Some Historic Alterations of the Mississippi River and Prospects for Restoration, Southeast Louisiana

By

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Lake Pontchartrain Basin Foundation

November 29, 2007

International Delta Roundtable

Lafayette, LA

See references at end of presentation

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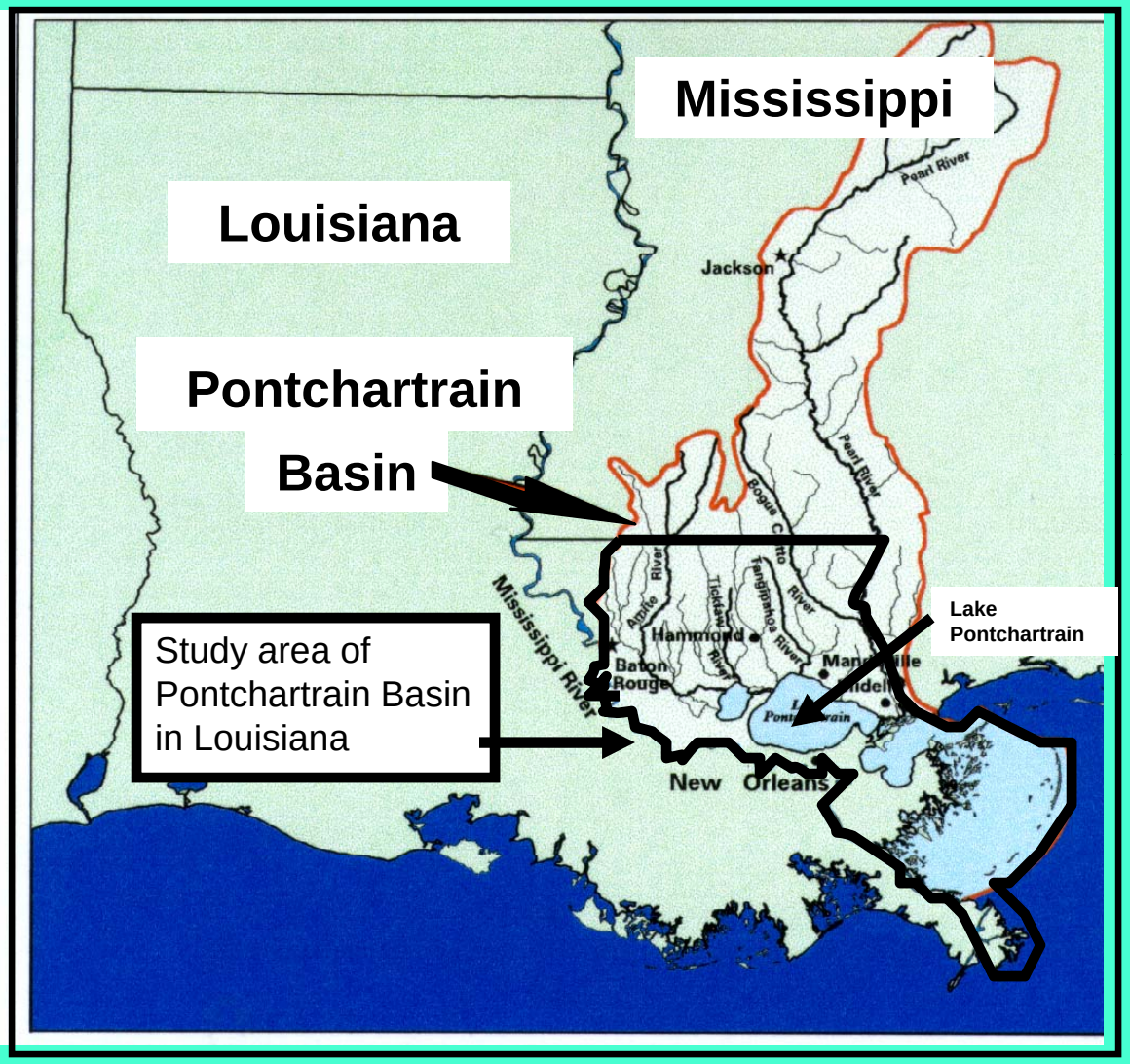

Pontchartrain Basin

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Study Area & Principal Geomorphic Regions

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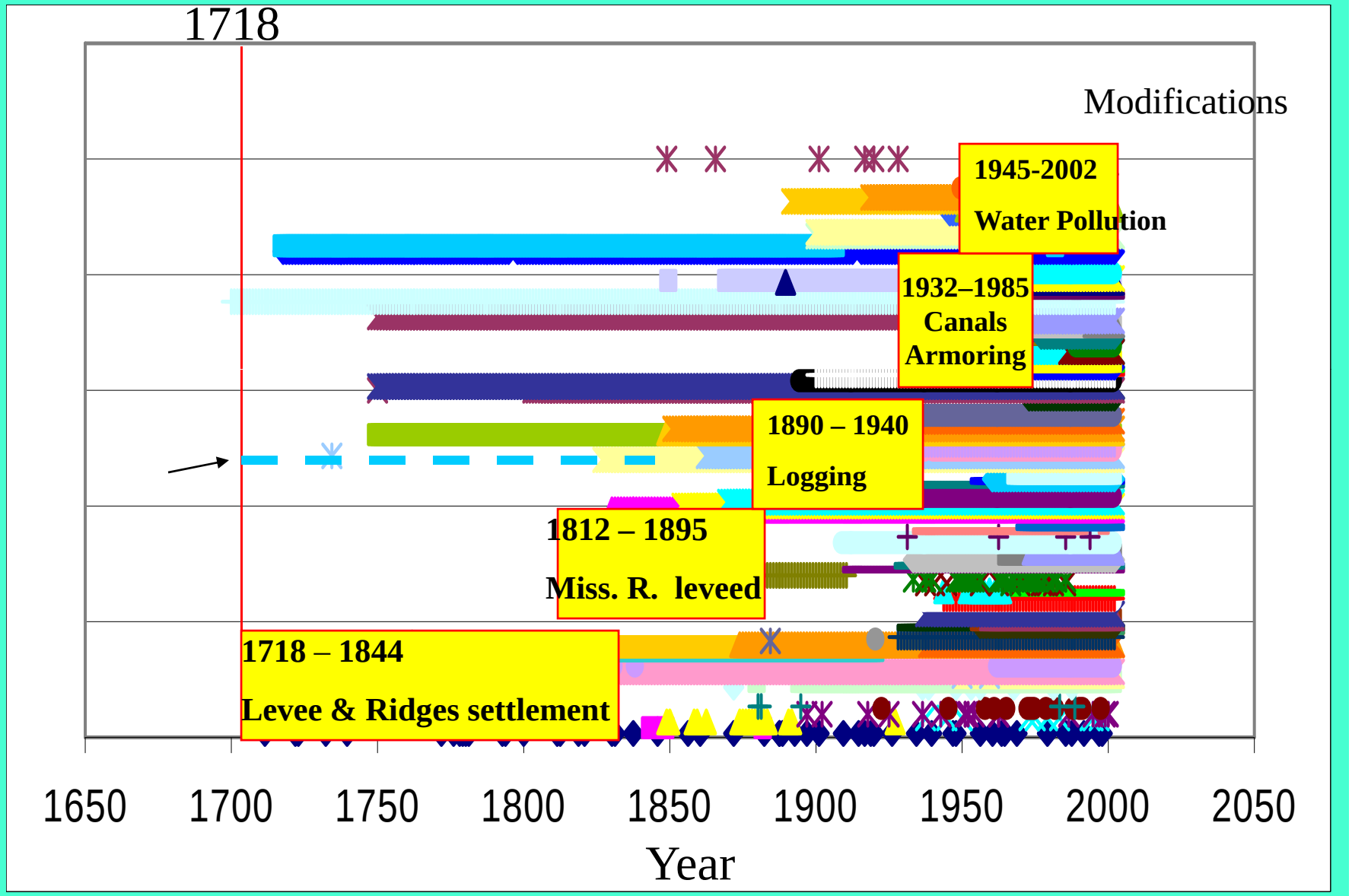
5 Dominant Periods of Environmental Impacts in the Pontchartrain Basin



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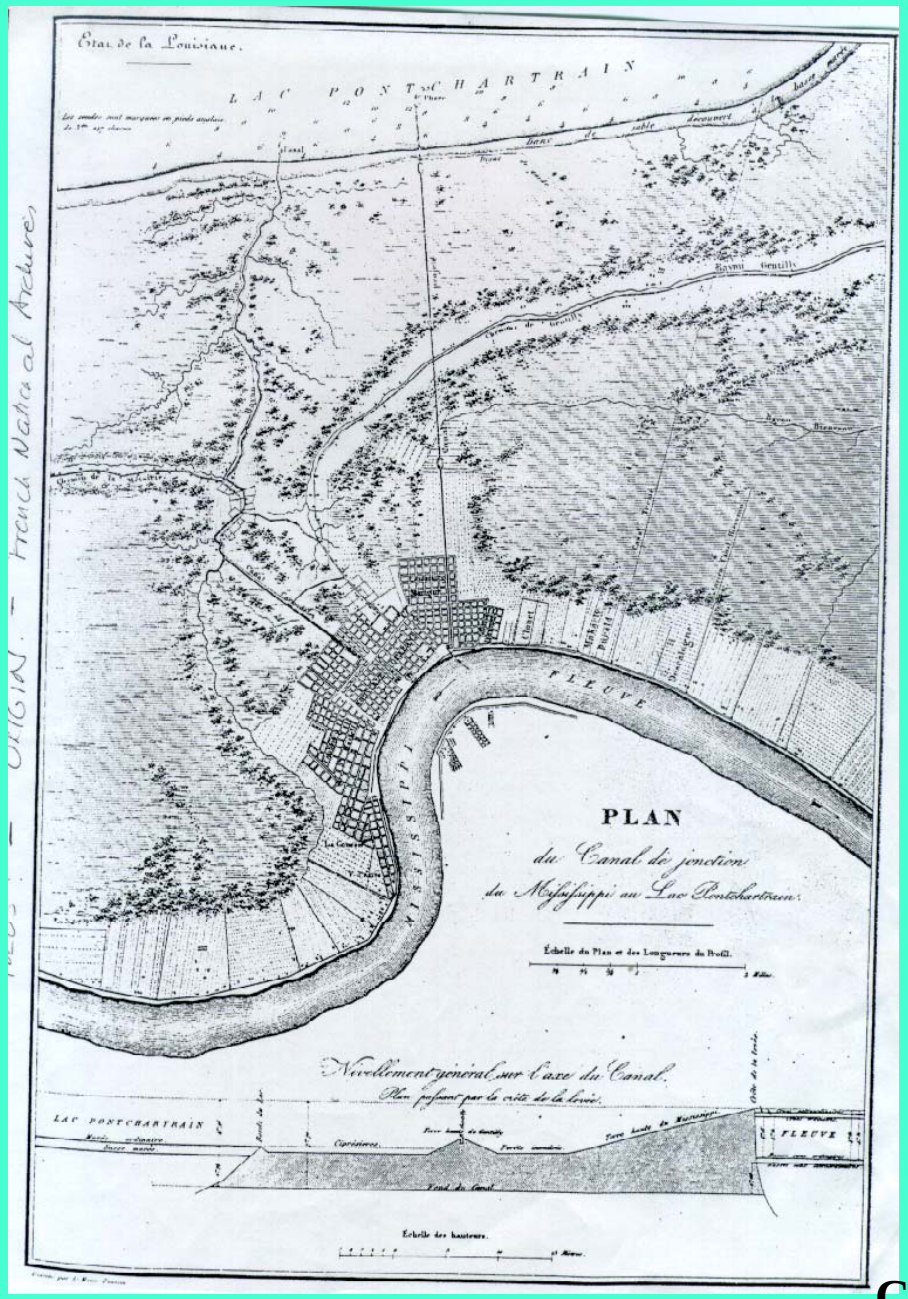
Lopez, 2003

New Orleans circa Trudeau, 1803 (French Archives)

Levee & Ridge Settlement



Conniff and Others, 1999)

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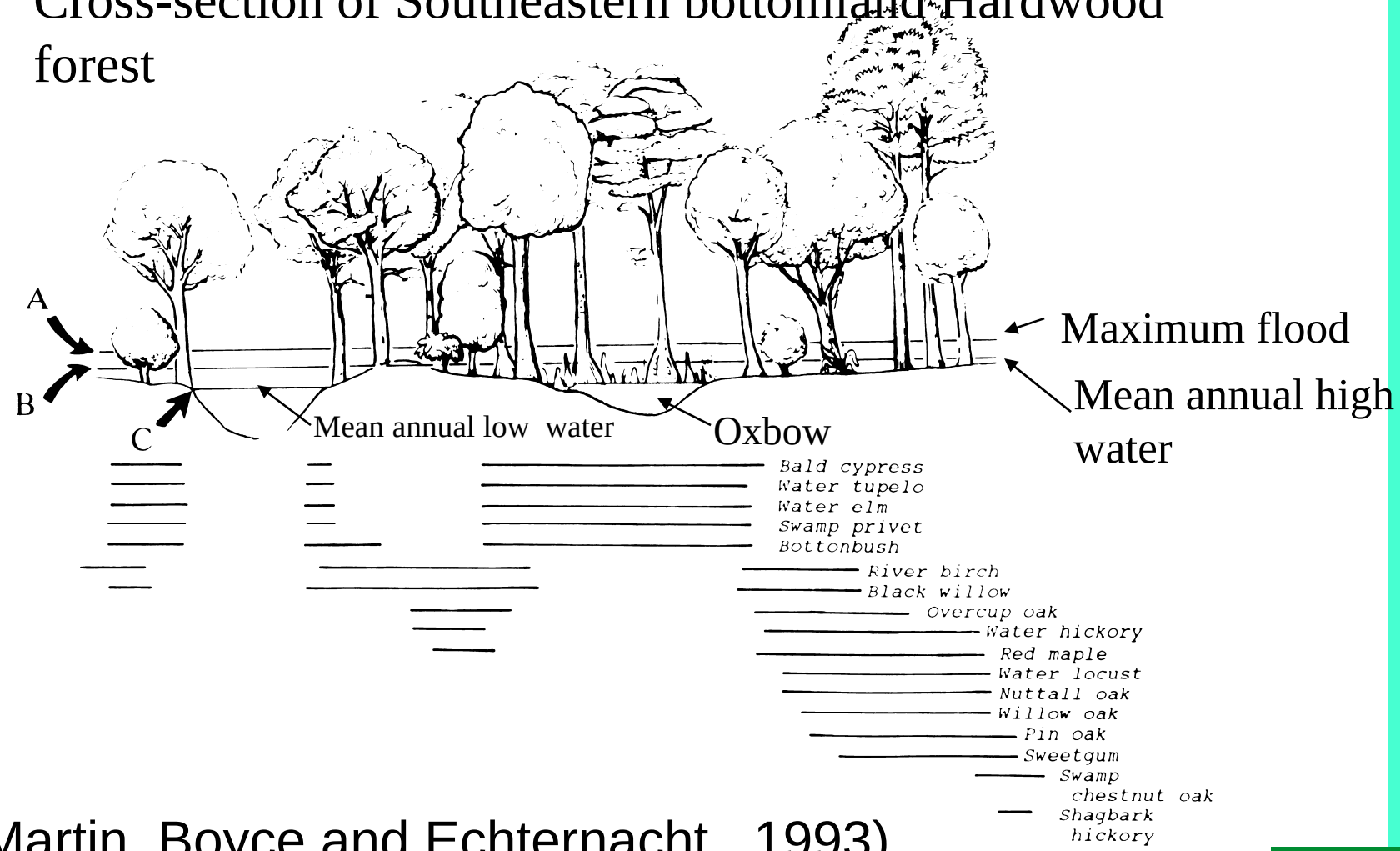
Cross-section of Southeastern bottomland Hardwood forest



Martin, Boyce and Echternacht, 1993)

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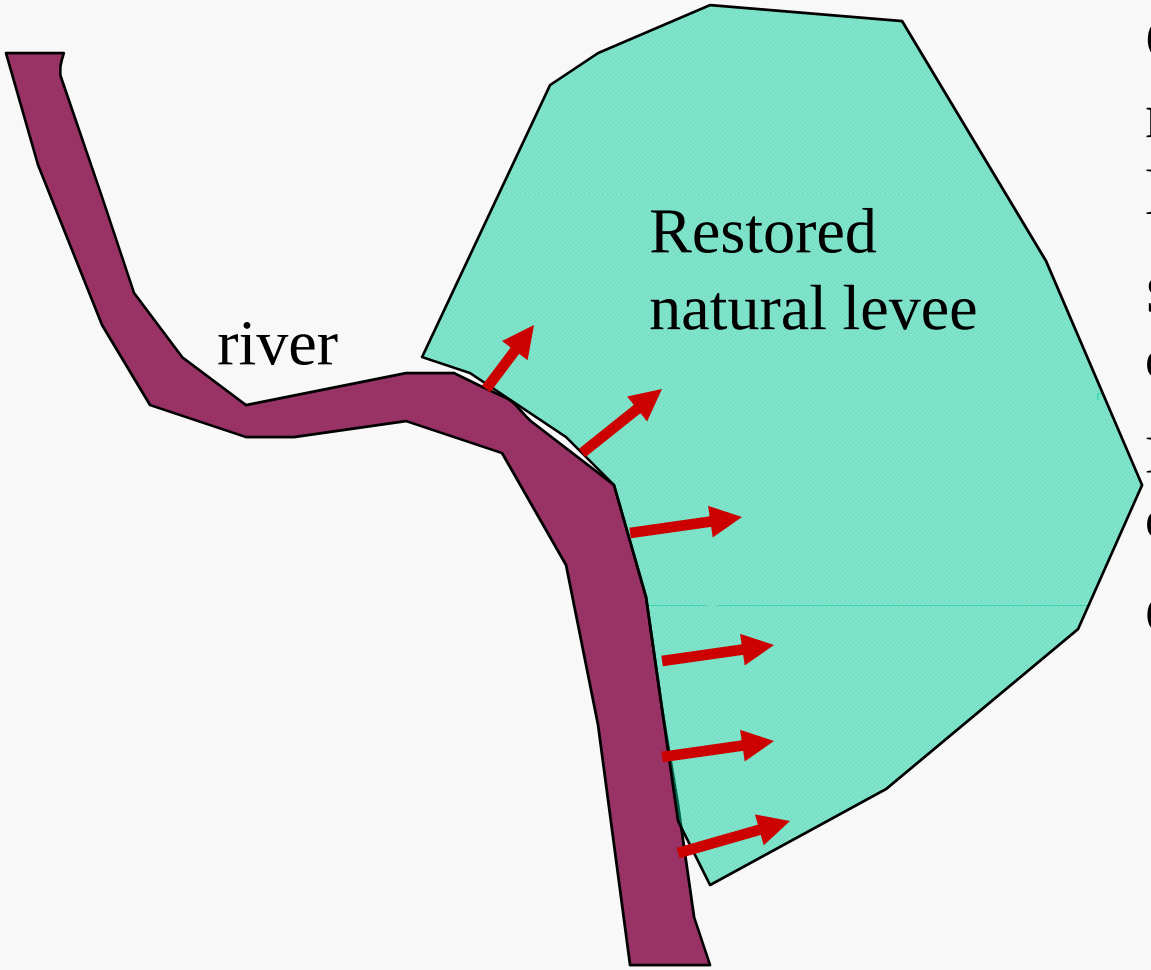

Conceptual model for restoration of a natural levee

Several mile reach of discharge

Minimum 3-4 year cycle of discharge

Overland flow

1 mile

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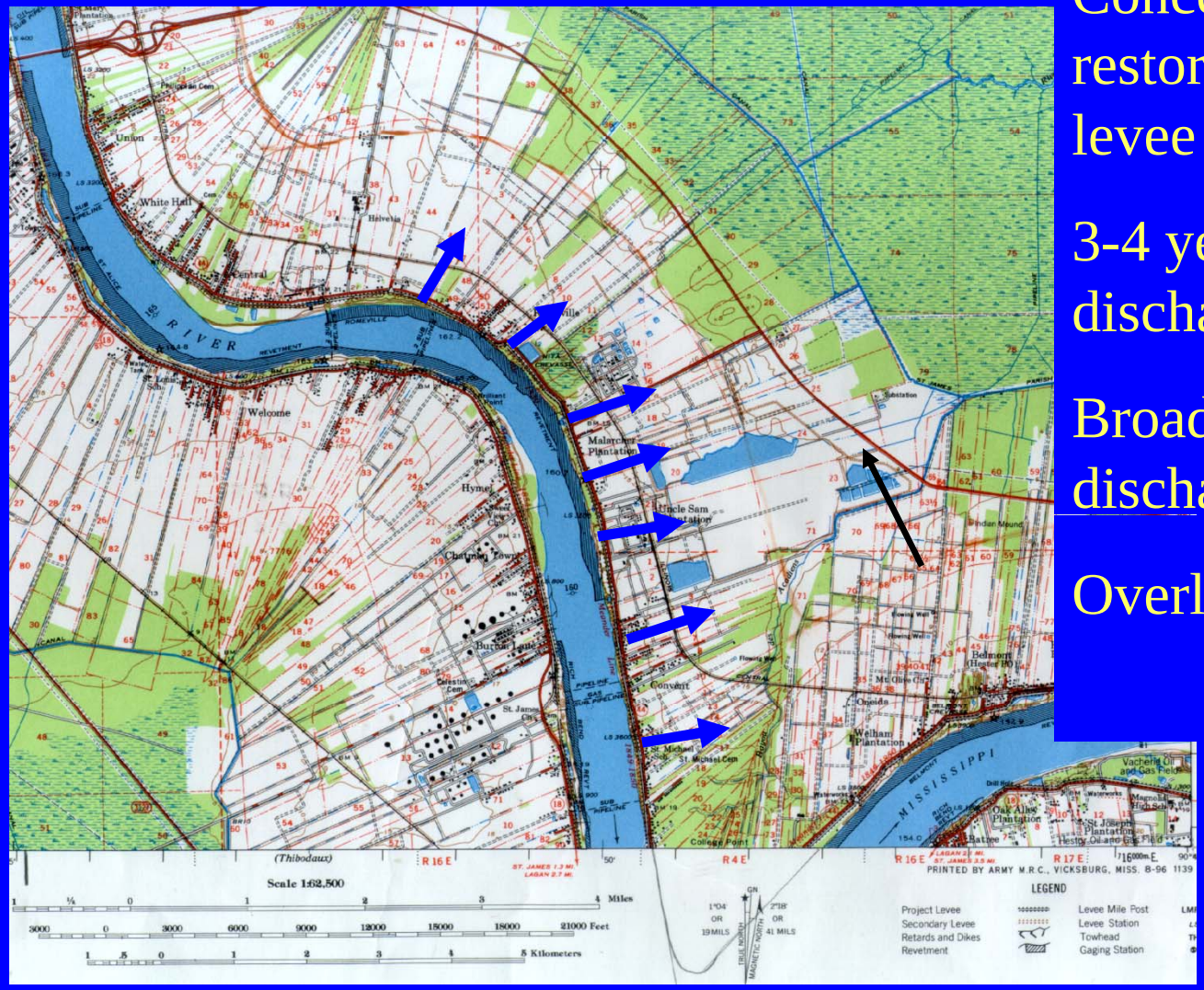

Conceptual model for restoration of a natural levee

3-4 year cycle of discharge

Broad area of discharge

Overland flow

1 mile

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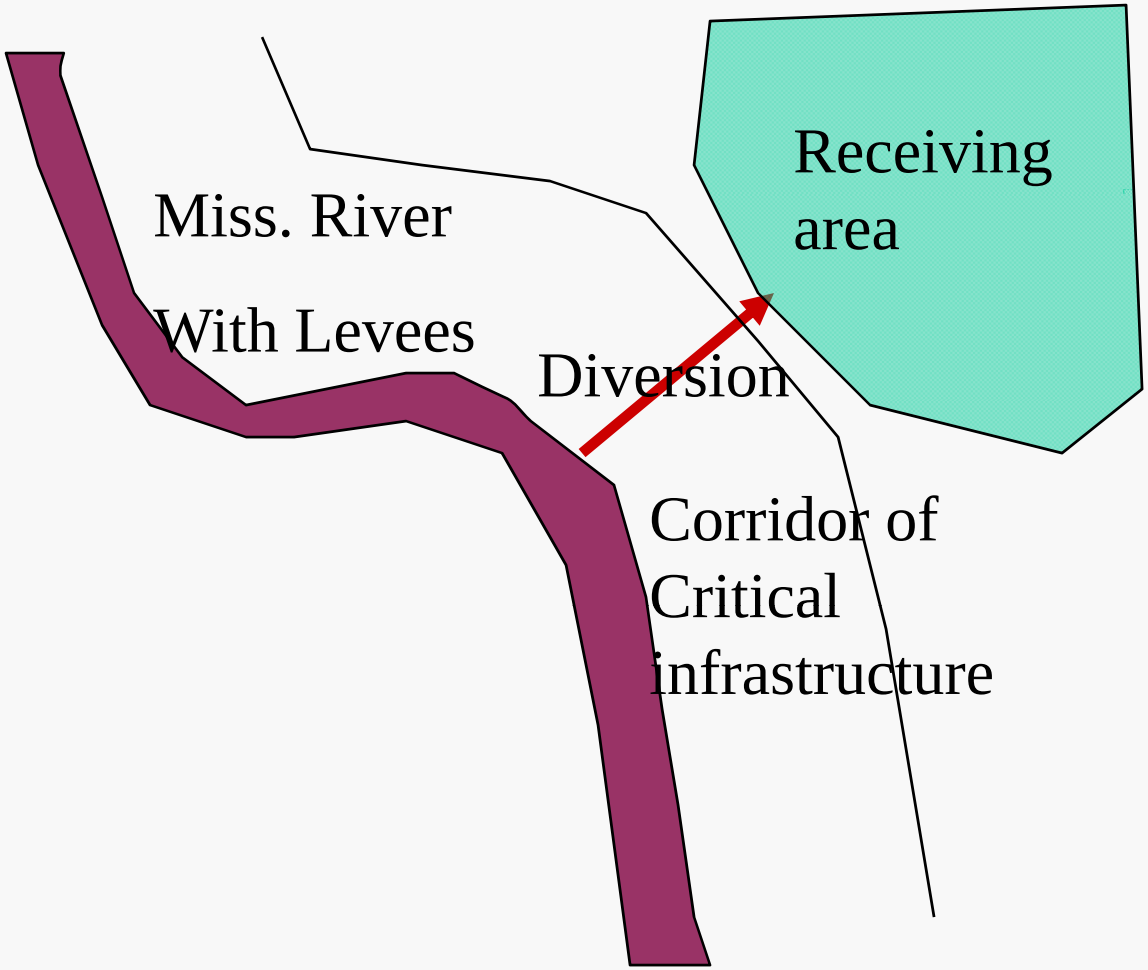

Typical restoration model

Outfall channel bypasses most of the natural levee to avoid land use conflicts

1 mile

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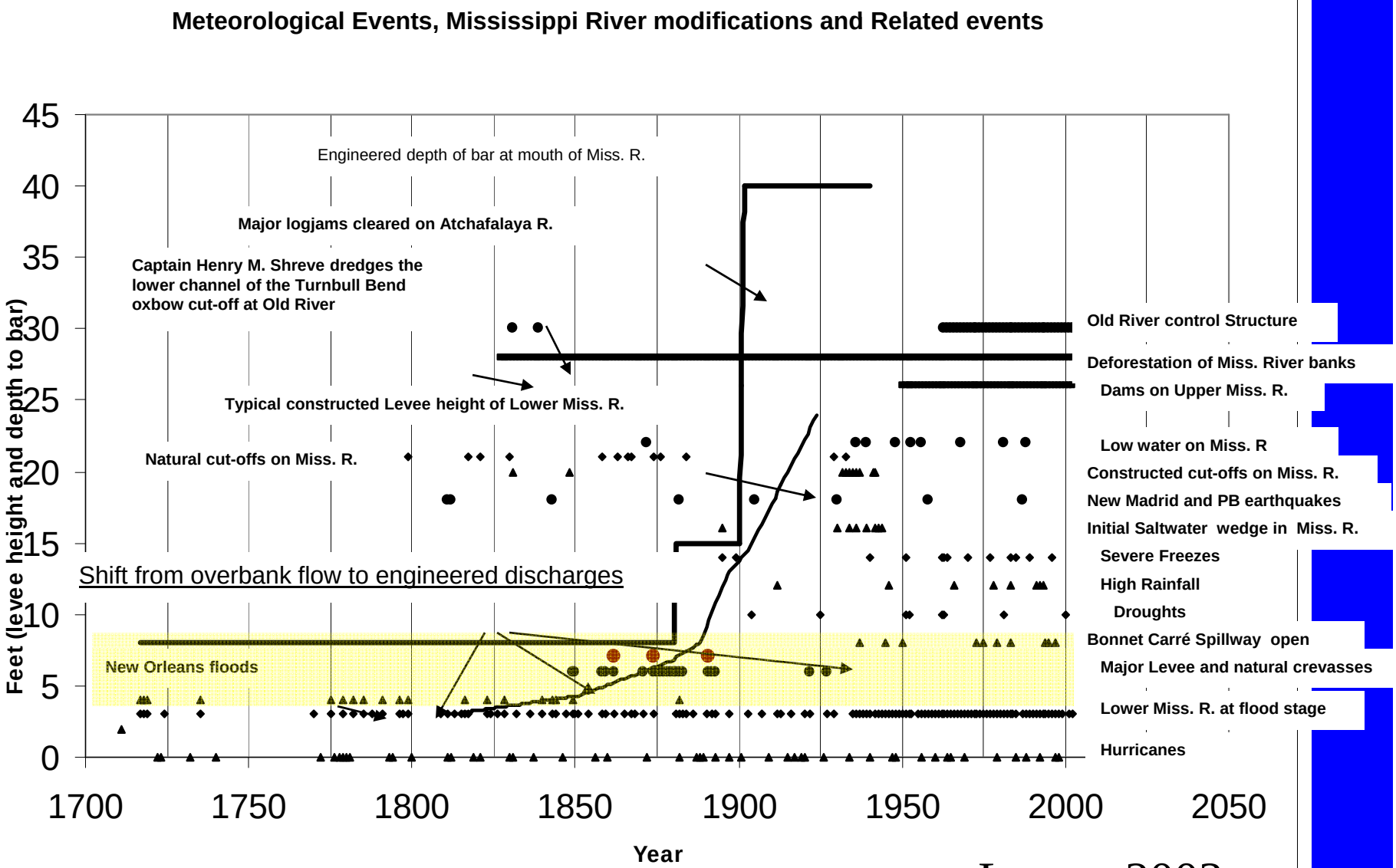
Chronological graph of significant meteorological events, Mississippi River Modifications and related events in the Pontchartrain Basin.



Lopez, 2003

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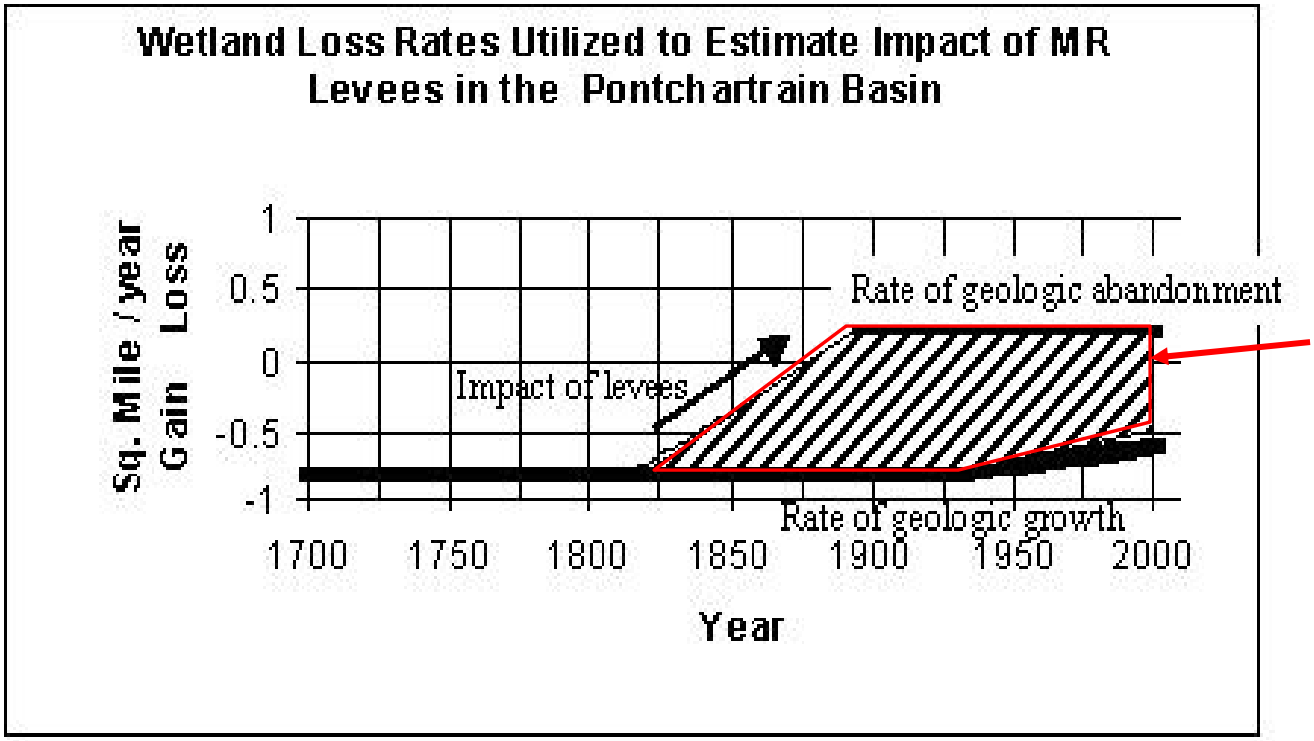
Graph of wetland growth and loss rates for the portion of the Balize delta impacted by Mississippi River levees.



Net Impact

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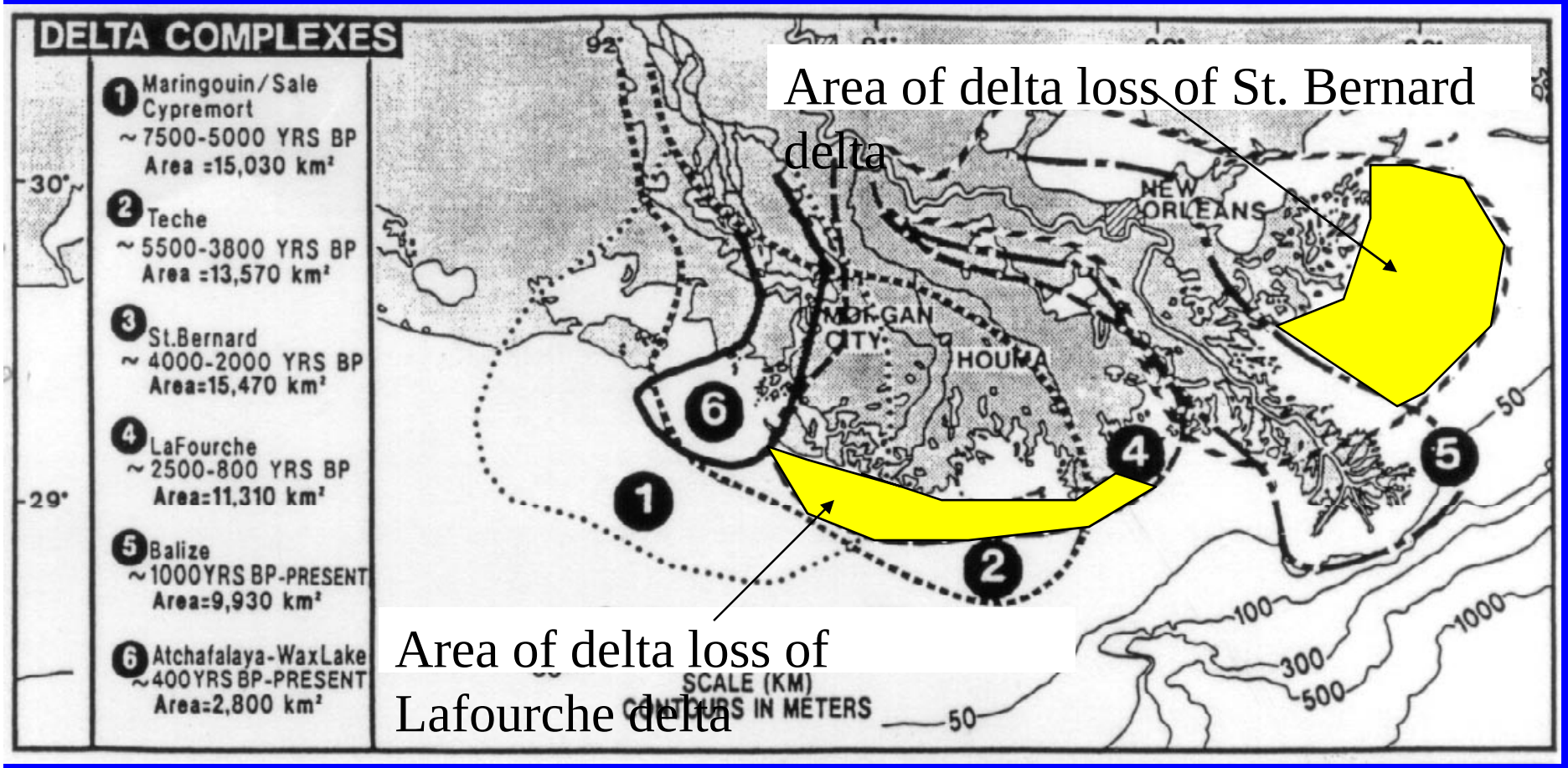

Coleman, Roberts and Stone, 1998

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Age (Yr BP)	Duration	Maximum Extent sq. miles (km^2)	Loss	growth rate sq. Mile/year	loss rate
Balize/Plaquemines Delta					
1000 – present[1]	1000	3,829 (9,917)	--	3.8 (9.7)	--
800 - present [2]	800	--	--	--	- -
Lafourche Delta					
2500 - 800[1]	1700	4,366 (11,308)	709 (1,836)	2.6 (6.5)	0.88(2.3)
2000- 800[2]	1200	--	292 (756)	--	0.36(0.9)
St. Bernard Delta					
4000 - 2000[1]	2000	6,000 (15,540)	1787 (4,628)	3.0(7.8)	0.89(2.3)
4500 – 2000[2]	2500	--	2233 (5,783)	--	1.12 (2.9)
Average rates of St. Bernard and Lafourche deltas only				2.80 (7.3)	0.81 (2.0)

1 Coleman and others, 1998
2 Saucier, 1994

Lopez, 2003 & 2004

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Conclusions

Deltaic growth has occurred much faster than deltaic loss in the Lafourche and St. Bernard deltas requiring an asymmetrical growth – abandonment curve.

Considering simply the geologic record processes of growth and abandonment, suggests a total of 141 square miles of total negative impact to wetlands in the Pontchartrain Basin from 1812 to 2002 as a result of construction of artificial levees.

The impact of artificial levees was principally that it halted new growth of wetlands and to a much lesser degree did it accelerate wetland loss.

Simply considering the modeled geologic rates without consideration of other possible interacting processes, suggests that artificial levees may account for roughly 1/5 of the wetland loss in the Pontchartrain Basin from 1932 to 1990.

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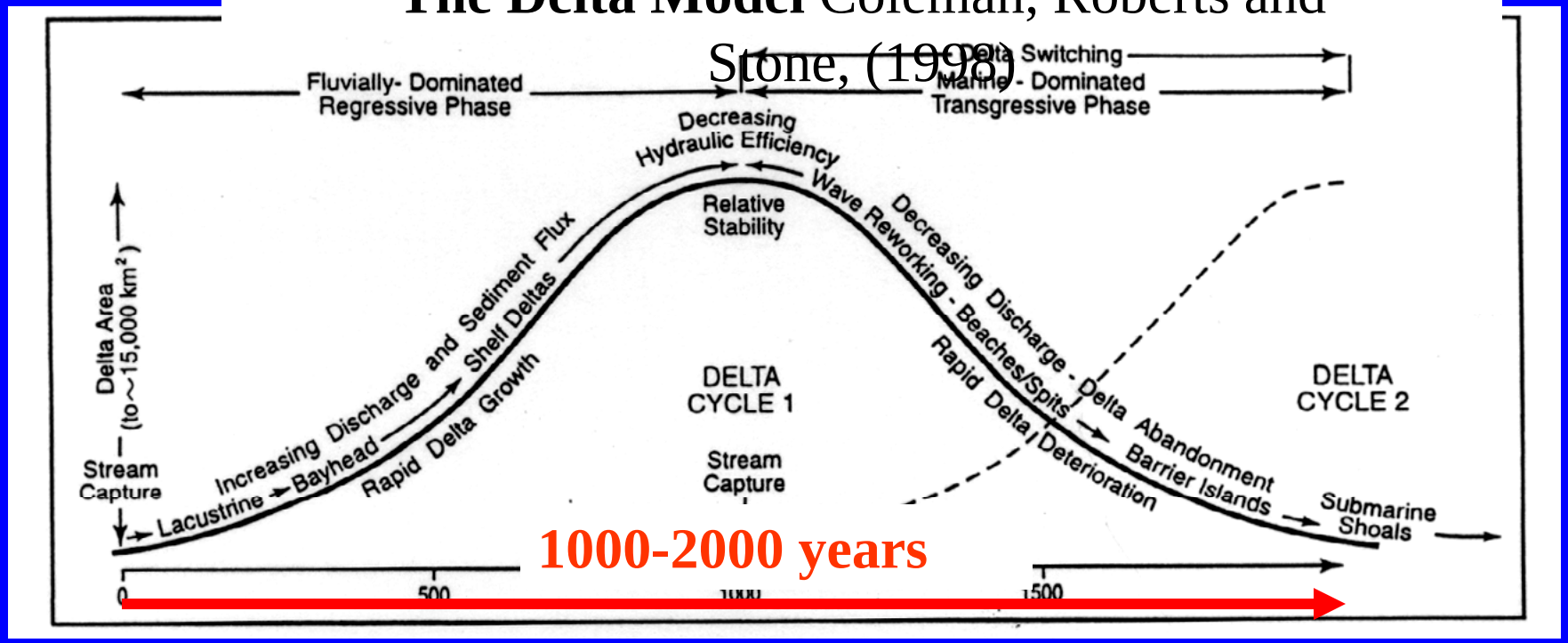
The Delta Model Coleman, Roberts and Stone, (1998)



Observations

Symmetrical

hydrology and delta growth / abandonment are in phase

180^0 phase of next cycle

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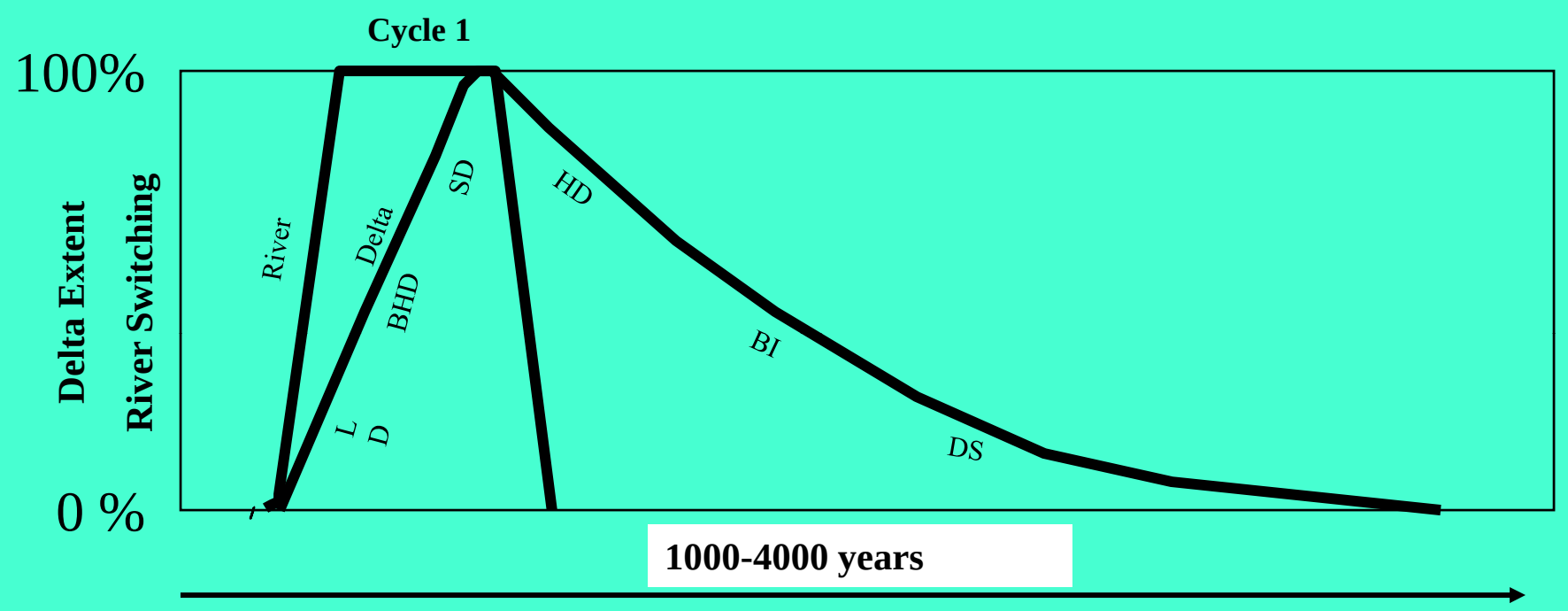
Lopez, 2003

Modified Delta Cycle



Differences:

Separate hydrologic and delta growth curves

Asymmetrical shape

Deltaic cycle is significantly longer

Overlapping cycles

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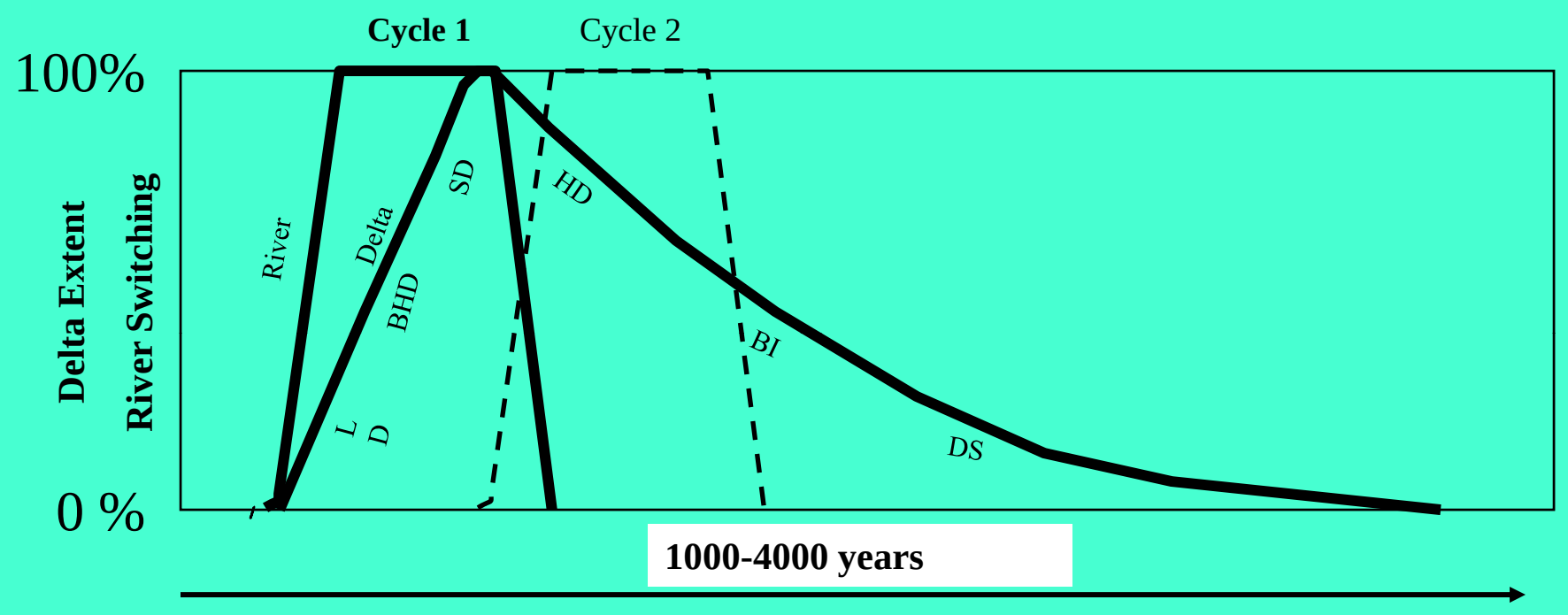
Lopez, 2007, GCAGS



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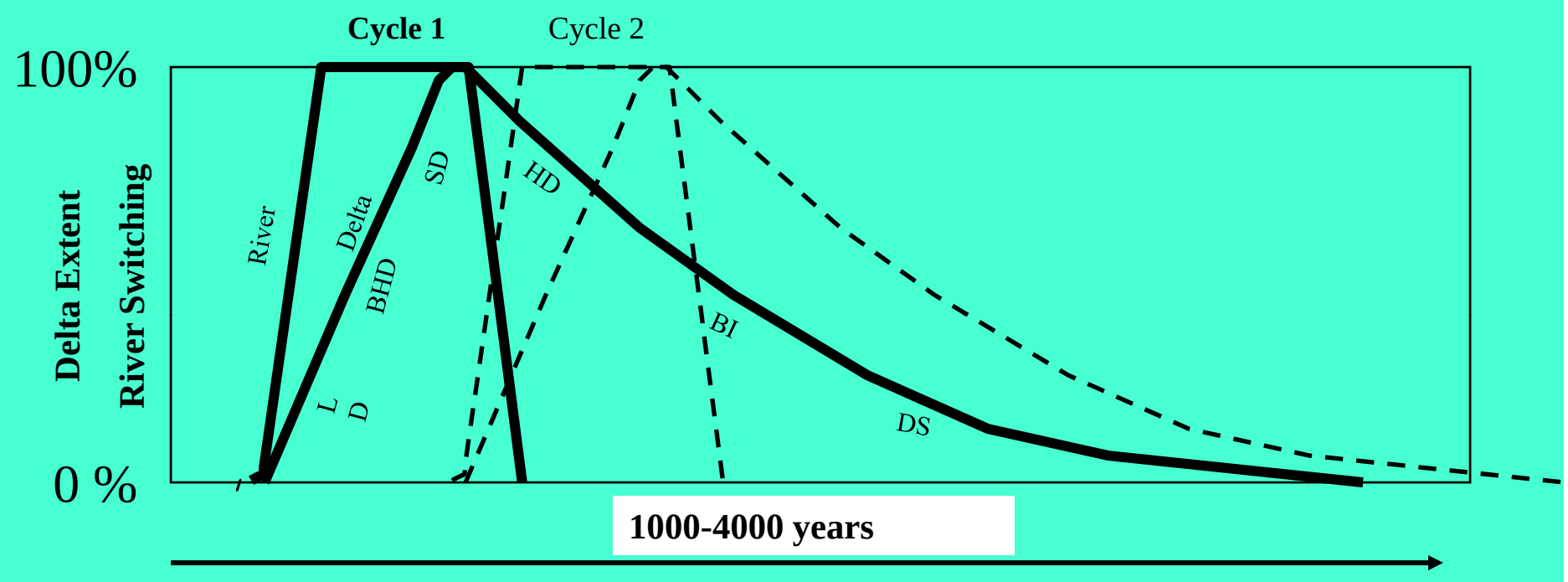

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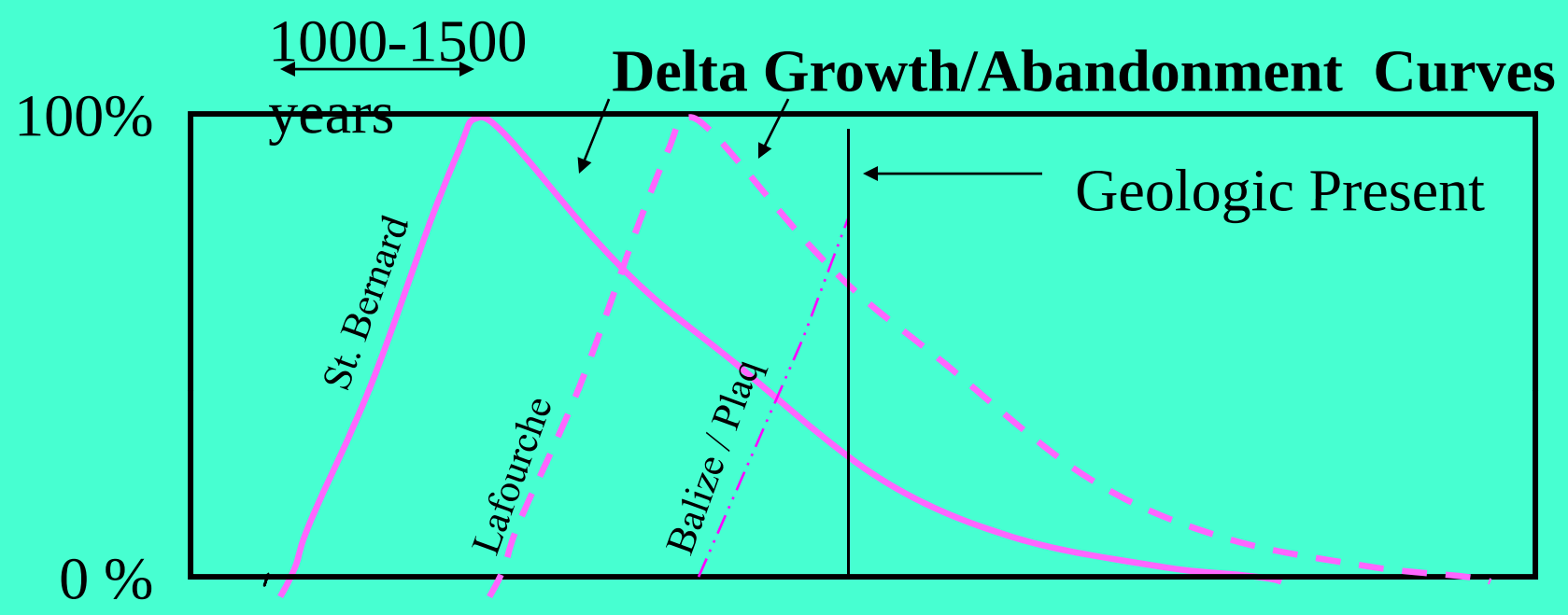
Delta Growth Model



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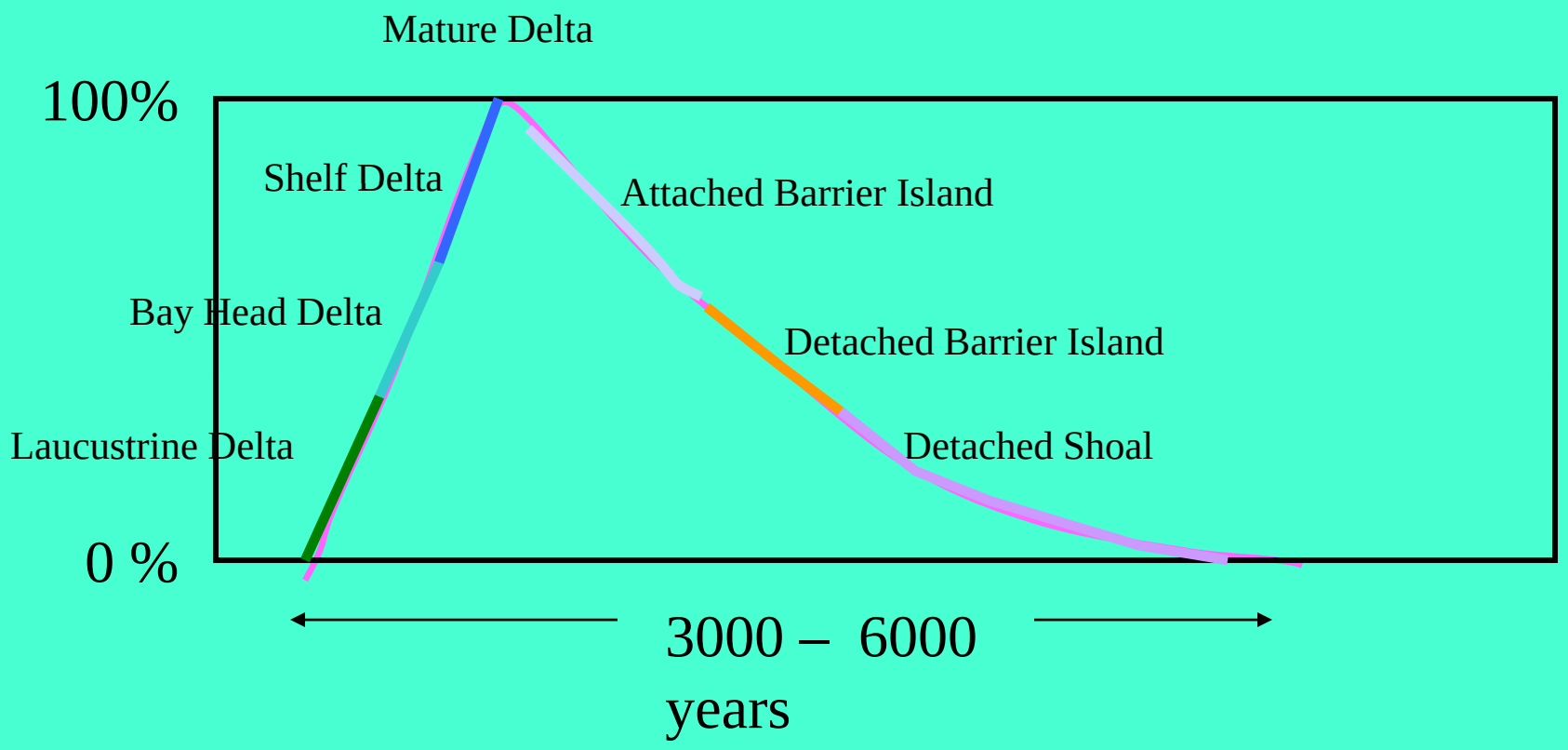
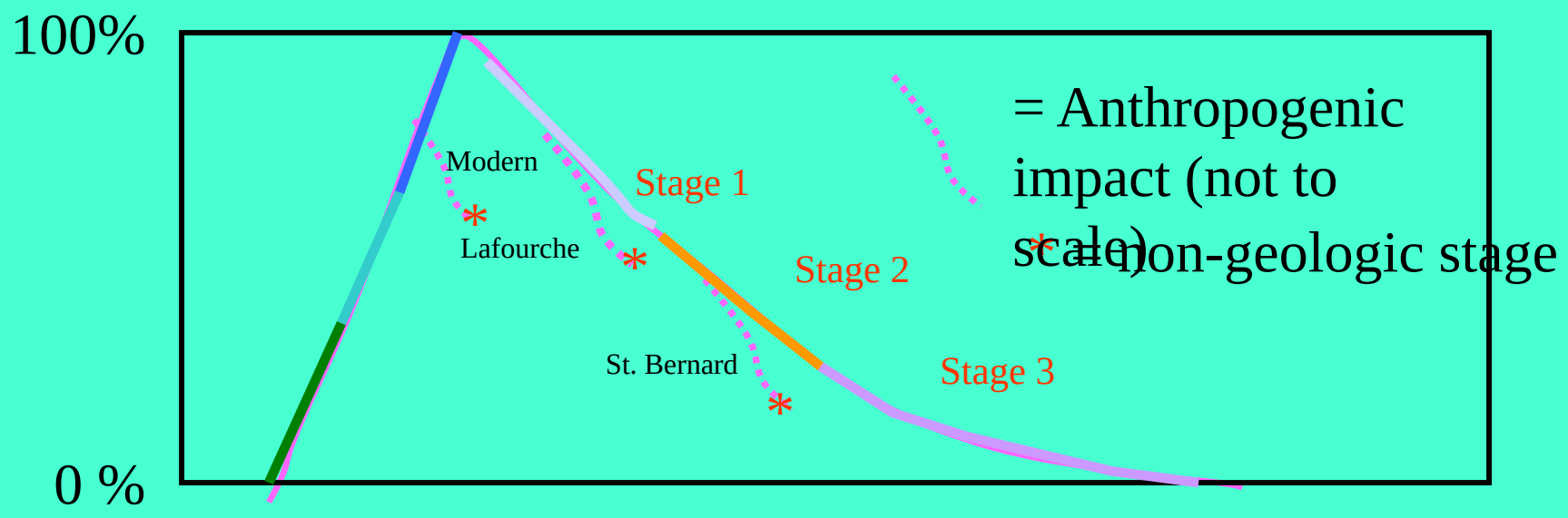


Lopez, 2007, GCAGS

Modified Delta Growth Model with Anthropogenic Departures



Lopez, 2007

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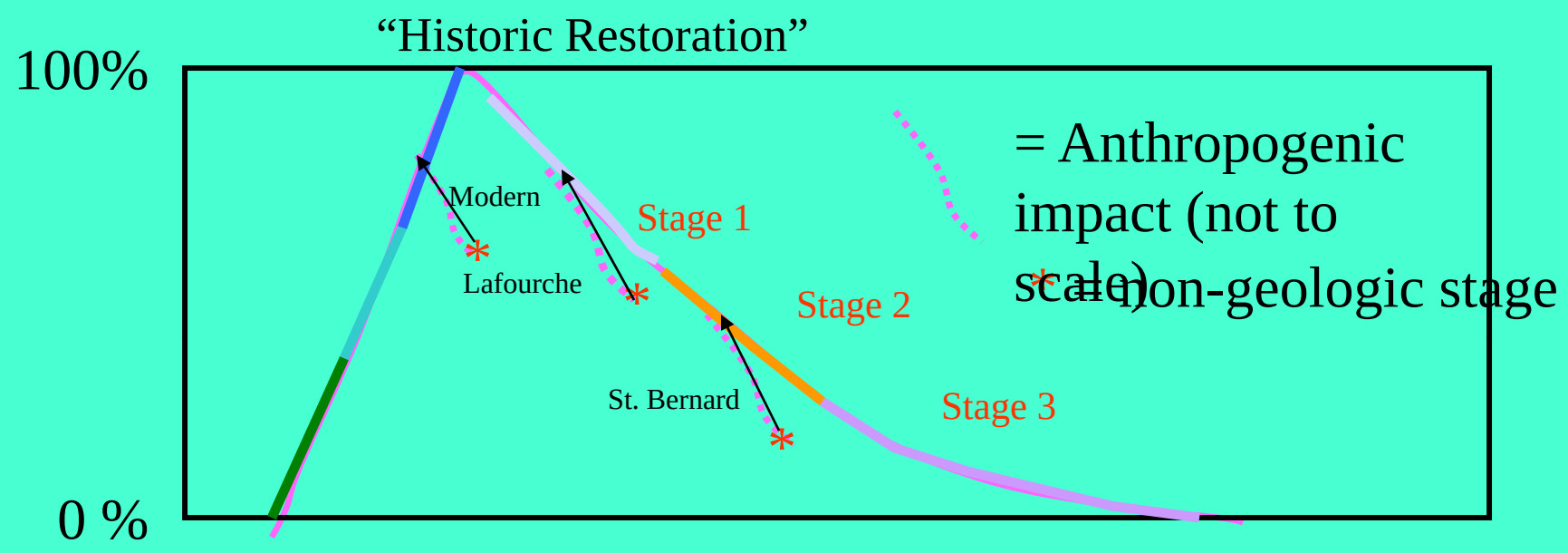

Lopez, 2007

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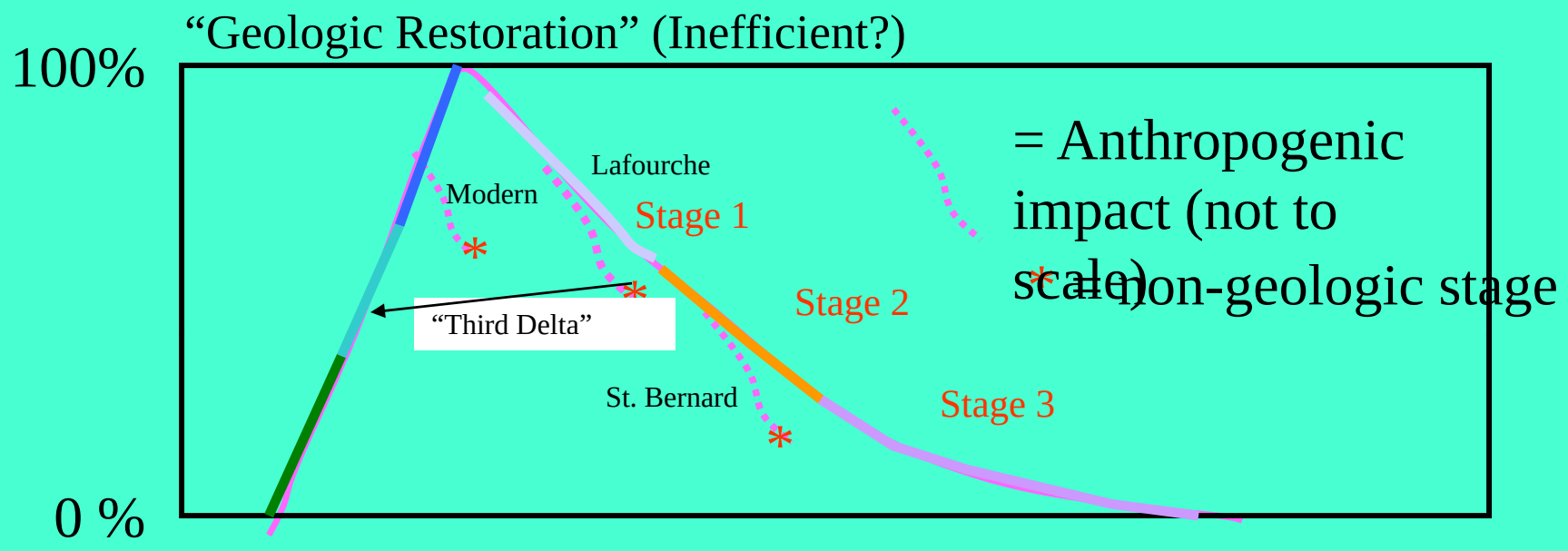

Lopez, 2007

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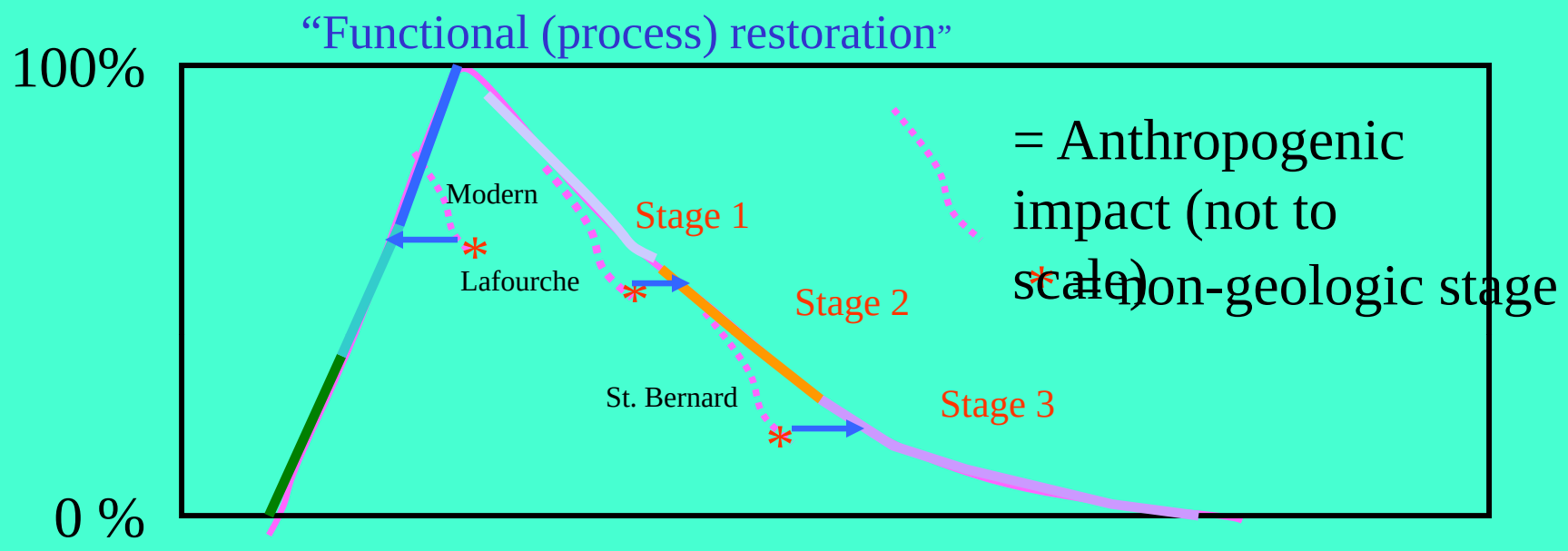

Lopez, 2007

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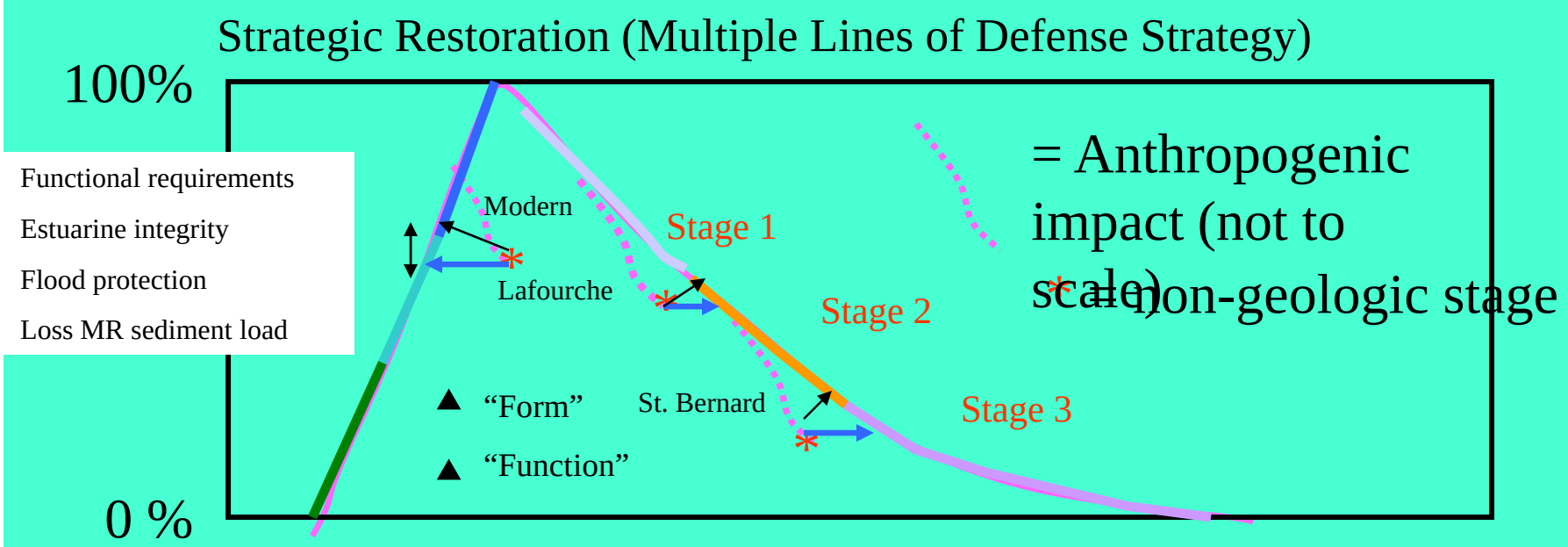

Implications of an Asymmetrical Delta Cycle

1) Abandoned deltas are relatively stable and may have acceptable rates of natural loss or gain

2) Restoration is moving the anthropogenic altered delta back to any position back on the delta cycle curve

3) Restoration needs to be primarily functional (processes) but requires some restoration of form (Land)

4) Efficiency suggests restoration to historic delta stage condition

Lopez, 2003

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MLODS.org

Multiple Lines of Defense Strategy

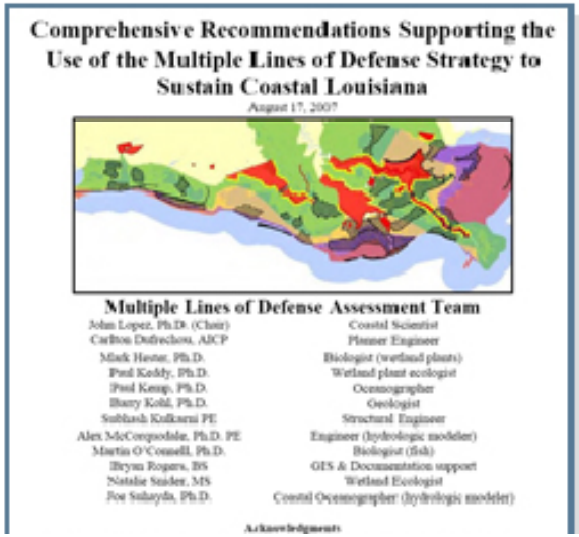
Comprehensive Recommendations to Sustain Coastal Louisiana

- Home
- Strategy Summary
- Assessment Team
- 2007 Draft Report
- Other Documents
- Submit a Comment

What is the Multiple Lines of Defense Strategy?

The Multiple Lines of Defense Strategy is a methodology to design flood control and wetland restoration in coastal Louisiana. The strategy works on the well-founded premise that coastal Louisiana must be protected from hurricane surge by both man-made features, such as levees, and by the natural coastal wetland buffer along the Louisiana coast. Levees alone will not work. Together, a healthy coastal estuary and appropriately designed levees system can sustain Louisiana's ecology and economy of the coast.

The picture above illustrates the eleven



Comprehensive Recommendations Supporting the Use of the Multiple Lines of Defense Strategy to Sustain Coastal Louisiana

August 17, 2007

Multiple Lines of Defense Assessment Team

John Lopez, Ph.D. (Chair)	Coastal Scientist
Carlton Dufrechou, AICP	Planner Engineer
Mark Hester, Ph.D.	Biologist (wetland plants)
Paul Keddy, Ph.D.	Wetland plant ecologist
Paul Kemp, Ph.D.	Oceanographer
Harry Kohl, Ph.D.	Geologist
Subhash Kulkarni PE	Structural Engineer
Alex McCorquodale, Ph.D. PE	Engineer (hydrologic modeler)
Martin O'Connell, Ph.D.	Biologist (fish)
Bryan Rogers, BS	GIS & Documentation support
Natalie Snider, MS	Wetland Ecologist
Joe Suhayda, Ph.D.	Coastal Oceanographer (hydrologic modeler)

Acknowledgments

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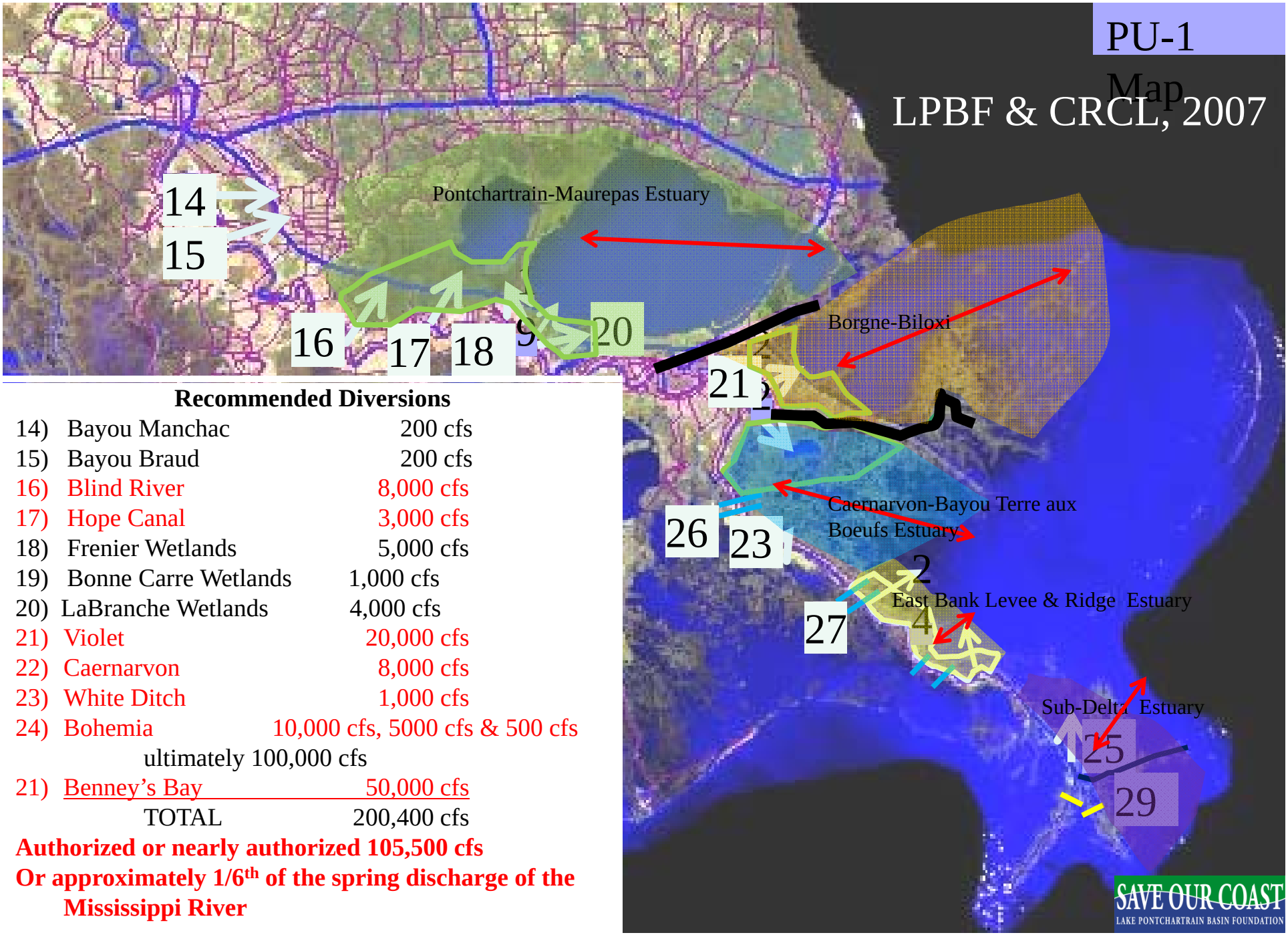


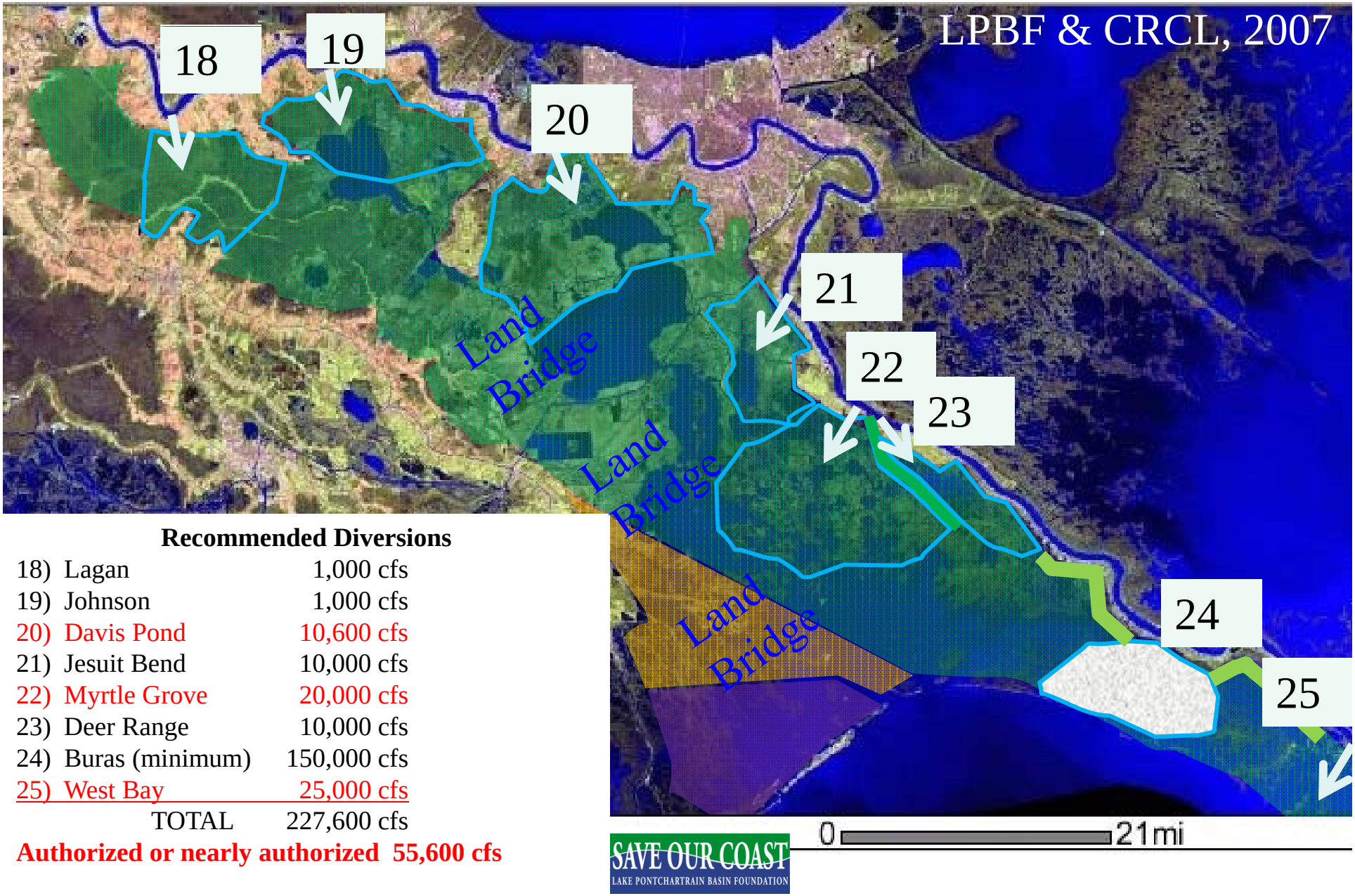
Recommended Diversions

14)	Bayou Manchac	200 cfs
15)	Bayou Braud	200 cfs
16)	Blind River	8,000 cfs
17)	Hope Canal	3,000 cfs
18)	Frenier Wetlands	5,000 cfs
19)	Bonne Carre Wetlands	1,000 cfs
20)	LaBranche Wetlands	4,000 cfs
21)	Violet	20,000 cfs
22)	Caernarvon	8,000 cfs
23)	White Ditch	1,000 cfs
24)	Bohemia	10,000 cfs, 5000 cfs & 500 cfs
	ultimately 100,000 cfs	
21)	Benney's Bay	50,000 cfs
	TOTAL	200,400 cfs

Authorized or nearly authorized 105,500 cfs

Or approximately 1/6th of the spring discharge of the Mississippi River

Proposed Diversions in Planning Unit 2



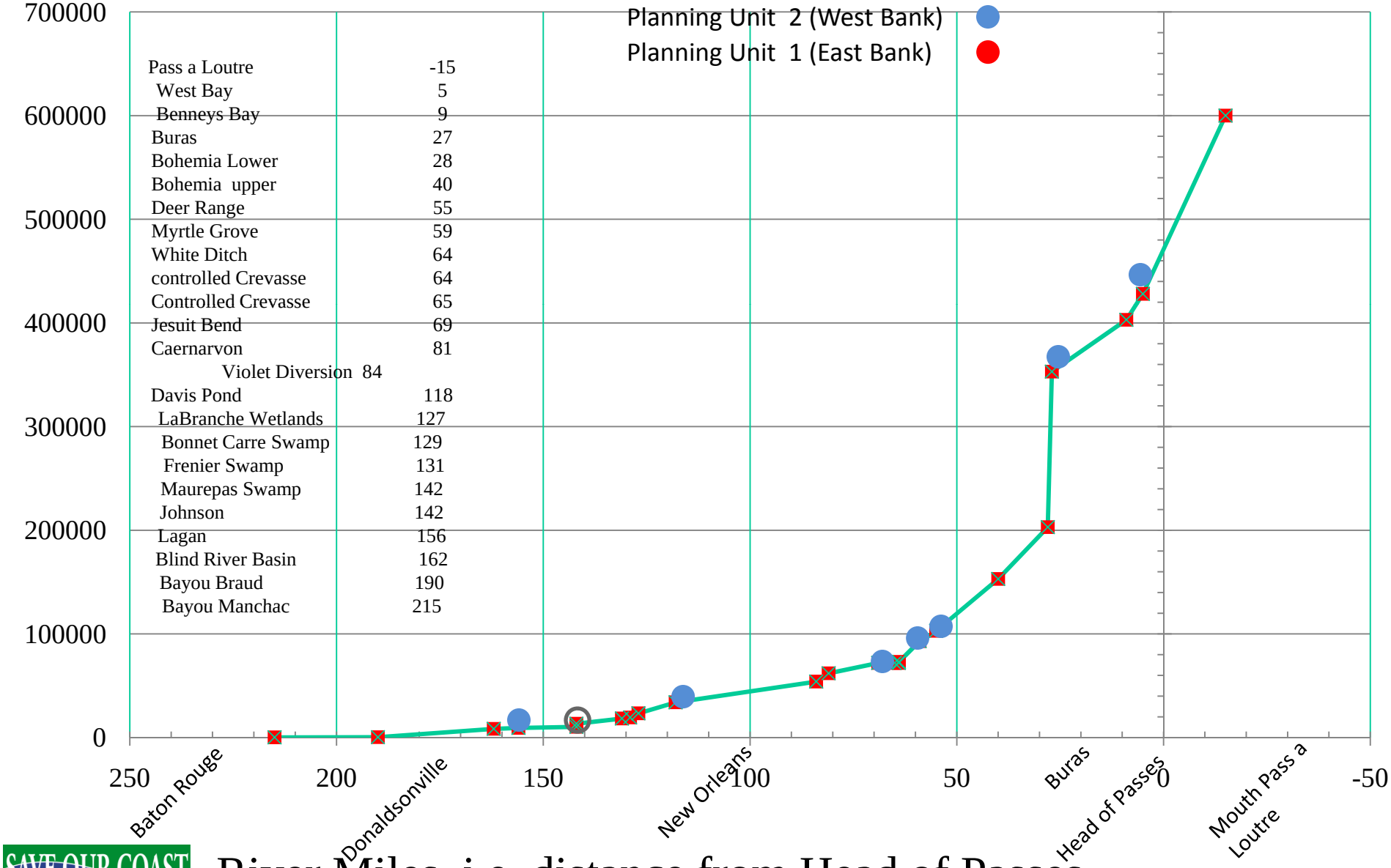
Recommended Diversions

18)	Lagan	1,000 cfs
19)	Johnson	1,000 cfs
20)	Davis Pond	10,600 cfs
21)	Jesuit Bend	10,000 cfs
22)	Myrtle Grove	20,000 cfs
23)	Deer Range	10,000 cfs
24)	Buras (minimum)	150,000 cfs
25)	West Bay	25,000 cfs
	TOTAL	227,600 cfs

Authorized or nearly authorized 55,600 cfs

Q

Proposed Cumulative Spring Q Diverted vs. River Mile
Excludes proposed "controlled crevasses"



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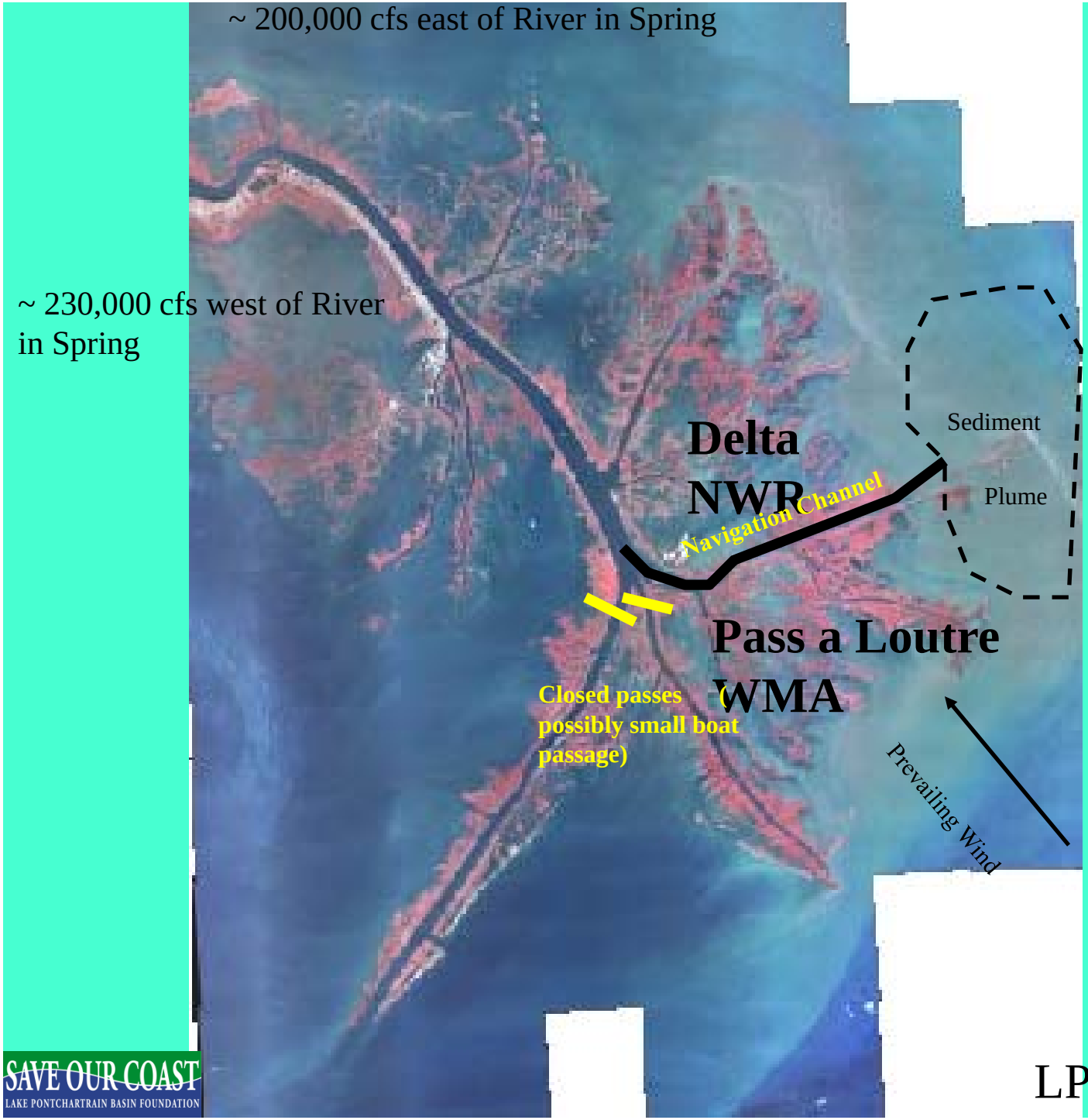
River Miles, i.e. distance from Head of Passes



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LPBF & CRCL, 2007

References

Lake Pontchartrain Basin Foundation and Coalition to Restore Coastal Louisiana, Comprehensive Recommendation supporting the use of the Multiple Lines of Defense Strategy to Sustain Coastal Louisiana, see MLODS.org or SaveourLake.org

Lake Pontchartrain Basin Foundation, 2006, Comprehensive Habitat Management Plan for the Pontchartrain Basin, Lake Pontchartrain Basin Foundation, Metairie, LA http://www.saveourlake.org

Lopez, J. A., 2003, Chronology and Analysis of the Environmental Impacts within the Pontchartrain Basin of the Mississippi River Delta Plain: 1718 -2002, University of New Orleans Dissertation, New Orleans Louisiana

Lopez, J.A., 2004, Wetland Loss in the Pontchartrain Basin (PB) attributed to the Construction of Artificial Levees along the Mississippi River in Southeast Louisiana, Basics of the Basin Research Symposium 2004, University of New Orleans, Proceedings p. 29

Lopez, J. A., 2006, The Multiple Lines of Defense Strategy to Sustain Coastal Louisiana, Lake Pontchartrain Basin Foundation, Metairie, LA. at http://www.saveourlake.org

Lopez, J.A., 2007, Re-assessment of the Mississippi River "Delta Model" Curve, Gulf Coast Association of Geological Societies, Proceedings 2007 Corpus Christi, TX

Lopez, J.A. and C. Dufrechou, 2007, COASTAL PLANNING IN LOUISIANA REDEFINED POST-HURRICANES KATRINA AND RITA, Coastal Zone 07 Proceedings, Portland Oregon.

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See:

SaveOurLake.org

And

MLODS.org

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