Implications of Sea Level Rise: Case Study on the East Land Bridge

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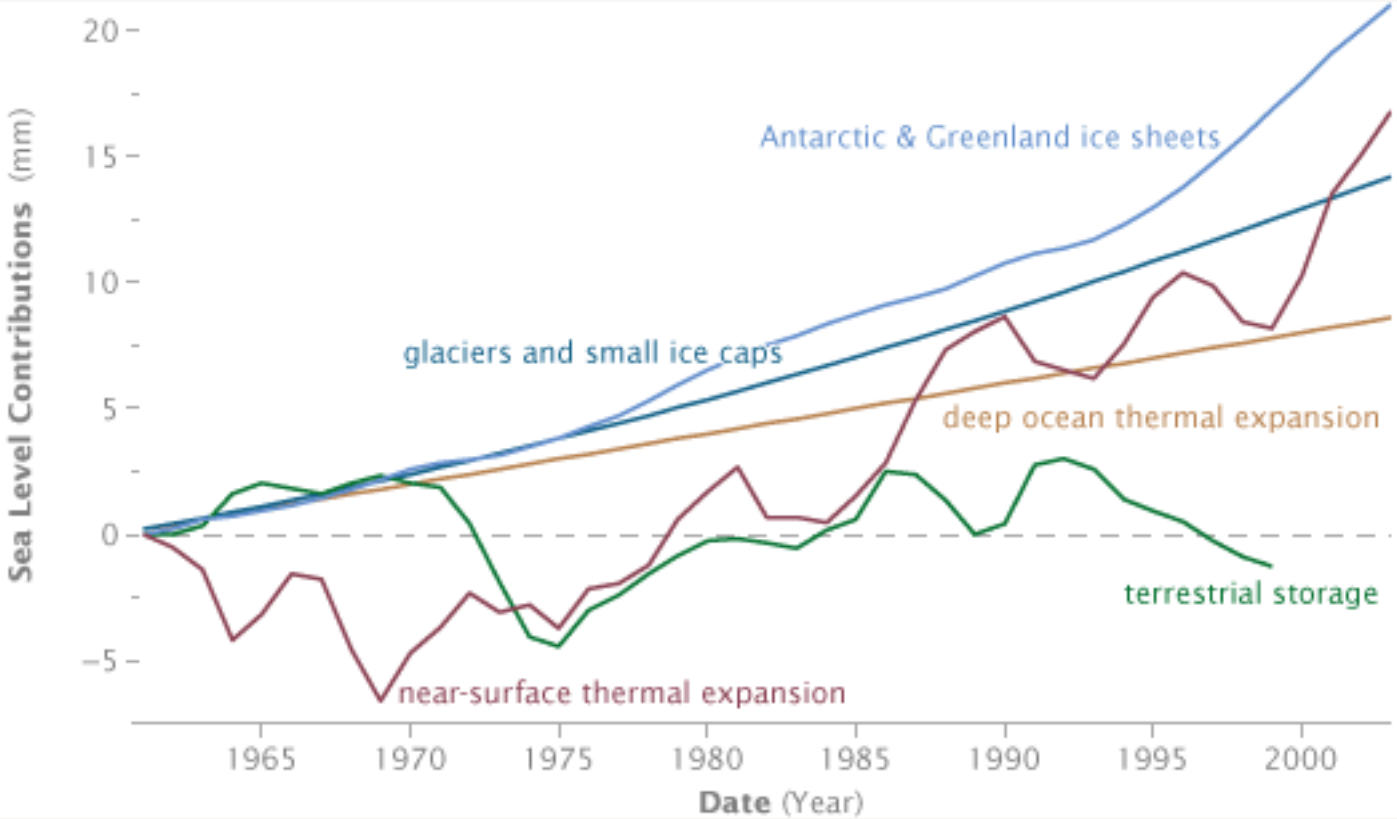
SLR Contributions to 2004



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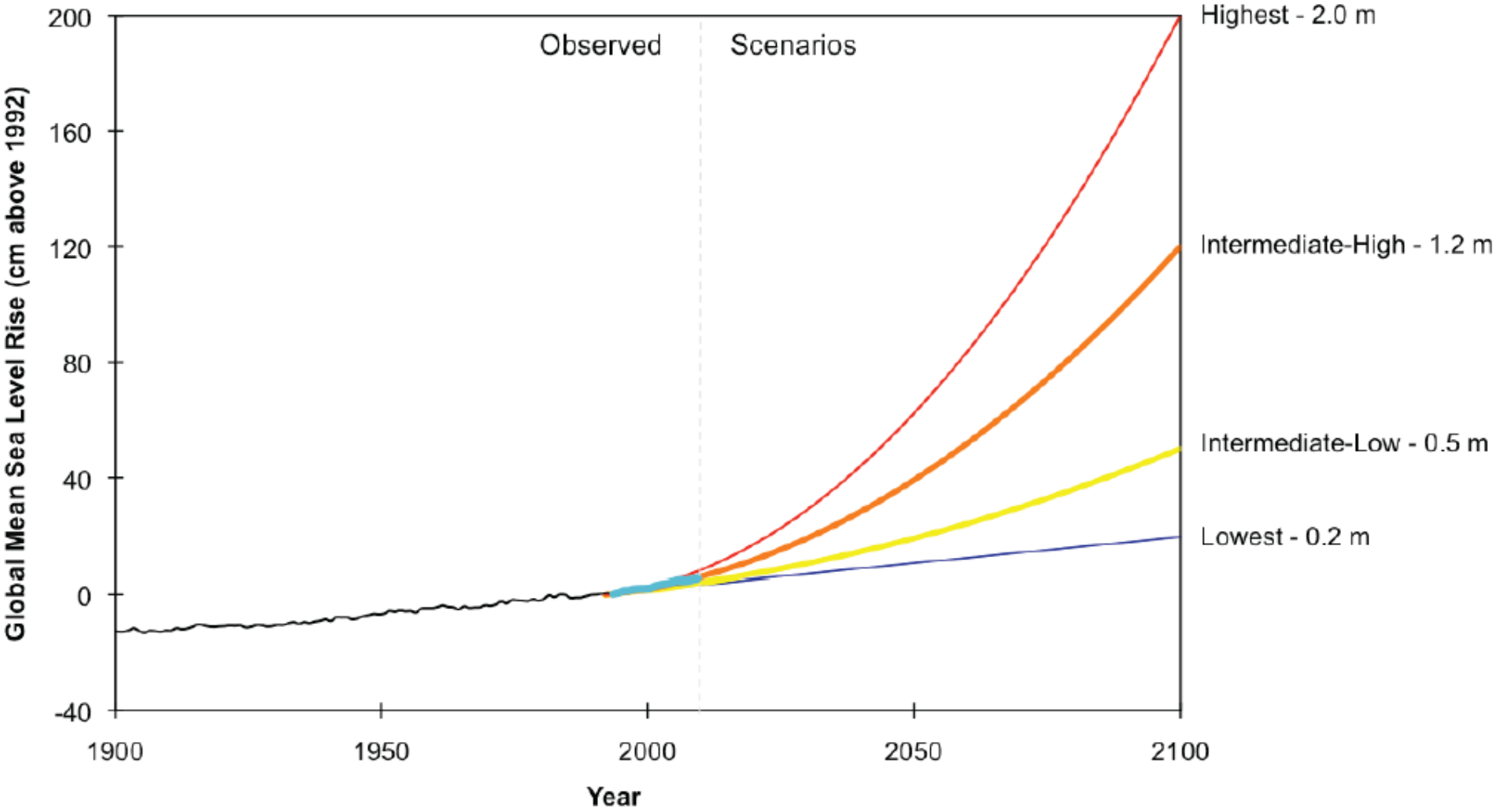
NOAA 2012 Global Sea Level Rise Scenarios



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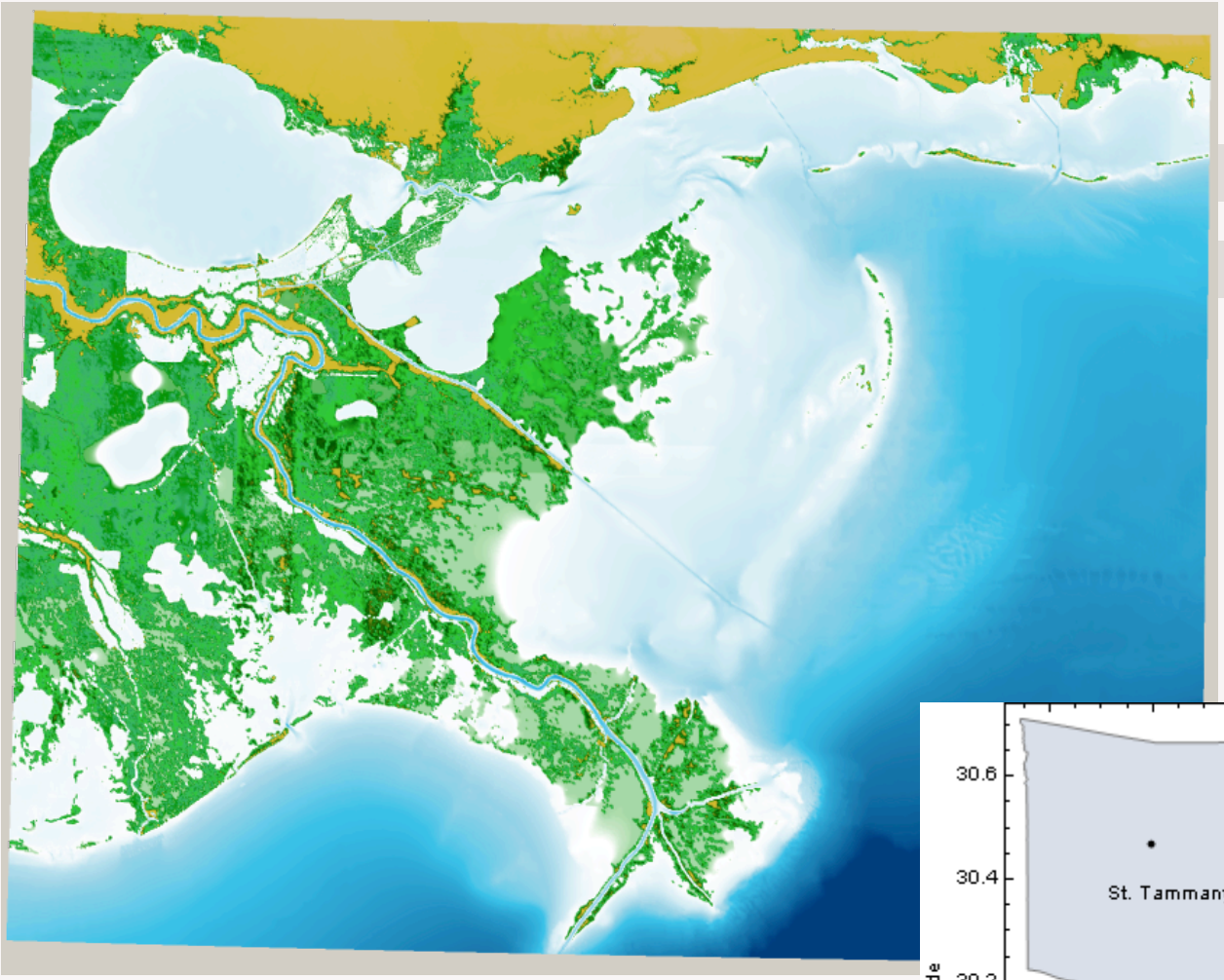


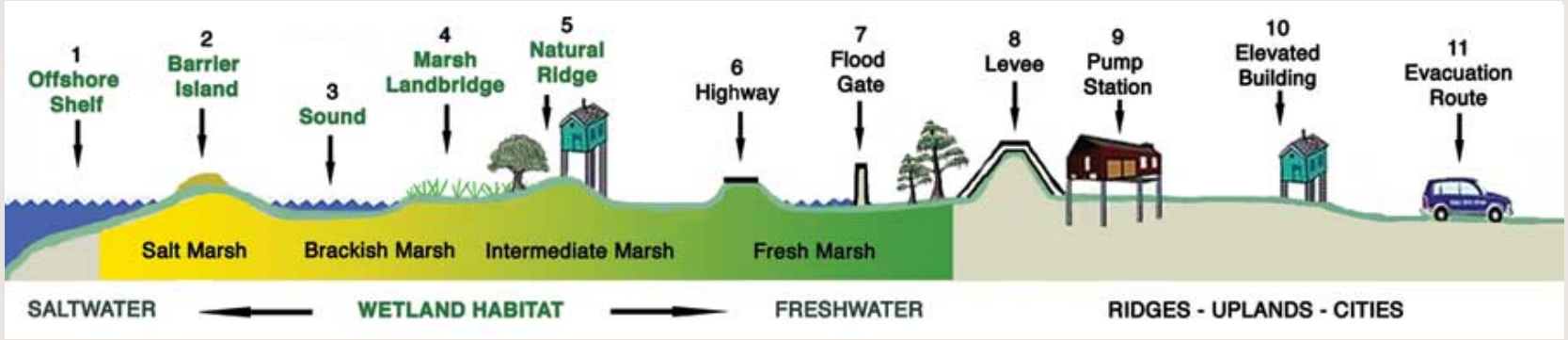
NOAA DEM

Timeline for study: 2060

Regional influence: St. Tammany, Orleans, St. Bernard parishes and State of Mississippi

Critical location: direct line of defense against storm surge

Multiple Lines of Defense Principle



- Barrier Island
- Rock Dike
- Augmented Armored Berm
- Marsh Restoration
- Elevated and Augmented Highway
- Earthen Levee, Floodwalls and Flood Gates

Limit realm of potential measures to well-defined and recognized framework

Lopez, J., and M. Davis. *Framework for Environmental Assessment of Alternative Flood Control Structures on Chef Menteur and Rigolets Passes Within the Lake Pontchartrain Estuary, Southeast Louisiana*. New Orleans, LA: Lake Pontchartrain Basin Foundation, April 2011.
Lopez, J., N. Snider, C. Dufrechou, M. Hester, and P. Keddy. *Comprehensive Recommendations Supporting the Use of the Multiple Lines of Defense*
Lopez, J., and M. Davis. *Framework for Environmental Assessment of Alternative Flood Control Structures on Chef*

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Coastal areas and navigational structures

Coastal areas and

- Challenges
  - Challenges
  - Viability and long-term value of various shoreline protection schemes
  - Shoreline erosion/accretion
  - Storm surge/tidal events combined
  - threaten entire project

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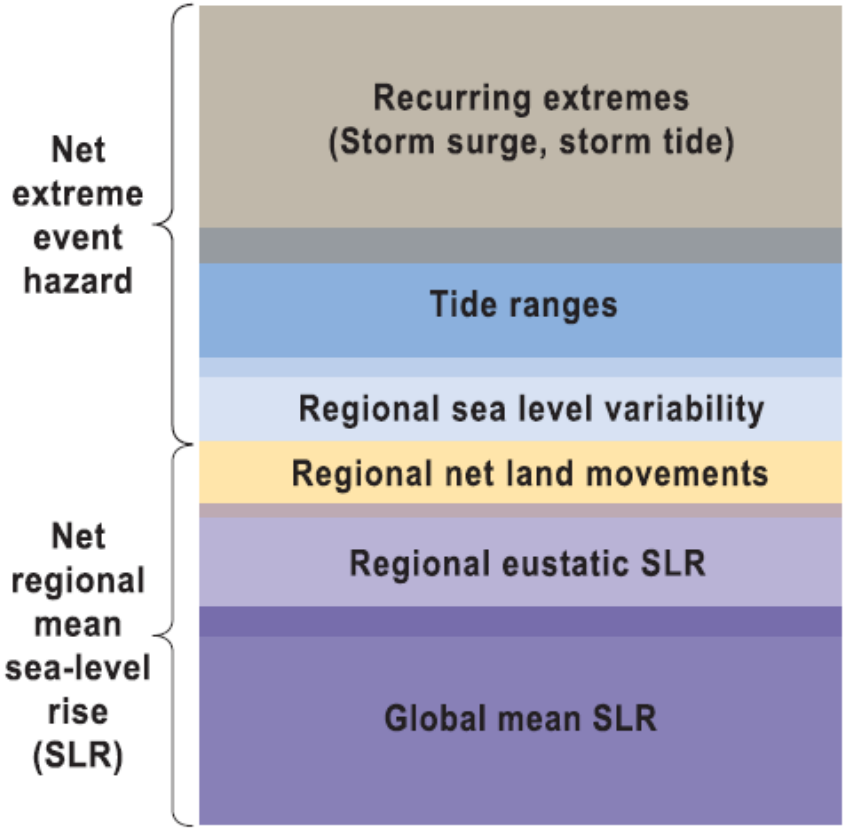
Main Contributors to Local Extreme Sea Levels



	Timeframe	Cause	Predictability
Recurring extremes (Storm surge, storm tide)	Hours–days	Wave, winds, storm strength, coastal and offshore form	Moderate from observations; future very uncertain
Tide ranges	Daily–yearly	Gravitational cycles	Very predictable
Regional sea level variability	Seasonal–decadal	Wave climates	Not well known
Regional net land movements	Decades–millennia	Tectonics and compression	predictable once measured
Regional eustatic SLR	Months–decades	Ocean warming, currents, climate	Existing effects observable, future effects uncertain
Global mean SLR	Decades–centuries	Climate change (temperature, ice melt)	Short term extend current rates, future changes uncertain especially beyond 2100

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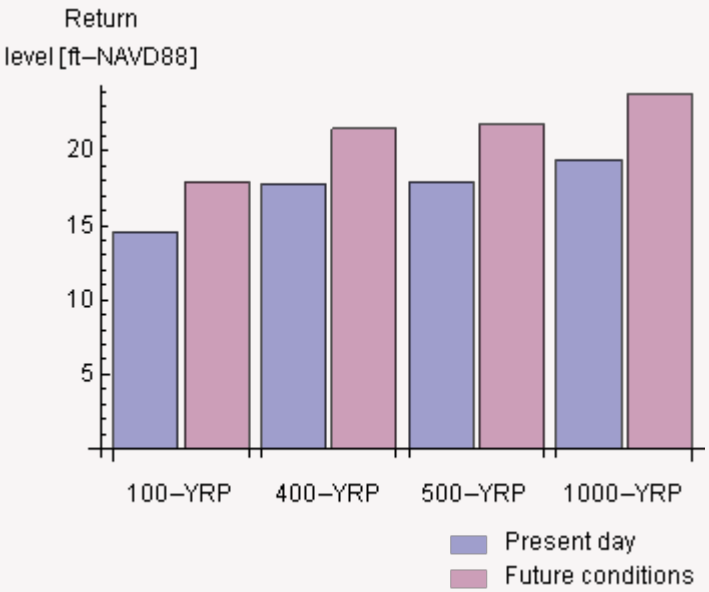
Present Day and Estimated Future Condition Storm Surge Hazard at ELB

- In LACPR Technical Report
  - Include high estimates for future sea-level rise conditions
  - Estimates provide a good reference for the existing flood risk in the South Lake Pontchartrain region, in the absence of a flood control system
  - Return periods: 100, 400 and 1000-YRP
- Double check with most recently (1984) FEMA FIRM stating 18ft-NGVD29 storm surge elevation

Added value: design basis for flood control system to be investigated in this study



Return period	Present conditions (base case) [ft]	Future conditions [ft]
100-YRP	14.6	17.9
400-YRP	17.8	21.5
1000-YRP	19.4	23.8

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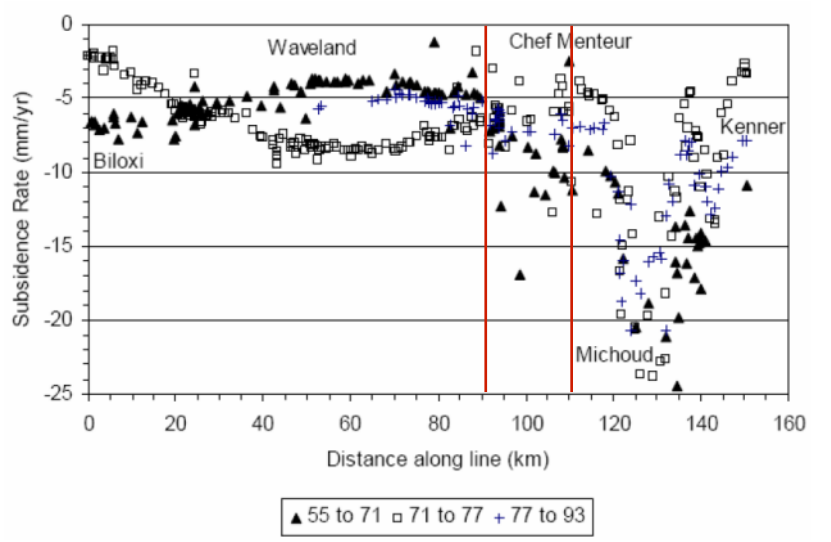
Design Subsidence Rate

Location	Easting	Northing	Subsidence by 2060 [m (ft)]		
	[m]	[m]	Low	Average	High
Chef Menteur, LA	229904	3329253	0.15 (0.49)	0.35 (1.15)	0.6 (1.97)
Michoud, LA	217710	3325564	0.35 (1.15)	0.75 (2.46)	1.2 (3.94)

LAPCR: 2.0 mm/year regional rate; or 0.3ft in 50 years.

USGS: 3.0 mm/year local subsidence rate; or 0.5ft in 50 years.



Design subsidence rate

Location	Subsidence rate [mm/ year]	Subsidence over 50 years [m (ft)]	Subsidence over 100 years [m (ft)]
ELB	3.0	0.15 (0.50)	0.30 (1.0)

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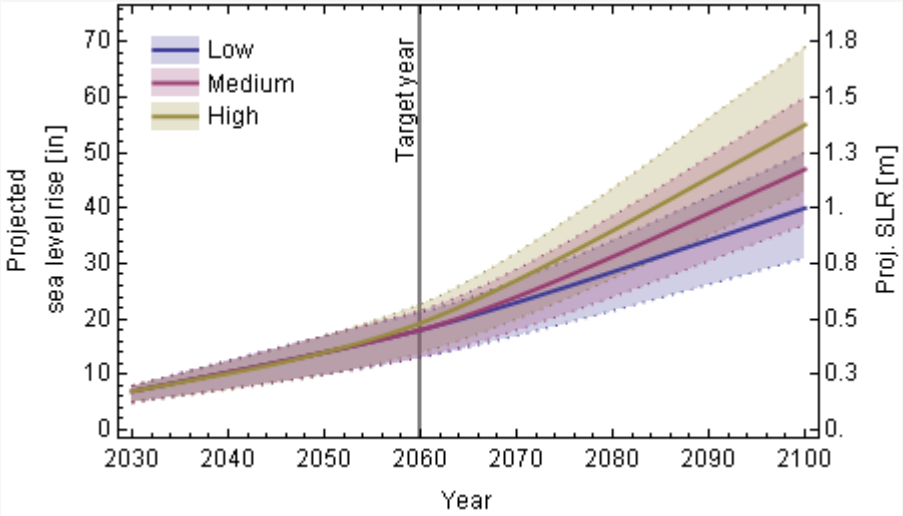
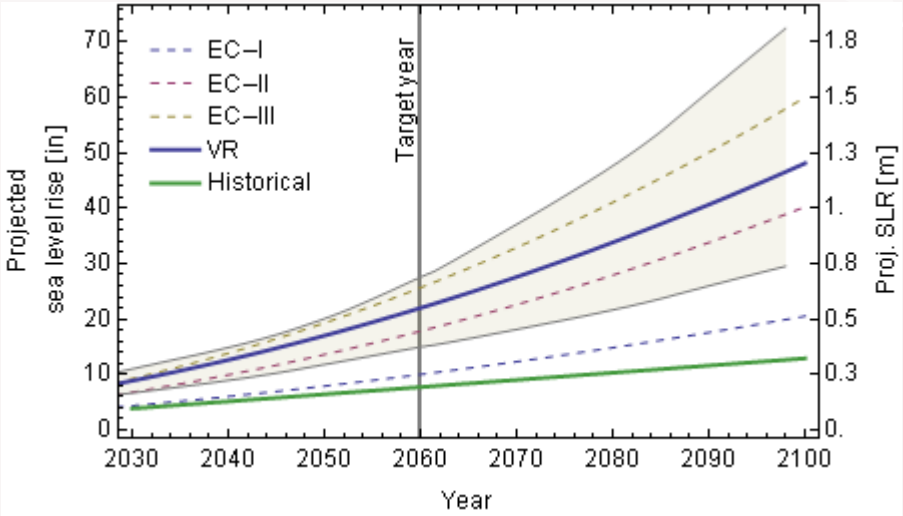
Sea-level Rise





Coastal feature	SLR by 2060 (confidence level)
Low-lying shoreline protection where primary purpose is to slow down erosion/shoreline retreat where failure would be local and limited in severity.	0.47m or 1.55ft (calculated from the mid-range VR, akin to a 50% confidence level)
Critical feature (e.g. levee or floodwall) destined to protect public and private properties and where failure would be catastrophic.	0.7m or 2.3ft (upper limit of VR results, akin to a 90% confidence level)

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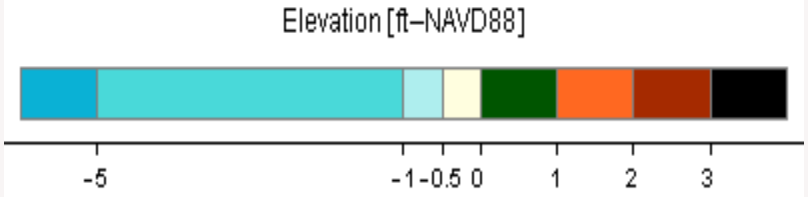
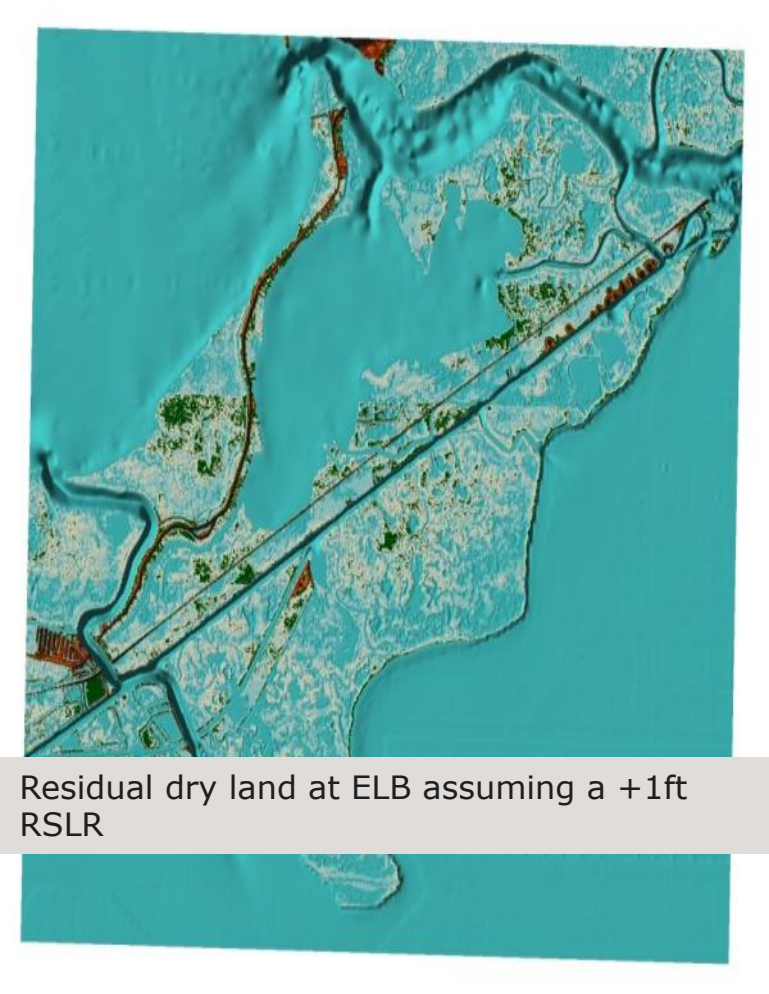
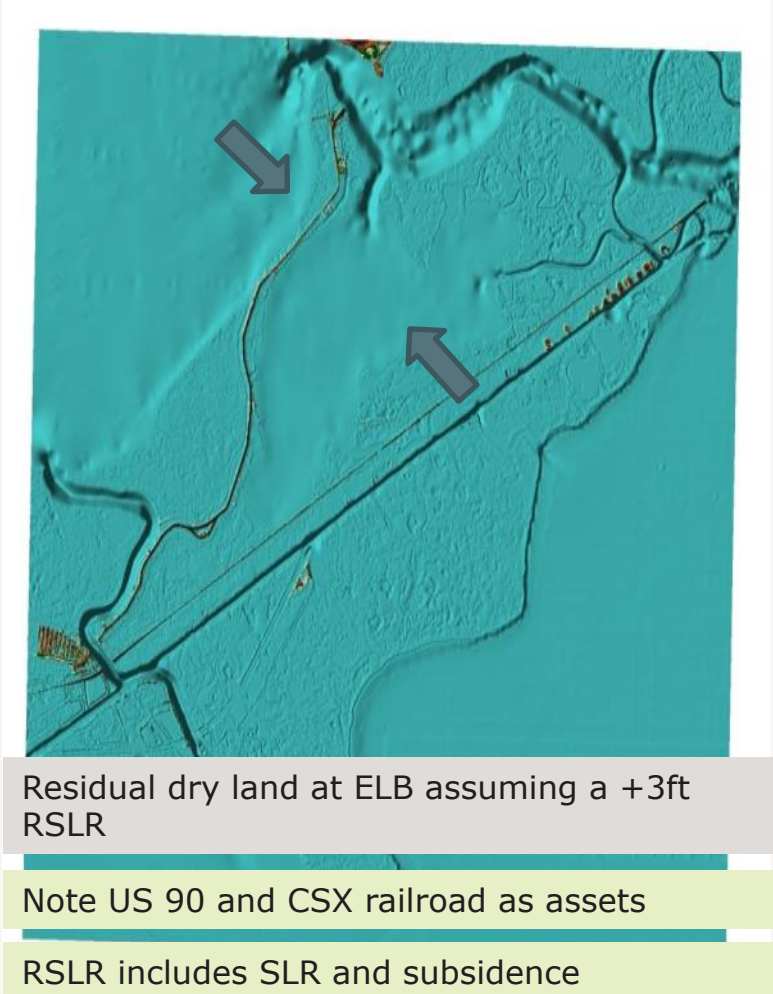




Residual dry land at ELB assuming a +1ft RSLR



Residual dry land at ELB assuming a +3ft RSLR

Note US 90 and CSX railroad as assets

RSLR includes SLR and subsidence

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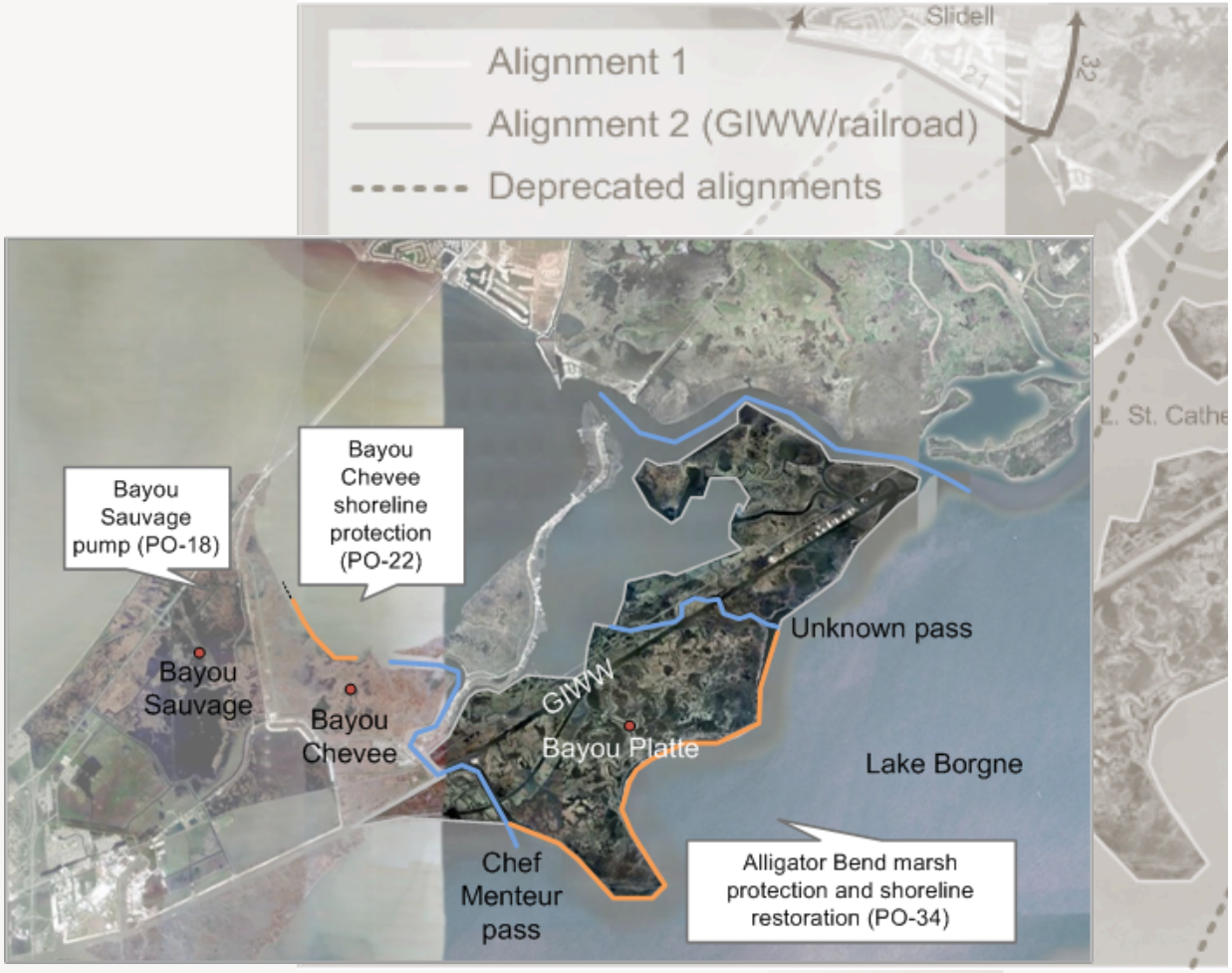
Implications of Sea Level Rise

ELB Project Values To Date

$56,538,200.00



- **Bayou Sauvage, PO-16**
  - Freshwater Impoundment
  - Marsh restoration
  - ***$1,680,193.00***
- **Bayou Sauvage, PO-18**
  - Pump station
  - Marsh restoration
  - On Lake Pontchartrain side, North of ELB
  - ***$1,692,552.00***
- **Bayou Chevee, PO-22**
  - Shoreline protection (wake wash)
  - On Lake Pontchartrain side, North of ELB
  - ***$2,589,403.00***
- **Alligator Bend, PO-34**
  - Marsh restoration project
  - Shoreline protection (wave action)
  - ***$29,716,052.00***
- **Orleans Land Bridge, PO-36EB**
  - Shoreline protection on the northwest rim of Lake Borgne
  - ***$20,860,000.00***

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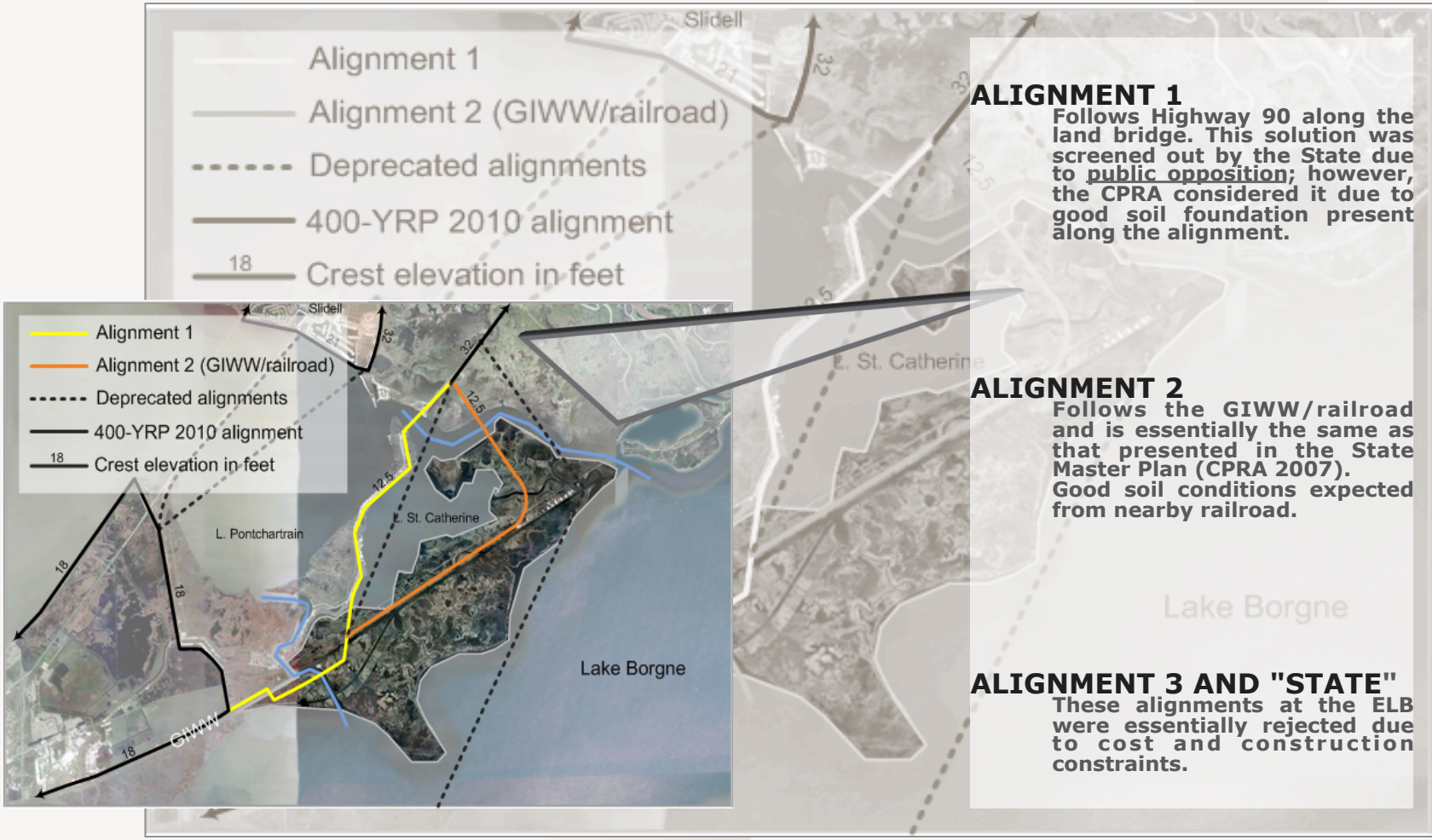
Implications of Sea Level Rise

Proposed ELB High Crest Levee

$825,000,000.00



ALIGNMENT 1

Follows Highway 90 along the land bridge. This solution was screened out by the State due to public opposition; however, the CPRA considered it due to good soil foundation present along the alignment.

ALIGNMENT 2

Follows the GIWW/railroad and is essentially the same as that presented in the State Master Plan (CPRA 2007). Good soil conditions expected from nearby railroad.

ALIGNMENT 3 AND "STATE"

These alignments at the ELB were essentially rejected due to cost and construction constraints.

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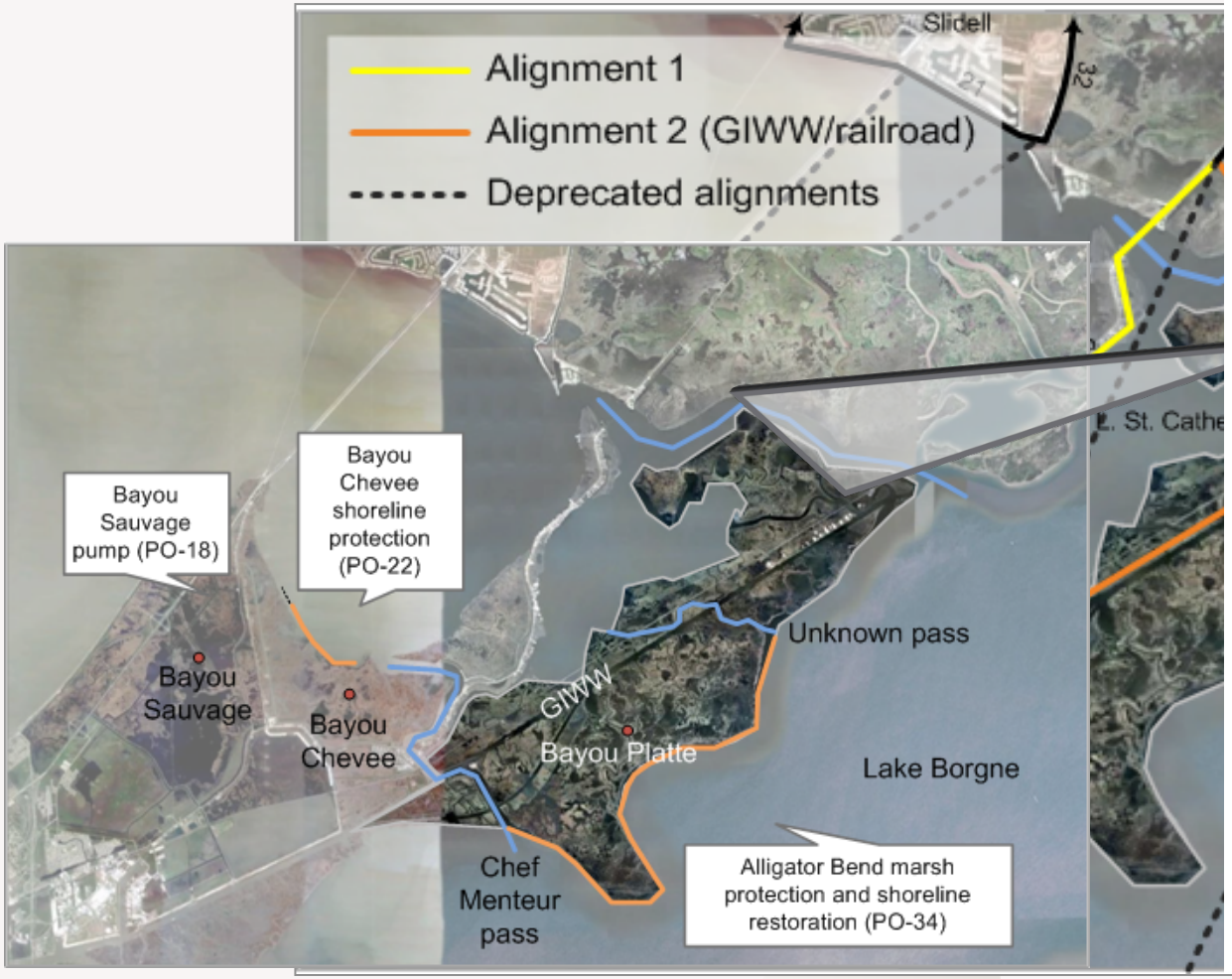
Implications of Sea Level Rise

Total Value of ELB Projects = **$881,538,200.00**



BORGNE

- **EAST LAND BRIDGE**
  - HIGH CREST LEVEE
  - *$825,000,000.00*
- **BAYOU SAUVAGE, PO-18**
  - PUMP STATION
  - MARSH RESTORATION
  - ON LAKE PONTCHARTRAIN SIDE, NORTH OF ELB
  - ***$1,692,552.00***
- **BAYOU CHEVEE, PO-22**
  - SHORELINE PROTECTION (WAKE WASH)
  - ON LAKE PONTCHARTRAIN SIDE, NORTH OF ELB
  - ***$2,589,403.00***
- **ALLIGATOR BEND, PO-34**
  - MARSH RESTORATION PROJECT
  - SHORELINE PROTECTION (WAVE ACTION)
  - ***$29,716,052.00***
- **ORLEANS LAND BRIDGE, PO-36EB**
  - SHORELINE PROTECTION ON THE NORTHWEST RIM OF LAKE BORGNE
  - ***$20,860,000.00***
- **EAST LAND BRIDGE**
  - HIGH CREST LEVEE
  - ***$825,000,000.00***

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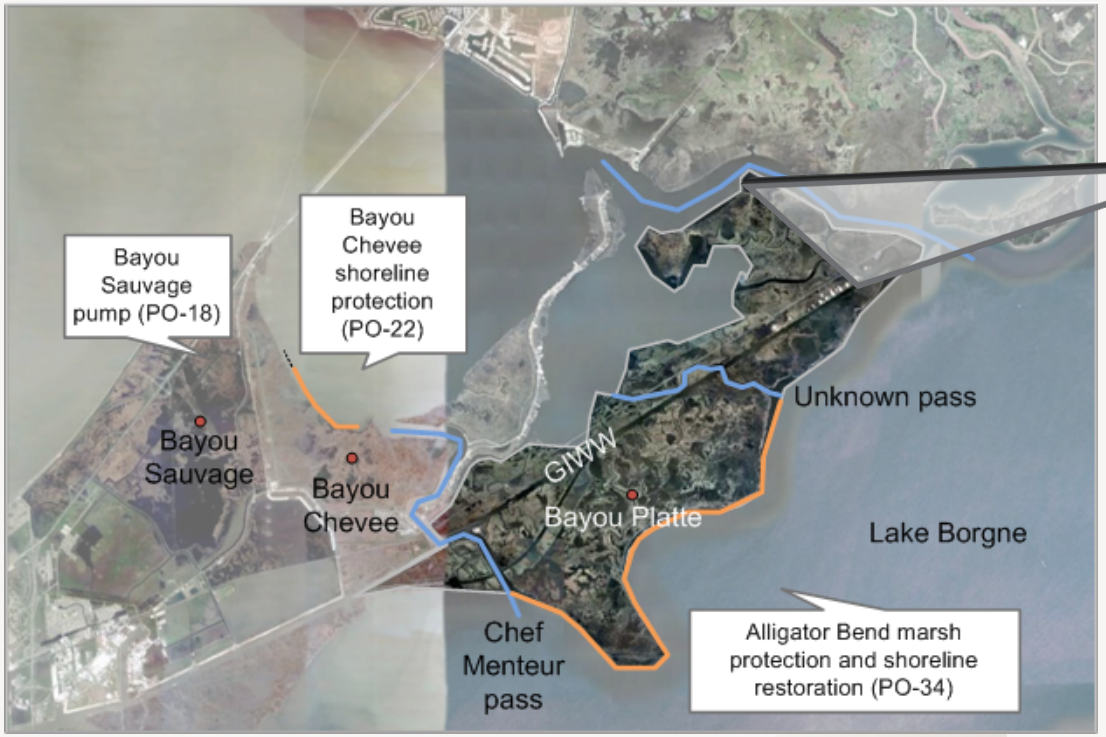
Tulane University Ongoing Research

Department of Energy, National Institute for Climate Change Research (NICCR)

Infrastructure Development Grant

Tulane University Ongoing Research



- The purpose of the project is to simulate storm-surge flooding and record plant response.
- Possible application for CPRA Applied Research Grant Program

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