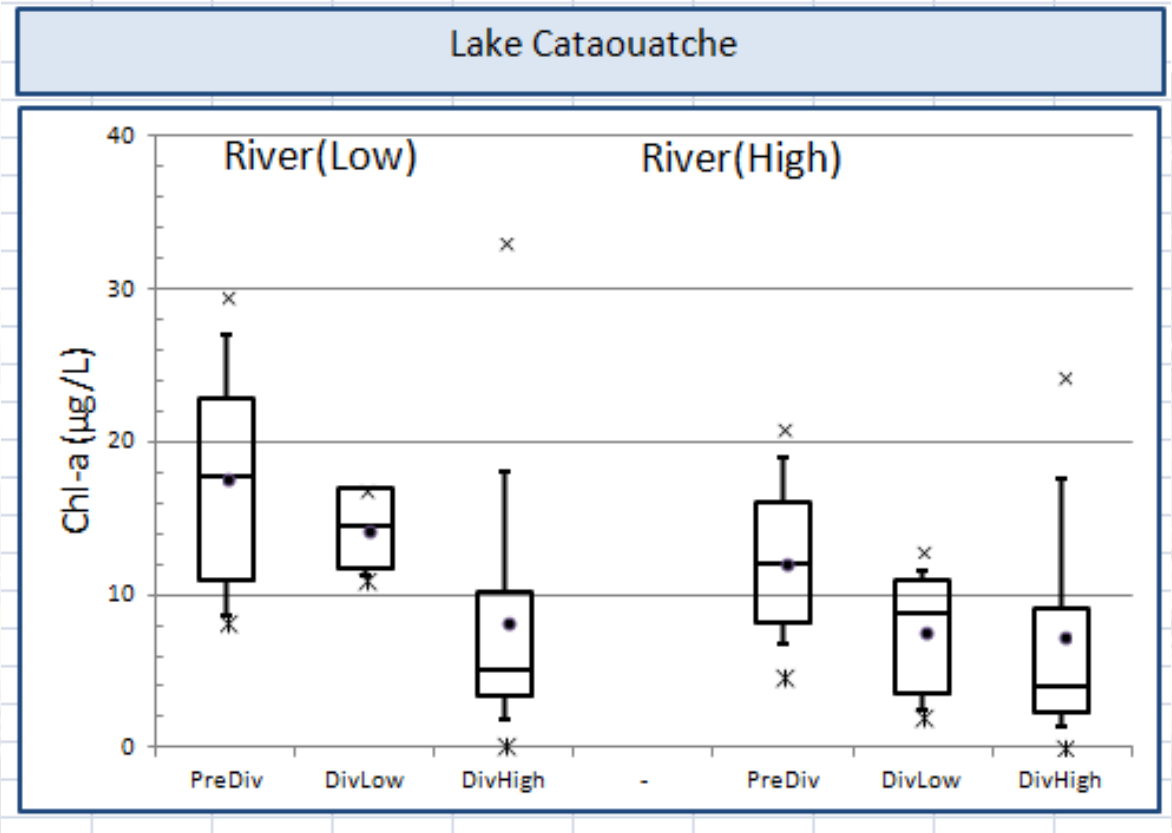
Chlorophyll a, Lake Cataouatche

Pre-Diversion , Residence time ~100-120 days

Post-Diversion , Residence time ~1-15 days



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Summary

- Salinity Intrusion Most effective mid-basin (5 ppt line) at low river flow.
- Little effect at high river flow or in lower basin (15 ppt line). Salinity controlled by river & Gulf of Mexico
- Removal Efficiency: Lower diversion flow achieves higher removal % for Nitrogen & TSS; results comparable to literature for Caernarvon, Fourleague Bay
- Phytoplankton: Biomass increases in Davis Pond from nutrient uptake; decreases in Barataria basin from increased flushing and much lower residence time
- Confounding effects of physical forcing (e.g., wind, rain, storm events, river flow; Gulf circulation) make it difficult to isolate effect of river diversion on mid-basin salinity

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Recommendations

- Perform similar analysis for winter (Dec-May); higher diversion flows based on 15 ppt salinity target in Barataria Bay
- Perform analysis for Spring/Summer 2010 for maximum diversion discharge; BP Oil Spill "experiment"
- Refine analysis with filters to control for seasonal rainfall conditions (low/high)
- Refine analysis to control for diversion operations (on, off)

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Questions?
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Removal Efficiency

			Removal Efficiency			
Davis Pond (2003-2012)			Total-N	Total-P	NO3NO2	TSS
River	Diversion	Season	RE(%)	RE(%)	RE(%)	RE(%)
River/Low	Diversion/Low	Summer/Fall	50%	28%	97%	94%
River/High	Diversion/Low	Summer/Fall	45%	14%	93%	77%
River/Low	Diversion/High	Summer/Fall	27%	43%	89%	77%
River/High	Diversion/High	Summer/Fall	20%	10%	93%	44%

			Removal Efficiency		
			Total-N	Total-P	NO3NO2
Study Area	Citation	Season	RE(%)	RE(%)	RE(%)
Fourleague Bay	Perez et al. 2011	Winter/Spr	43%	20%	51%
Caernarvon	Day et al. 2009	Annual	44%	62%	57%
Caernarvon	Lundberg et al 2014	Summer/Fall	no data	no data	95%
Davis Pond	CH2MHill 2013	P-k-C* Avg Ops	42%	38%	65%

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