RESTORE

THE MISSISSIPPI RIVER DELTA

www.mississippiriverdelta.org  fb.me/MississippiRiverDelta  @RestoreDelta

Delta Restoration to Sustain Navigation and Flood Control

G. Paul Kemp, David Rogers and Clint Willson

Audubon

EDF ENVIRONMENTAL DEFENSE FUND®
Finding the ways that work

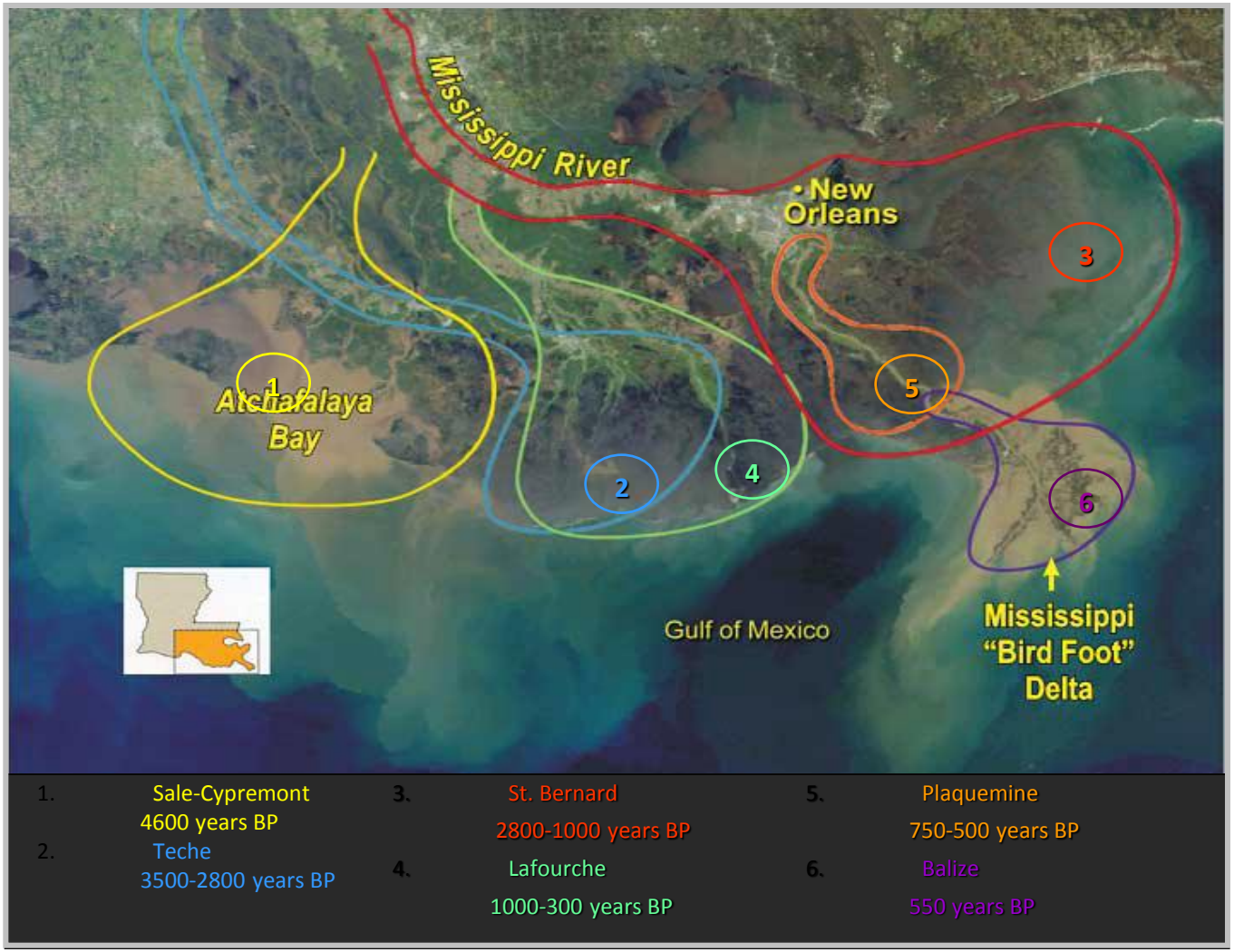
NATIONAL WILDLIFE FEDERATION®


Old River Control Structures
RK 524
Morganza Floodway
RK 467
Baton Rouge
RK 370
ATCHAFALAYA RIVER
MISSISSIPPI RIVER
Bonnet Carre Floodway
RK 213
New Orleans
RK 172
Belle Chasse
RK 127
Houma
Venice
RK 17.5
Head of Passes
RK 0.0
Atchafalaya Deltas
Plaquemines-Balize Delta

Natural Processes and Timescales for Delta

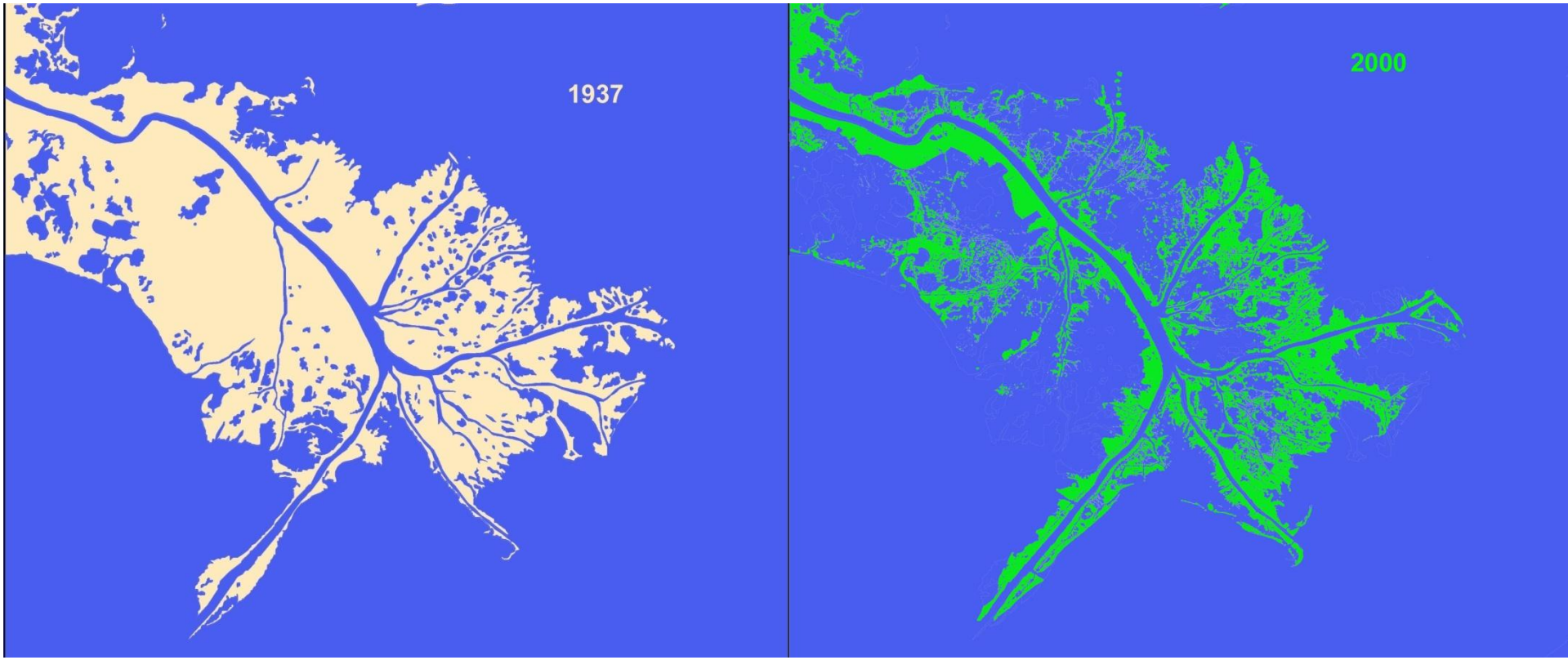
Event	Timescale	Impact
River switching	1,000 yrs	Deltaic lobe formation Net advance of deltaic landmass
Major river floods	50-100 yrs	Channel switching initiation Crevasse splay formation Major deposition
Major storms	5-20 yrs	Major deposition Enhanced production
Average river floods	Annual	Enhanced production Freshening (lower salinity) Nutrient input Enhanced 1º and 2º production
Normal storm events (Frontal passage)	Weekly	Enhanced production Organism transport Net material transport
Tides	Daily	Drainage/marsh production Low net transport

The Delta Cycle: Delta Lobe Switching

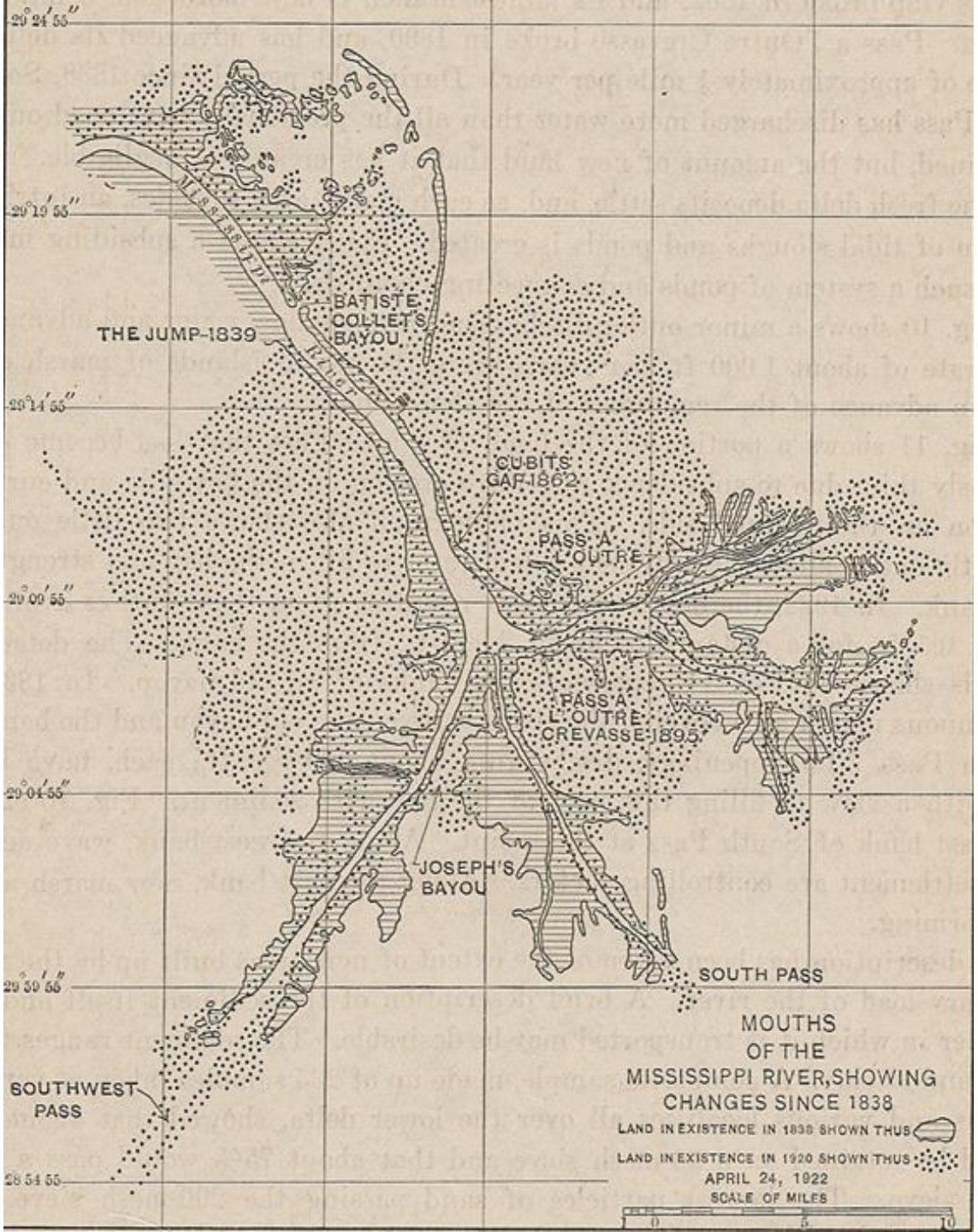


Diversions Build Land

Mouth of the Mississippi is a Hard Place for Nature or Man to Build but is critical to $10 B in exports, mostly agricultural products




WHAT IS LEFT…


29° 24′ 55″
29° 19′ 55″
29° 14′ 55″
29° 09′ 55″
29° 04′ 55″
29° 59′ 55″
28° 54′ 55″
MISSISSIPPI RIVER
BATISTE COLLETS BAYOU
THE JUMP-1839
CUBITS GAP-1862
PASS A L'OUTRE
PASS A L'OUTRE CREVASSE-1895
JOSEPH'S BAYOU
SOUTH PASS
SOUTHWEST PASS
MOUTHS OF THE MISSISSIPPI RIVER, SHOWING CHANGES SINCE 1838
LAND IN EXISTENCE IN 1838 SHOWN THUS
LAND IN EXISTENCE IN 1920 SHOWN THUS
APRIL 24, 1922
SCALE OF MILES
0
5
10

What is Happening to the Lower Mississippi River?

- Water discharge through upstream passes has increased

- Volume of dredging in Southwest Pass has decreased, but the unit cost has increased dramatically

- Sediment deposition has moved upriver from the dredge template but the 45 foot navigation channel is harder to reliably maintain

www.mvn.usace.army.mil/pao/bro/wheeler.htm

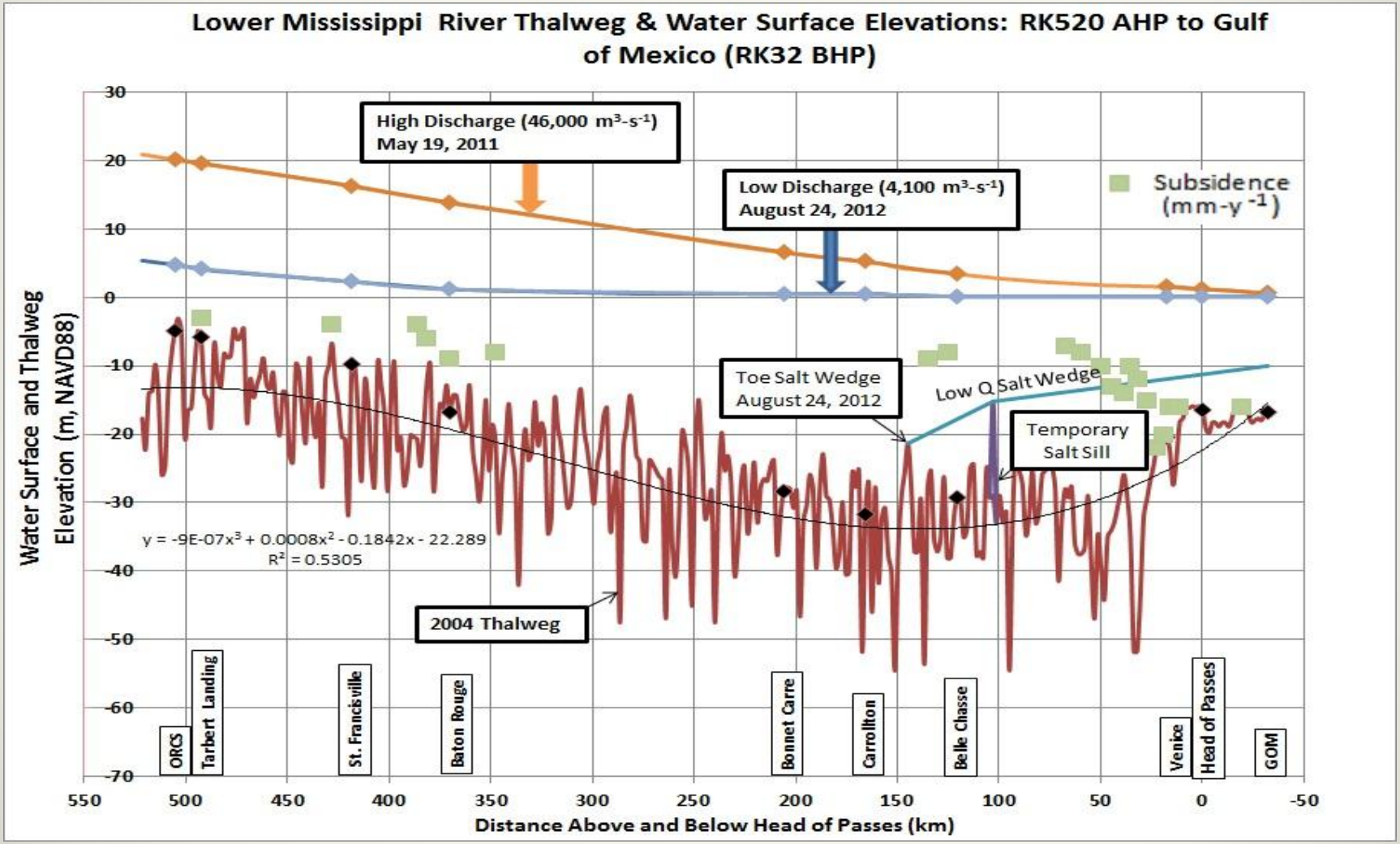
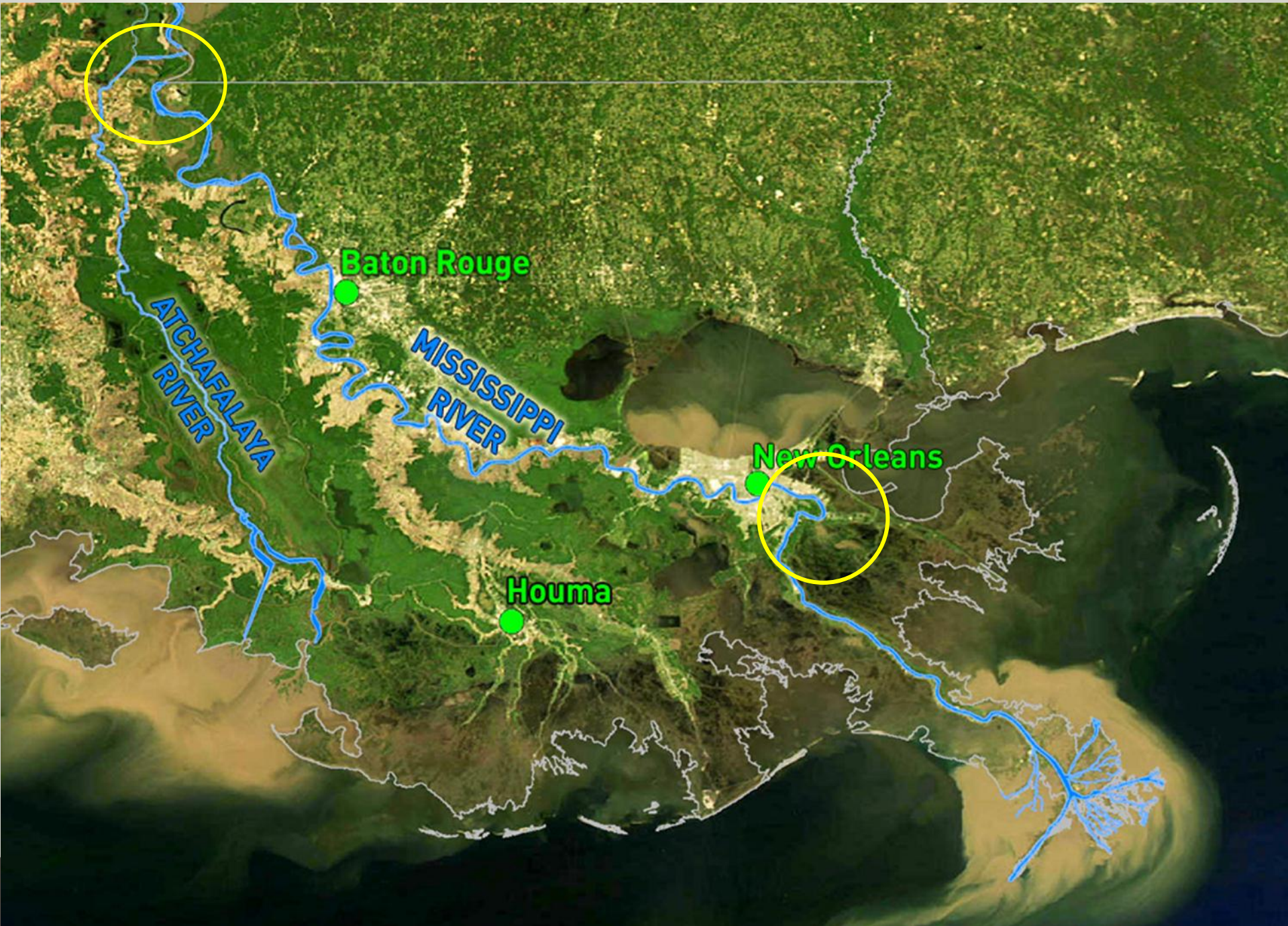
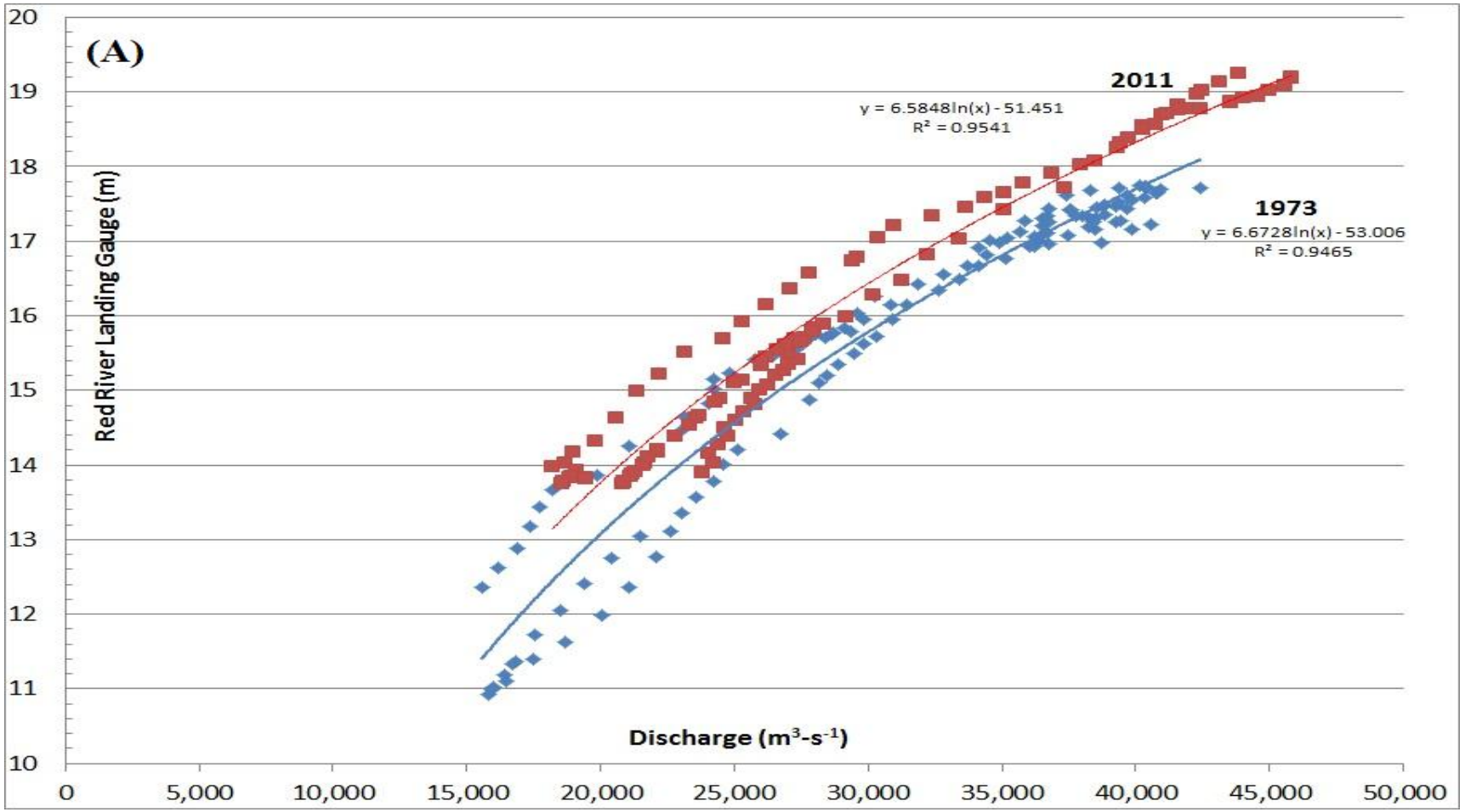

Lower Mississippi River Thalweg & Water Surface Elevations: RK520 AHP to Gulf of Mexico (RK32 BHP)
High Discharge (46,000 m³-s⁻¹) May 19, 2011
Low Discharge (4,100 m³-s⁻¹) August 24, 2012
Subsidence (mm-y⁻¹)
Toe Salt Wedge August 24, 2012
Low Q Salt Wedge
Temporary Salt Sill
y = -9E-07x³ + 0.0008x² - 0.1842x - 22.289
R² = 0.5305
2004 Thalweg
Water Surface and Thalweg Elevation (m, NAVD88)
Distance Above and Below Head of Passes (km)
ORCS
Tarbert Landing
St. Francisville
Baton Rouge
Bonnet Carre
Carrollton
Belle Chasse
Venice
Head of Passes
GOM

Table 2. LMMR Bed and Water Slopes for 2011 High and 2012 Low Discharge Measured at Tarbert Landing (RK493)					
Reach	Up	Down	Thalweg	Low Q ($4{,}100\ m^3\text{-}s^{-1}$)	High Q ($46{,}000\ m^3\text{-}s^{-1}$)
Old River to Baton Rouge	RK503	RK370	5.19×10^{-05}	2.65×10^{-05}	4.67×10^{-05}
Baton Rouge to New Orleans	RK370	RK172	6.83×10^{-05}	3.32×10^{-06}	4.21×10^{-05}
New Orleans to Myrtle Grove	RK165	RK93	0	0	3.53×10^{-05}
Myrtle Grove to Fort St. Phillip	RK93	RK32	0	0	1.61×10^{-05}
Fort St. Phillip to Cubits Gap	RK32	RK05	-6.29×10^{-04}	0	1.55×10^{-05}


Baton Rouge
ATCHAFALAYA RIVER
MISSISSIPPI RIVER
New Orleans
Houma

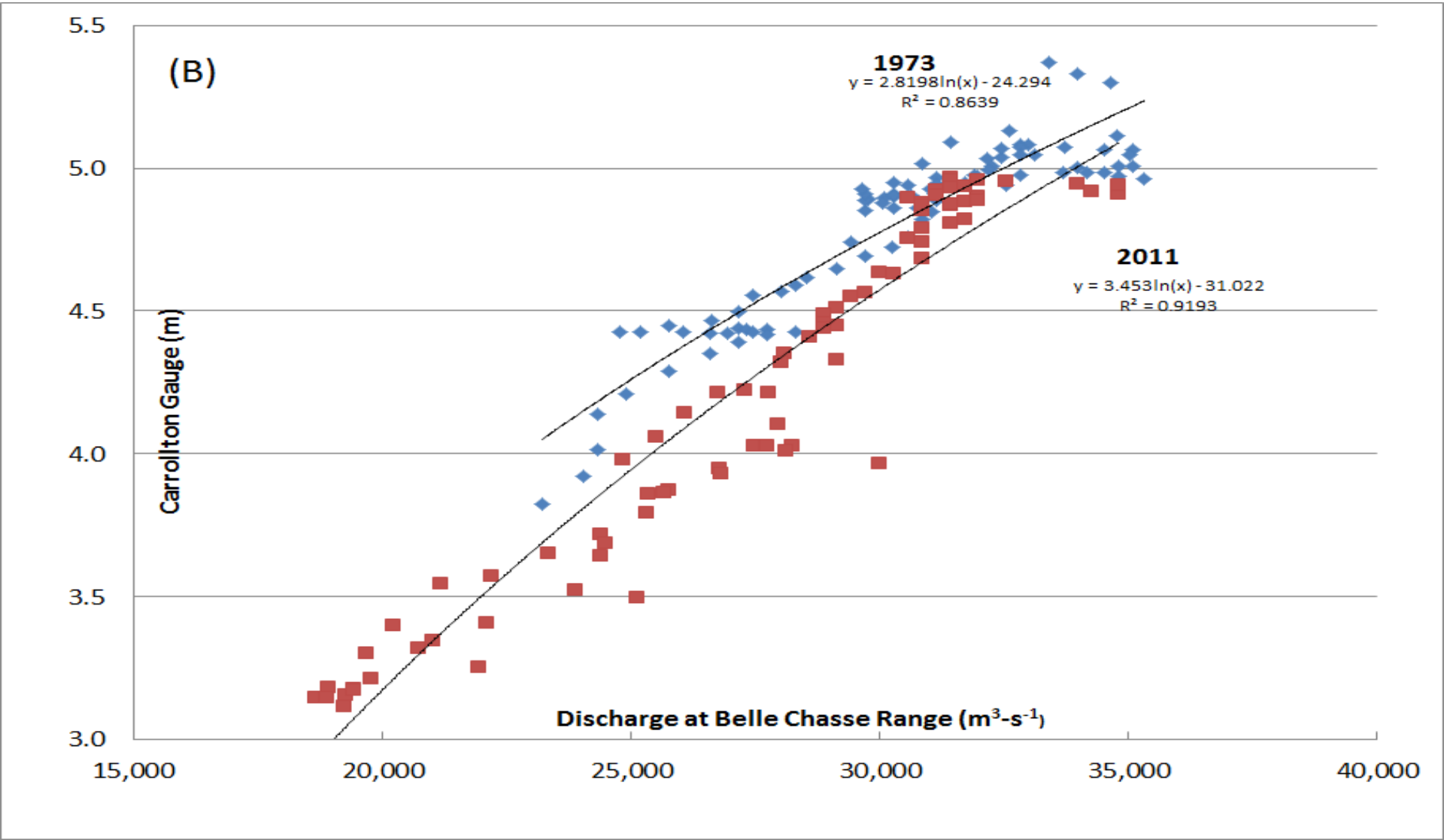
And Flood Flowlines are Rising

Comparison of 1973 and 2011 Stage-Discharge at Red River Landing upstream of Baton Rouge



And Falling...

Comparison of 1973 and 2011 Stage-Discharge at Belle Chasse



Landsat Image from April 21, 1983 at a Tarbert Landing discharge of 31,130 m^3-s^{-1} showing sediment plume confined to PBD well downstream of where the east bank levee ends at Bohemia (RK 75)

Landsat Image from April 10, 2011 at a Tarbert Landing discharge of 25,488 m^3-s^{-1} showing sediment plume created by overbank flow from the river beginning at the Bayou Lamocque bend (RK 55) halfway between Bohemia and Fort St. Phillip, 22 km

Deltaic geomorphology

Sinking and Slumping at ~ >2 m/century (0.8 in/yr)
Without Considering Sea Level Rise

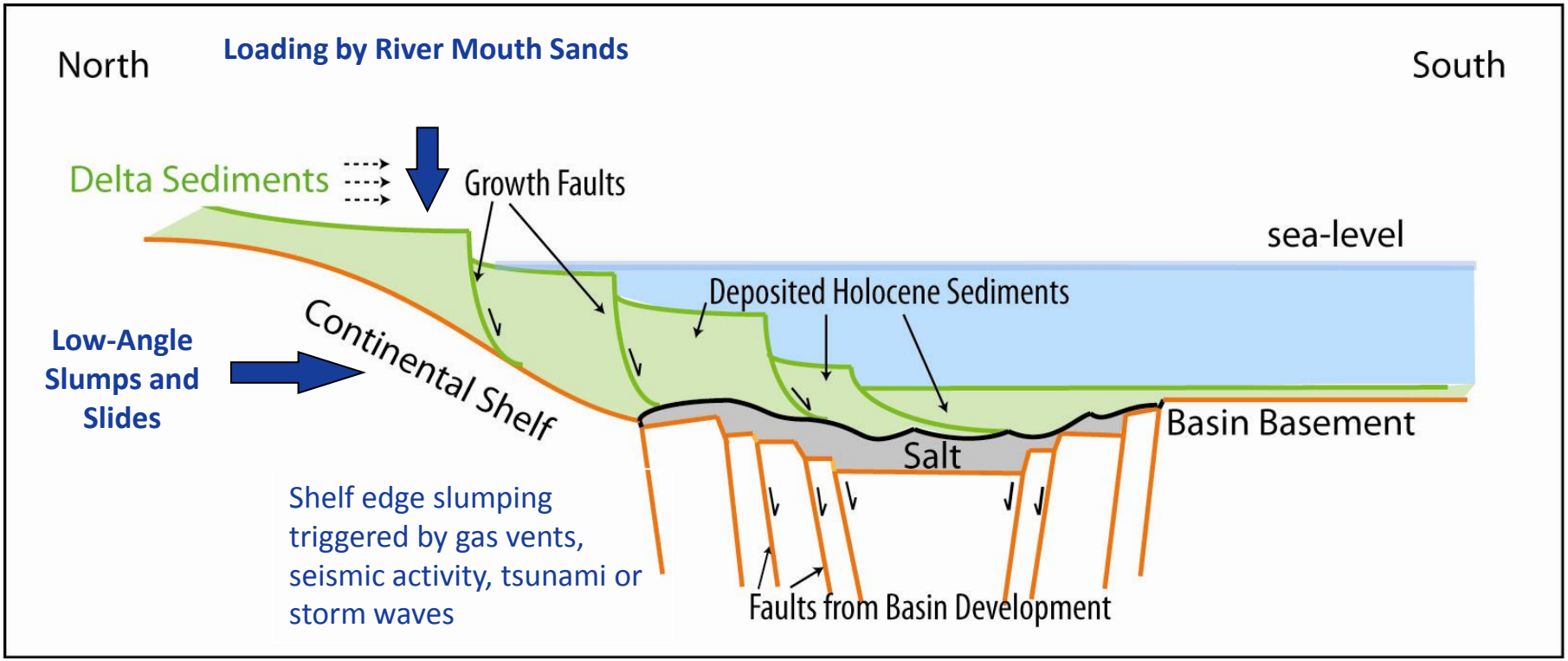
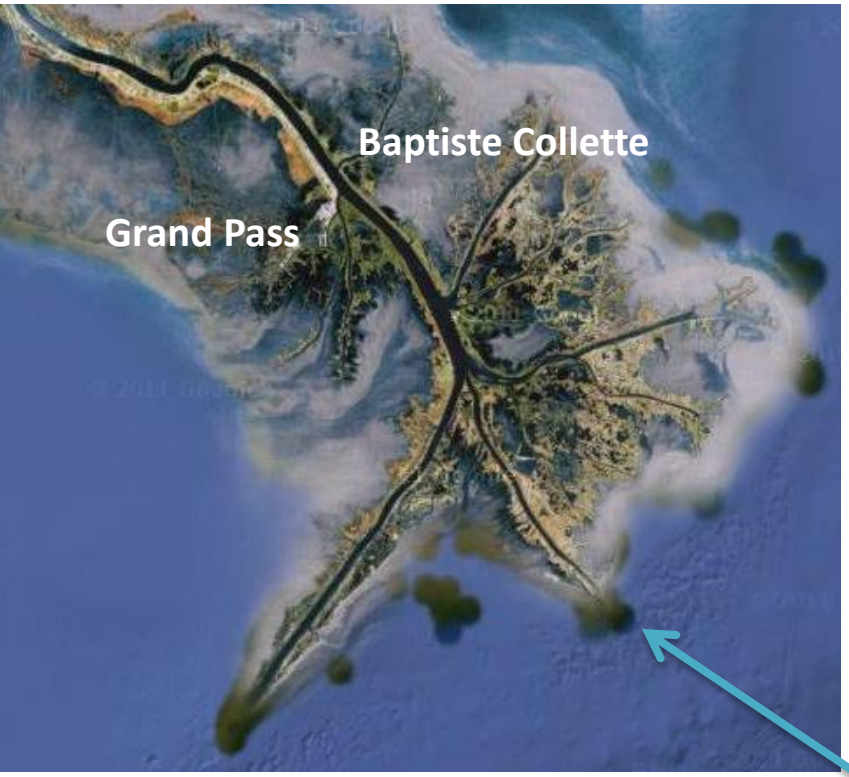
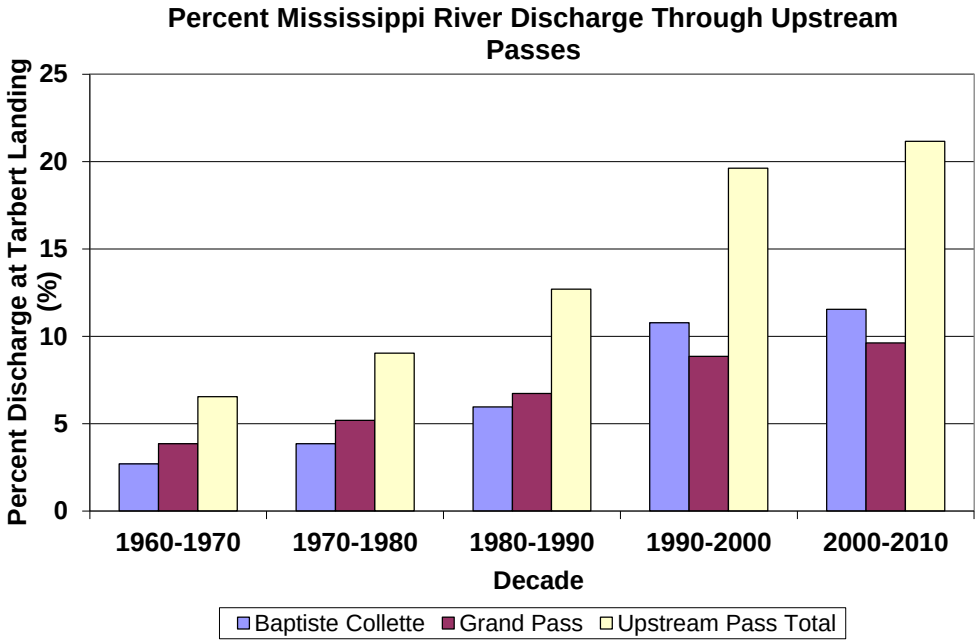


Figure from: Reed and Yuill, 1999

Water Discharge is Bypassing the Bird's Foot Through Upstream Passes

(It is growing shorter!)

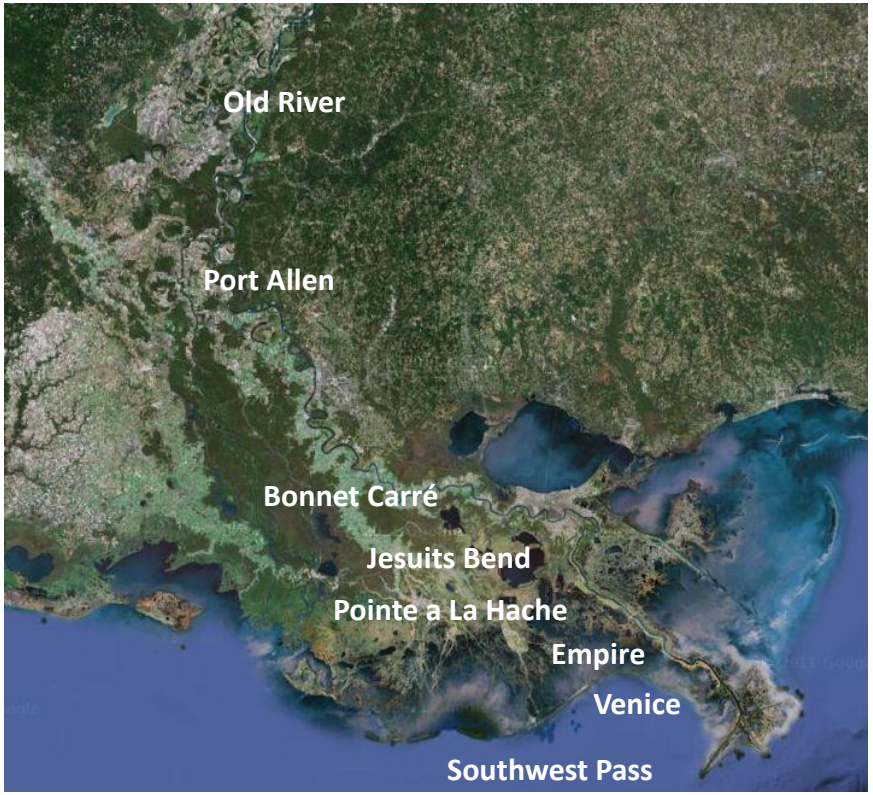


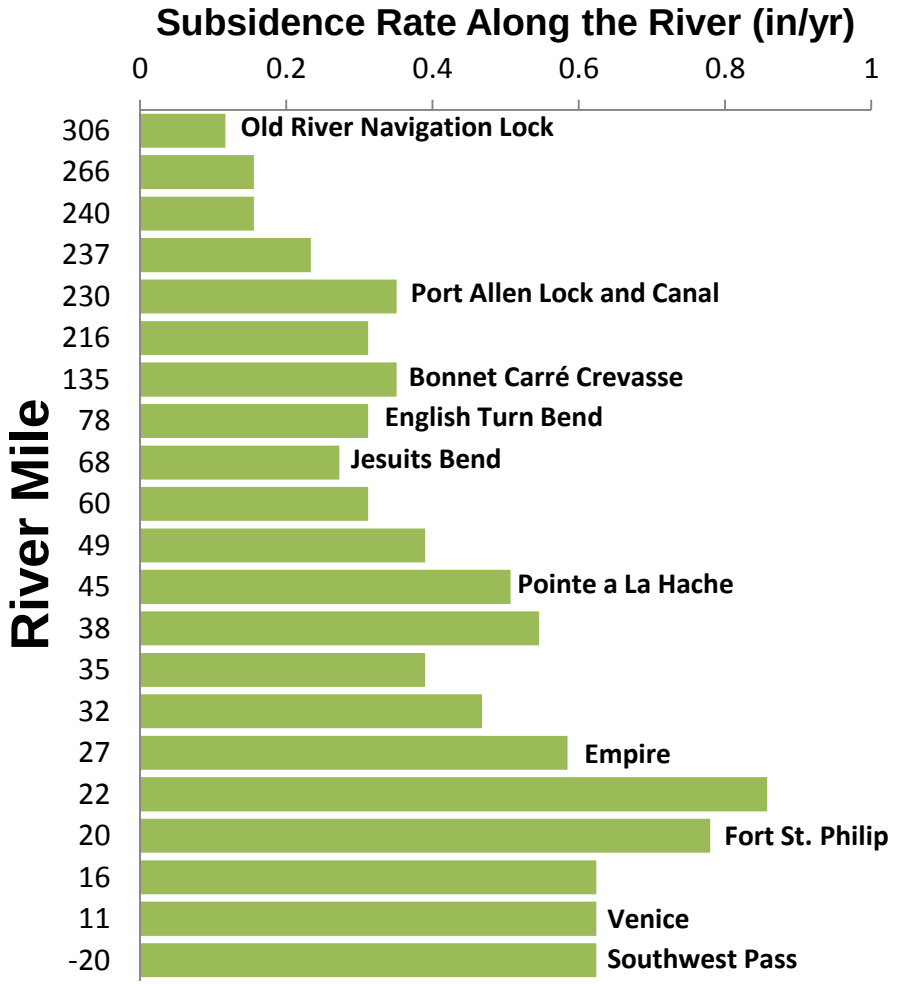


South Pass silted in!

The Land is Sinking

At the Bird's Foot: 0.6 – 0.9 in/yr or 0.5 - 0.8 ft/decade





Data from: West Bay Sediment Diversion ERDC Report: Brown et al., 2009

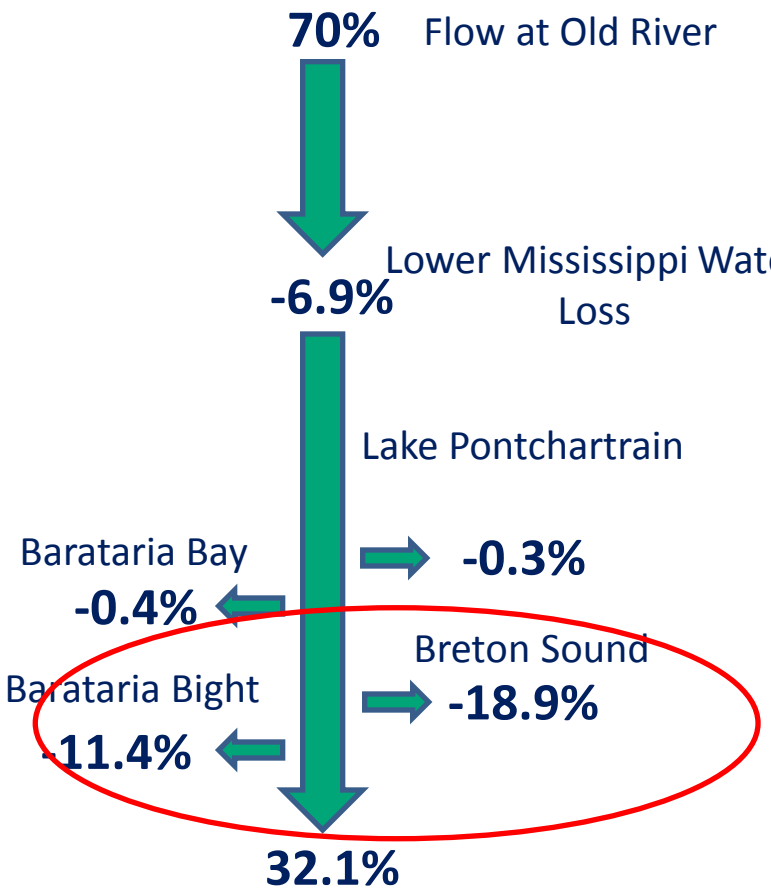
Myrtle Grove Field Data Program

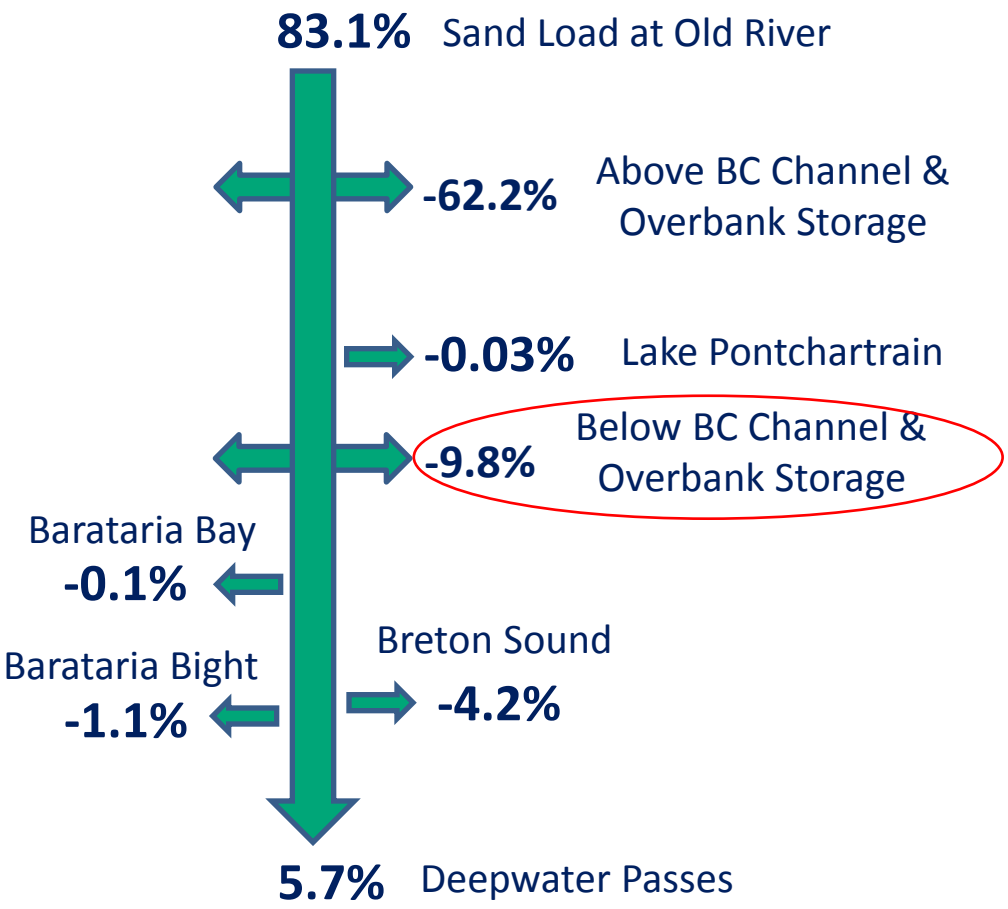
Dr. Mead Allison, UT
Austin
Ehab Meselhe, ULL
Lafayette

JOINTLY FUNDED BY STATE & NGOs

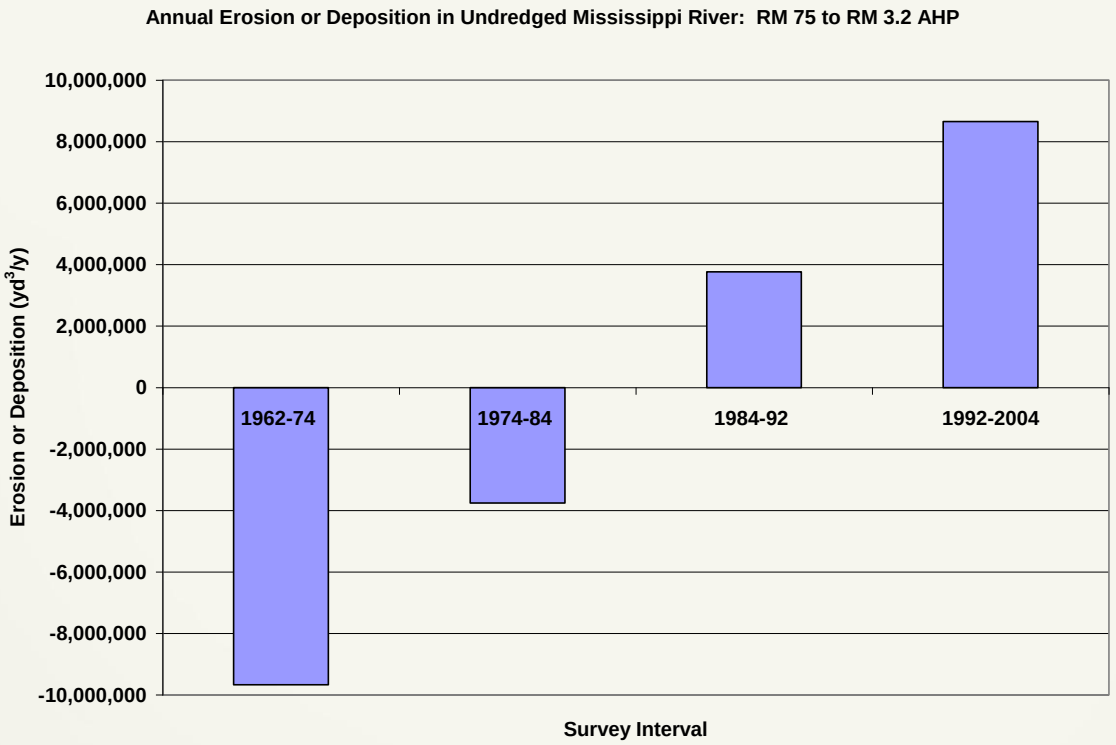
- High-resolution Bathymetry
- Water Discharge
- Bottom Currents
- Suspended Load
- Bedload transport
- Suspended Grain Size
- Bed material Grain Size

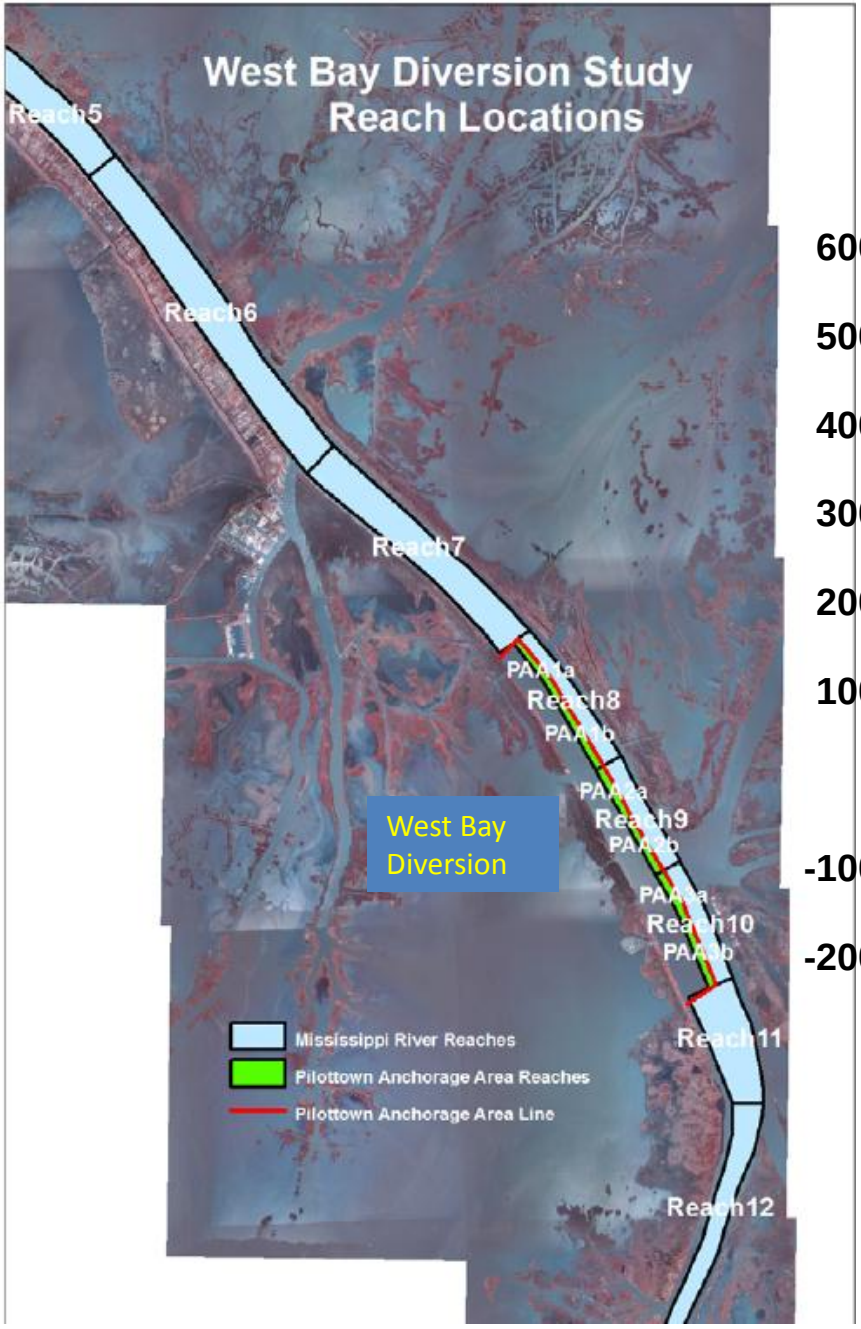
Mississippi River Water and Suspended Sand Budget 2008-2010

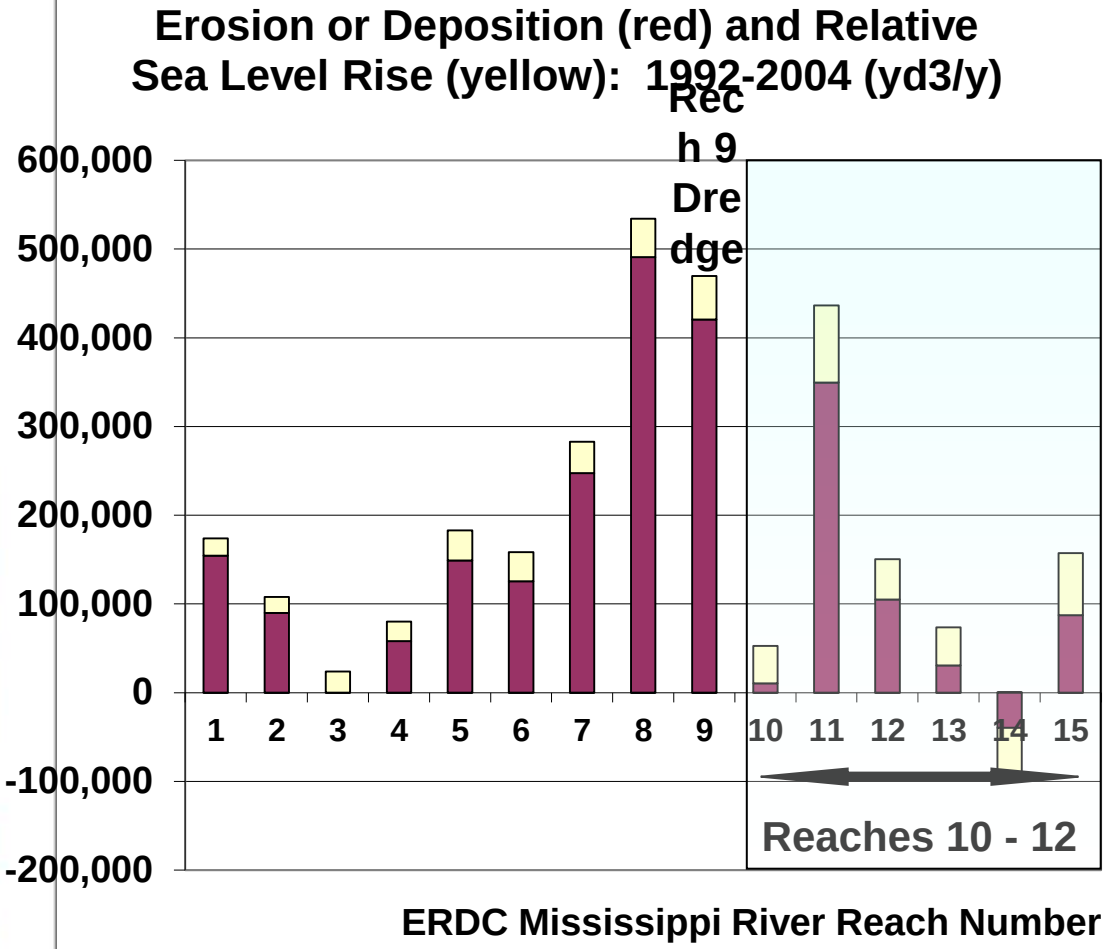




Allison et al. 2012, A water and sediment budget for the lower Mississippi–Atchafalaya River n flood years 2008–2010. Journal of Hydrology

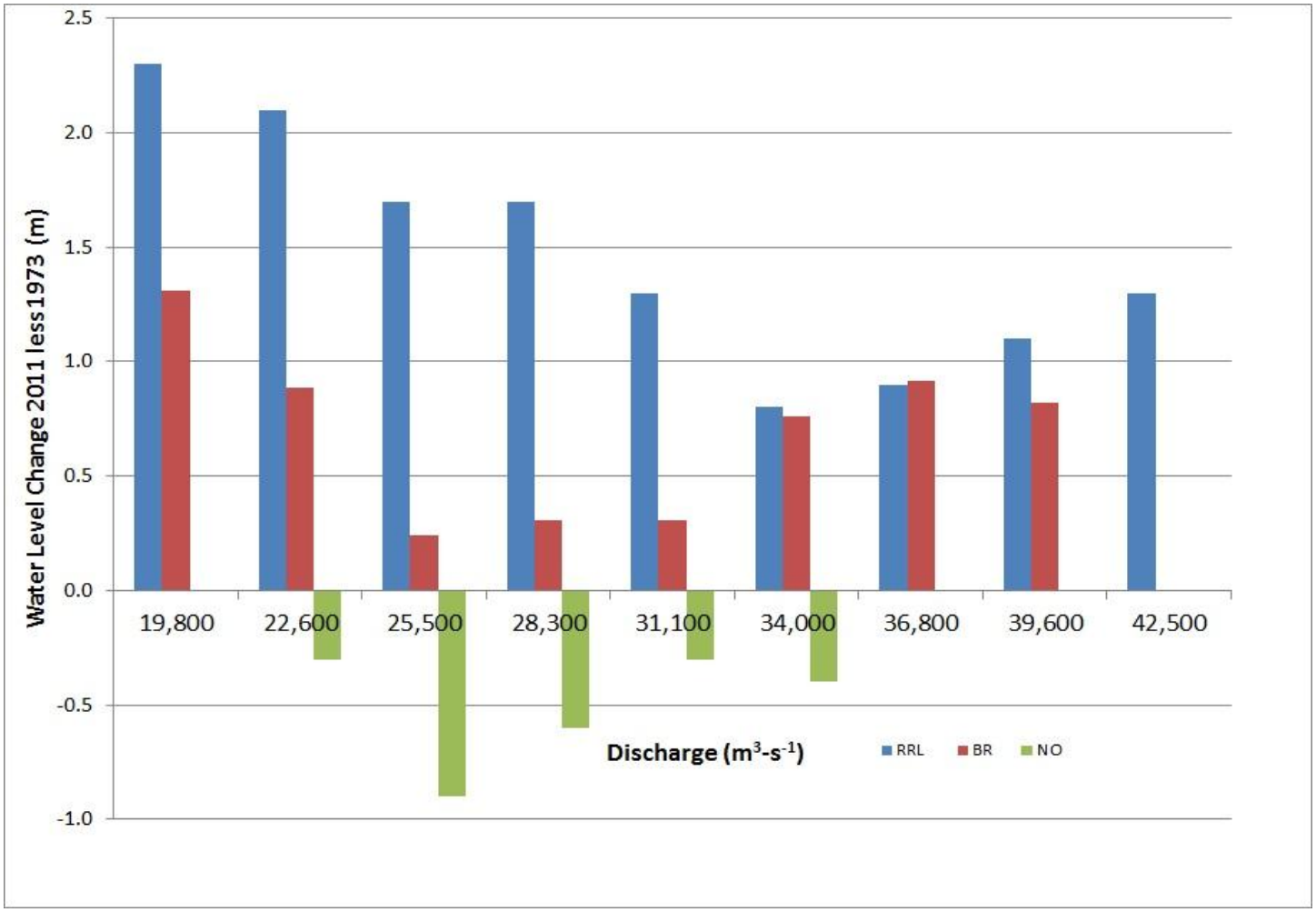

Annual Erosion or Deposition in Undredged Mississippi River: RM 75 to RM 3.2 AHP
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
-2,000,000
-4,000,000
-6,000,000
-8,000,000
-10,000,000
Erosion or Deposition (yd3/y)
1962-74
1974-84
1984-92
1992-2004
Survey Interval





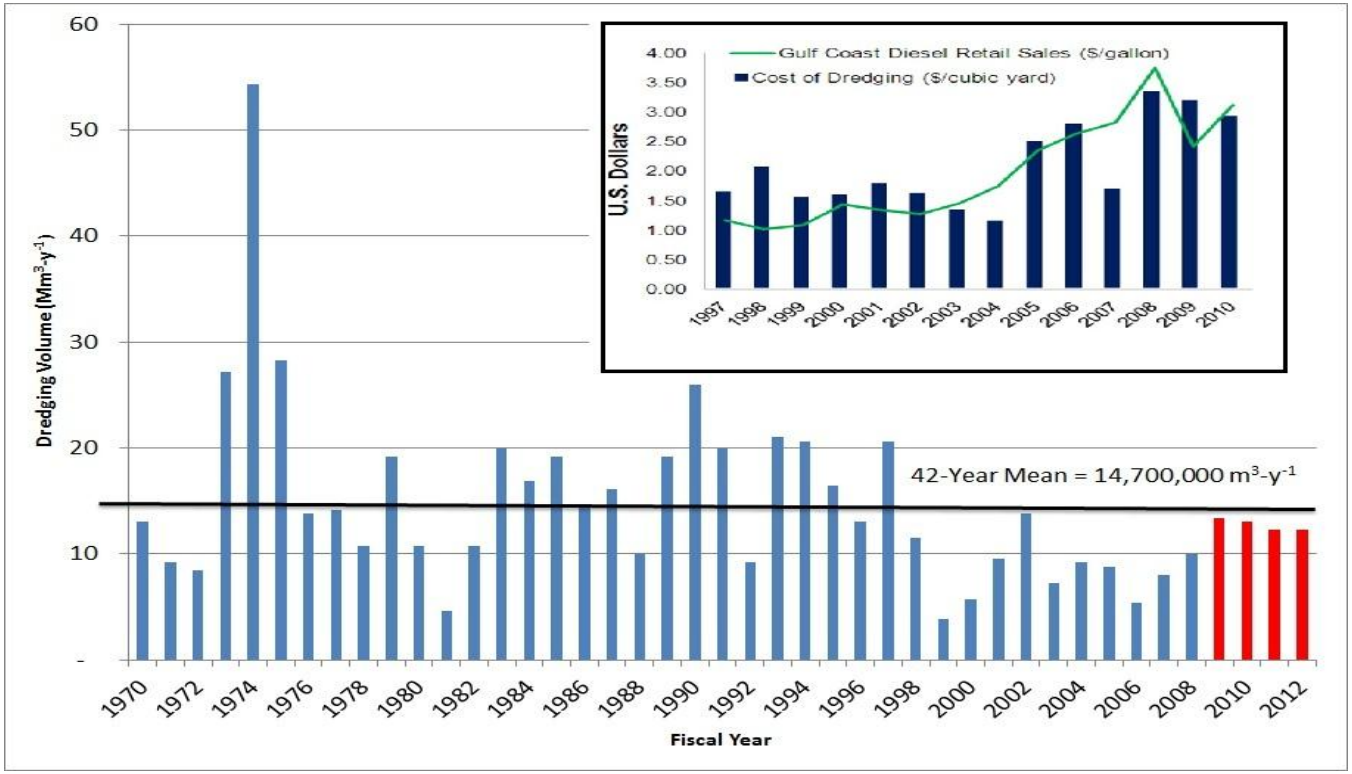
Sediment is deposited upstream of traditionally dredged reaches

Increase or decrease in water elevation at specific discharges from 1973 to 2011 at Red River Landing (blue RK 503), Baton Rouge (red RK 370) and New Orleans (green RK 172).



Dredging Volume is Reduced at Southwest Pass

Total Yearly Dredge Volumes for Southwest Pass 1970 to 2008

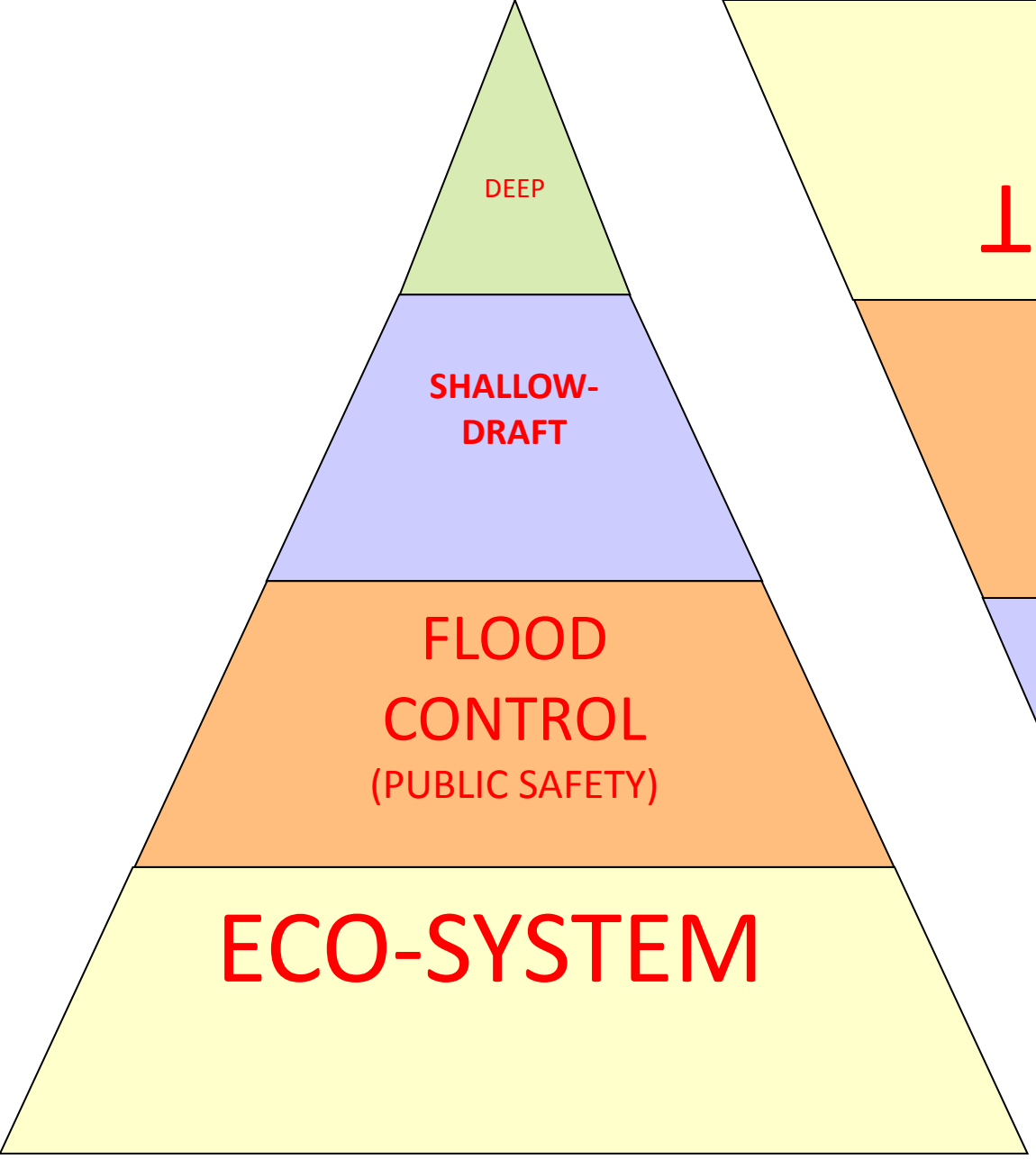


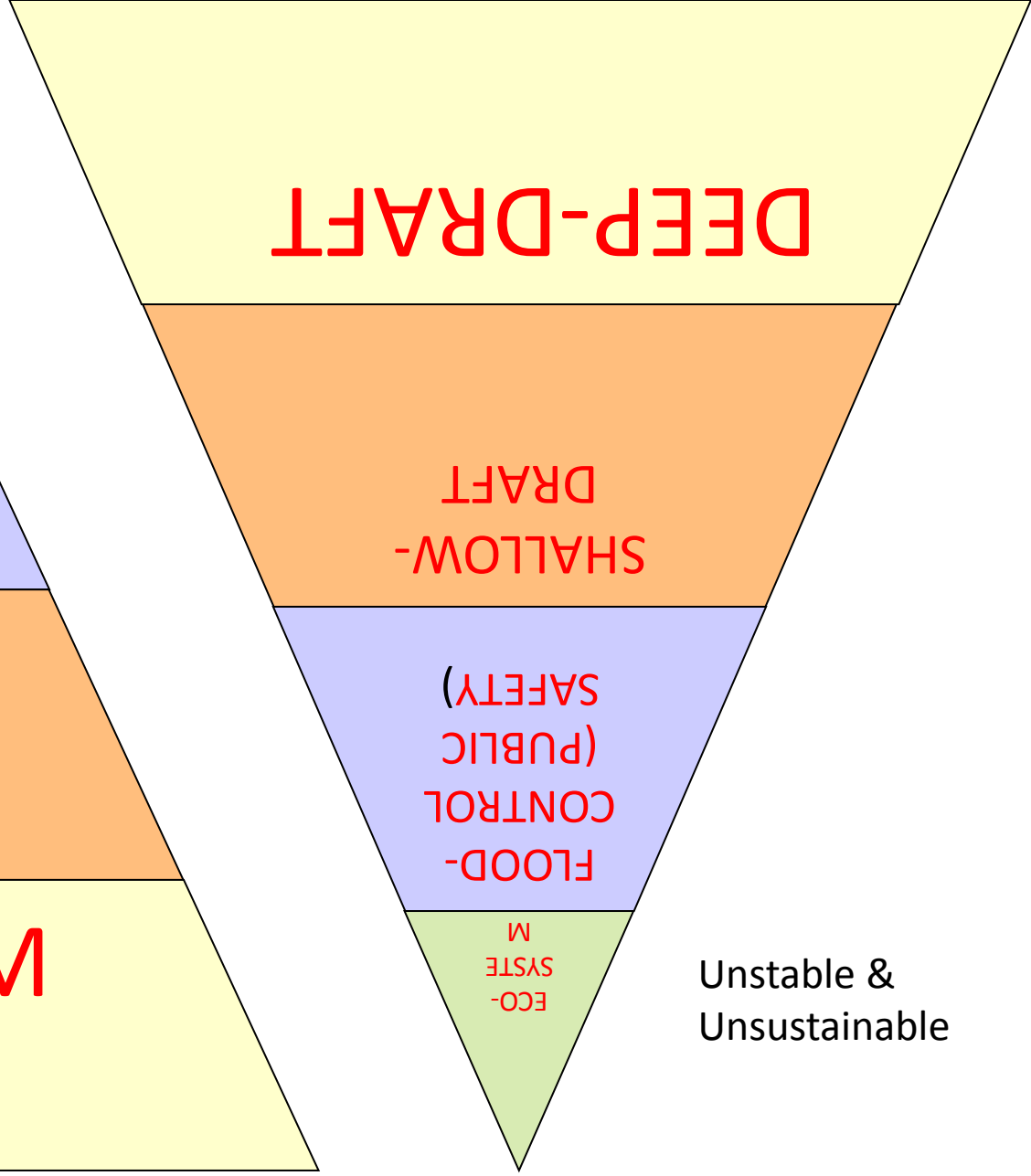
Data from: West Bay Sediment Diversion ERDC Report: Brown et al., 2009

Putting together the pieces…

- Natural land-building outside Atchafalaya has ceased (most people have never seen it!)
- Collapse and loss of wetlands continues
- Bird foot is retreating from shelf edge *
- Diversions *can* work if designed/operated properly *
  - Get sediment out of river *upstream* to nourish wetlands

* NGO Contributions





Unstable &
Unsustainable

Why should environmental advocates care about navigation?

- Science-based restoration plans must work for all of us
- Promoting polices that secure funding for restoration
- Reaching out to stakeholders to craft joint solutions
- MISSISSIPPI RIVER BASED MARITIME INDUSTRY IS BIG BUSINESS
  - Deep-draft
  - Shallow-draft
  - Terminals

We want the sediment in wetlands. Ship operators want it out of the chanel

Shippers worry river may not be deep enough

Less dredging could mean smaller cargoes, higher costs

By Bartholomew Sullivan

Sunday, January 30, 2011

WASHINGTON -- Lower levels of funding for dredging the Mississippi River south of Baton Rouge will have "a ripple effect" upriver, raising the cost of importing material from overseas and exporting American agricultural products, says a coalition concerned with river commerce.

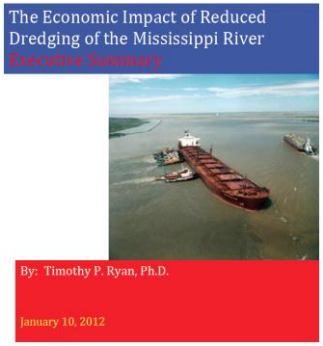
The Corps of Engineers, which is responsible for maintaining minimum depths along the length of the river, may not be able to maintain a 45-foot depth for the deep-draft shipping channel from the Gulf of Mexico to Baton Rouge this year, but will keep the river open to navigation with available money, said spokesman Robert T. Anderson of the corps' Vicksburg district.

Economic Losses at Various Channel Depths

Table 23
Incremental Losses at Various Channel Depths
(Dollar figures in millions)

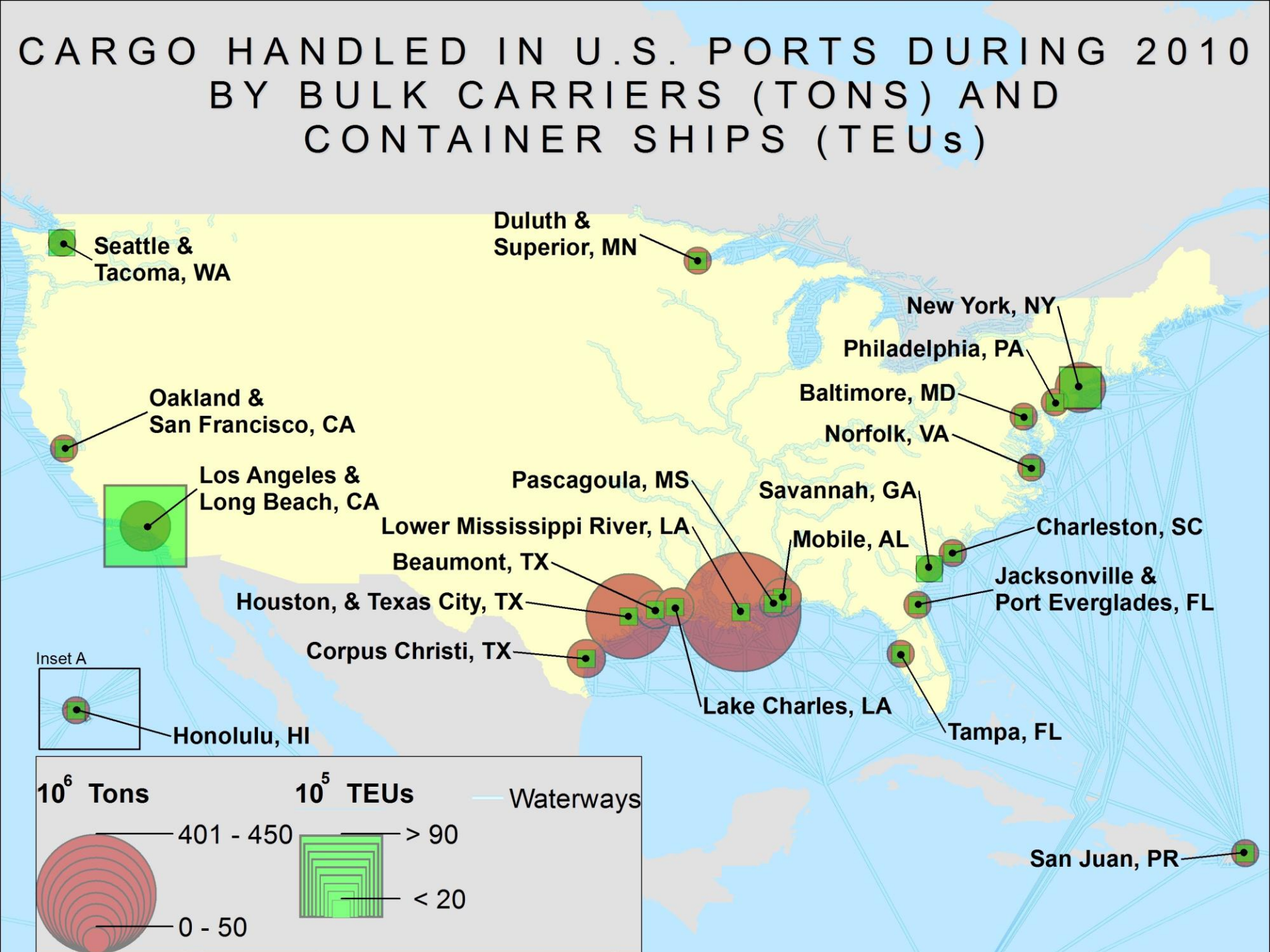
Depth in Feet	Direct Spending	Total Spending	Earnings	Federal Taxes
44-45	$455.23	$891.49	$121.53	$14.15
43-44	$593.98	$1,132.07	$157.04	$18.35
42-43	$772.74	$1,445.97	$203.30	$23.80
41-42	$1,073.69	$2,018.40	$275.42	$32.56
40-41	$1,643.00	$3,171.05	$417.50	$49.58
39-40	$1,887.83	$3,693.39	$470.63	$56.30
37-38	$2,082.72	$4,109.96	$520.31	$62.20
36-37	$2,371.36	$4,689.44	$602.18	$71.56
35-36	$2,371.35	$4,689.45	$602.20	$71.56
Average	$1,472.43	$2,871.25	$374.46	$44.45

Source: Author's Calculations



The Economic Impact of Reduced Mississippi River
Ryan; January 2012

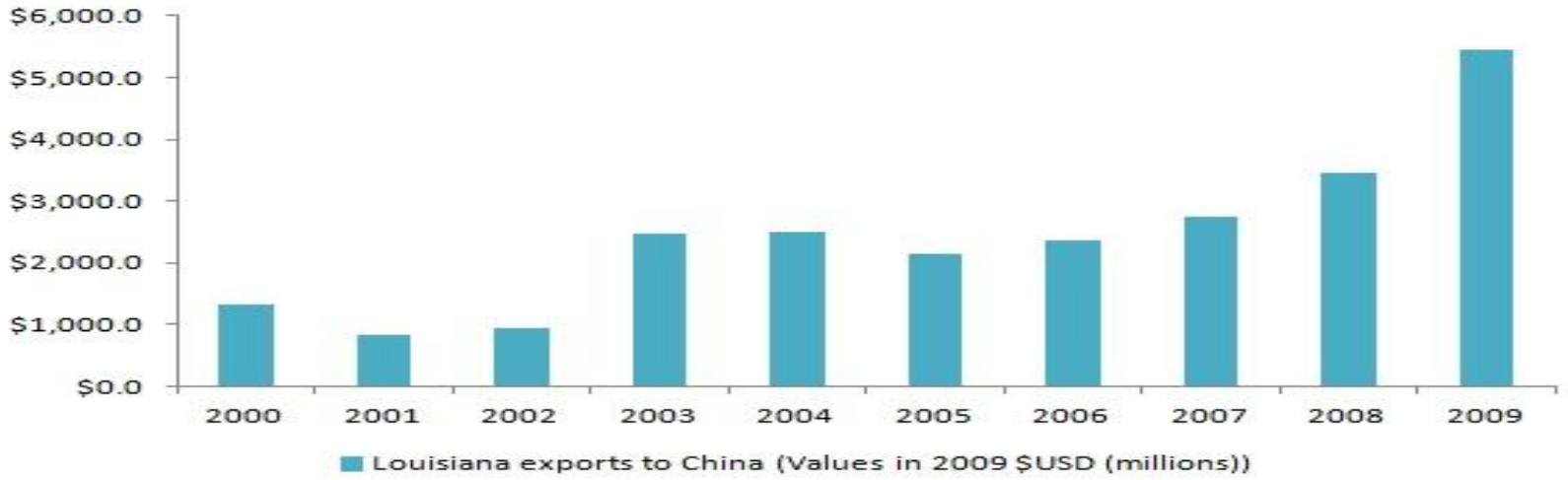
CARGO HANDLED IN U.S. PORTS DURING 2010 BY BULK CARRIERS (TONS) AND CONTAINER SHIPS (TEUs)



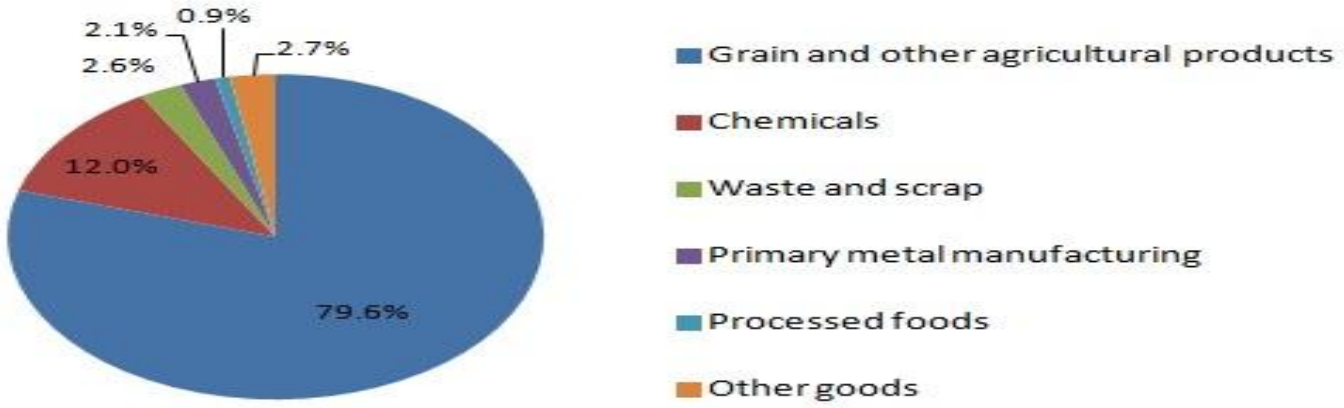
A 73 Barge ‘Tow’ Between New Orleans and Baton Rouge

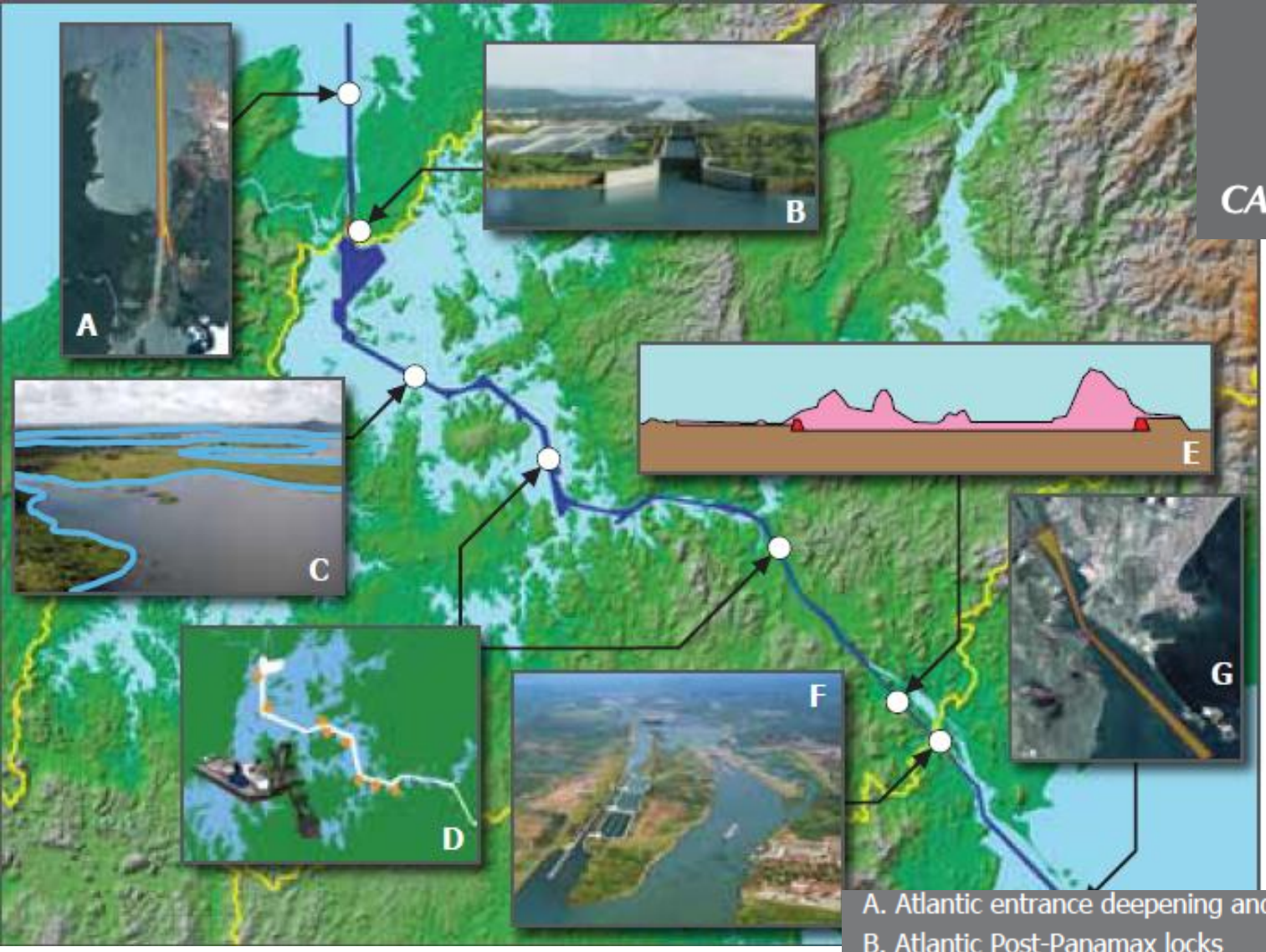
Nowhere but on the Lower Mississippi River…

U.S. exports to China via Louisiana, 2000 - 2009



Breakdown of shipments, 2009





CANAL DE PANAMÁ

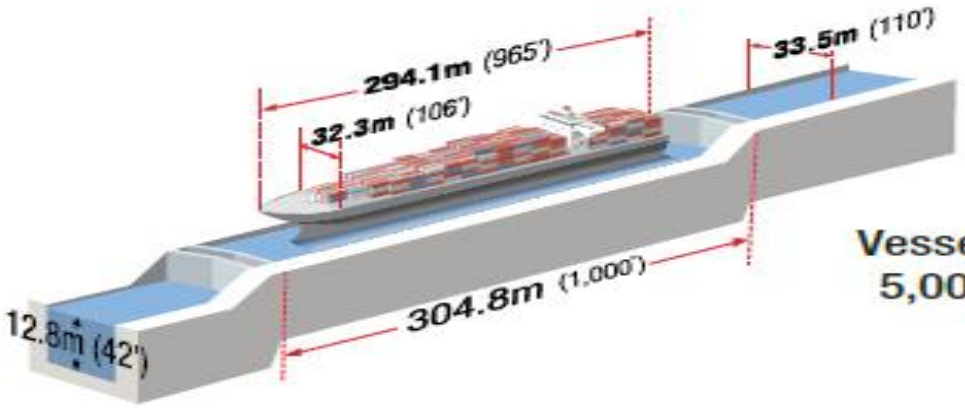
PANAMA CANAL EXPANSION

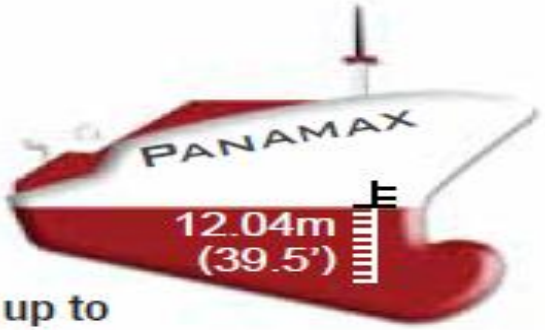
$5 B project to be complete in 2014

Time-scale for Navigation

A. Atlantic entrance deepening and widening
B. Atlantic Post-Panamax locks
C. Increasing Gatun Lake's maximum operating level
D. Deepening and widening of Gatun Lake and Culebra Cut navigational channels
E. Post-Panamax locks Pacific access channel
F. Pacific Post-Panamax locks
G. Pacific entrance deepening and widening

EXISTING LOCKS



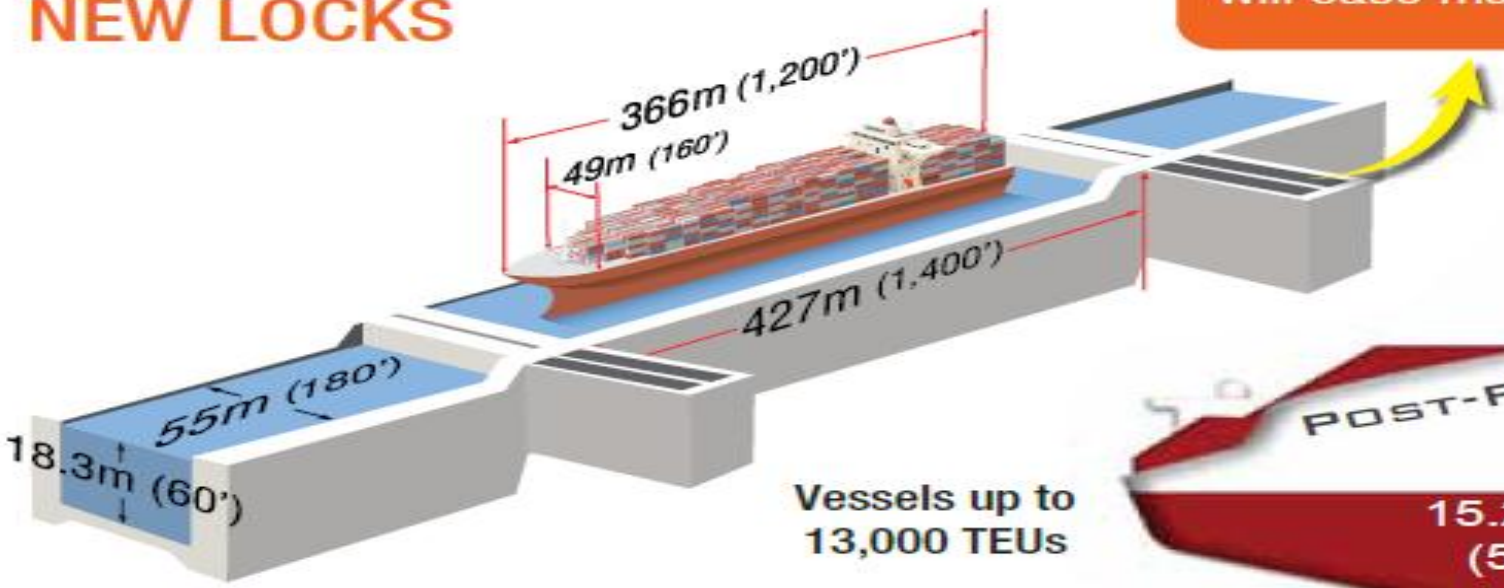


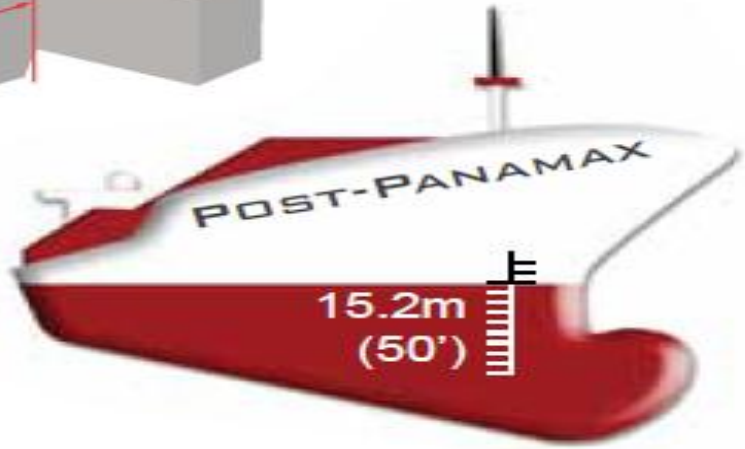
Vessels up to
5,000 TEUs

40 foot draft

NEW LOCKS

The use of rolling gates will ease maintenance

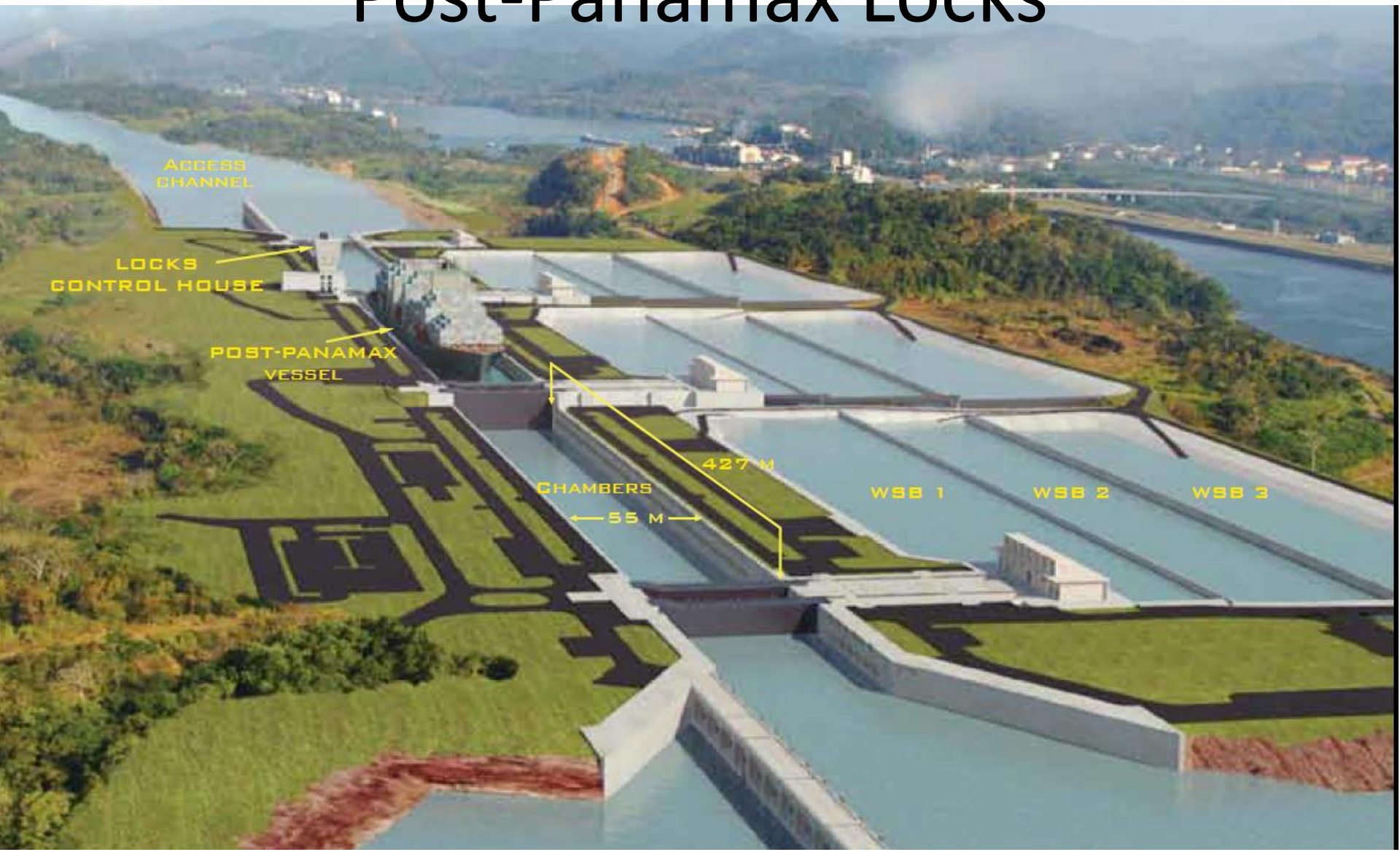




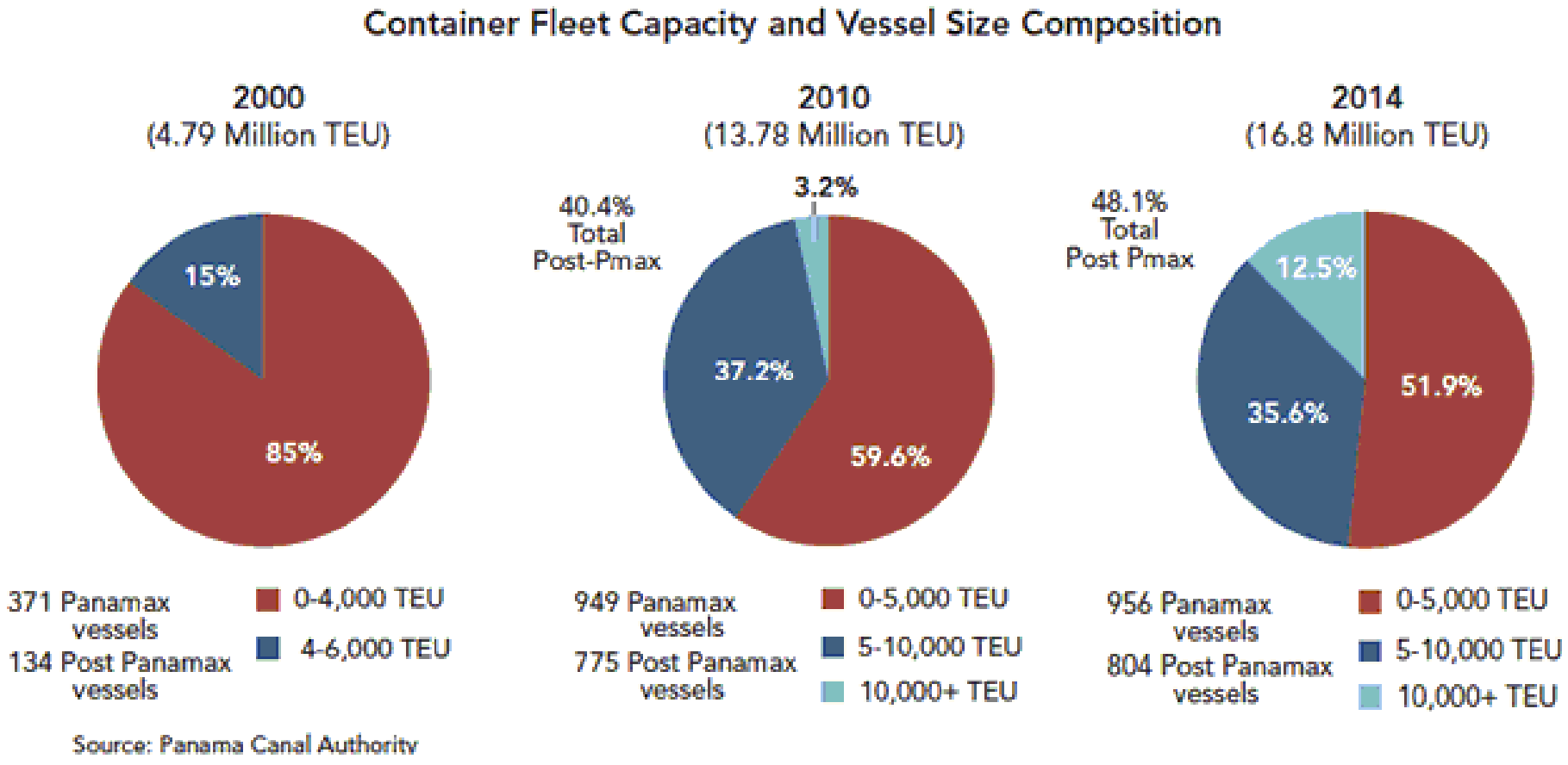
Vessels up to
13,000 TEUs

50 foot Draft

Post-Panamax Locks



Global Container Ship Fleet is Growing as are the Ships



And so are the Bulk Carriers most important to New Orleans

Length b.p.	222.00 m	A deck to B deck	2.80 m
Breadth mld.	38.00 m	B deck to C deck	2.80 m
Depth mld.	20.70 m	C deck to D deck	2.80 m
Scantling draft	14.90 m	D deck to Bridge deck	2.80 m
MCR	12240 kW	Bridge deck to compass deck	2.80 m
Service speed	14.1 knots	Upper deck to forecastle deck	2.40 m

92,500DWT Post Panamax Bulk Carrier

Status Quo for Navigation

- **Limited funding for dredging Southwest Pass**
- **Reduced draft levels mean lost revenues**
- **Shallow draft users *depend on* a thriving deep-draft system at mouth of the river**
- **River mouth is becoming geologically unstable in ways that could threaten *all* navigation**
- **Obsolescence of fixed port infrastructure**

- **Opportunity for deeper (55 ft) and more reliable navigation entrance**
- **Reduced dredging costs in the long-term**
- **Maximum sediment for land-building**
- **A healthy Delta that protects shallow and deep-draft channels and ports from storms**
- **Strong political alliance to achieve both ecological and economic goals**

Science Summary

- River wants to be shorter, is abandoning the bird-foot mouth
- Gradient shift raises flood flowline and favors upstream diversions, whether controlled or uncontrolled
- Diversions can be operated at high discharge to reduce flood flowline, so that levees do not need to be lifted
- Large, well-designed diversions can capture sand efficiently and potentially reduce dredging

Navigation Questions

- Can we design a better navigation entrance that takes advantage of the new geological understanding?
- If we can extract the sediment upstream during high discharge with large diversions, can we more reliably operate the navigation entrance for a 55 foot controlling depth without increasing dredging costs?

An Immodest Proposal

- The Corps of Engineers and State Office of Coastal Protection and Restoration are embarking on a multi-year study of the Lower Mississippi but we are concerned that more urgent effort is needed
- Our private NGO consortium has raised seed funds to initiate an international design competition to bring fresh ideas to New Orleans. We need your help!

International Design Competition

- While the design competition approach may seem radical, it is not unprecedented on the Mississippi River…
  - Consider that Mr. Eads' Jetties at South Pass were constructed with private funds in the late 1800s as a speculative venture that successfully increased draft across the bar and revolutionized deep-draft navigation in the lower River. *His reward was a 30 year maintenance contract*

Too bad Mr. Eads is not around to help us now!

International Design Competition

- While the design competition approach may seem radical, it is not unprecedented for other projects of national importance…
  - Acquisition of next generation fighter aircraft, for example, have long been done in this way, with qualified vendors proposing different designs to meet DOD specifications
  - Finalists are then paid to build prototypes that then compete for the contract

International Design Competition

- If New Orleans and Louisiana is to thrive in the future, it must take advantage of its position at the entrance of the Mississippi River
  - To remain competitive economically
  - To address the ecological collapse of the delta that provides protection from storms and so many other benefits

Post-Panamax Locks 2014

Delta Restoration to Sustain Navigation and Flood Control

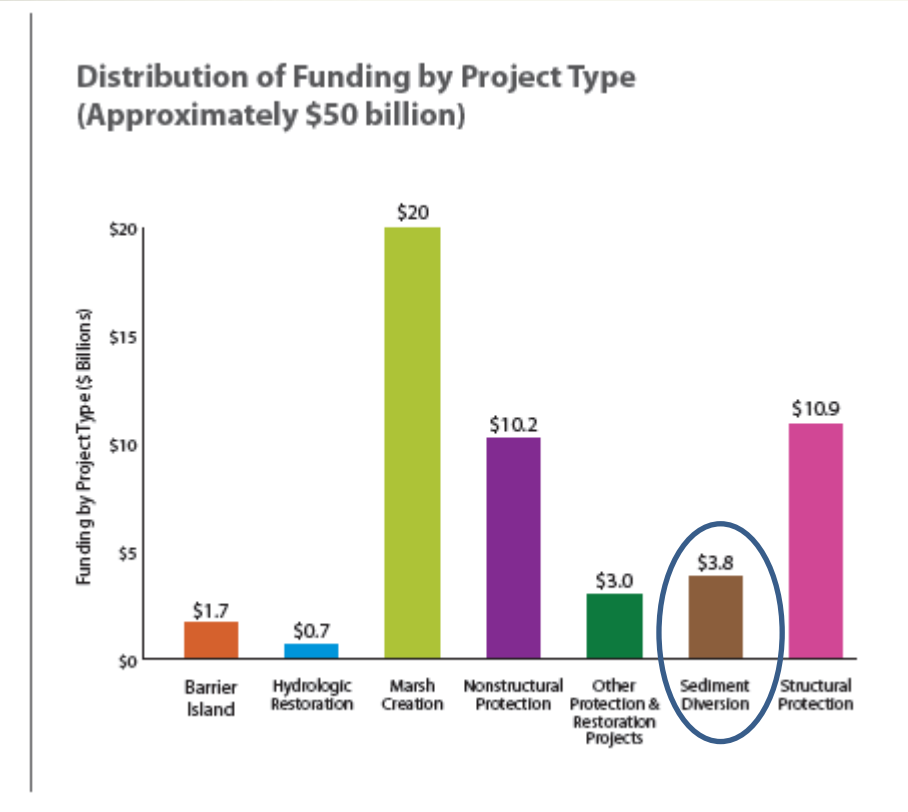
G. Paul Kemp, David Rogers and Clint Willson

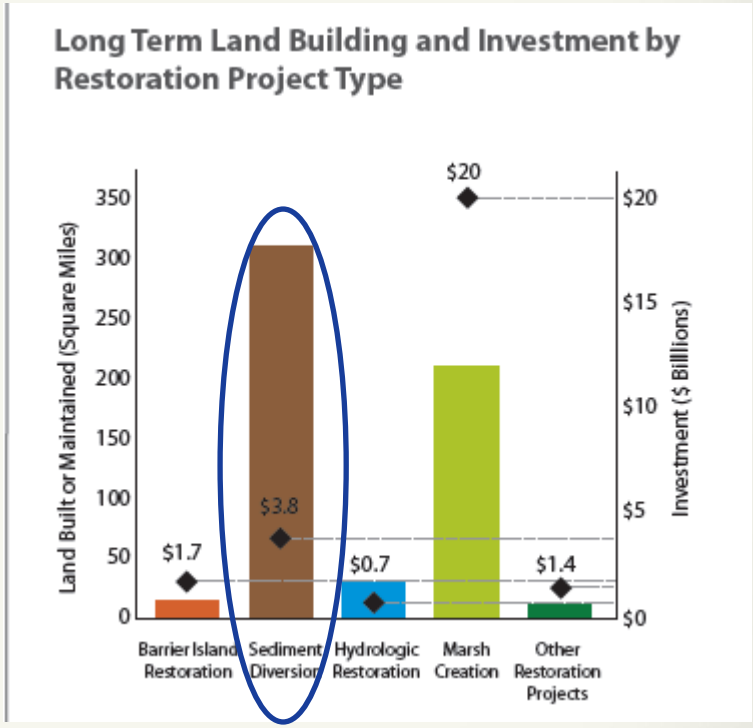
Audubon

EDF ENVIRONMENTAL DEFENSE FUND®
Finding the ways that work

NATIONAL WILDLIFE FEDERATION®

The Mississippi River is our most Valuable Restoration Asset





Figures from Louisiana's Comprehensive Master Plan for a Sustainable Coast, 2012

A number of NGO scientists and SEST members participated in developing this plan and ensuring its adoption by the State legislature this year