2017 COASTAL MASTER PLAN

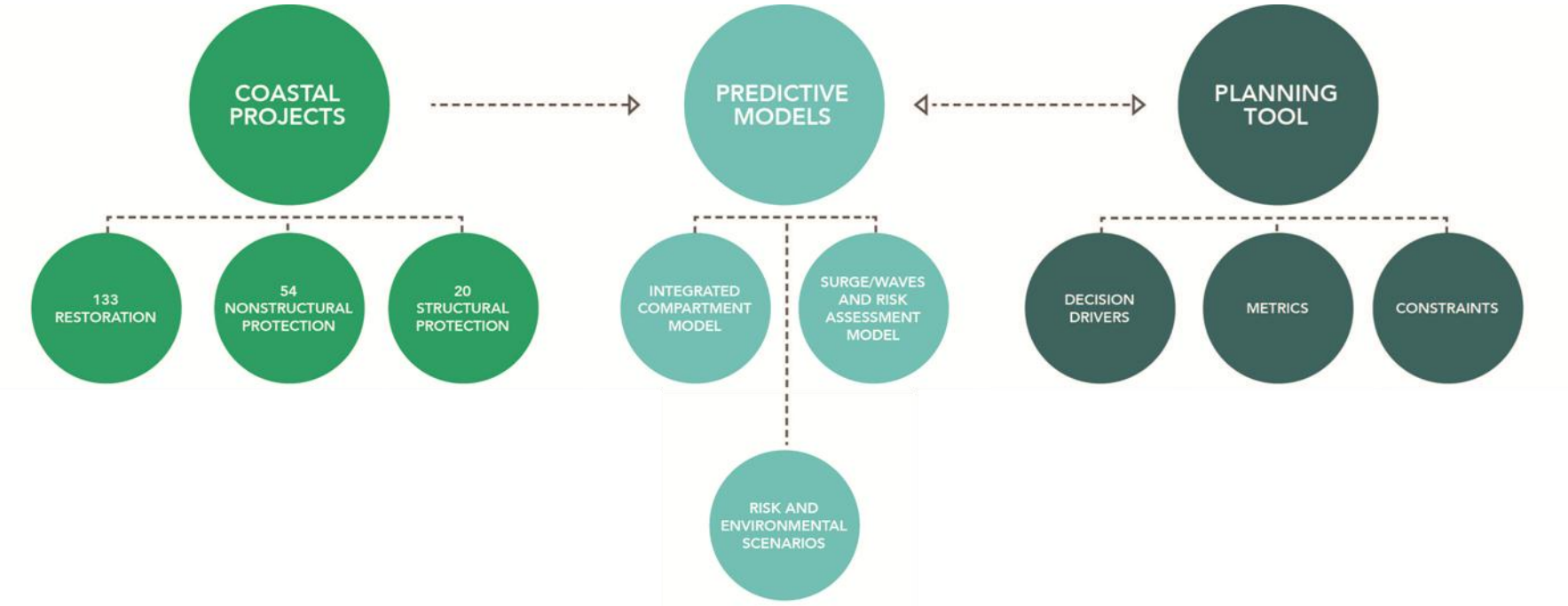
MODELING UPDATE #3

September 22, 2016

WEBINAR AGENDA

Welcome and Introduction	Mandy Green, CPRA
Environmental Scenarios and Input Data	Ehab Meselhe, Water Institute
Model Overviews, Initial Condition, and FWOA	
▪ **Landscape/Ecosystem**	Eric White, Water Institute David Lindquist, CPRA
▪ **Surge/Waves**	Hugh Roberts, Arcadis
▪ **Risk Assessment**	Jordan Fischbach, RAND
Project Results	
▪ **Surge/Waves**	Hugh Roberts, Arcadis
▪ **Risk Assessment**	Jordan Fischbach, RAND
▪ **Landscape/Ecosystem**	Eric White, Water Institute David Lindquist, CPRA
Additional questions	
Adjourn	
***Facilitated by Nick Speyrer**	

PLANNING FRAMEWORK



MASTER PLAN MODELING

- Evaluation of a future without additional action
- Evaluation of the land building and risk reduction potential of individual restoration and protection projects, respectively
- Evaluation of the land building and risk reduction potential of select groups of restoration and protection projects (alternatives)
- 50-year period of analysis

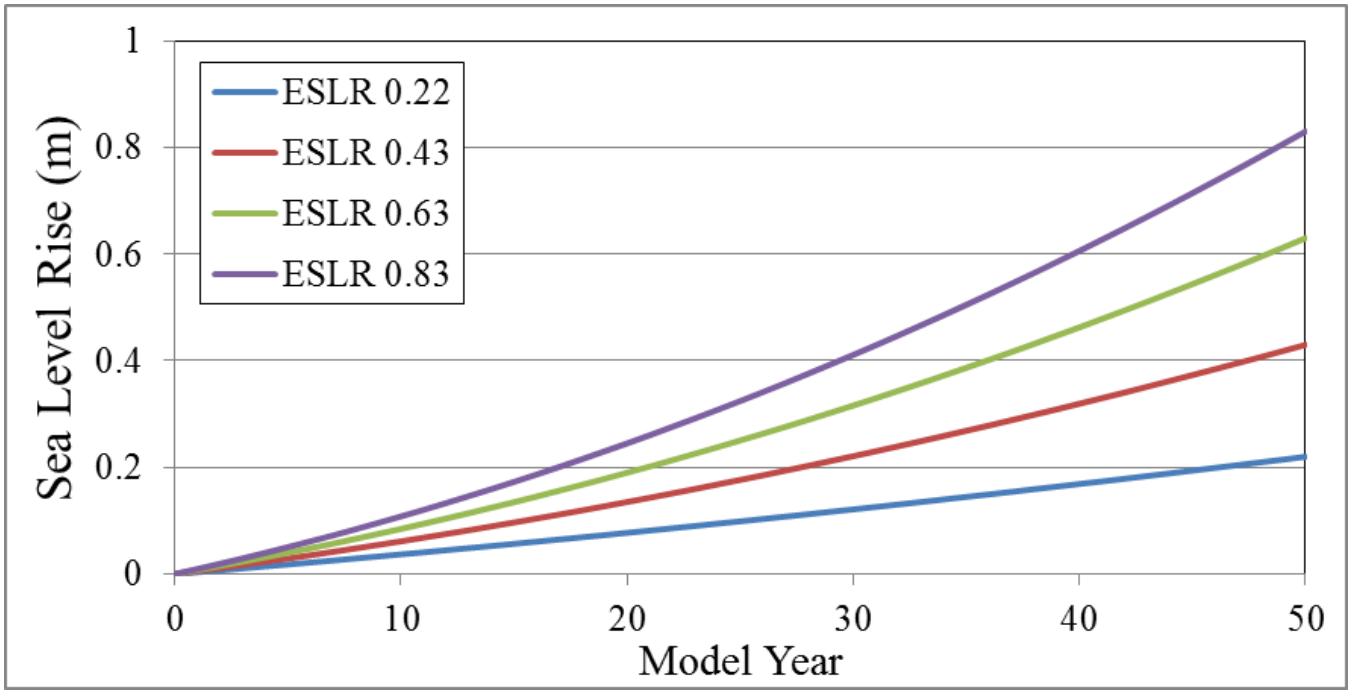
ENVIRONMENTAL SCENARIOS

DEVELOPING ENVIRONMENTAL SCENARIOS

- Revisited 2012 Coastal Master Plan Future Scenarios effort
  - selected variables relevant to the 2017 analyses
  - identified whether plausible ranges should be modified using recent literature, data, and other information
- Designed focused numerical experiments and performed analysis to assess the response of key ICM output
- Evaluated model outputs for land change over 50 years
- Identified three scenarios (combination of values of environmental variables)
- Values are relevant to each environmental variable and may therefore refer to a time series or a spatial map, as appropriate

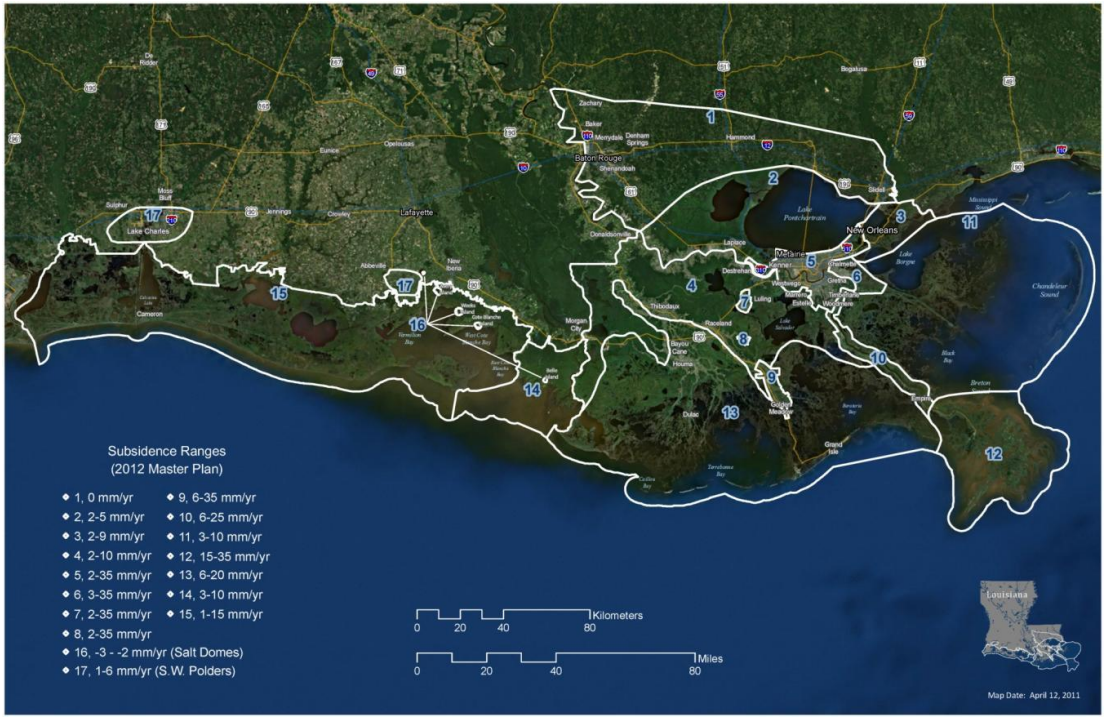
EVALUATING ENVIRONMENTAL SCENARIOS

- **Eustatic Sea Level Rise**
  - Plausible range: 0.14 to 0.83 m over 50 years



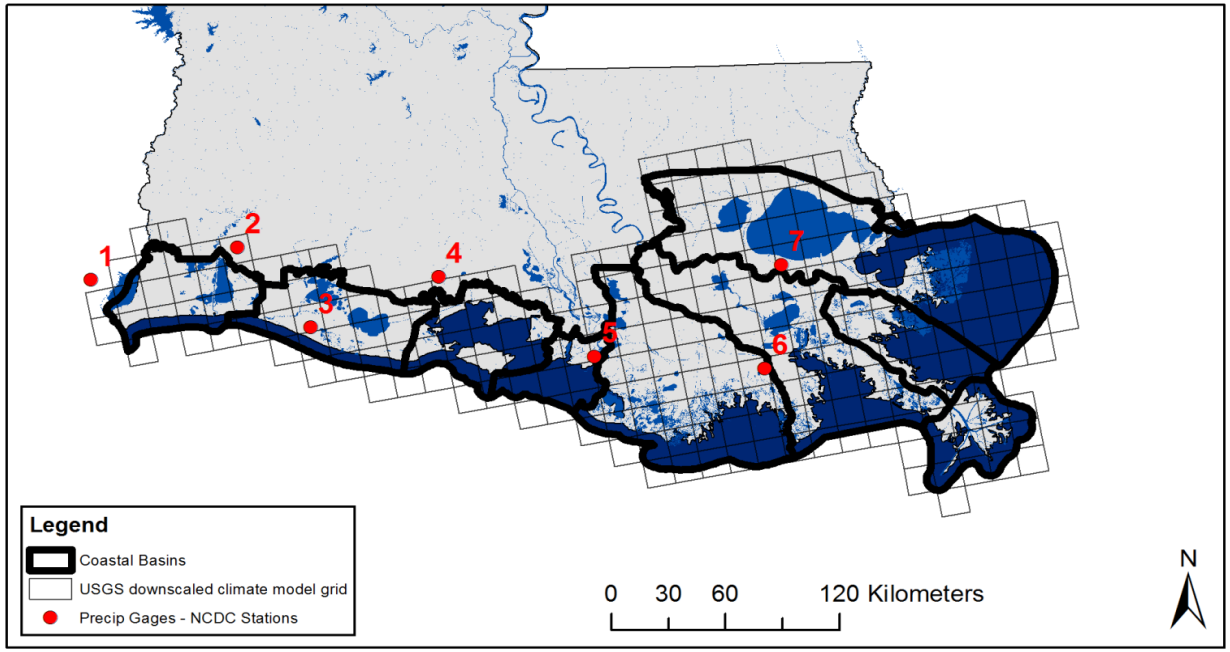
EVALUATING ENVIRONMENTAL SCENARIOS

- **Subsidence**
  - Plausible range: spatially variable; same as 2012 regions and values
  - Three subsidence rates were evaluated: 20%, 50%, and 75% of the identified rage for each region.



EVALUATING ENVIRONMENTAL SCENARIOS

- **Precipitation**
  - Plausible range: -5% to +14% of 50-yr observed cumulative



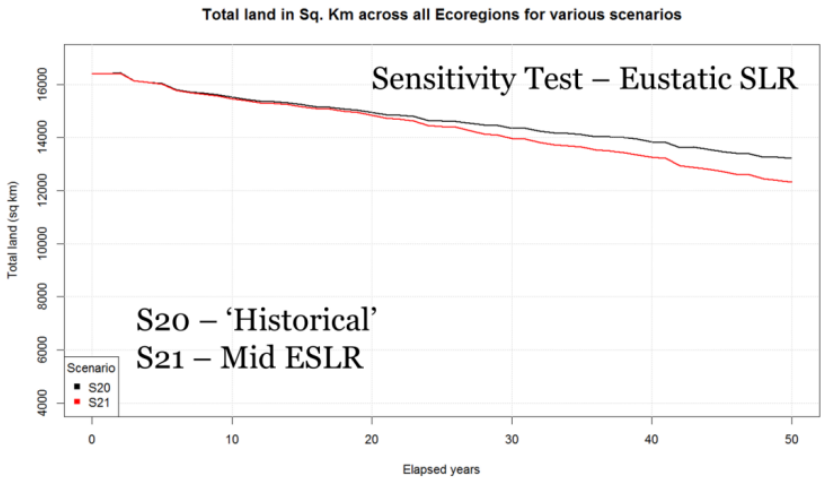
USGS Dynamical Downscaled Daily Regional Climate V1.0 – Eastern North America

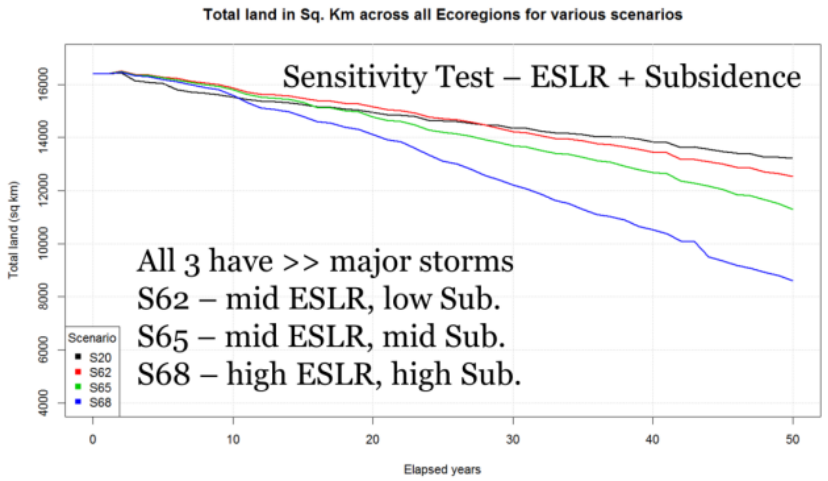
- **Evapotranspiration**
  - Plausible range: -30% to historic 50-yr cumulative

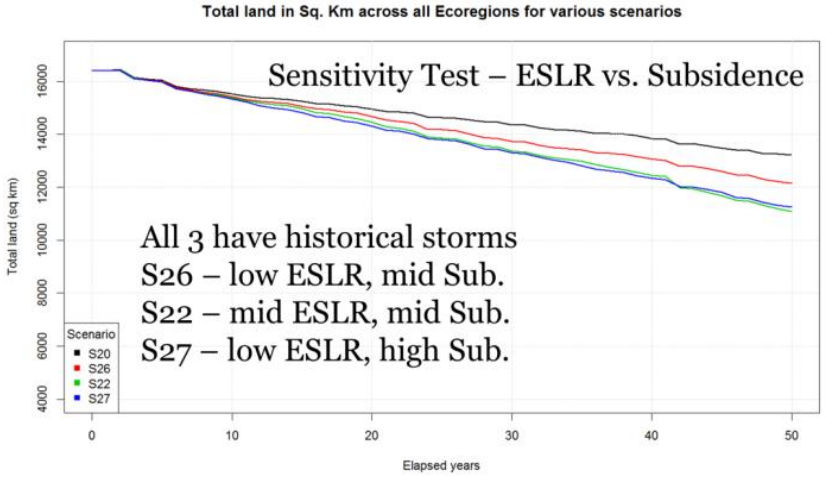
SENSITIVITY ANALYSES

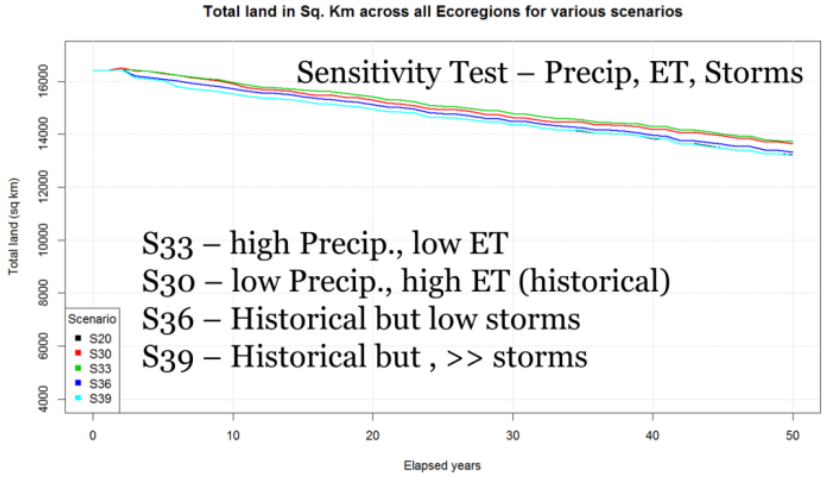
Run ID	Precipitation	ET	ESLR (m/50 years)	Subsidence	Number of Storms	Number of Major Storms
S20 (base)	Historical (mid)	Historical (high)	0.22 (low)	20% of range (low)	23 (High)	11 (Low)
S21	Historical (mid)	Historical (high)	0.43 (mid)	20% of range (low)	23 (High)	11 (Low)
S22	Historical (mid)	Historical (high)	0.43 (mid)	50% of range (mid)	23 (High)	11 (Low)
S24	Historical (mid)	Historical (high)	0.83 (high)	50% of range (mid)	23 (High)	11 (Low)
S26	Historical (mid)	Historical (high)	0.22 (low)	50% of range (mid)	23 (High)	11 (Low)
S27	Historical (mid)	Historical (high)	0.22 (low)	75% of range (high)	23 (High)	11 (Low)
S30	GENMOM (low)	Historical (high)	0.22 (low)	20% of range (low)	23 (High)	11 (Low)
S33	ECHAM (high)	GENMOM (low)	0.22 (low)	20% of range (low)	23 (High)	11 (Low)
S36	Historical (mid)	Historical (high)	0.22 (low)	20% of range (low)	17 (Low)	8 (Low)
S39	Historical (mid)	Historical (high)	0.22 (low)	20% of range (low)	23 (High)	18 (High)
S62	GENMOM (low)	Historical (high)	0.43 (mid)	20% of range (low)	23 (High)	18 (High)
S65	GENMOM (low)	Historical (high)	0.43 (mid)	50% of range (mid)	23 (High)	18 (High)
S68	GENMOM (low)	Historical (high)	0.83 (high)	75% of range (high)	23 (High)	18 (High)
S76	Historical (mid)	Historical (high)	0.43 (mid)	75% of range (high)	23 (High)	11 (Low)
S77	Historical (mid)	Historical (high)	0.83 (high)	20% of range (low)	23 (High)	11 (Low)

SENSITIVITY ANALYSES

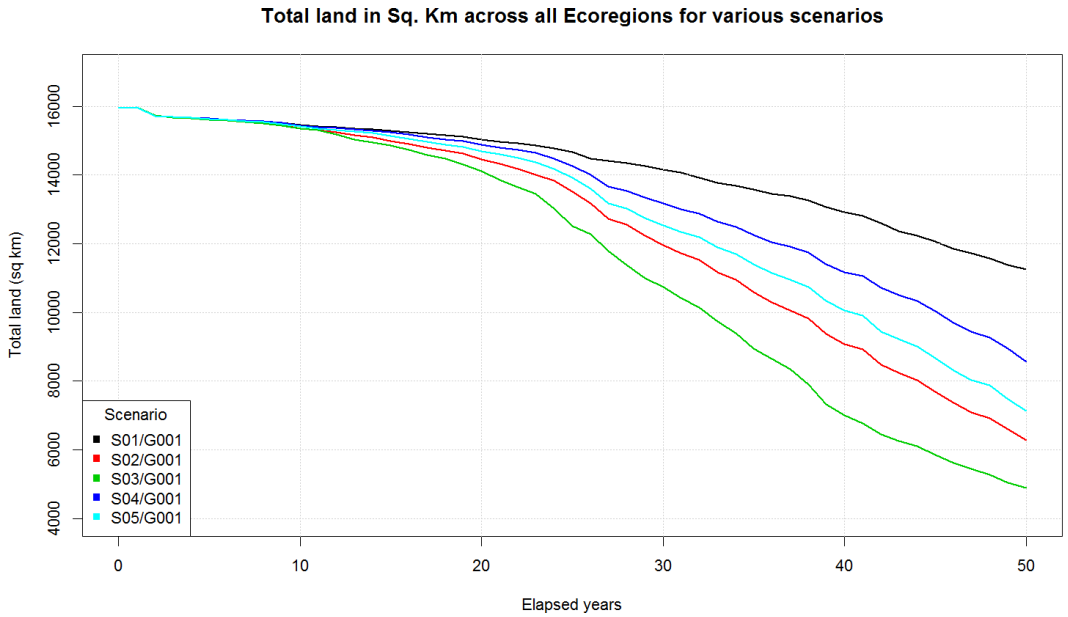








FIVE CANDIDATE SCENARIOS



Scenario	Precipitation	Evapotranspiration	ESLR (m/50yr)	Subsidence
1	>Historical (ECHAM)	<Historical	0.43	20% of range
2	>Historical (ECHAM)	Historical	0.63	50% of range
3	Historical	Historical	0.83	50% of range
4	>Historical (ECHAM)	Historical	0.63	20% of range
5	>Historical (ECHAM)	Historical	0.63	35% of range

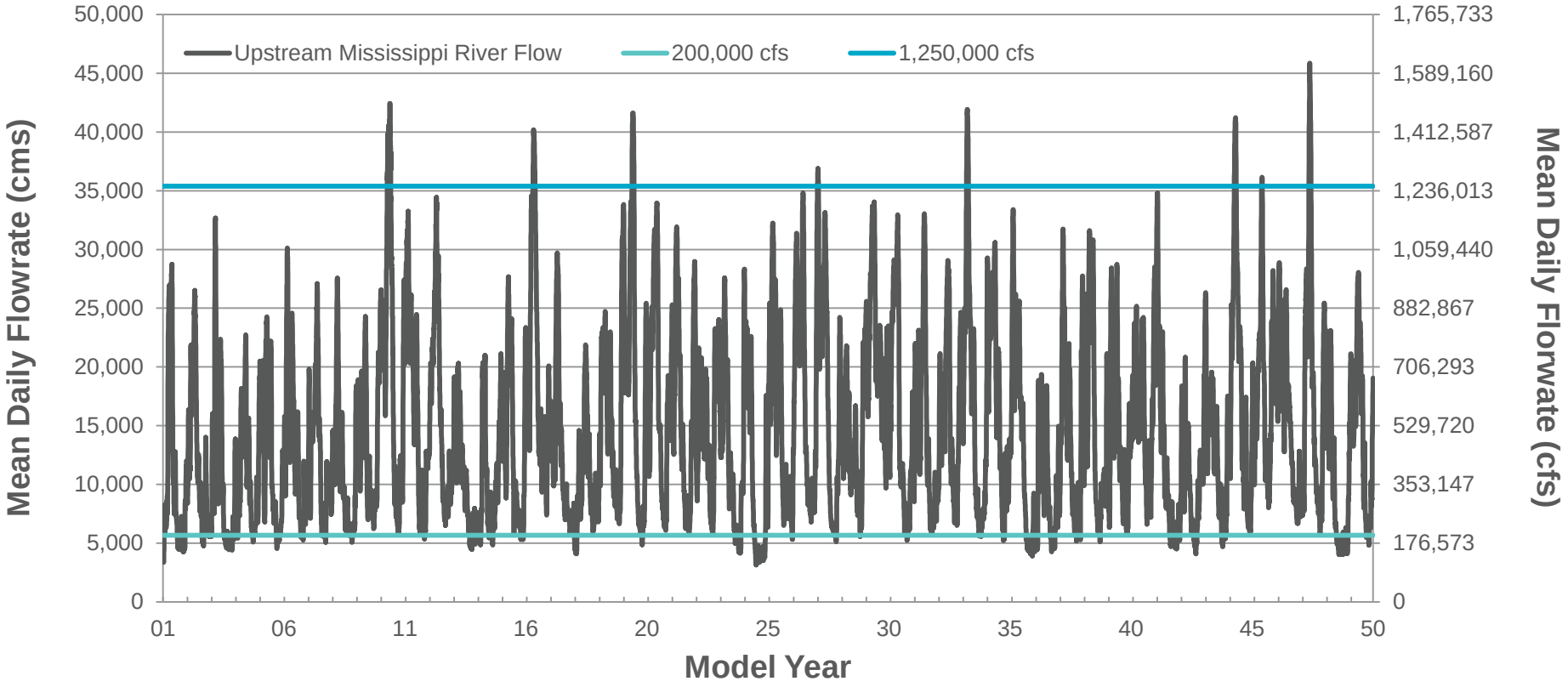
2017 FUTURE SCENARIOS

Scenario	Precipitation	ET	ESLR (m/50yr)	Subsidence
Low	>Historical	<Historical	0.43	20% of range
Medium	>Historical	Historical	0.63	20% of range
High	Historical	Historical	0.83	50% of range

Storm Scenarios used in CLARA	Overall frequency	Average intensity
Scenario 1	-28%	+10.0%
Scenario 2	-14%	+12.5%
Scenario 3	0%	+15.0%

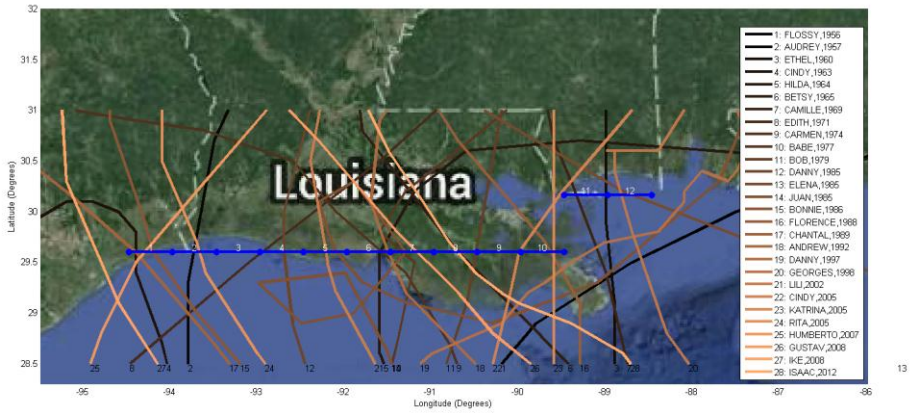
INITIAL CONDITION DATASETS

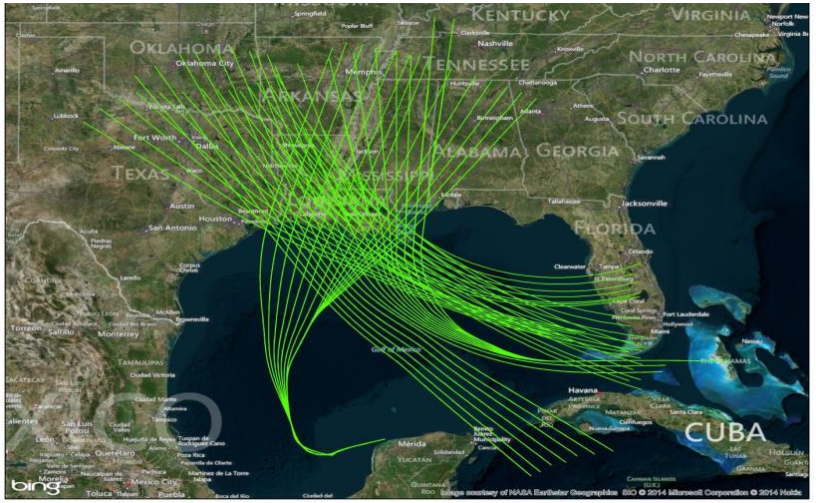
MISSISSIPPI RIVER HYDROGRAPH



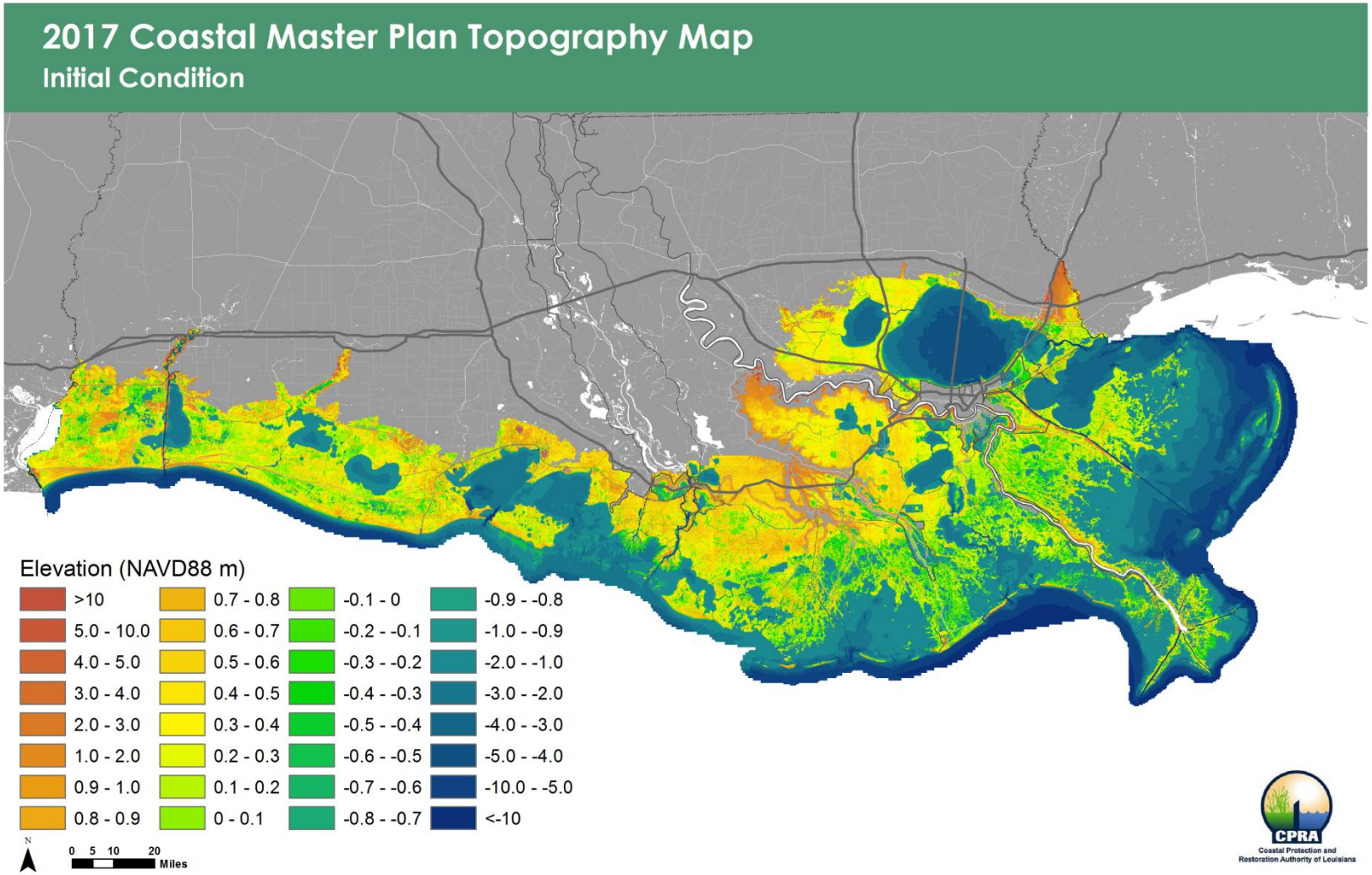
STORMS IN THE ICM BOUNDARY CONDITIONS

- Identify historical hurricane strikes (1950-2013)
- Locate ‘matching’ synthetic storms from JPMOS suite
- Apply storms as forcings in both the 8-year calibration/validation runs (5 storms) as well as the 50-year Master Plan (23 storms; 11 major hurricanes)
- Impacts to the landscape, including islands

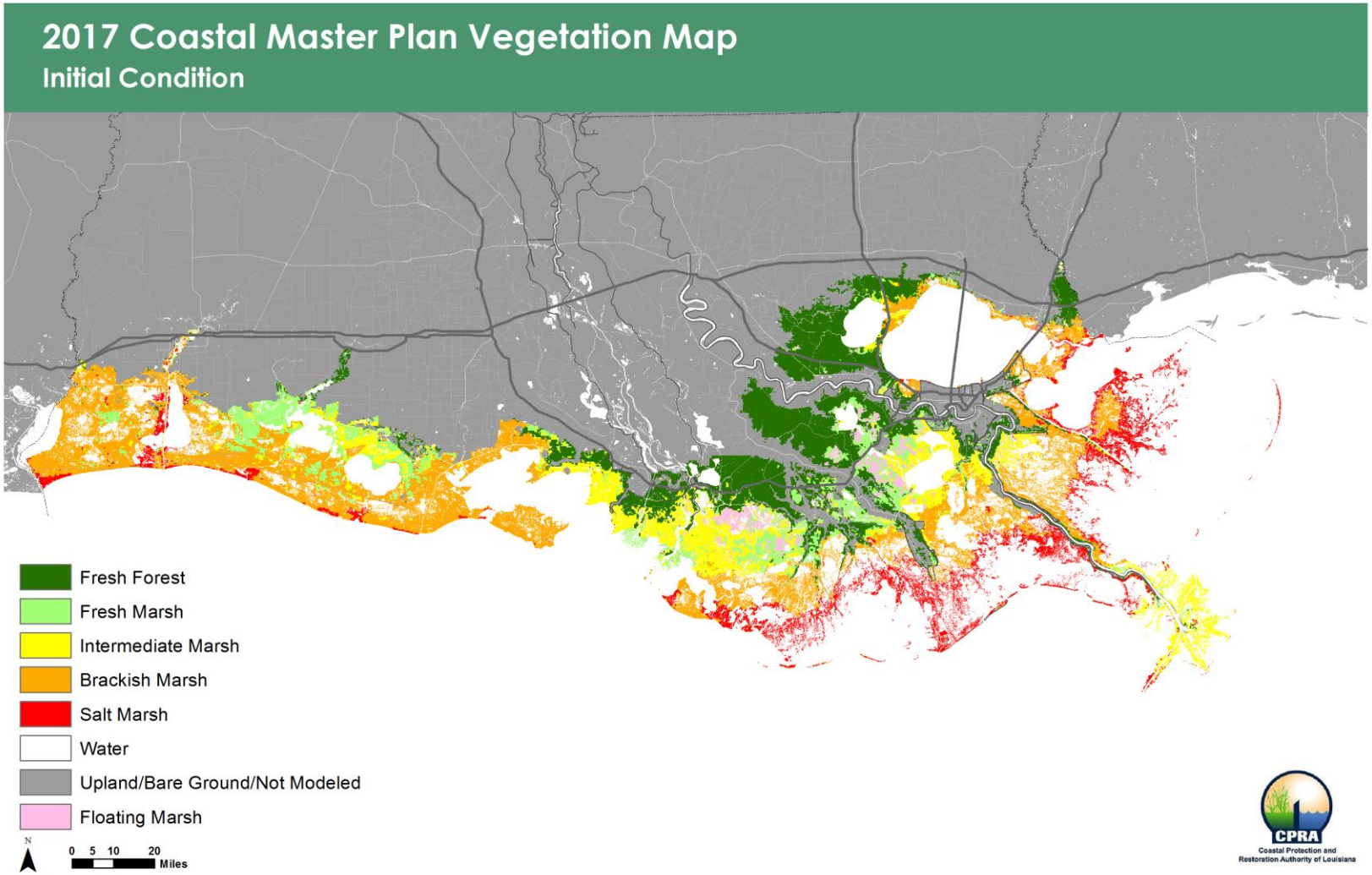




STARTING DEM



STARTING VEGETATION

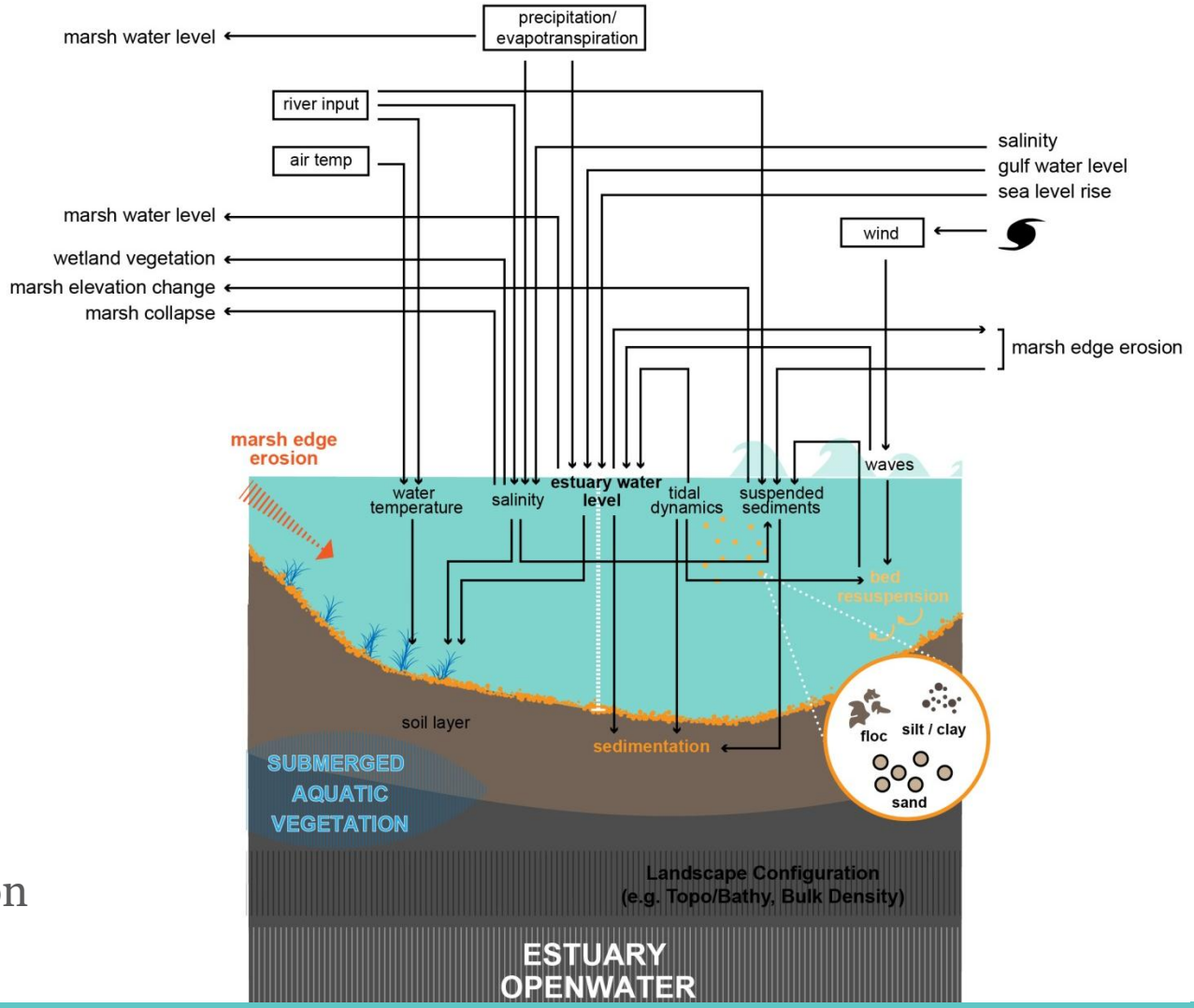


INTEGRATED COMPARTMENT MODEL

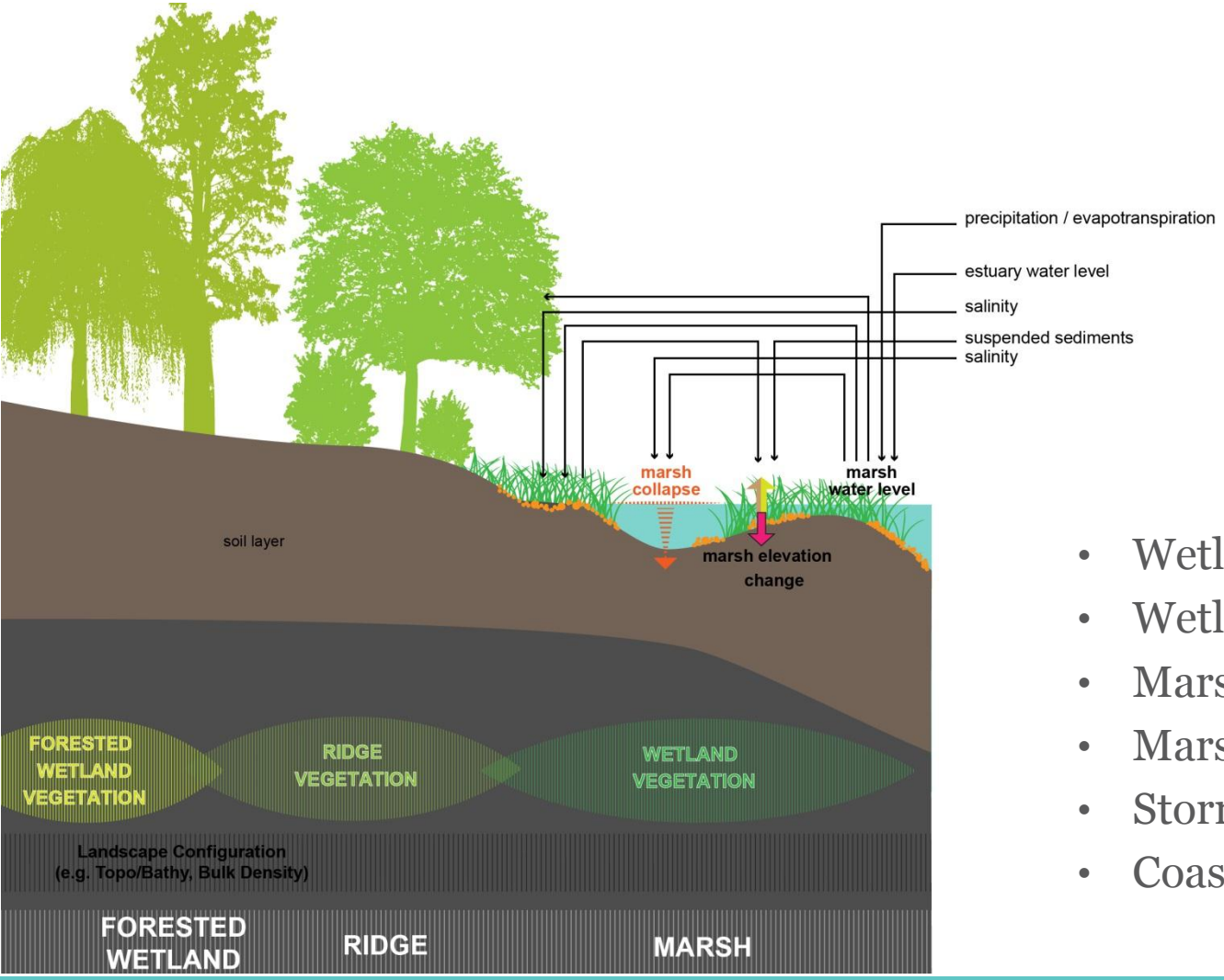
Overview

ESTUARY AND OPEN WATER PROCESSES

- Hydrodynamics
- Water quality
- Sedimentation
- Bed resuspension
- Sediment distribution



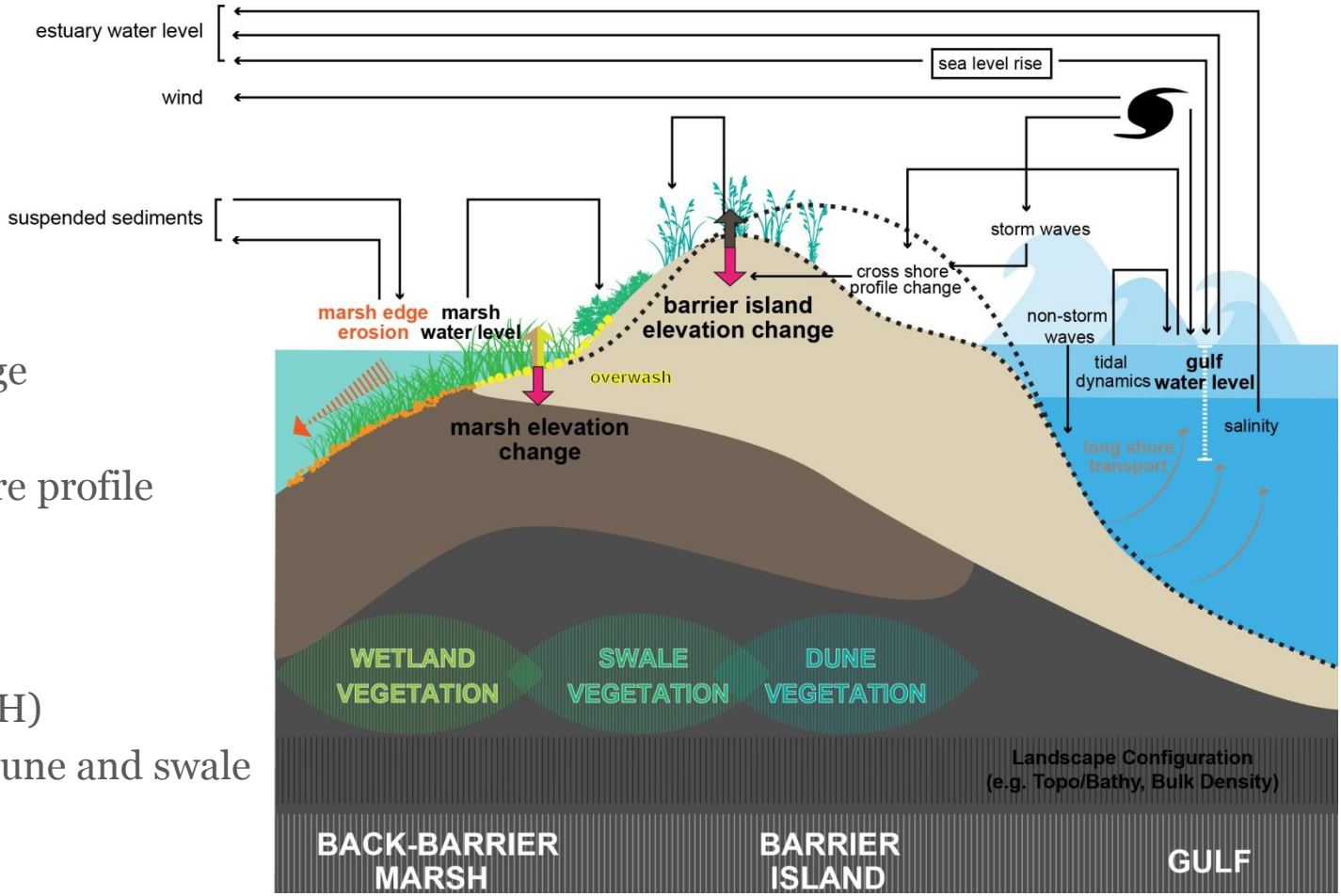
WETLAND PROCESSES AND VEGETATION



- Wetland elevation change
- Wetland area change
- Marsh collapse
- Marsh edge erosion
- Storm effects
- Coastal vegetation

BARRIER ISLAND PROCESSES

- Island elevation change
- Breaching
- Overwash / cross-shore profile change
- Longshore transport
- Wave transformation
- Storm effects (SBEACH)
- Back-barrier marsh, dune and swale vegetation



LAND AND VEGETATION

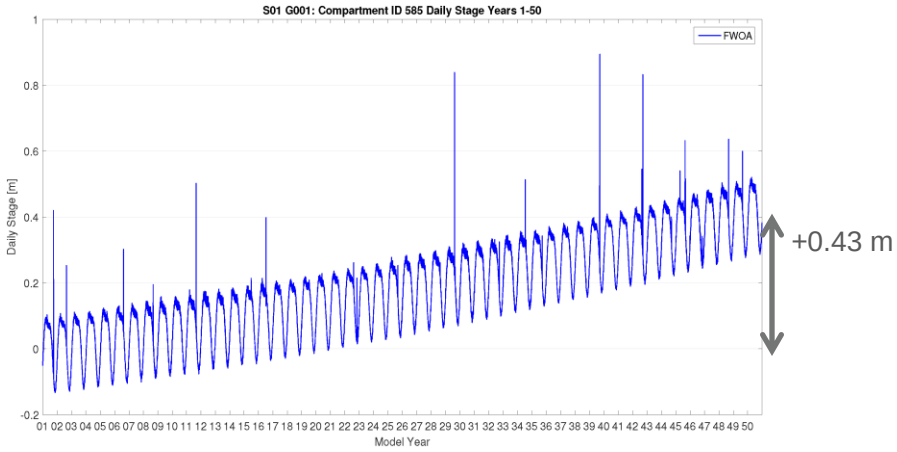
Future Without Action

FUTURE WITHOUT ACTION (G001)

Scenario	Precipitation	Evapotranspiration	ESLR (m/50yr)	Subsidence
Low	>Historical (ECHAM)	<Historical	0.43	20% of range
Medium	>Historical (ECHAM)	Historical	0.63	20% of range
High	Historical	Historical	0.83	50% of range

50 year simulation with tropical storms and varying:

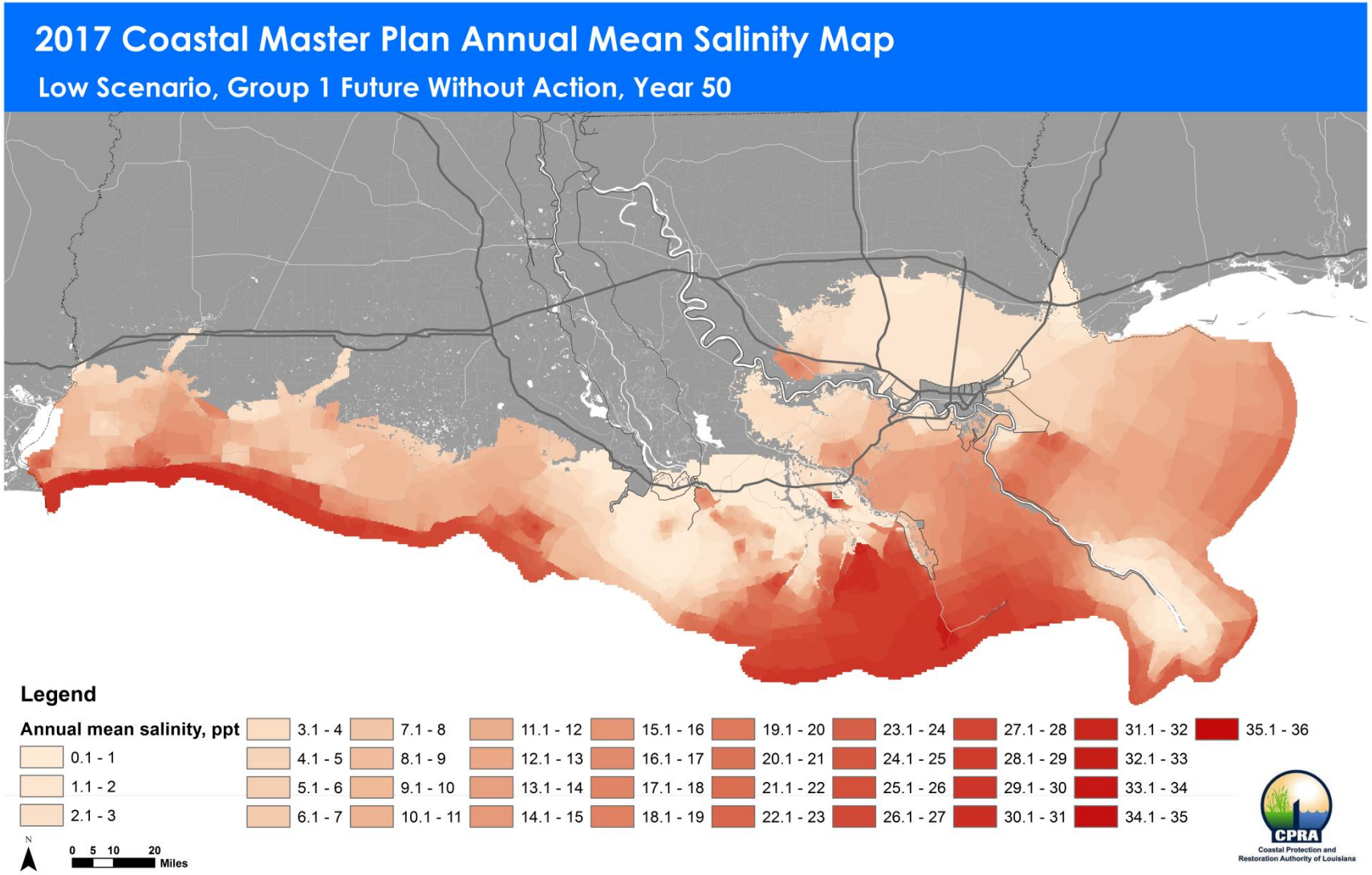
- Rates of eustatic sea level rise
- Rates of subsidence
- Precipitation & ET



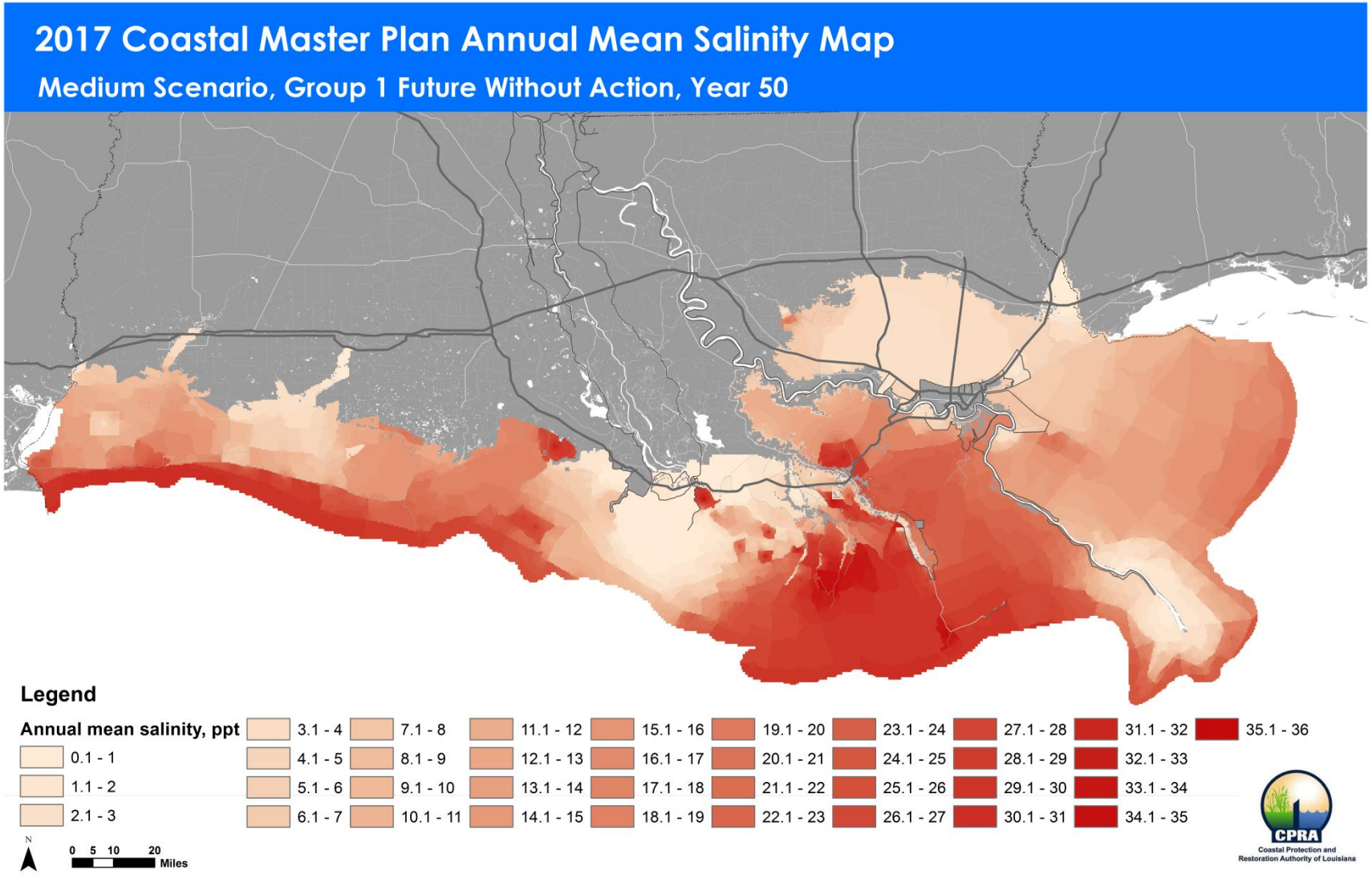
Water level in Calliou Bay – Low Scenario

Water level in Calliou Bay – High Scenario

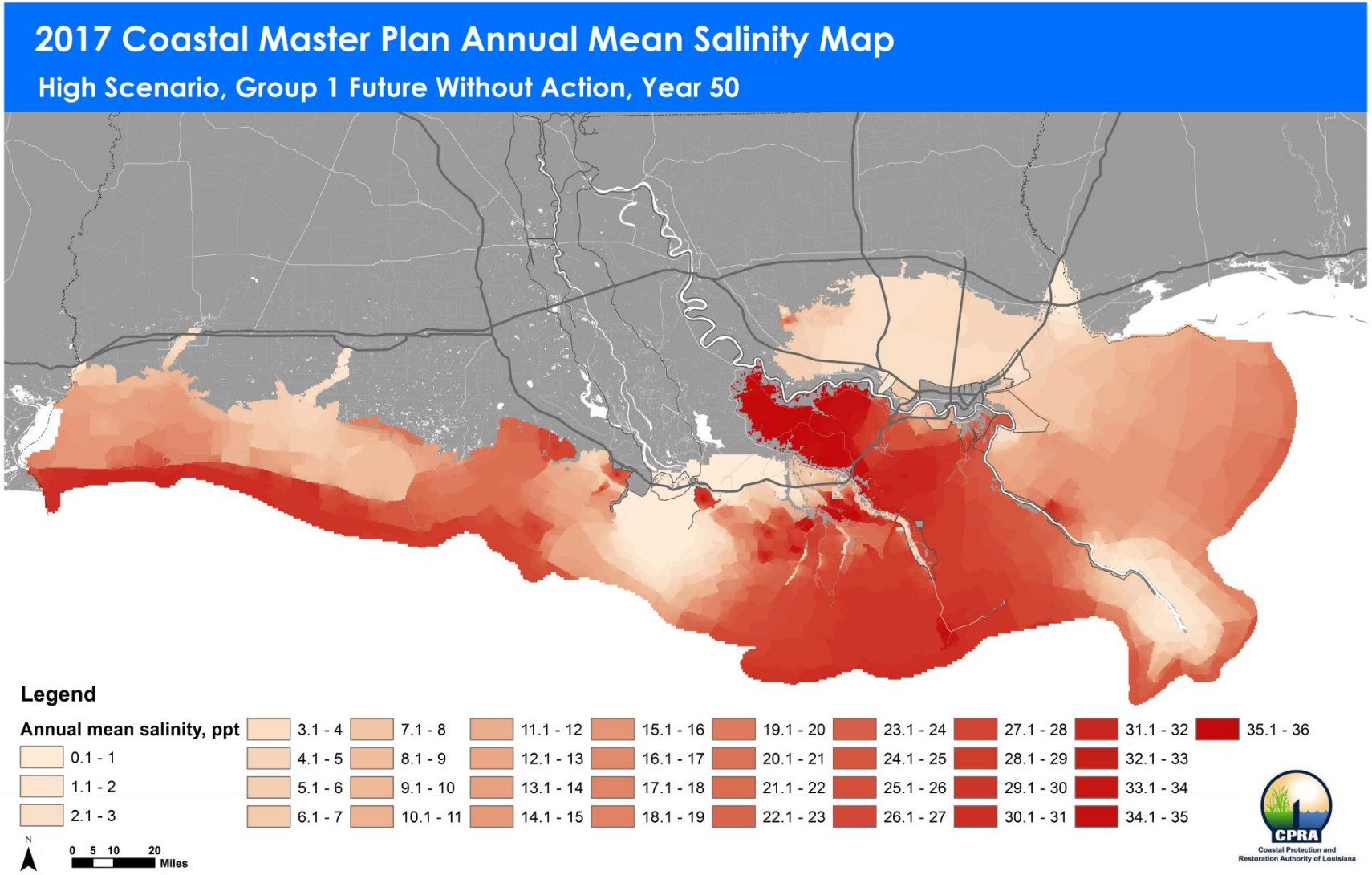
FUTURE WITHOUT ACTION (G001) – LOW SCENARIO



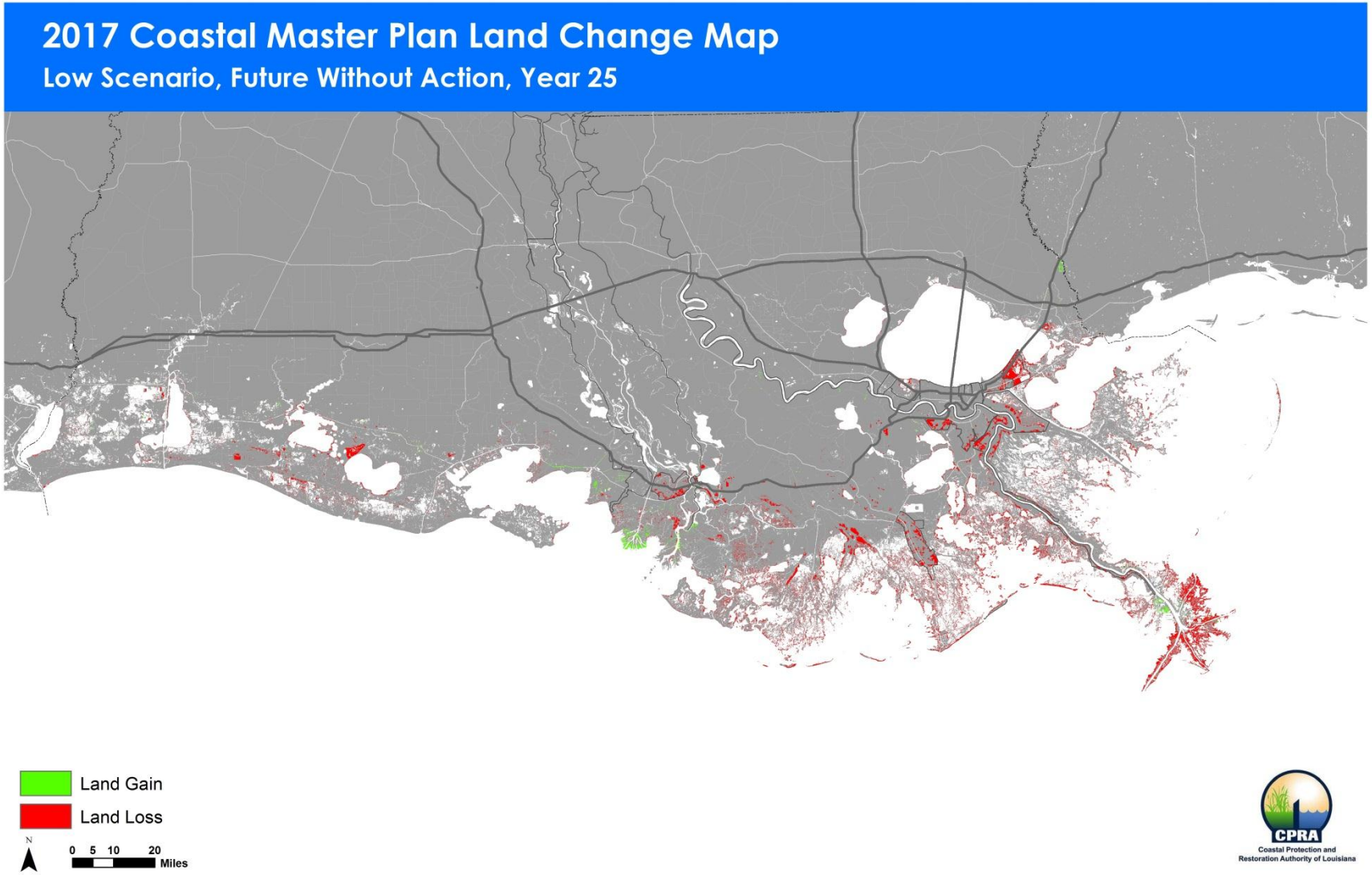
FUTURE WITHOUT ACTION (G001) – MEDIUM SCENARIO



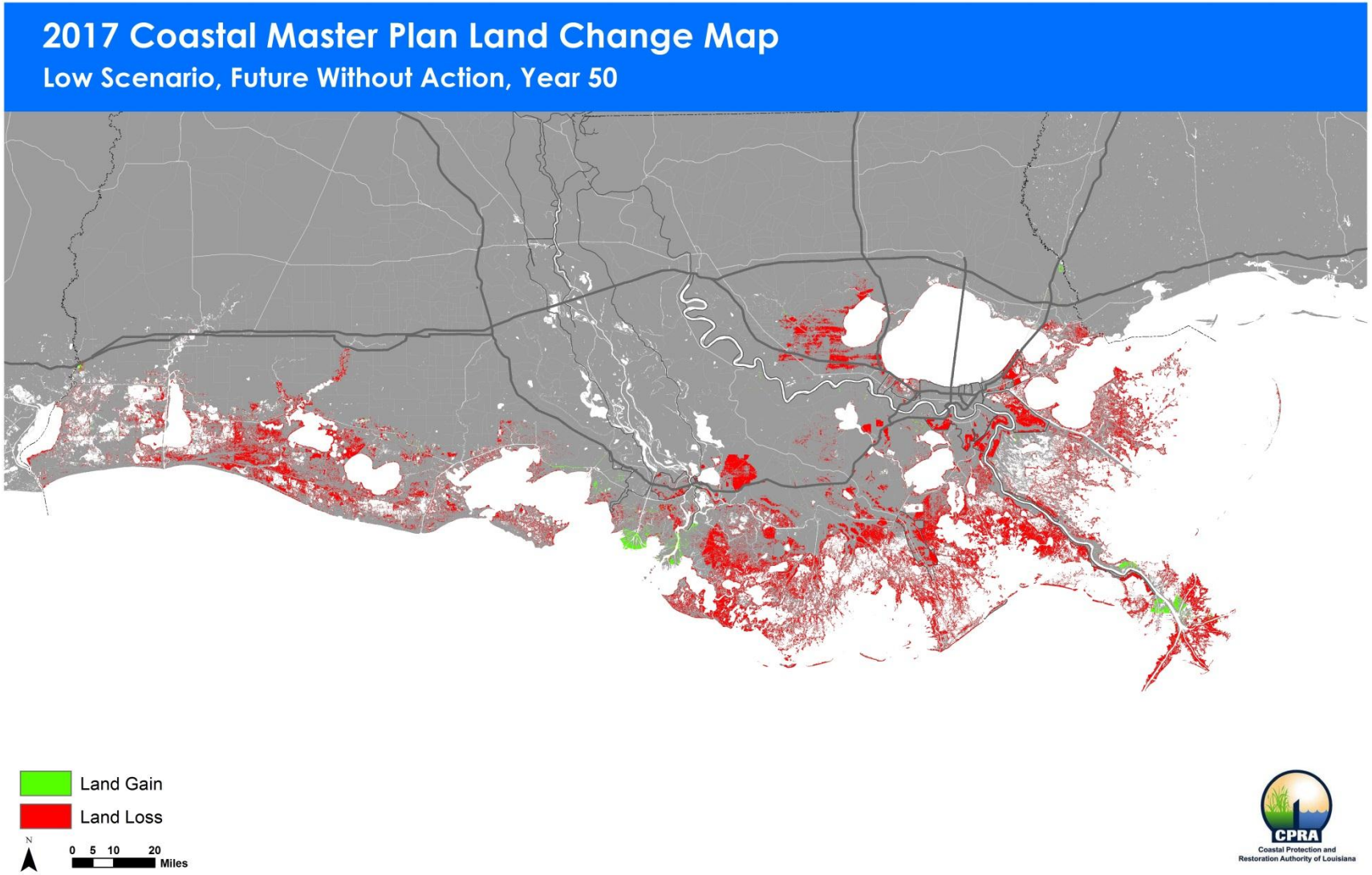
FUTURE WITHOUT ACTION (G001) – HIGH SCENARIO



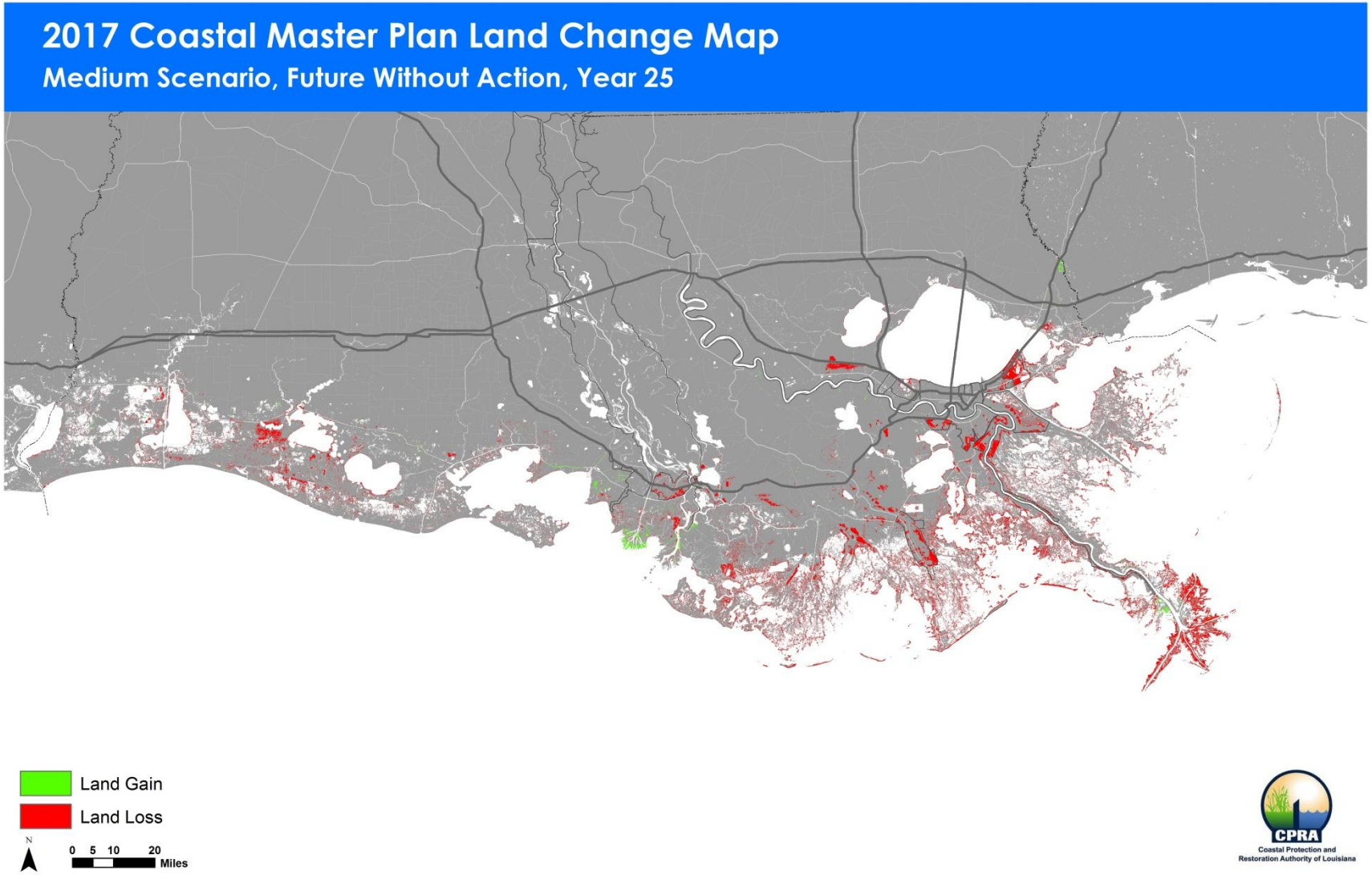
FUTURE WITHOUT ACTION (G001) – LOW SCENARIO



FUTURE WITHOUT ACTION (G001) – LOW SCENARIO



FUTURE WITHOUT ACTION (G001) – MEDIUM SCENARIO



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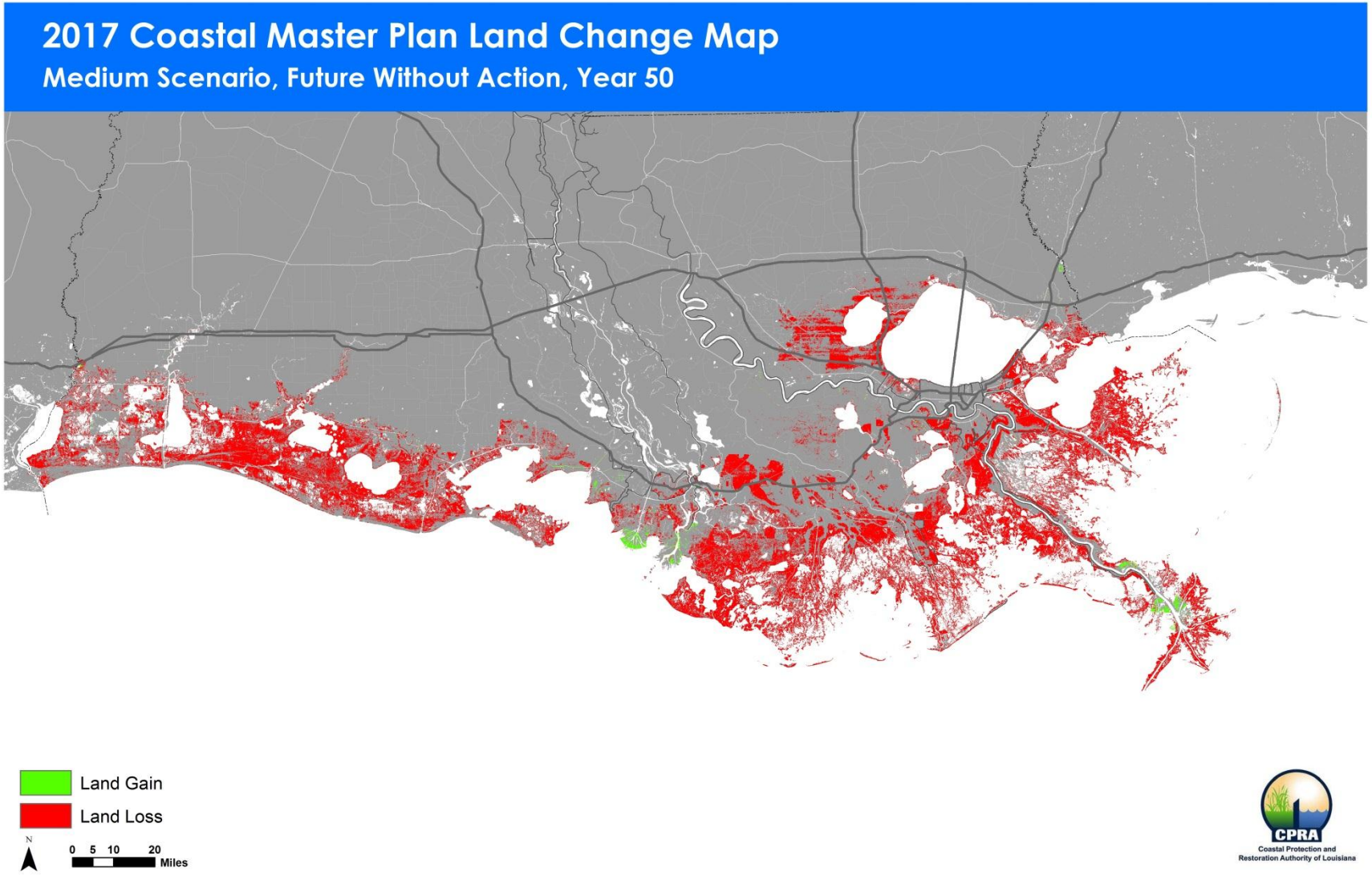

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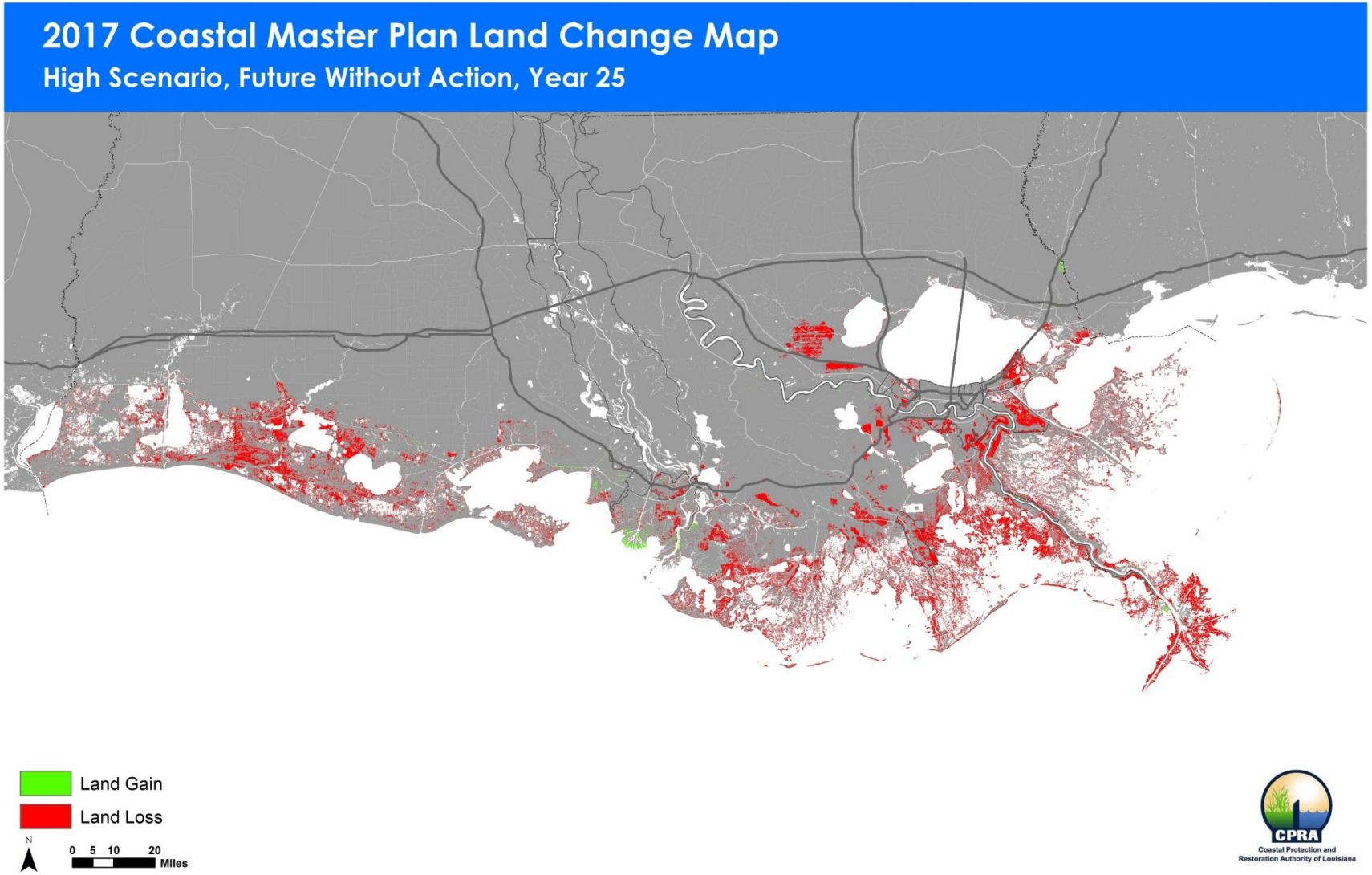

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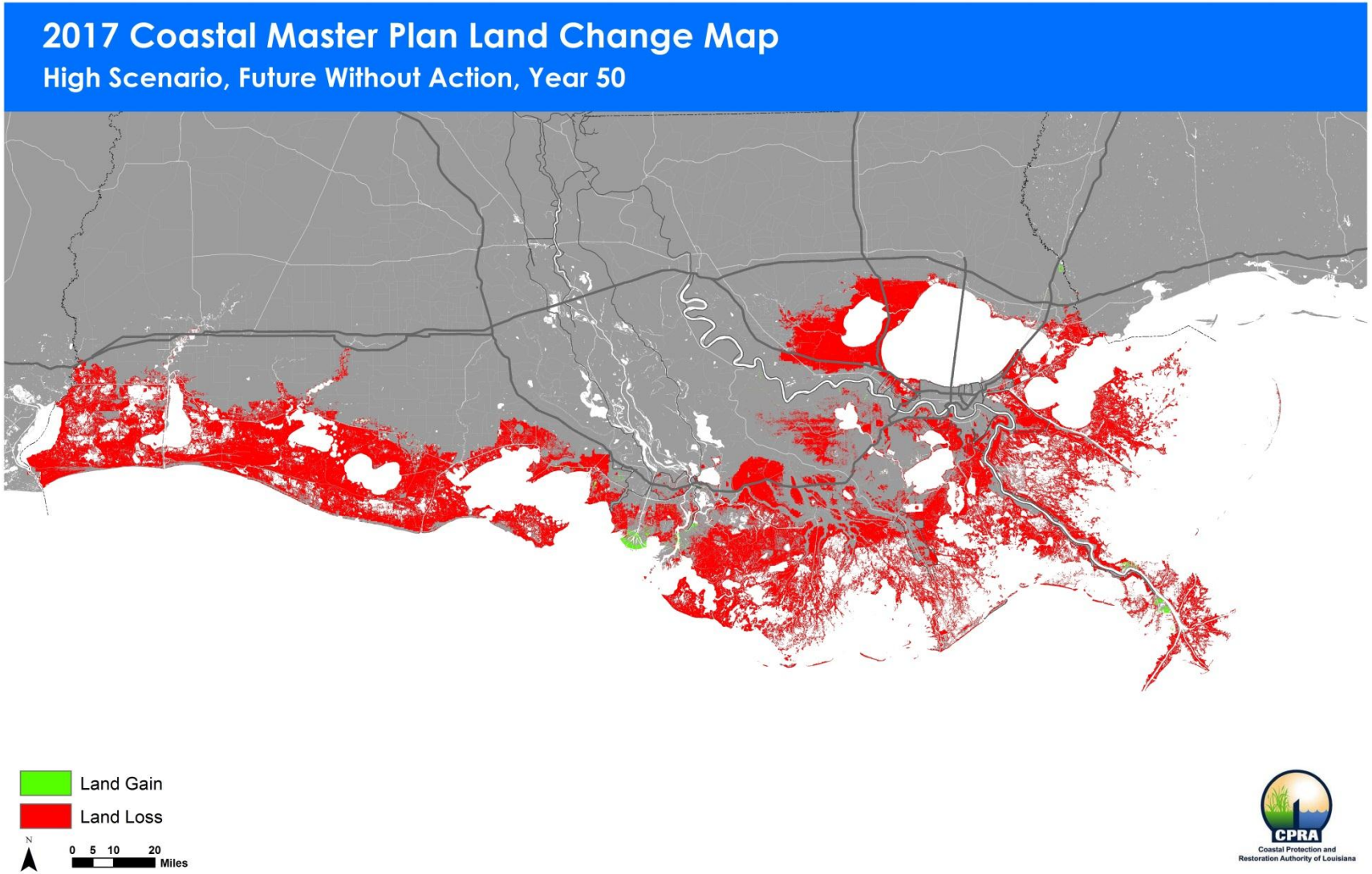
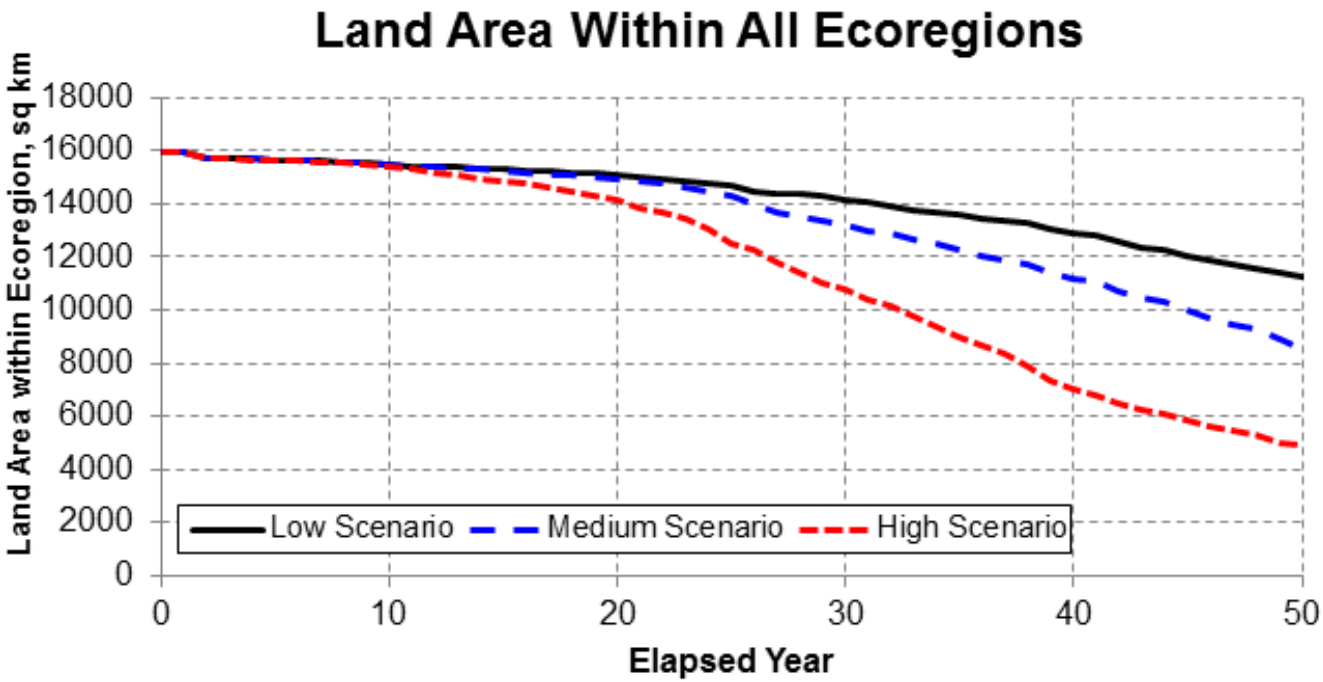


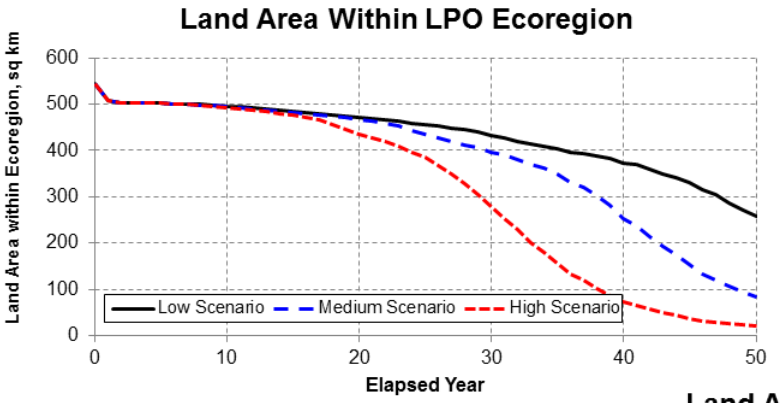
FUTURE WITHOUT ACTION (G001)

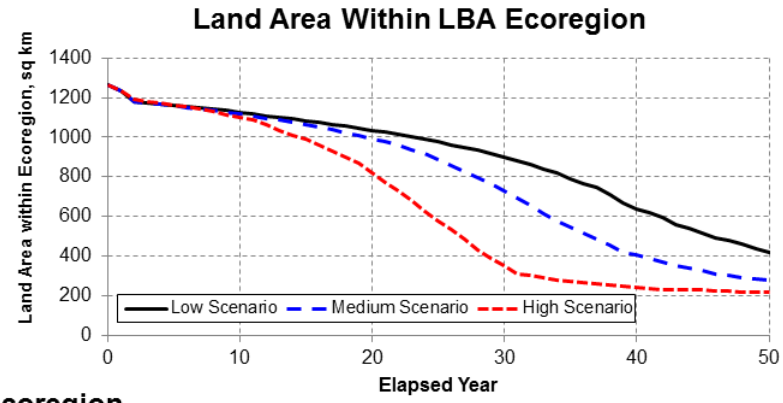
- **Coast wide land change over 50 year FWOA**

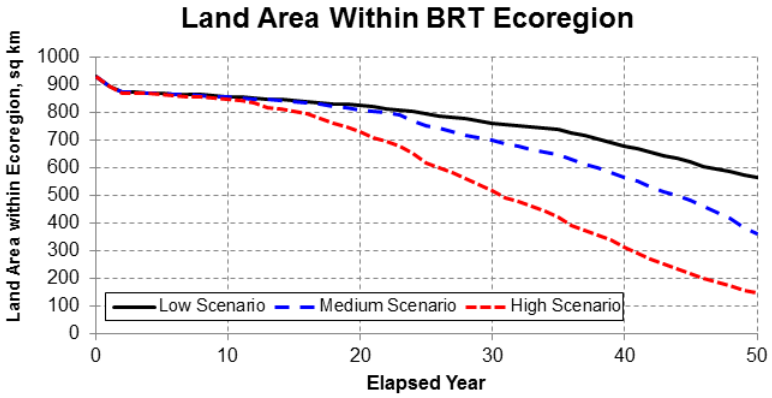


FUTURE WITHOUT ACTION (G001)

- **Sensitivity to scenarios varies across coast**
  - Eastern portion of model domain, generally consistent behavior across scenarios
  - Differences are in magnitude, not behavior

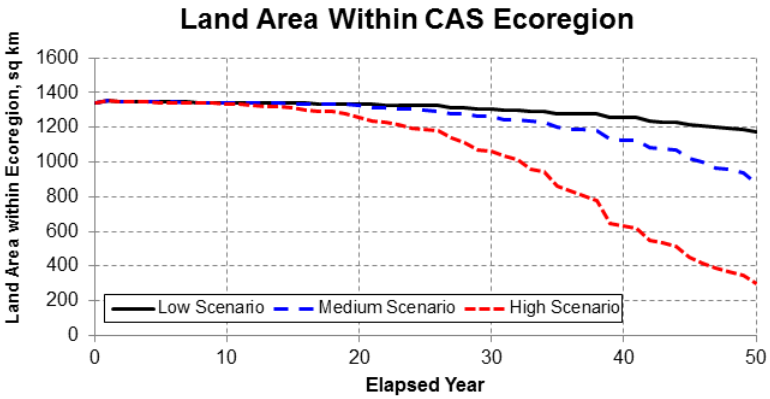


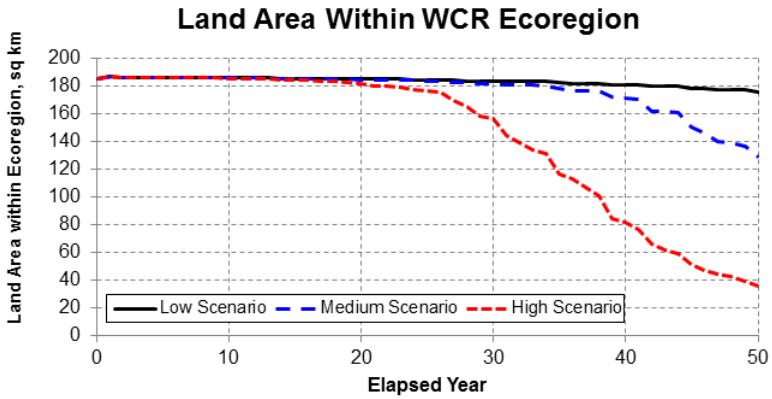




FUTURE WITHOUT ACTION (G001)

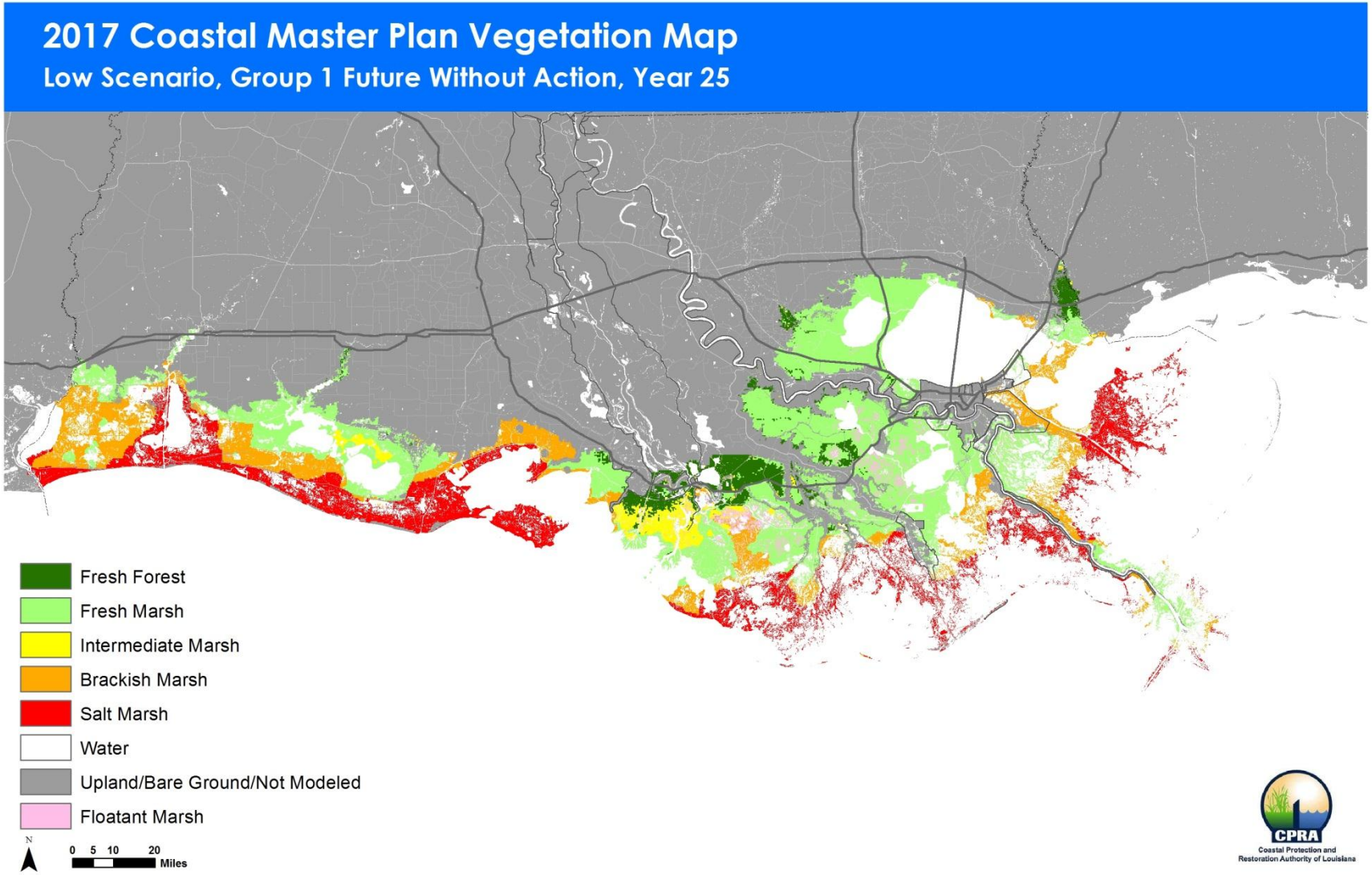
- **Sensitivity to scenarios varies across coast**
  - Western portion of model domain, inconsistent behavior across scenarios
  - Higher subsidence rates



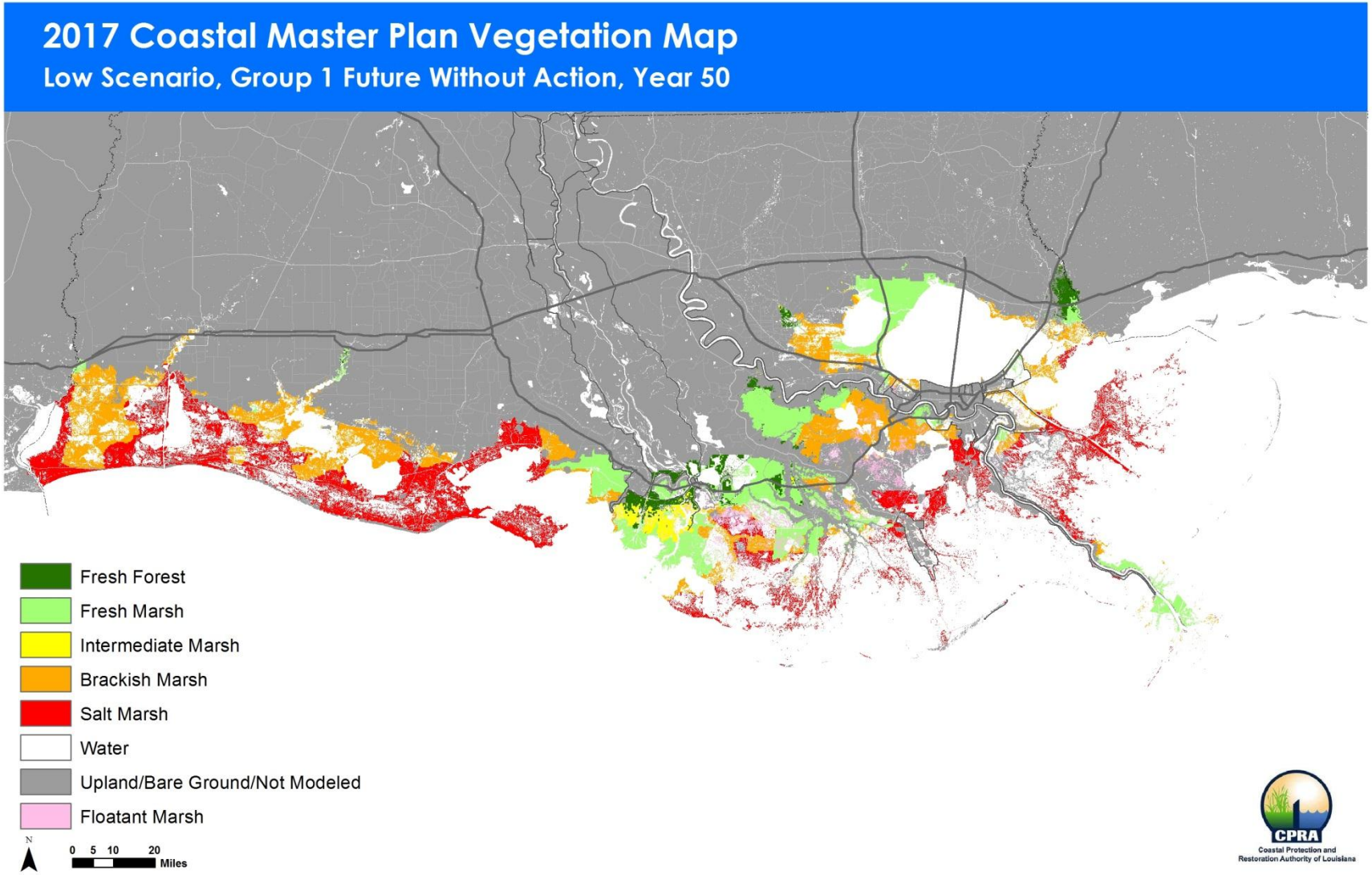


  - Subsidence rates in lower scenarios in western region are significantly lower than in the eastern part of the model domain

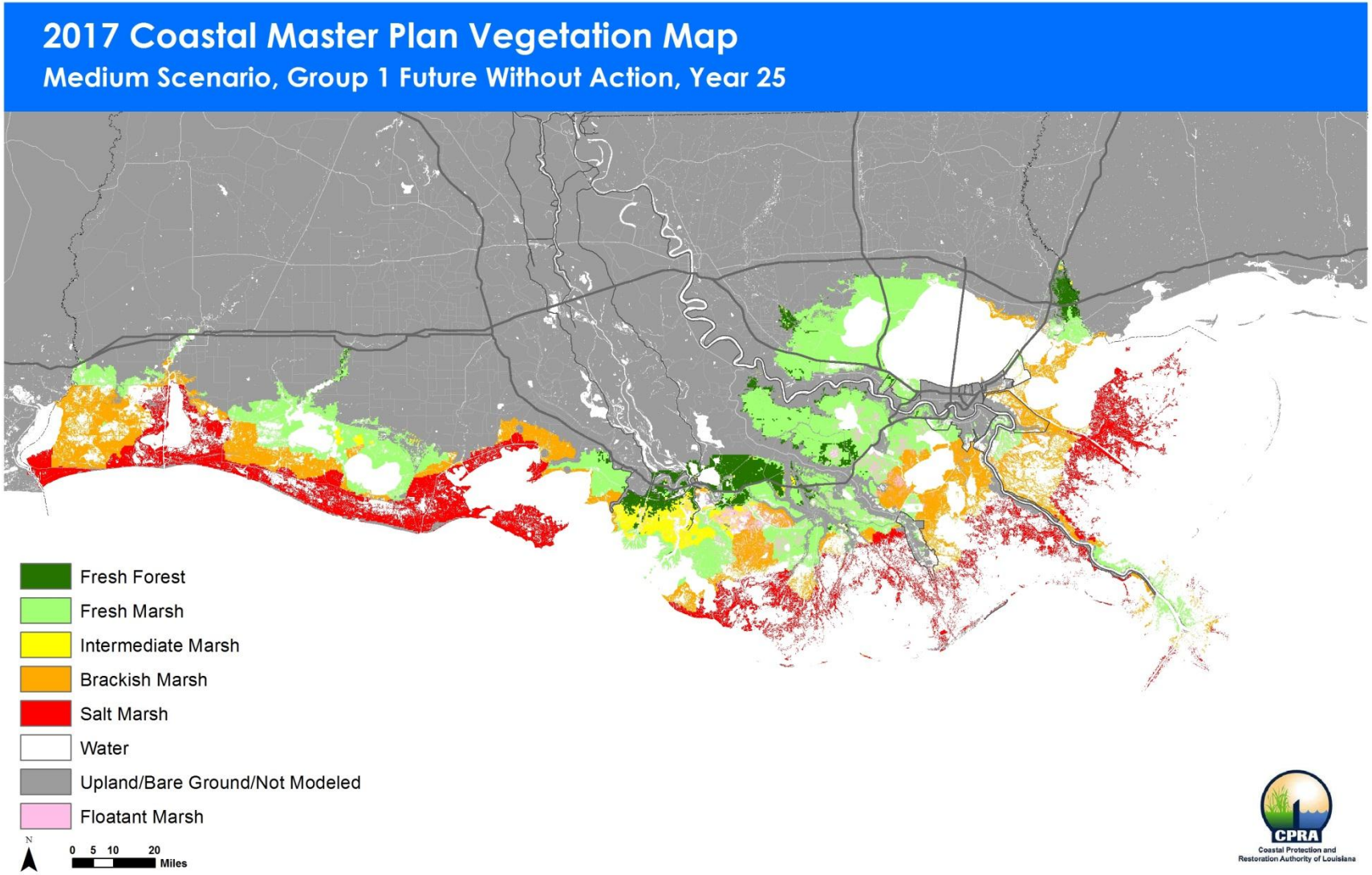
FUTURE WITHOUT ACTION (G001) – LOW SCENARIO



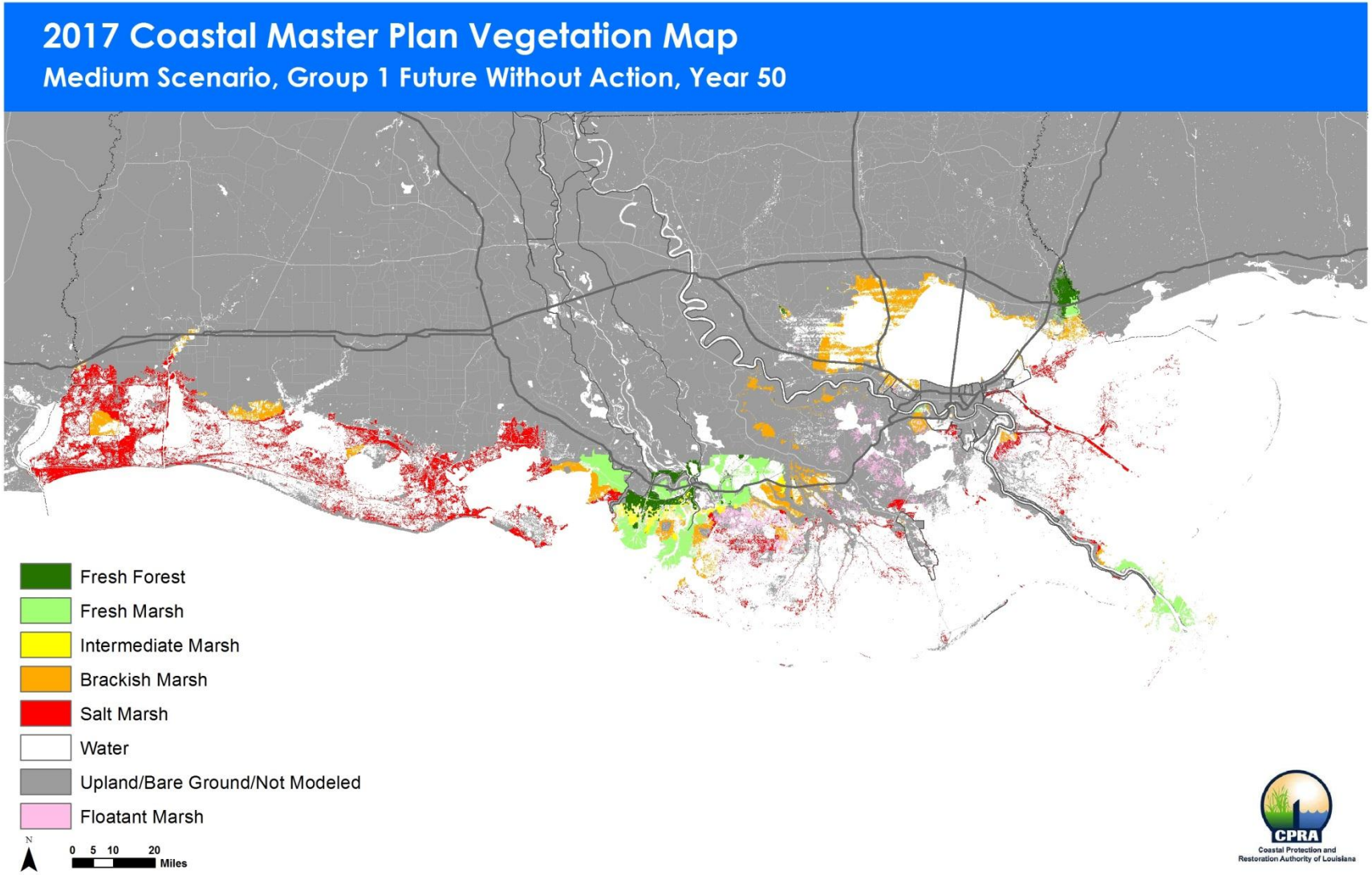
FUTURE WITHOUT ACTION (G001) – LOW SCENARIO



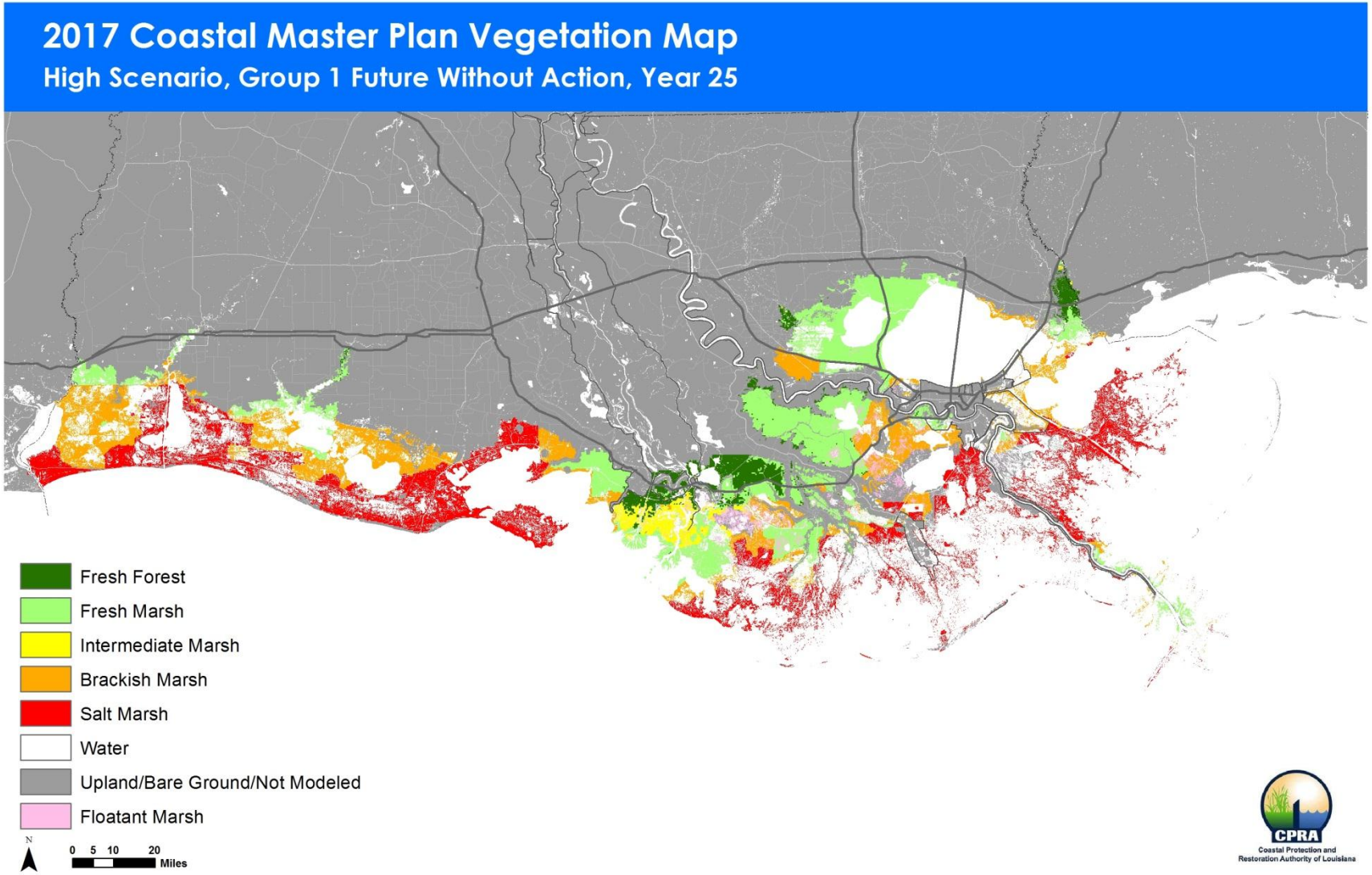
FUTURE WITHOUT ACTION (G001) – MEDIUM SCENARIO



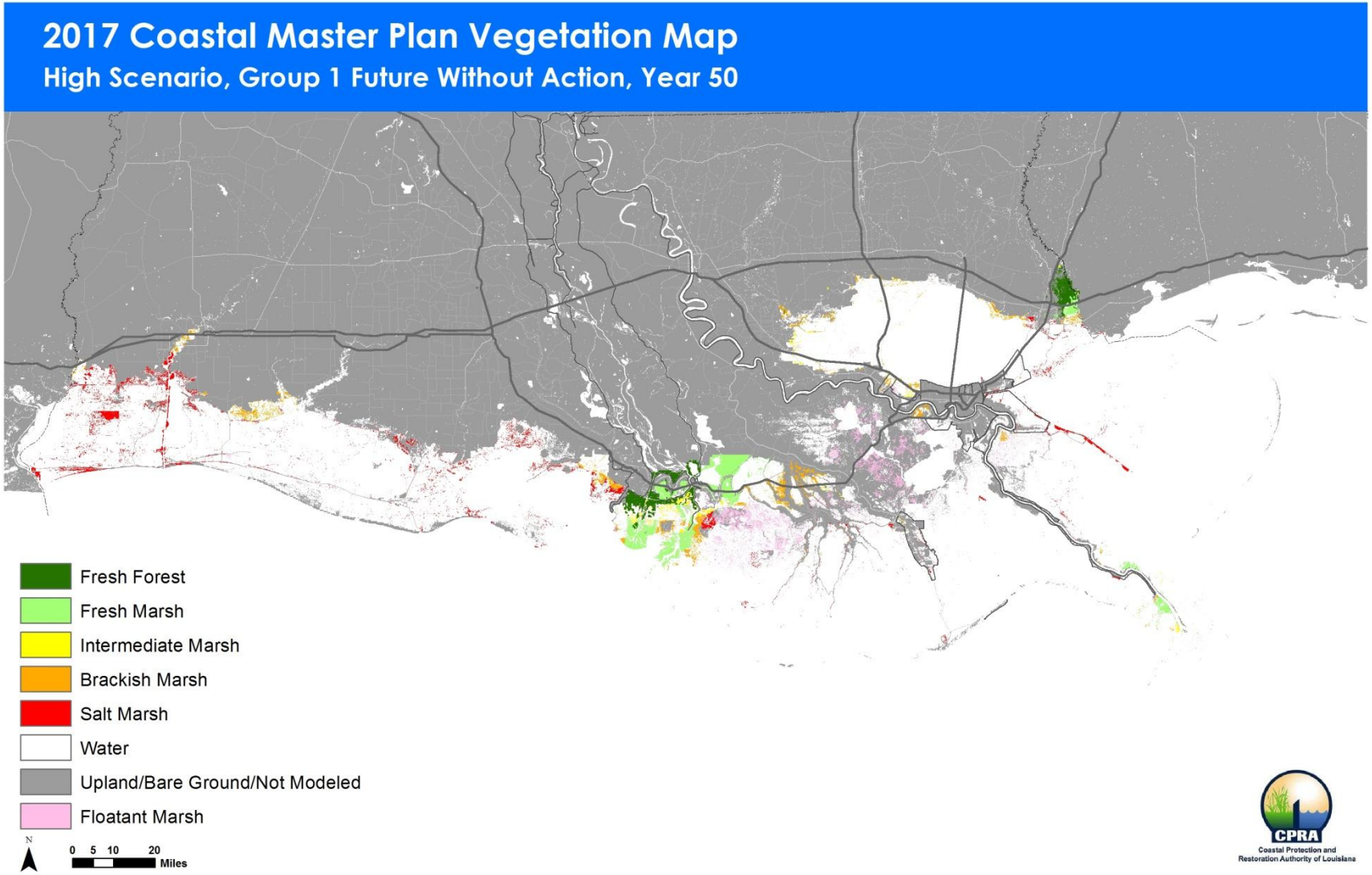
FUTURE WITHOUT ACTION (G001) – MEDIUM SCENARIO



FUTURE WITHOUT ACTION (G001) – HIGH SCENARIO



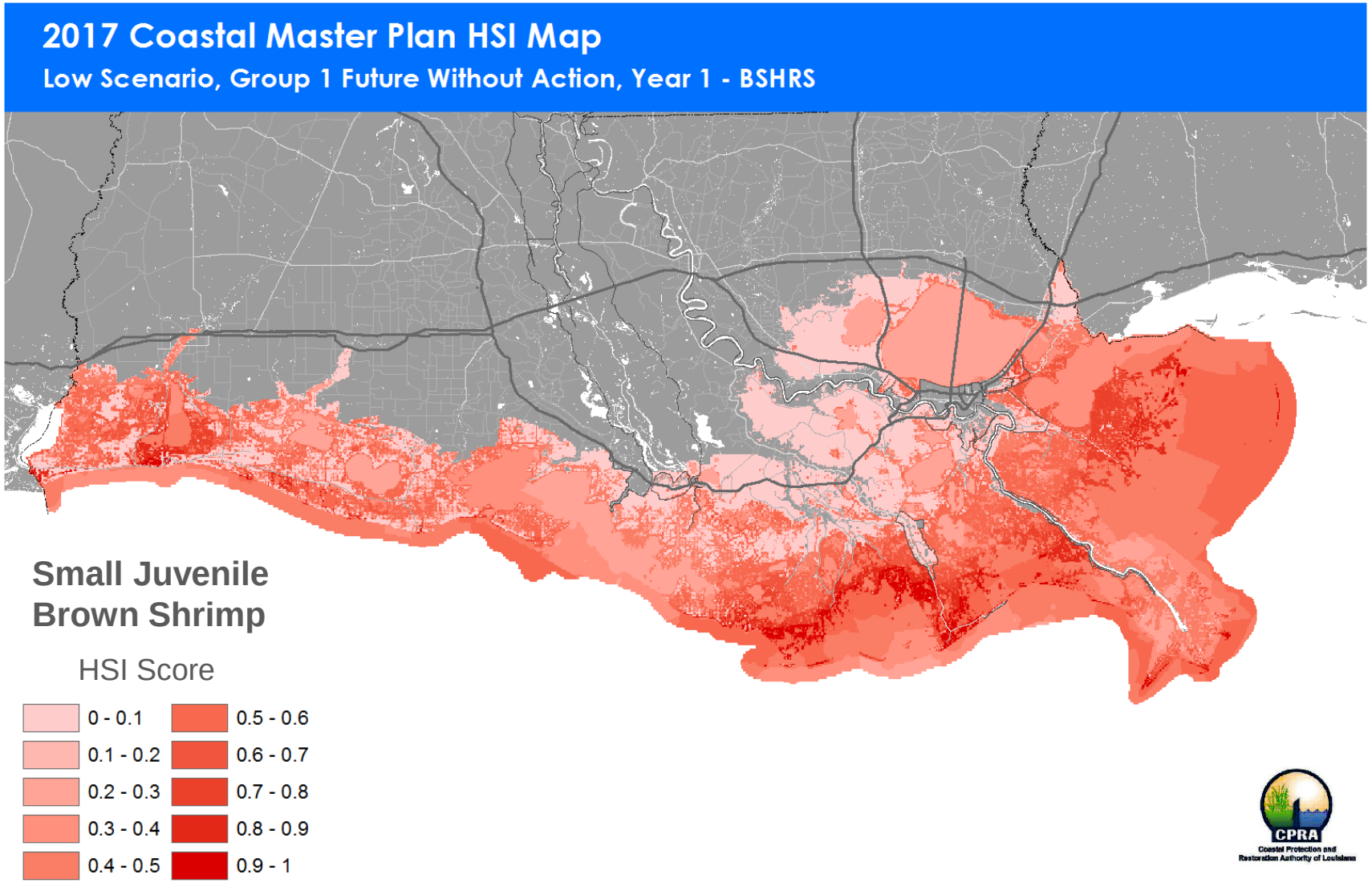
FUTURE WITHOUT ACTION (G001) – HIGH SCENARIO



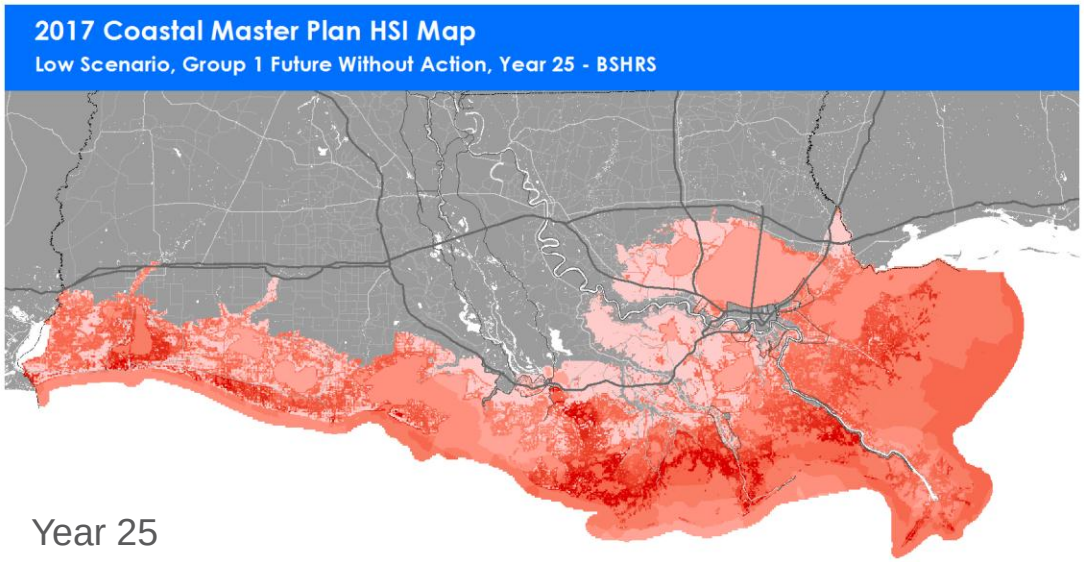
HABITAT SUITABILITY INDICES FISHERY BIOMASS

Future Without Action

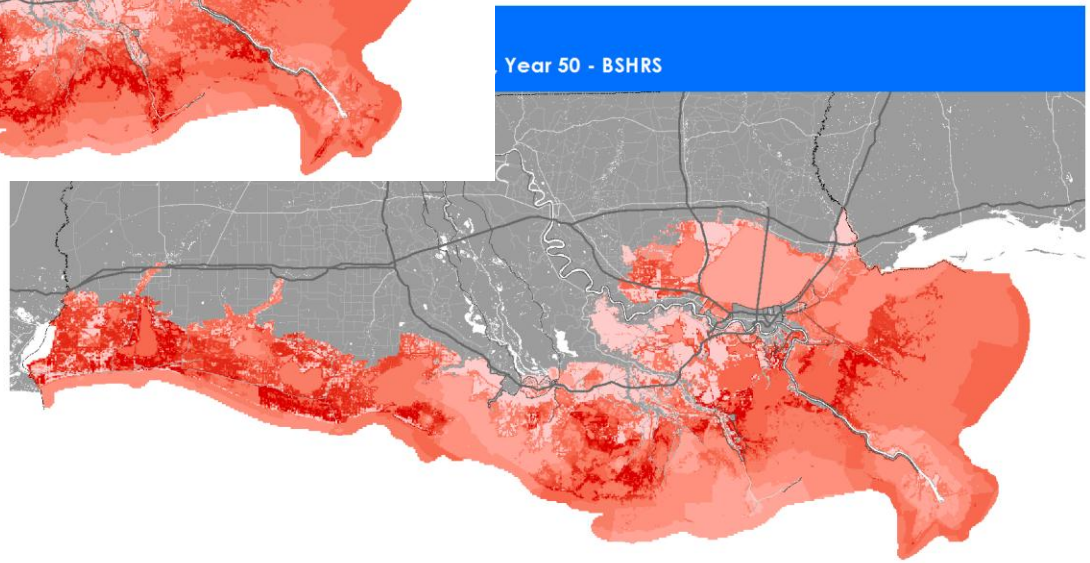
FUTURE WITHOUT ACTION



FUTURE WITHOUT ACTION – LOW SCENARIO



Year 25



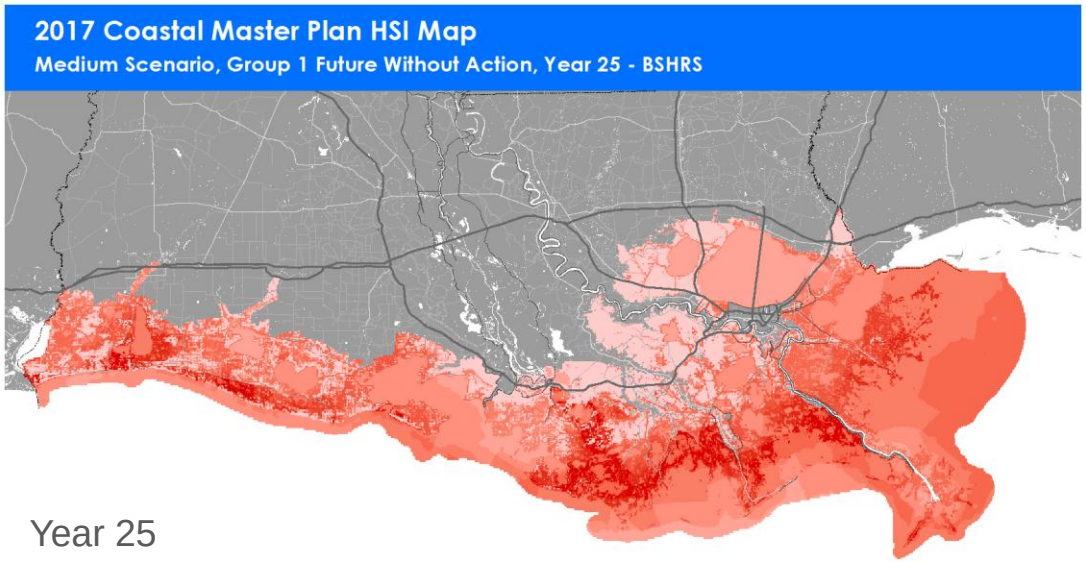
Year 50

Small Juvenile Brown Shrimp

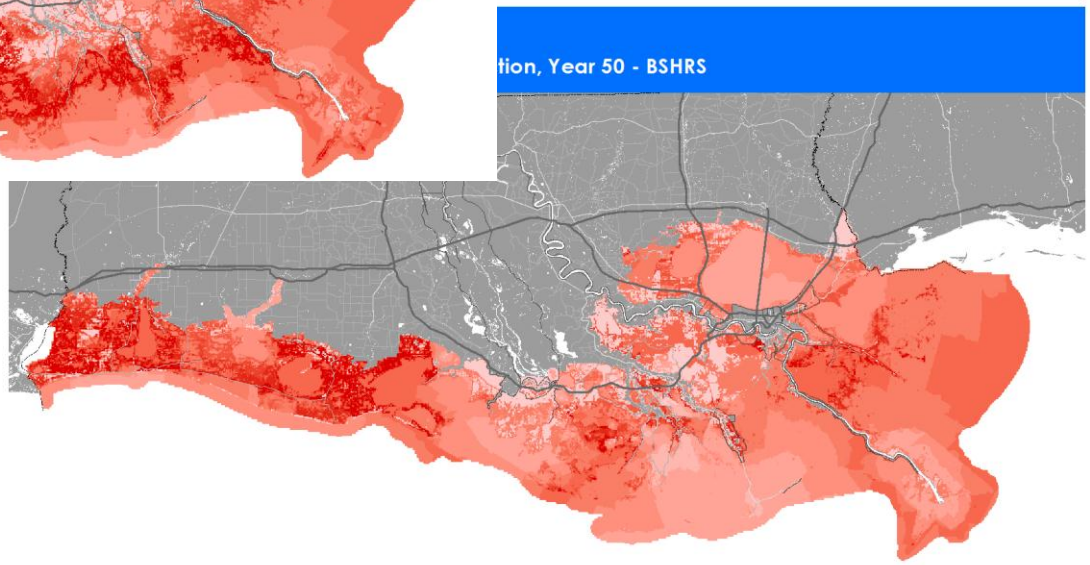
HSI Score

0 - 0.1	0.5 - 0.6
0.1 - 0.2	0.6 - 0.7
0.2 - 0.3	0.7 - 0.8
0.3 - 0.4	0.8 - 0.9
0.4 - 0.5	0.9 - 1

FUTURE WITHOUT ACTION – MEDIUM SCENARIO



Year 25



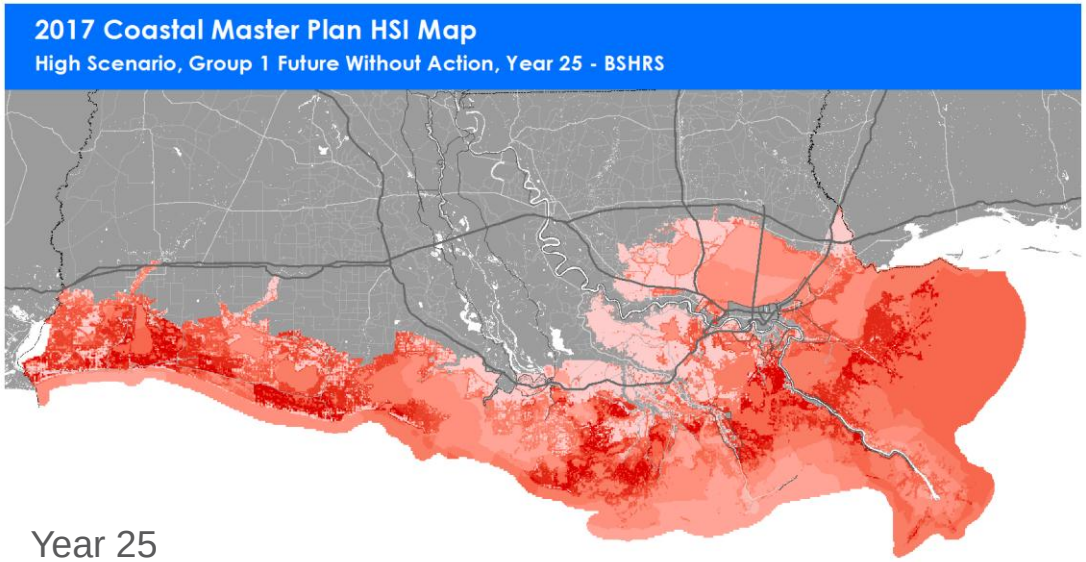
Year 50

Small Juvenile Brown Shrimp

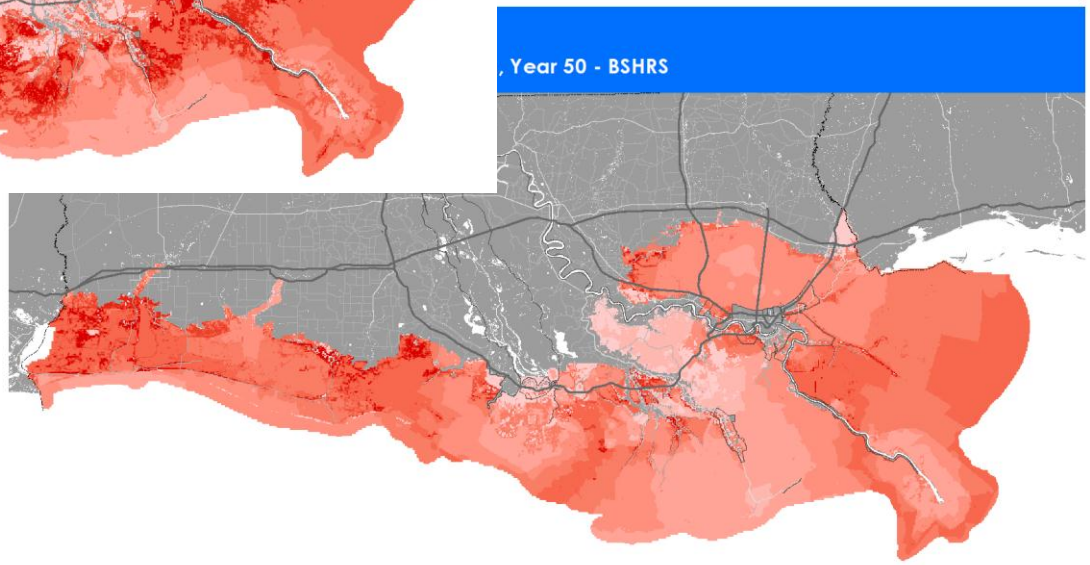
HSI Score

0 - 0.1	0.5 - 0.6
0.1 - 0.2	0.6 - 0.7
0.2 - 0.3	0.7 - 0.8
0.3 - 0.4	0.8 - 0.9
0.4 - 0.5	0.9 - 1

FUTURE WITHOUT ACTION – HIGH SCENARIO



Year 25



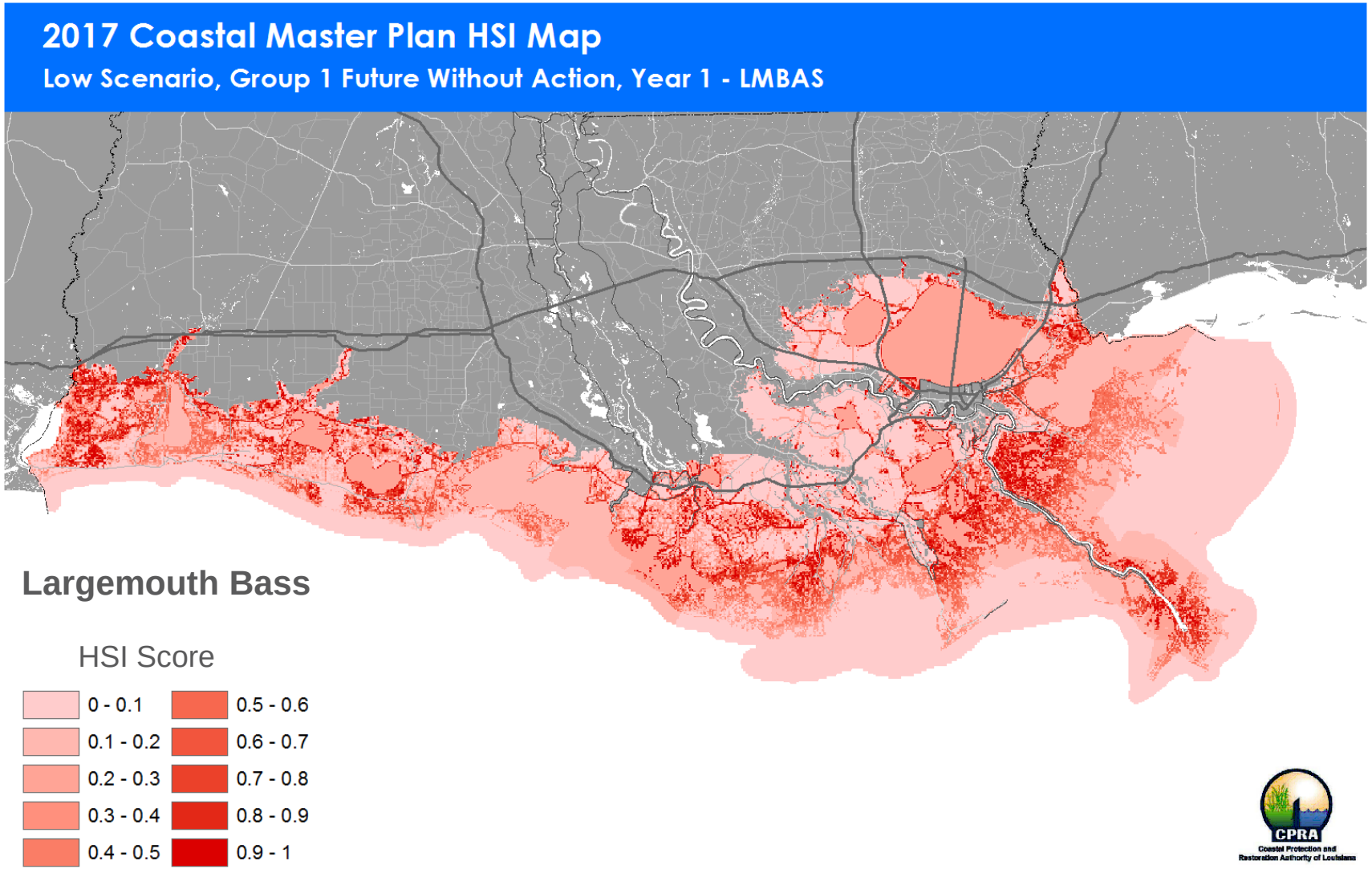
Year 50

Small Juvenile Brown Shrimp

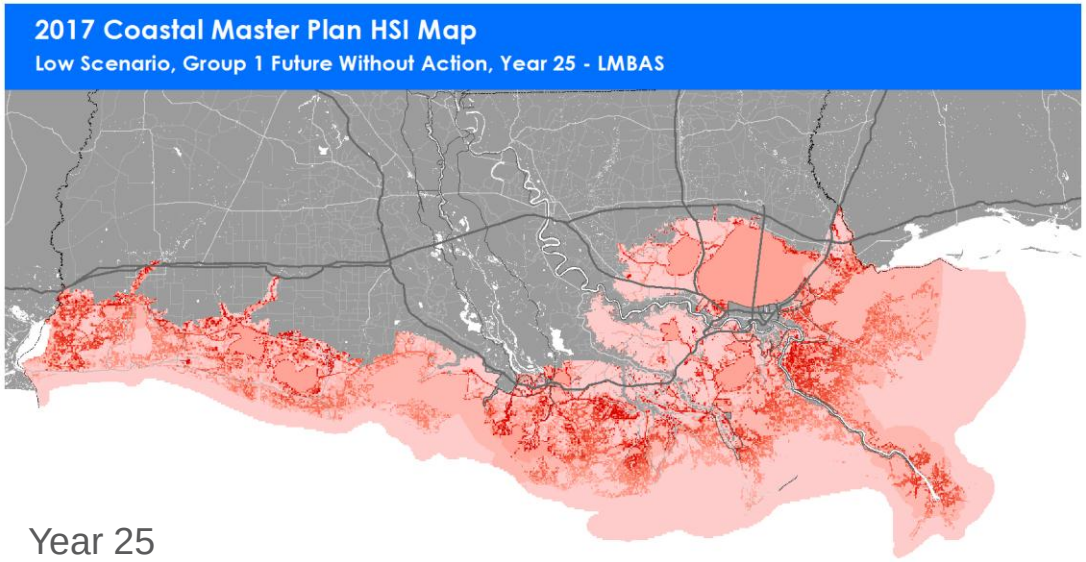
HSI Score

0 - 0.1	0.5 - 0.6
0.1 - 0.2	0.6 - 0.7
0.2 - 0.3	0.7 - 0.8
0.3 - 0.4	0.8 - 0.9
0.4 - 0.5	0.9 - 1

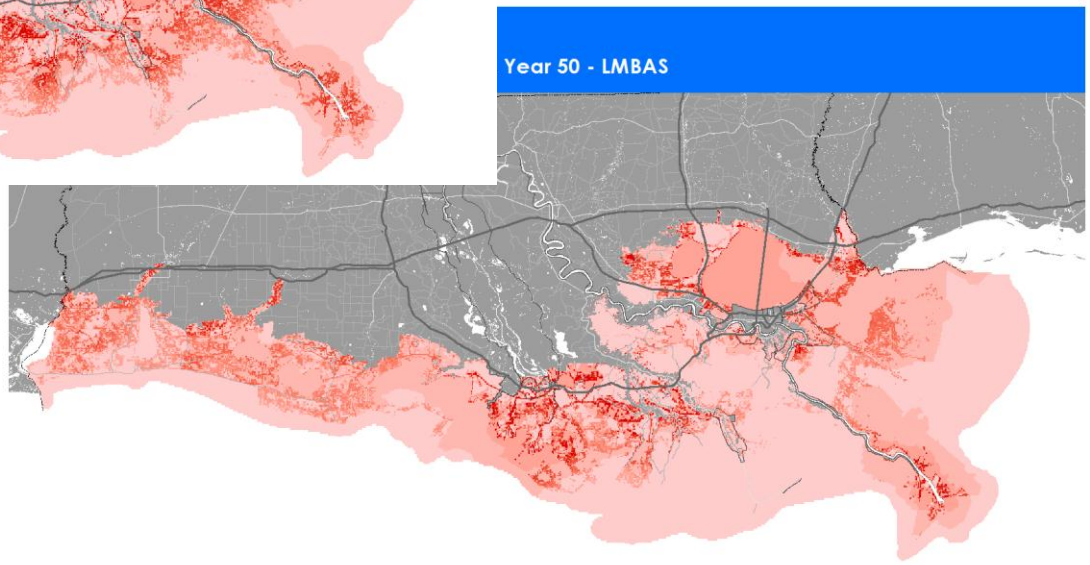
FUTURE WITHOUT ACTION



FUTURE WITHOUT ACTION – LOW SCENARIO



Year 25



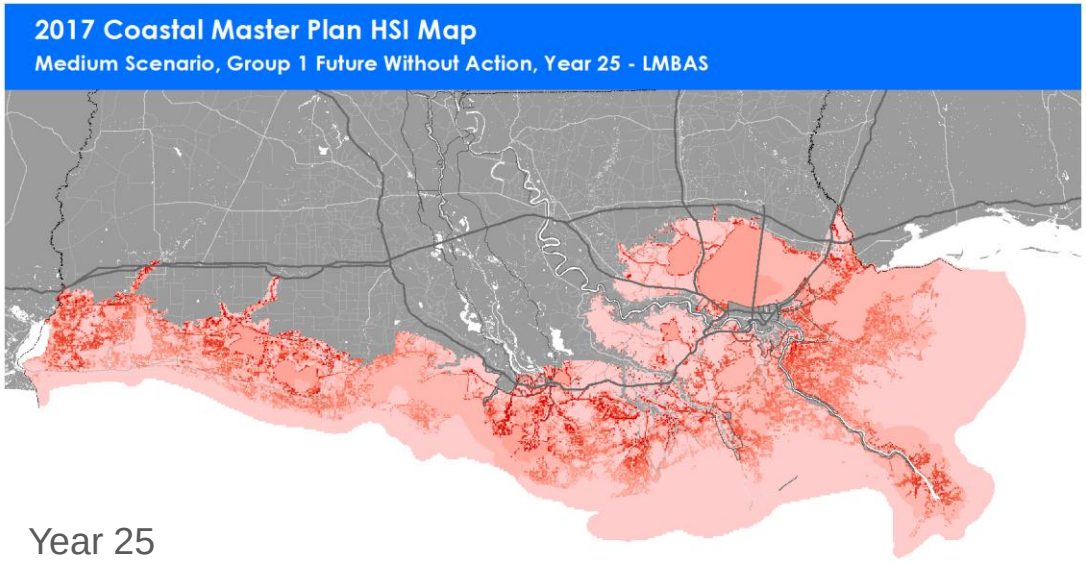
Year 50

Largemouth Bass

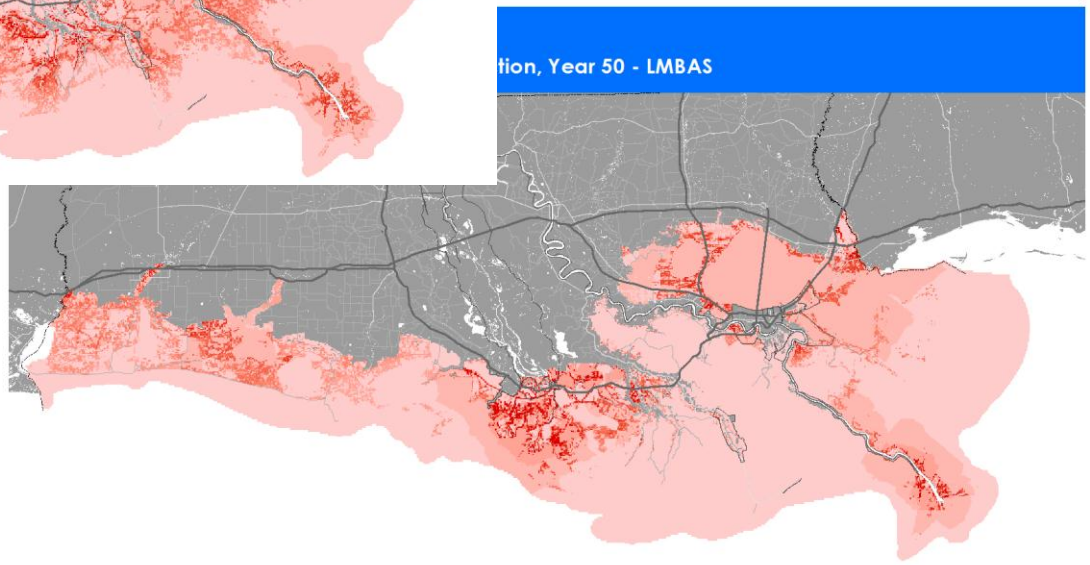
HSI Score

0 - 0.1	0.5 - 0.6
0.1 - 0.2	0.6 - 0.7
0.2 - 0.3	0.7 - 0.8
0.3 - 0.4	0.8 - 0.9
0.4 - 0.5	0.9 - 1

FUTURE WITHOUT ACTION – MEDIUM SCENARIO



Year 25



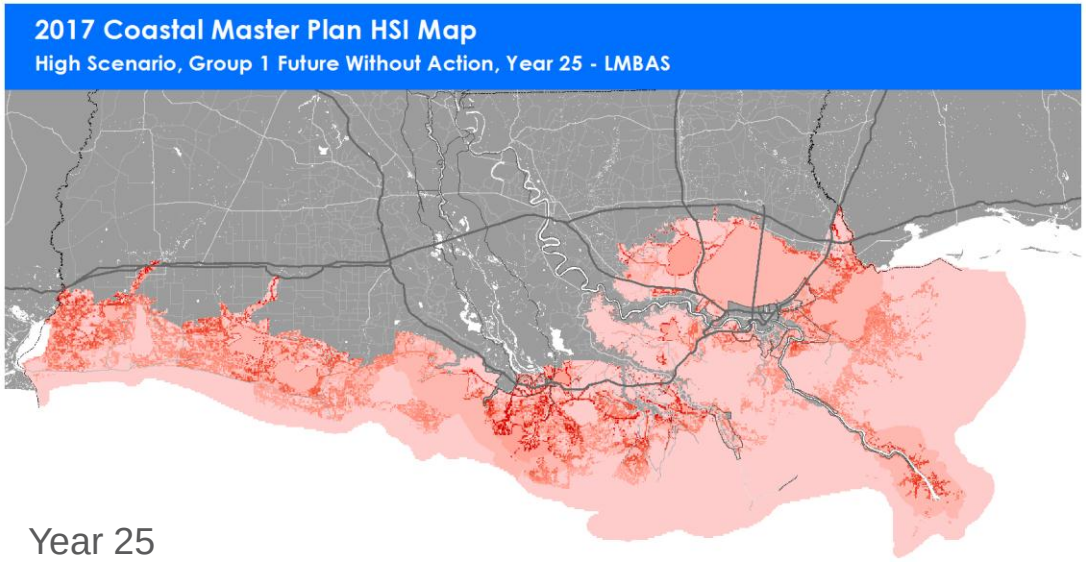
Year 50

Largemouth Bass

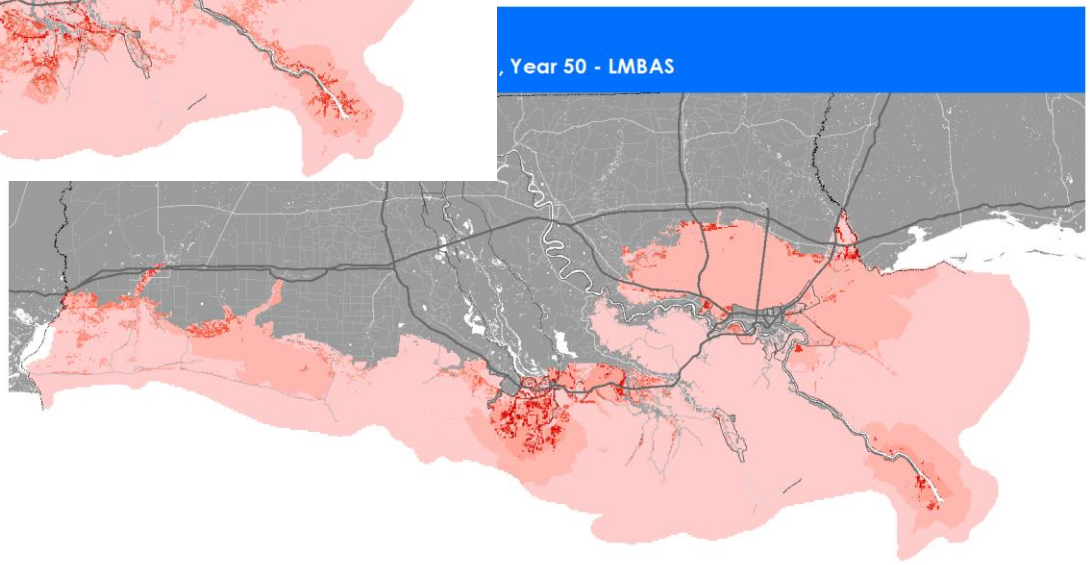
HSI Score

0 - 0.1	0.5 - 0.6
0.1 - 0.2	0.6 - 0.7
0.2 - 0.3	0.7 - 0.8
0.3 - 0.4	0.8 - 0.9
0.4 - 0.5	0.9 - 1

FUTURE WITHOUT ACTION – HIGH SCENARIO



Year 25



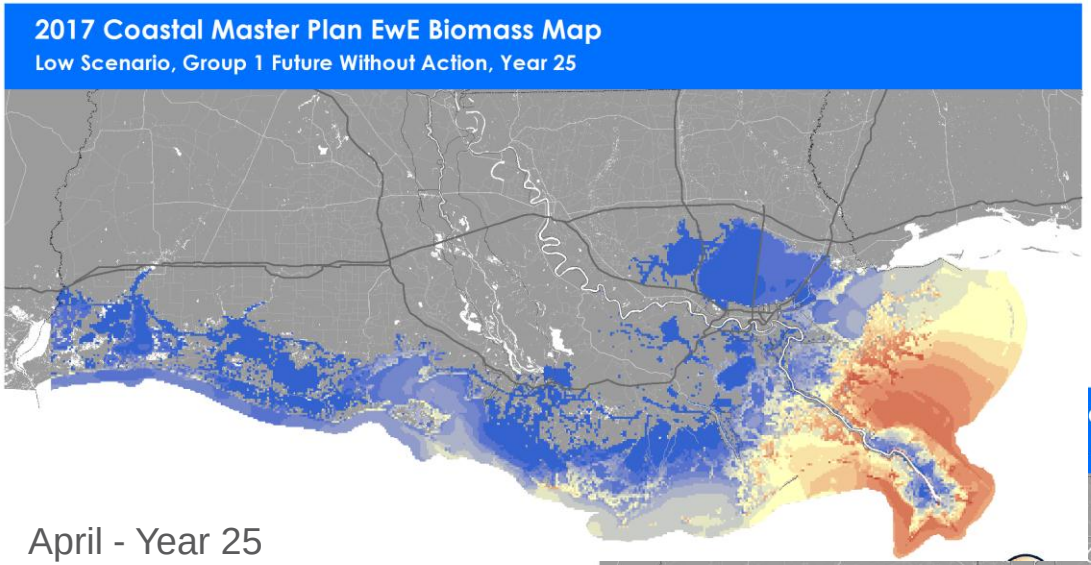
Year 50

Largemouth Bass

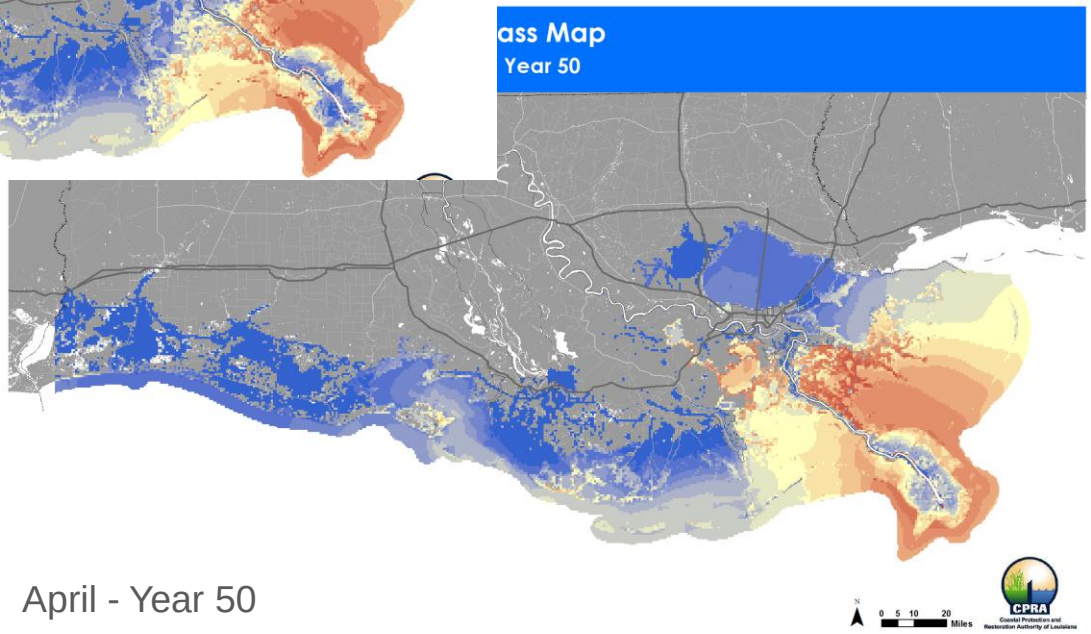
HSI Score

0 - 0.1	0.5 - 0.6
0.1 - 0.2	0.6 - 0.7
0.2 - 0.3	0.7 - 0.8
0.3 - 0.4	0.8 - 0.9
0.4 - 0.5	0.9 - 1

FUTURE WITHOUT ACTION – LOW SCENARIO



April - Year 25



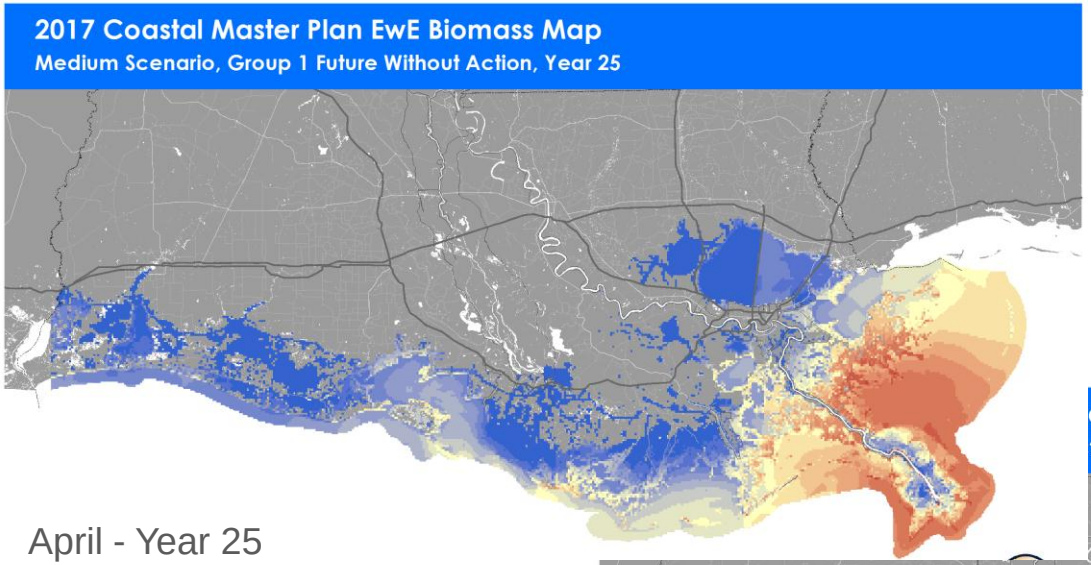
April - Year 50

Juv. Brown Shrimp

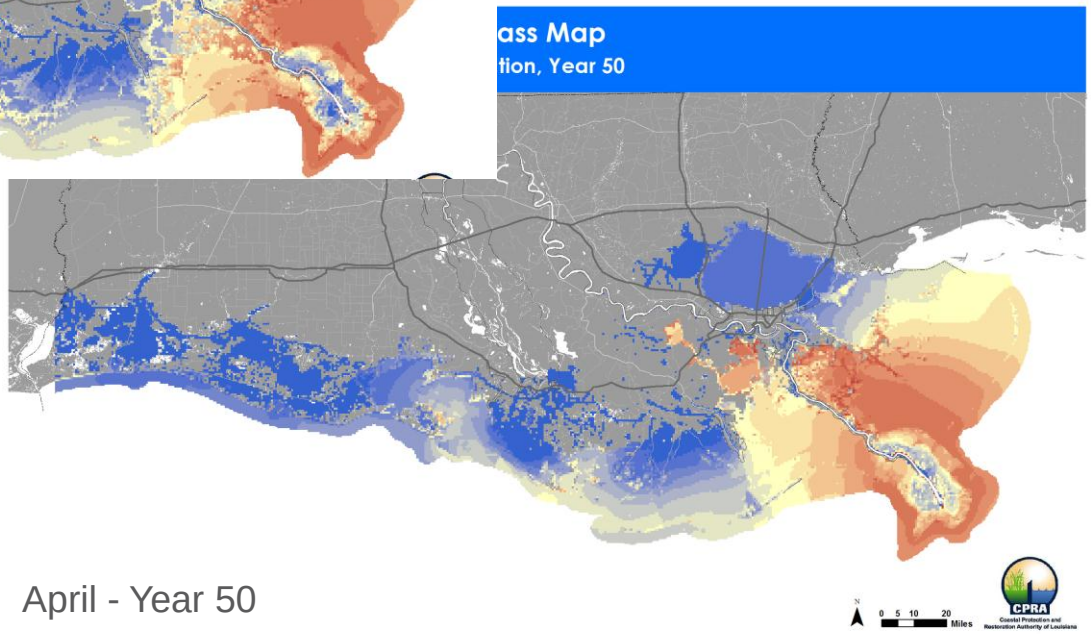
Biomass (tonnes/sq. km)

0 - 0.011	0.15 - 0.18
0.012 - 0.025	0.19 - 0.22
0.026 - 0.036	0.23 - 0.28
0.037 - 0.046	0.29 - 0.36
0.047 - 0.06	0.37 - 0.5
0.061 - 0.08	0.51 - 0.76
0.081 - 0.11	0.77 - 1.3
0.12 - 0.14	

FUTURE WITHOUT ACTION – MEDIUM SCENARIO



April - Year 25



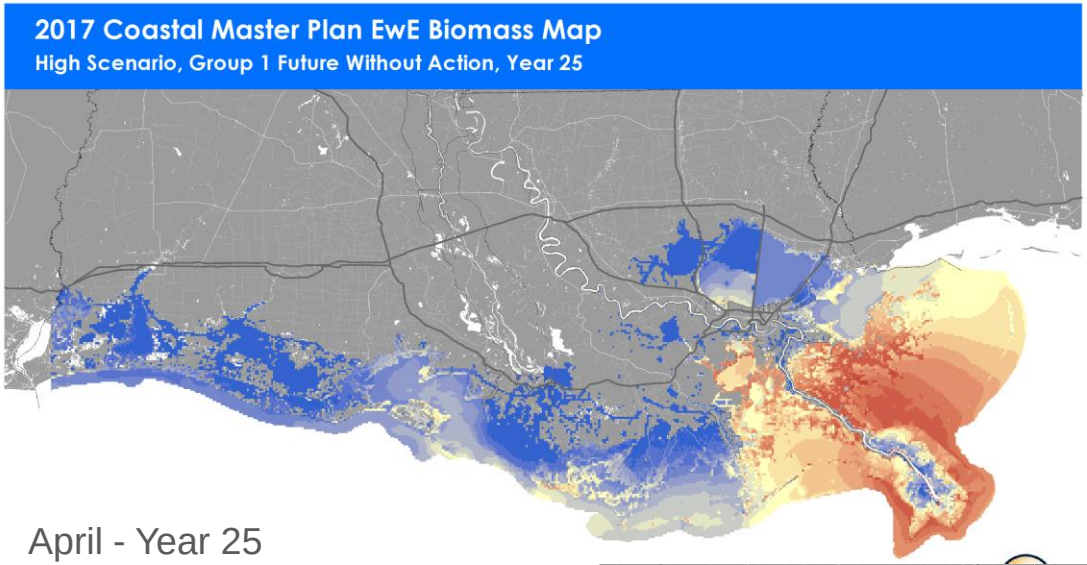
April - Year 50

Juv. Brown Shrimp

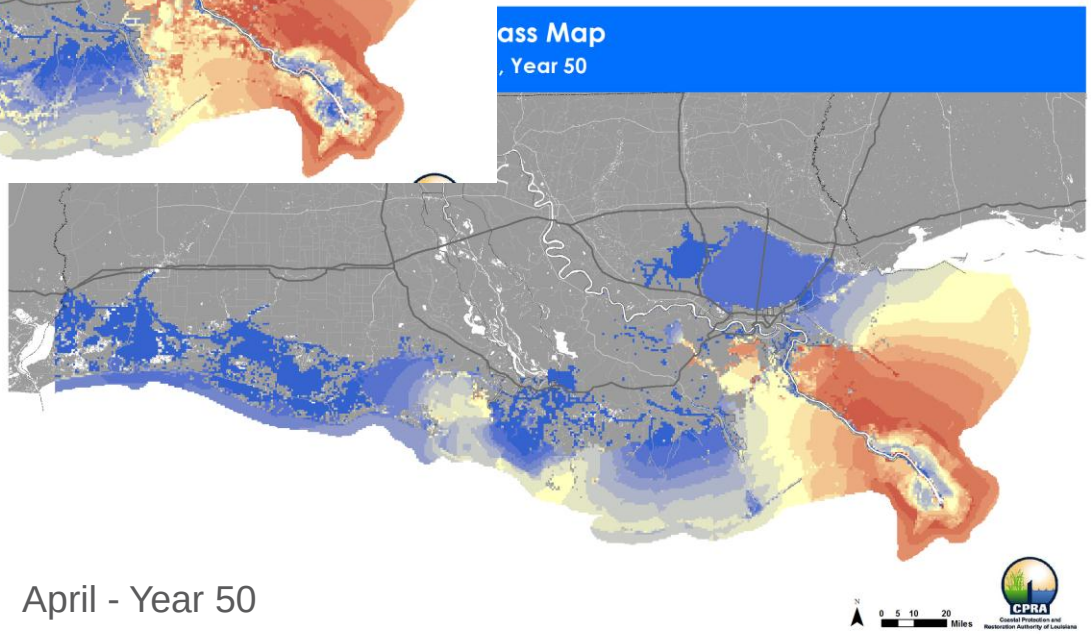
Biomass (tonnes/sq. km)

0 - 0.007	0.12 - 0.14
0.0071 - 0.02	0.15 - 0.18
0.021 - 0.03	0.19 - 0.23
0.031 - 0.04	0.24 - 0.29
0.041 - 0.05	0.3 - 0.44
0.051 - 0.065	0.45 - 0.73
0.066 - 0.08	0.74 - 1.4
0.081 - 0.11	

FUTURE WITHOUT ACTION – HIGH SCENARIO



April - Year 25



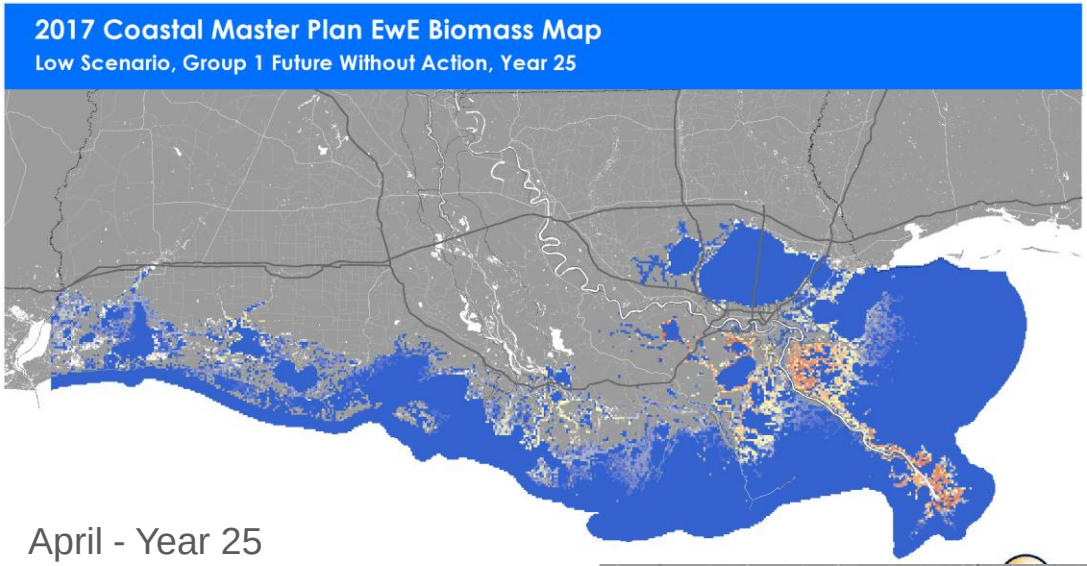
April - Year 50

Juv. Brown Shrimp

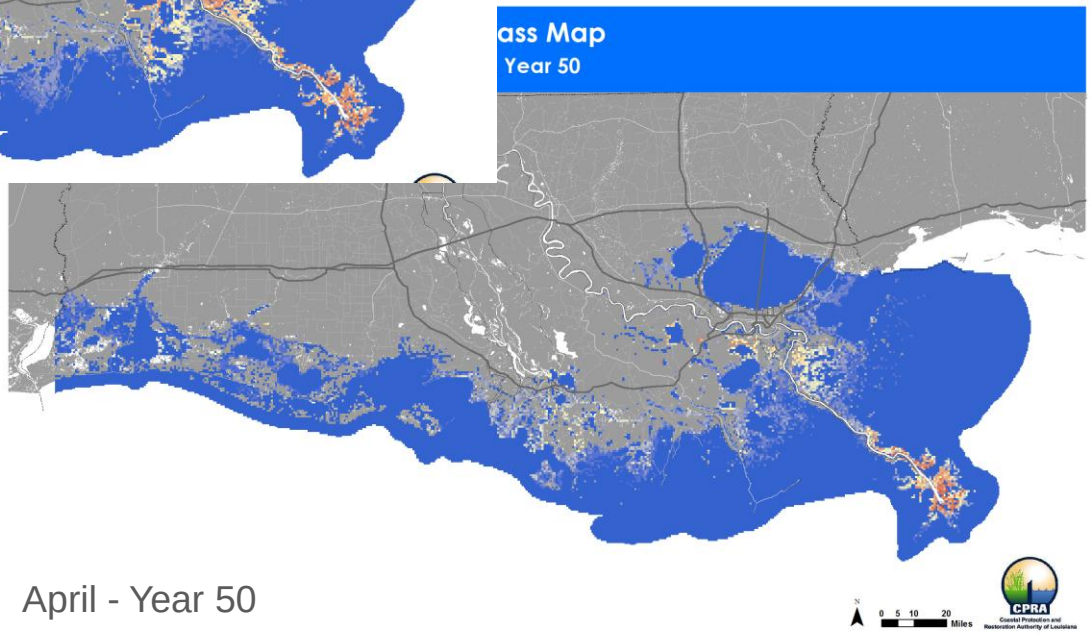
Biomass (tonnes/sq. km)

0 - 0.007	0.12 - 0.15
0.0071 - 0.019	0.16 - 0.19
0.02 - 0.031	0.2 - 0.24
0.032 - 0.043	0.25 - 0.3
0.044 - 0.055	0.31 - 0.38
0.056 - 0.069	0.39 - 0.71
0.07 - 0.087	0.72 - 1.6
0.088 - 0.11	

FUTURE WITHOUT ACTION – LOW SCENARIO



April - Year 25



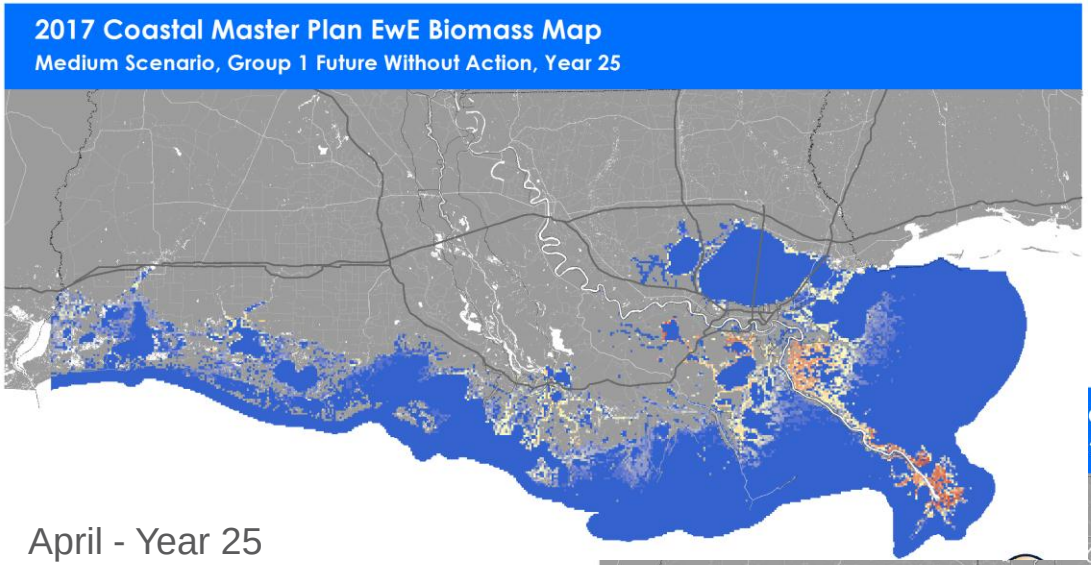
April - Year 50

Juv. Largemouth Bass

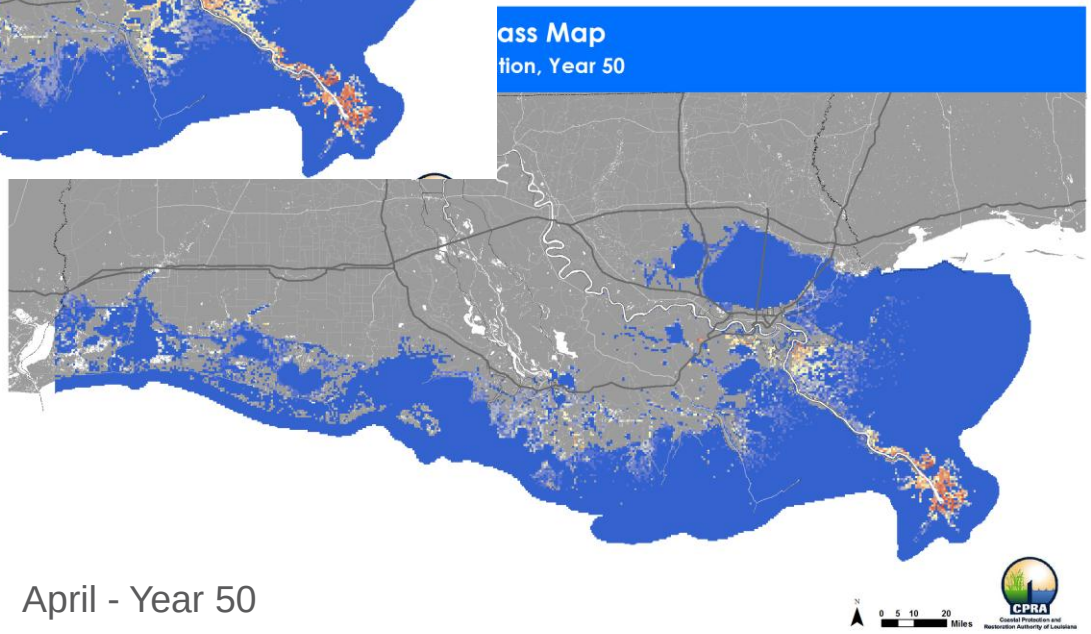
Biomass (tonnes/sq. km)

0 - 0.002	0.065 - 0.085
0.0021 - 0.007	0.086 - 0.12
0.0071 - 0.013	0.13 - 0.17
0.014 - 0.02	0.18 - 0.24
0.021 - 0.028	0.25 - 0.35
0.029 - 0.037	0.36 - 0.54
0.038 - 0.049	0.55 - 1.2
0.05 - 0.064	

FUTURE WITHOUT ACTION – MEDIUM SCENARIO



April - Year 25



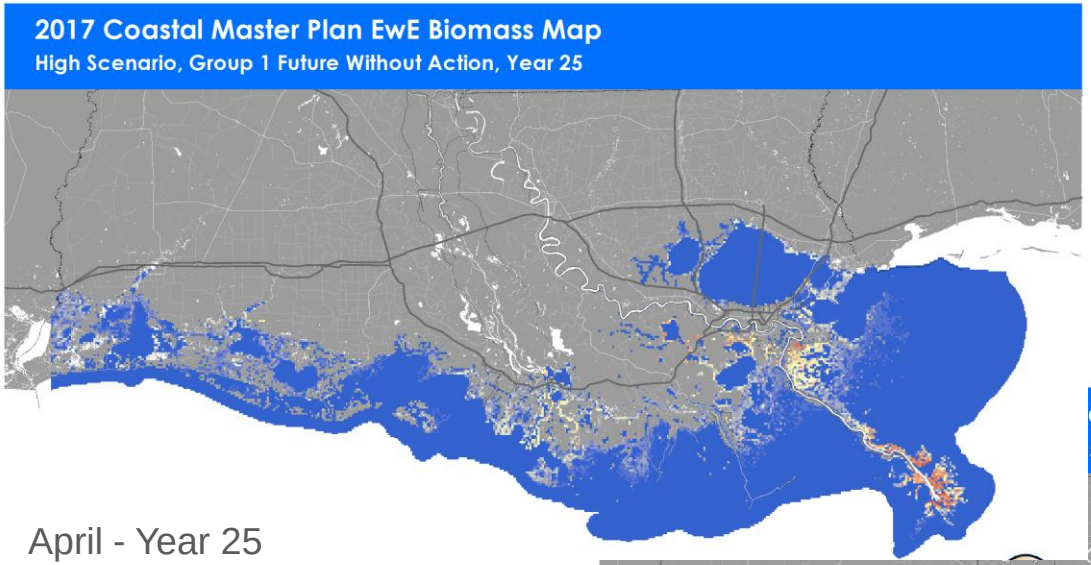
April - Year 50

Juv. Largemouth Bass

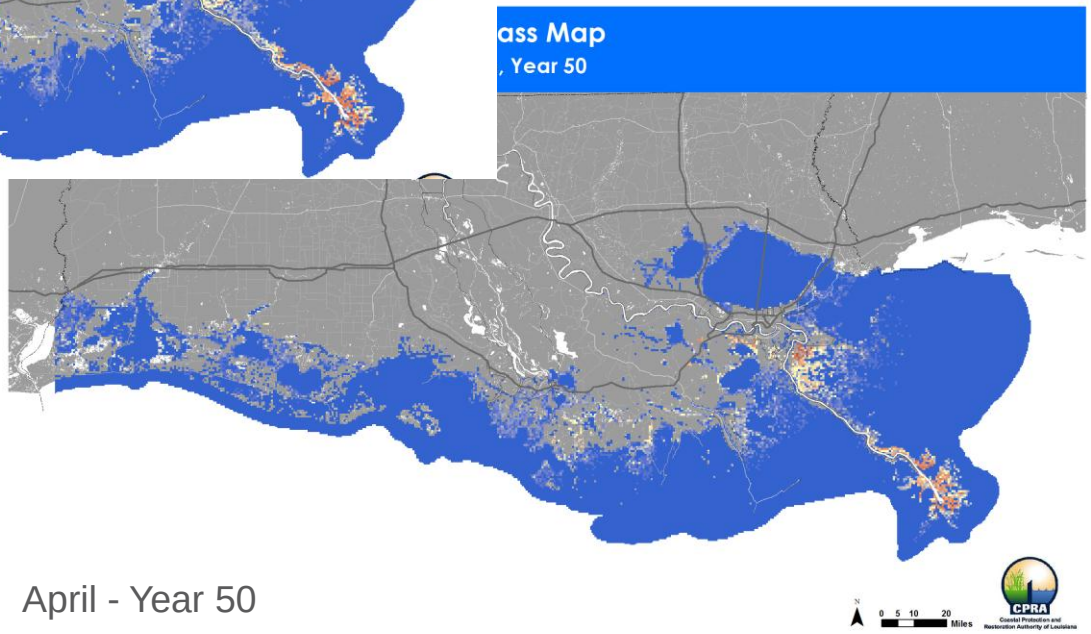
Biomass (tonnes/sq. km)

0 - 0.002	0.065 - 0.085
0.0021 - 0.007	0.086 - 0.12
0.0071 - 0.013	0.13 - 0.17
0.014 - 0.02	0.18 - 0.24
0.021 - 0.028	0.25 - 0.35
0.029 - 0.037	0.36 - 0.54
0.038 - 0.049	0.55 - 1.2
0.05 - 0.064	

FUTURE WITHOUT ACTION – HIGH SCENARIO



April - Year 25



April - Year 50

Juv. Largemouth Bass

Biomass (tonnes/sq. km)

0 - 0.002	0.065 - 0.085
0.0021 - 0.007	0.086 - 0.12
0.0071 - 0.013	0.13 - 0.17
0.014 - 0.02	0.18 - 0.24
0.021 - 0.028	0.25 - 0.35
0.029 - 0.037	0.36 - 0.54
0.038 - 0.049	0.55 - 1.2
0.05 - 0.064	

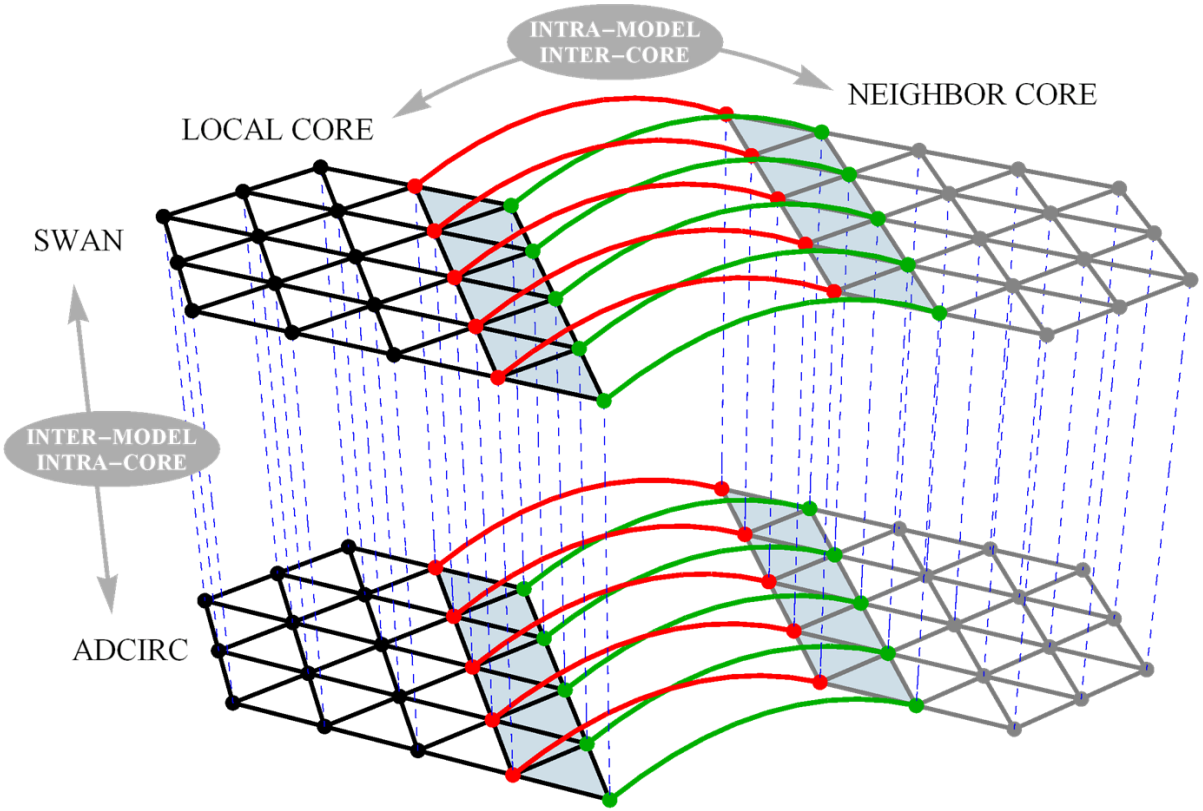
SURGE AND WAVES

Model Overview / Framework

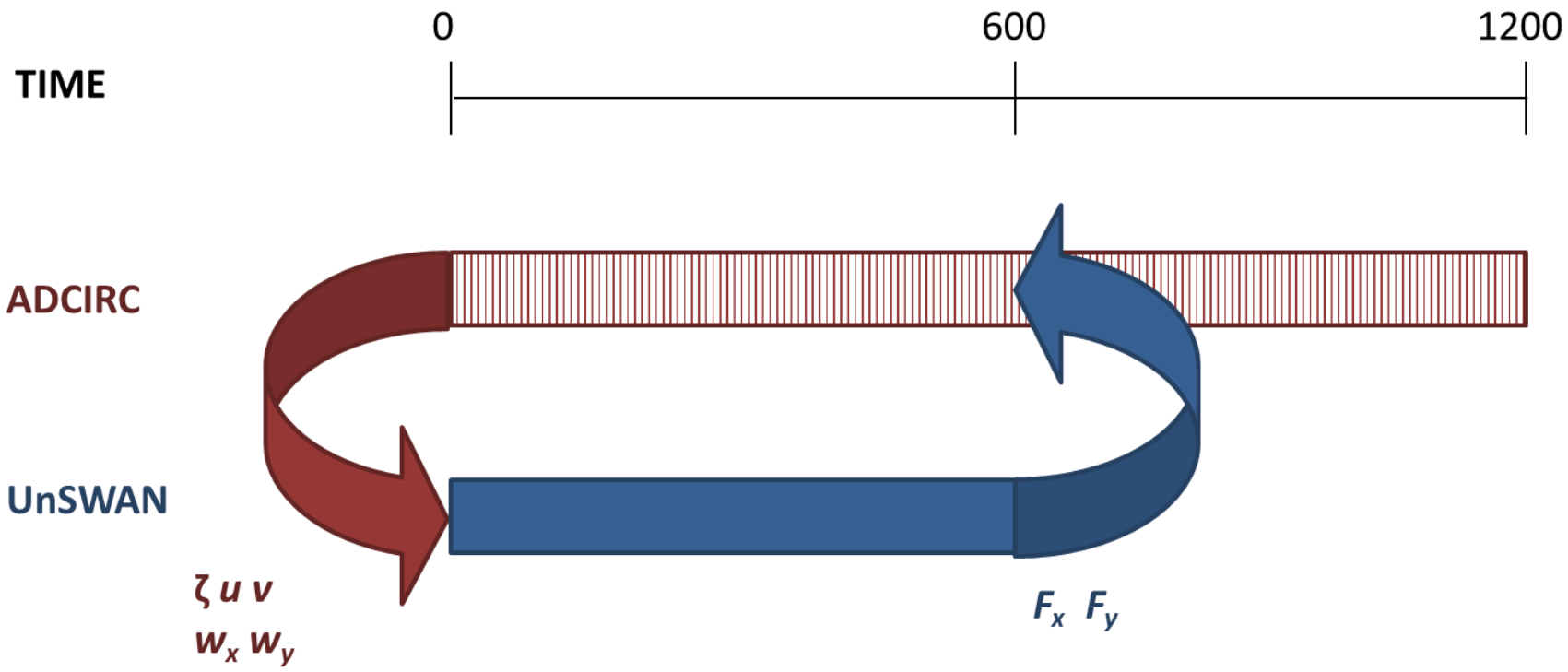
MODEL SELECTION

- **ADCIRC**
  - Circulation model (currents, water surface elevations)
  - 2-Dimensional Depth Integrated
  - Unstructured mesh
- **SWAN**
  - Spectral wave model
  - Same unstructured mesh as ADCIRC
  - Tightly coupled with ADCIRC

MODEL COUPLING



MODEL COUPLING

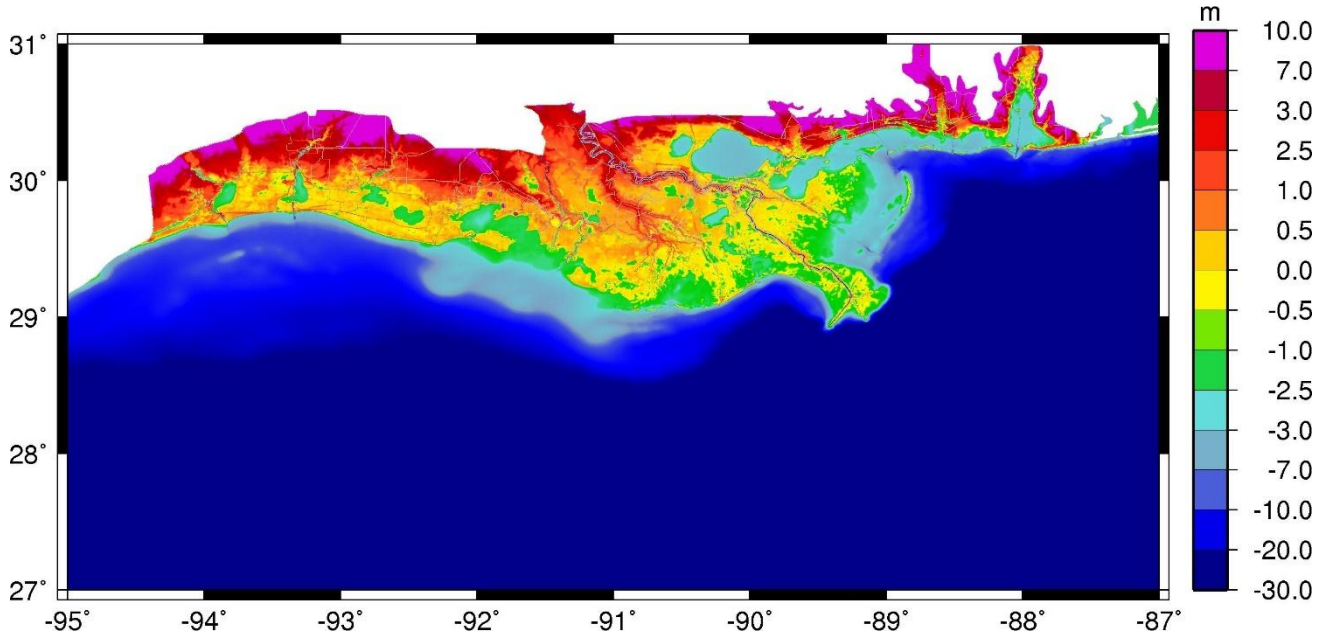


SURGE AND WAVES

Model Inputs

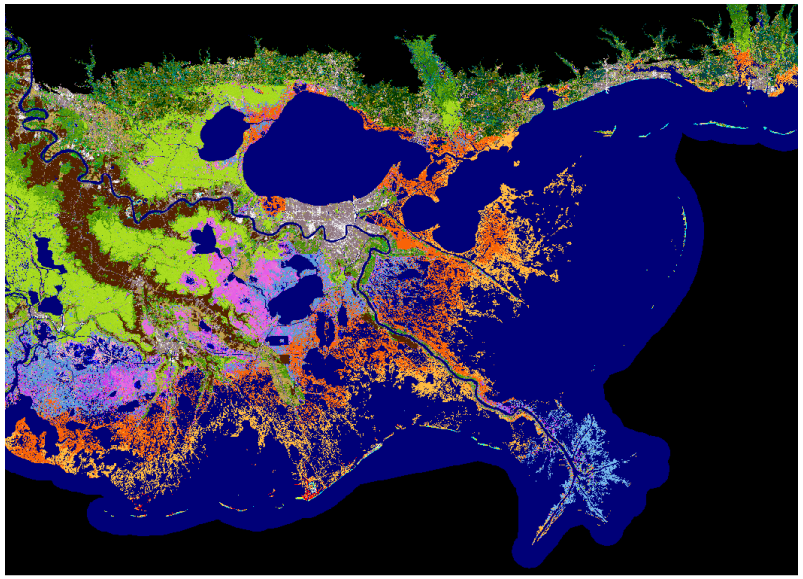
MODEL INPUTS

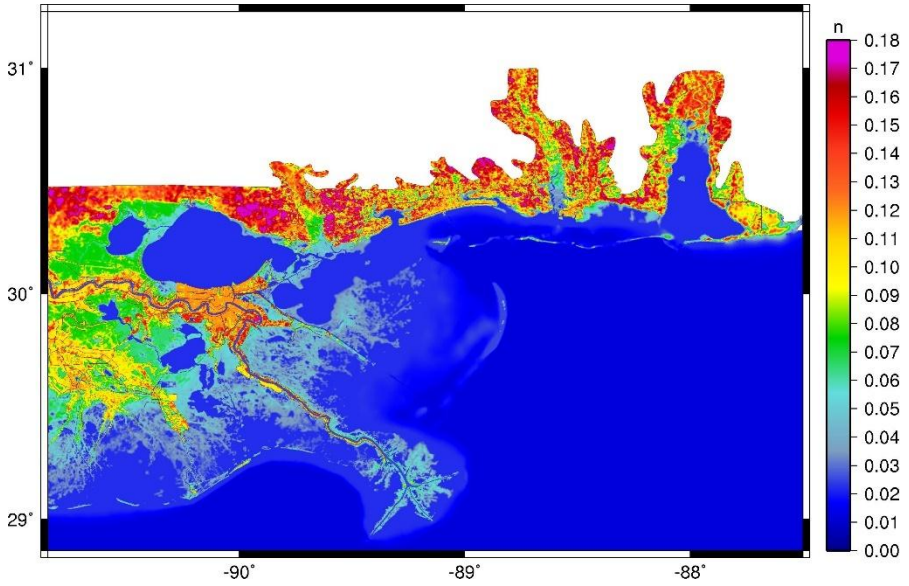
- **LIDAR & Bathymetric Sounding**
  - Interpolated to model
  - Checked for consistency with satellite imagery
  - Special care taken for raised features

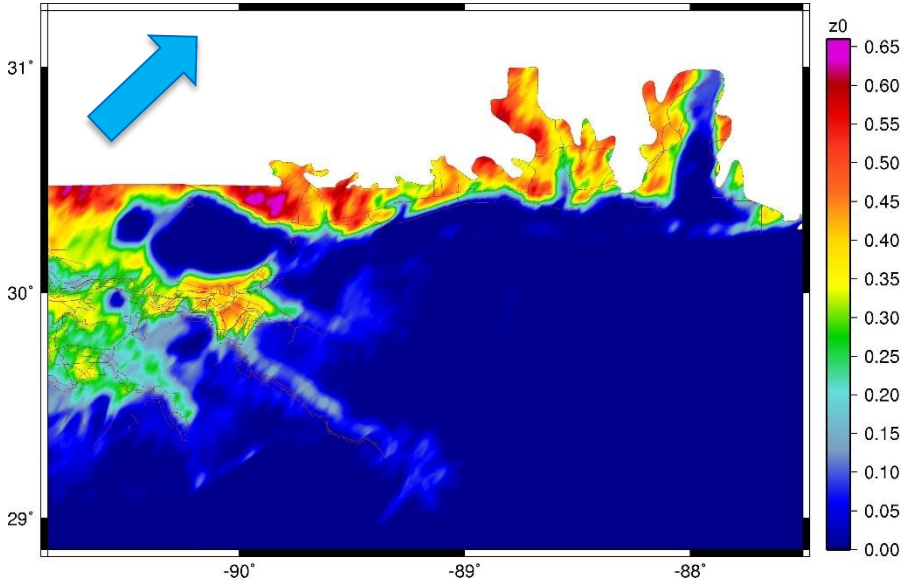


MODEL INPUTS

- **Land Use Data**
  - Determines model roughness
  - Directional based wind reduction coefficients

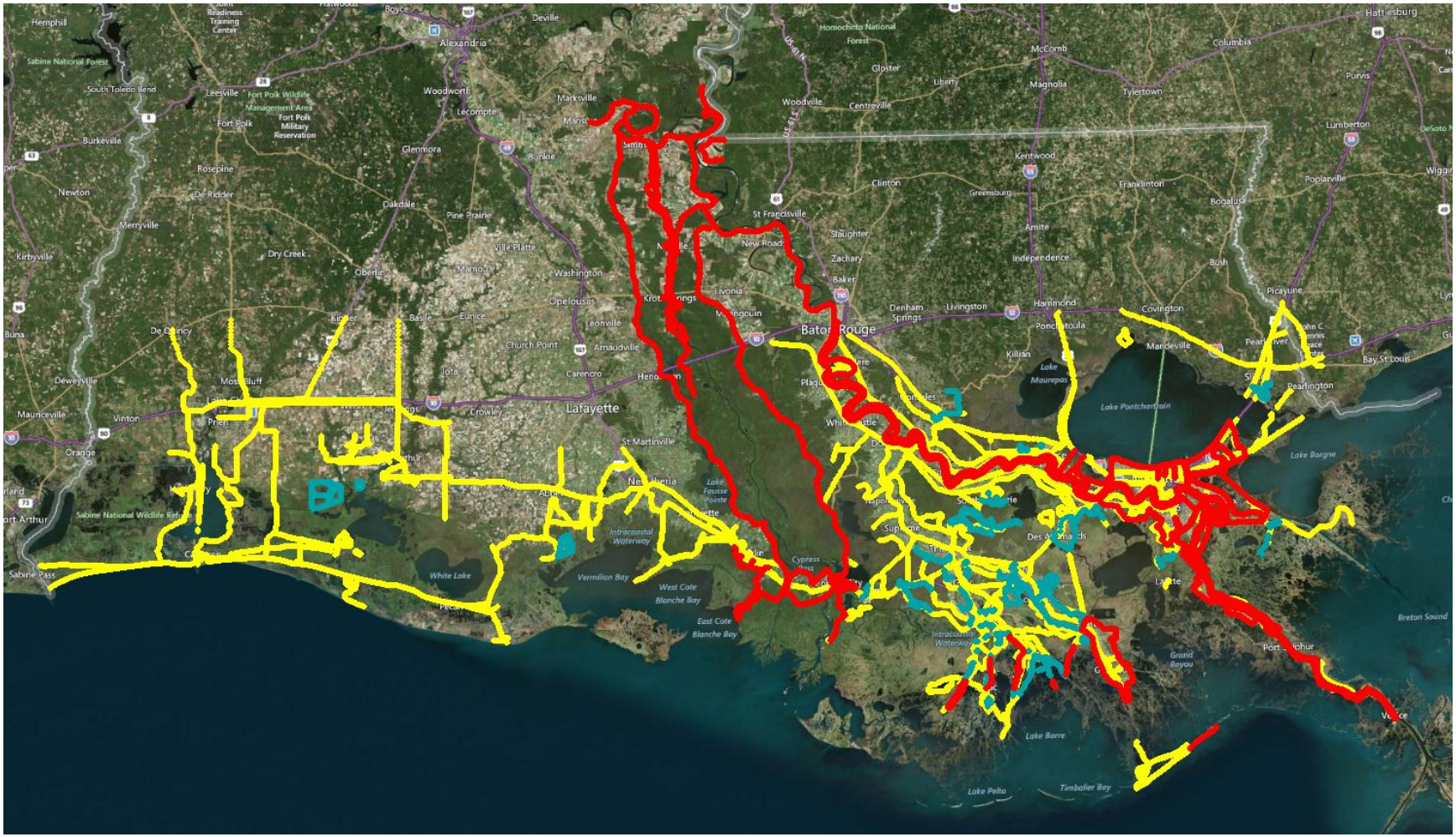






RAISED FEATURE SOURCES

- USACE
- Sea Grant
- USGS CoNED

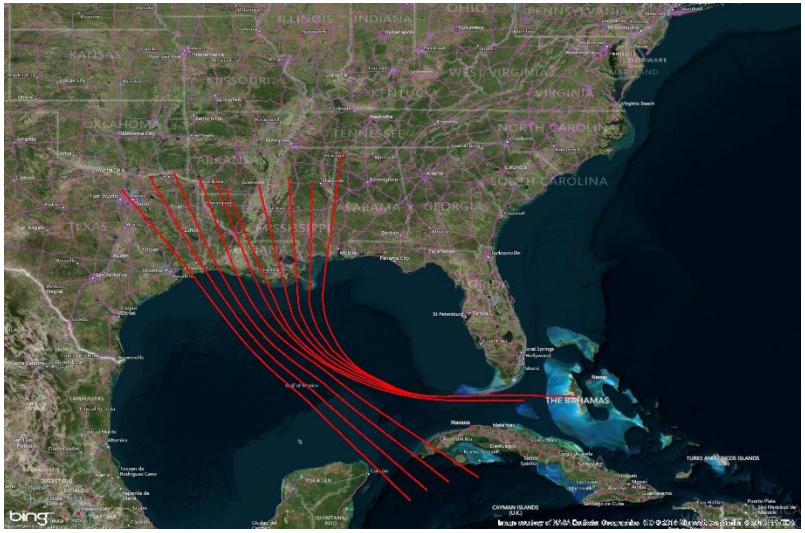


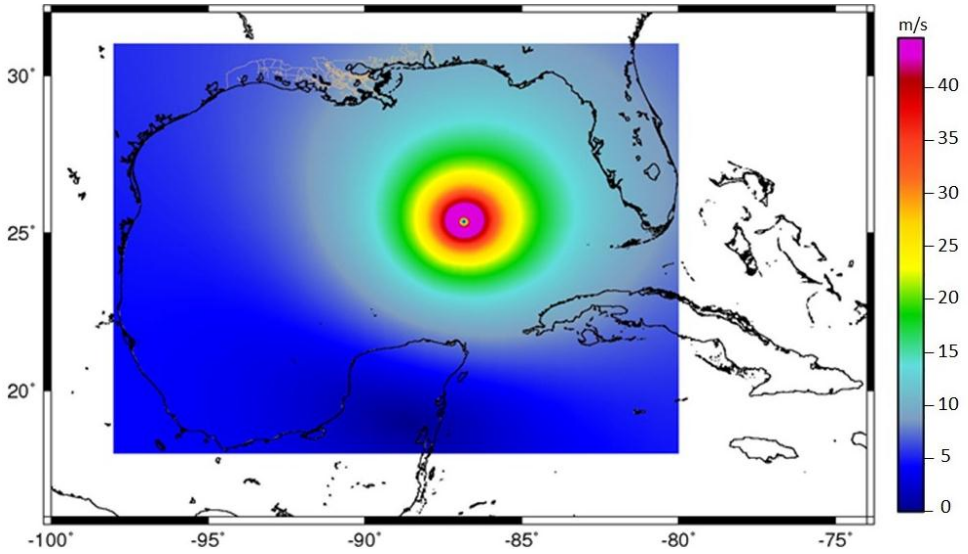
MODEL INPUTS

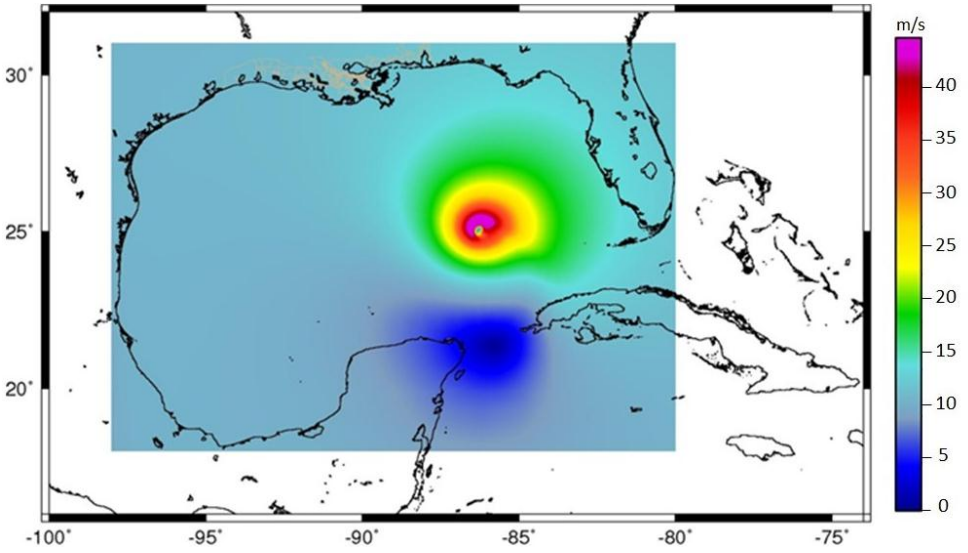
- **Riverine Flows**
  - Mississippi River @ Baton Rouge
    - 9174 cms
  - Atchafalaya River @ Spice Island Chute
    - 3936 cms
  - Flows derived from USACE analysis of seasonal flows

MODEL INPUTS

- 60 Synthetic Hurricanes
- 10 tracks



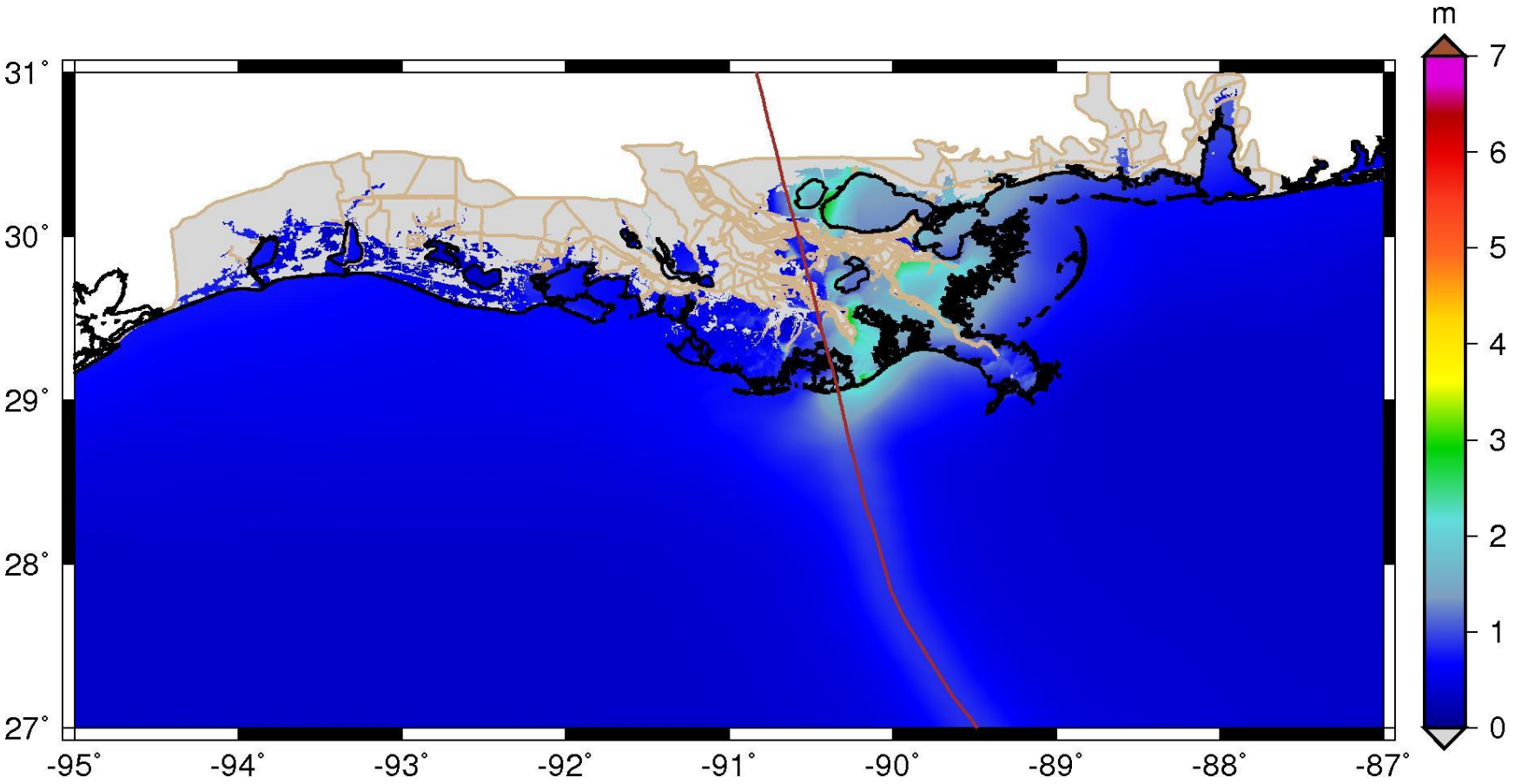




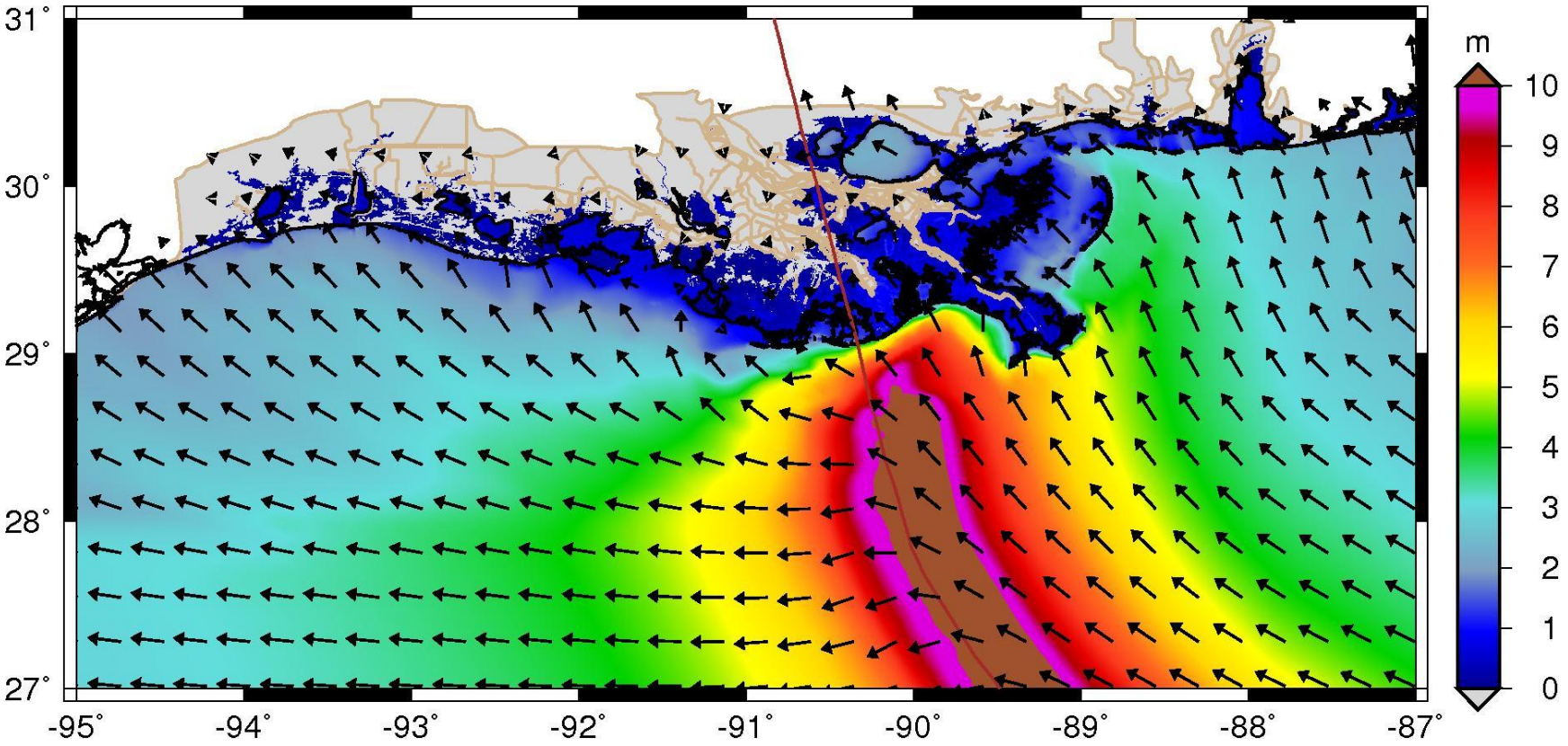
SURGE AND WAVES

Initial Conditions

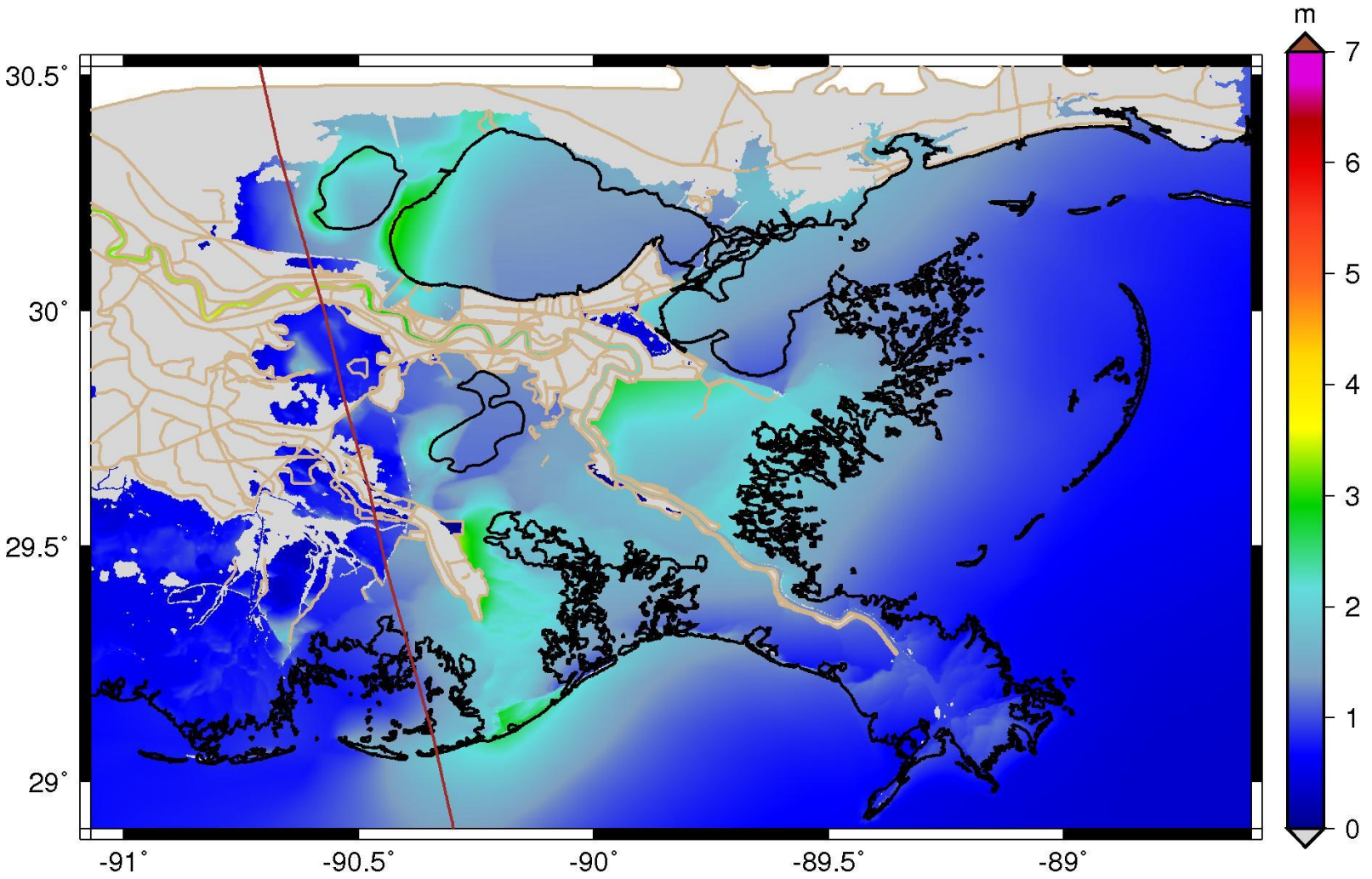
INITIAL CONDITIONS: STORM 010 MAX WSE



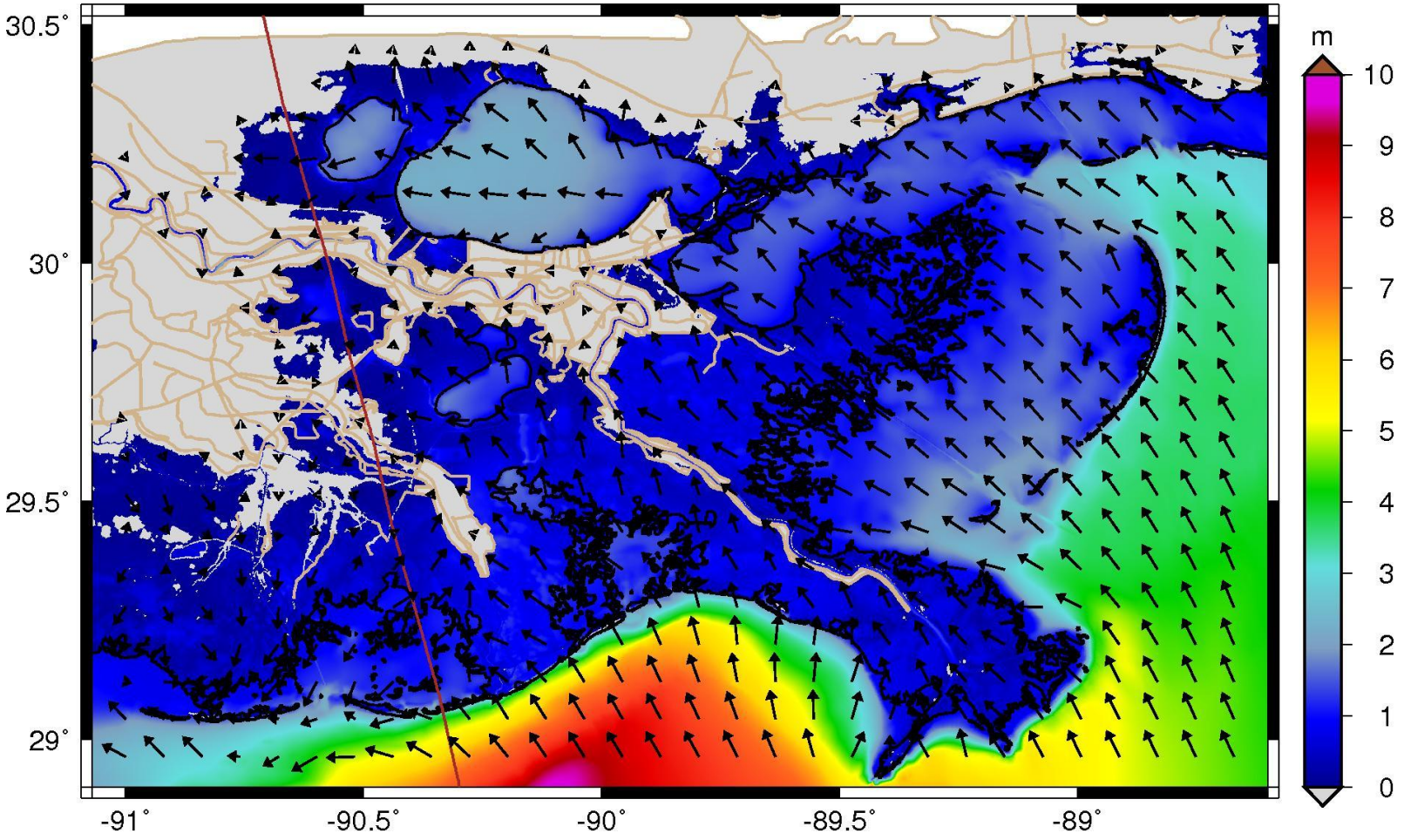
INITIAL CONDITIONS: STORM 010 MAX HS



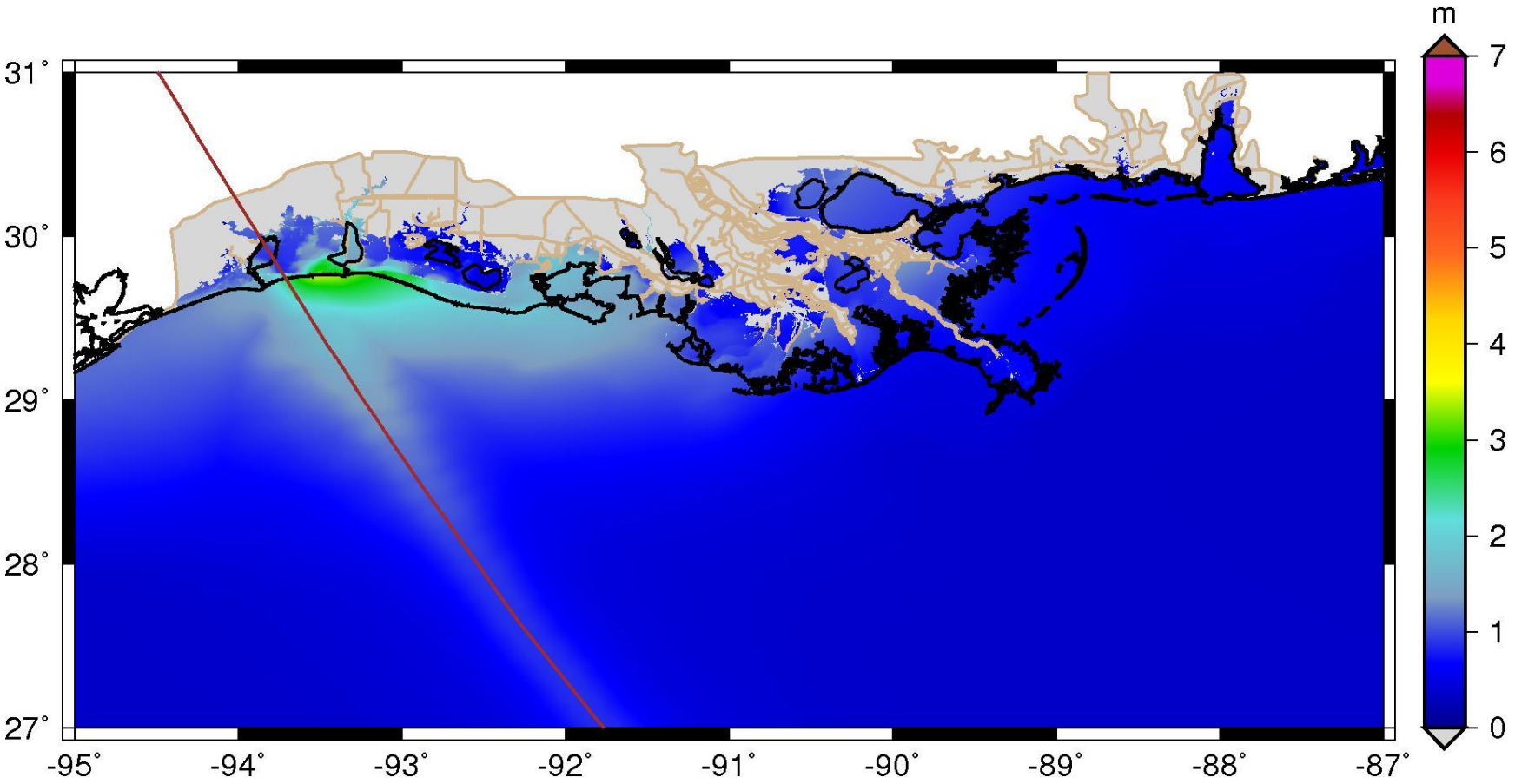
INITIAL CONDITIONS: STORM 010 MAX WSE



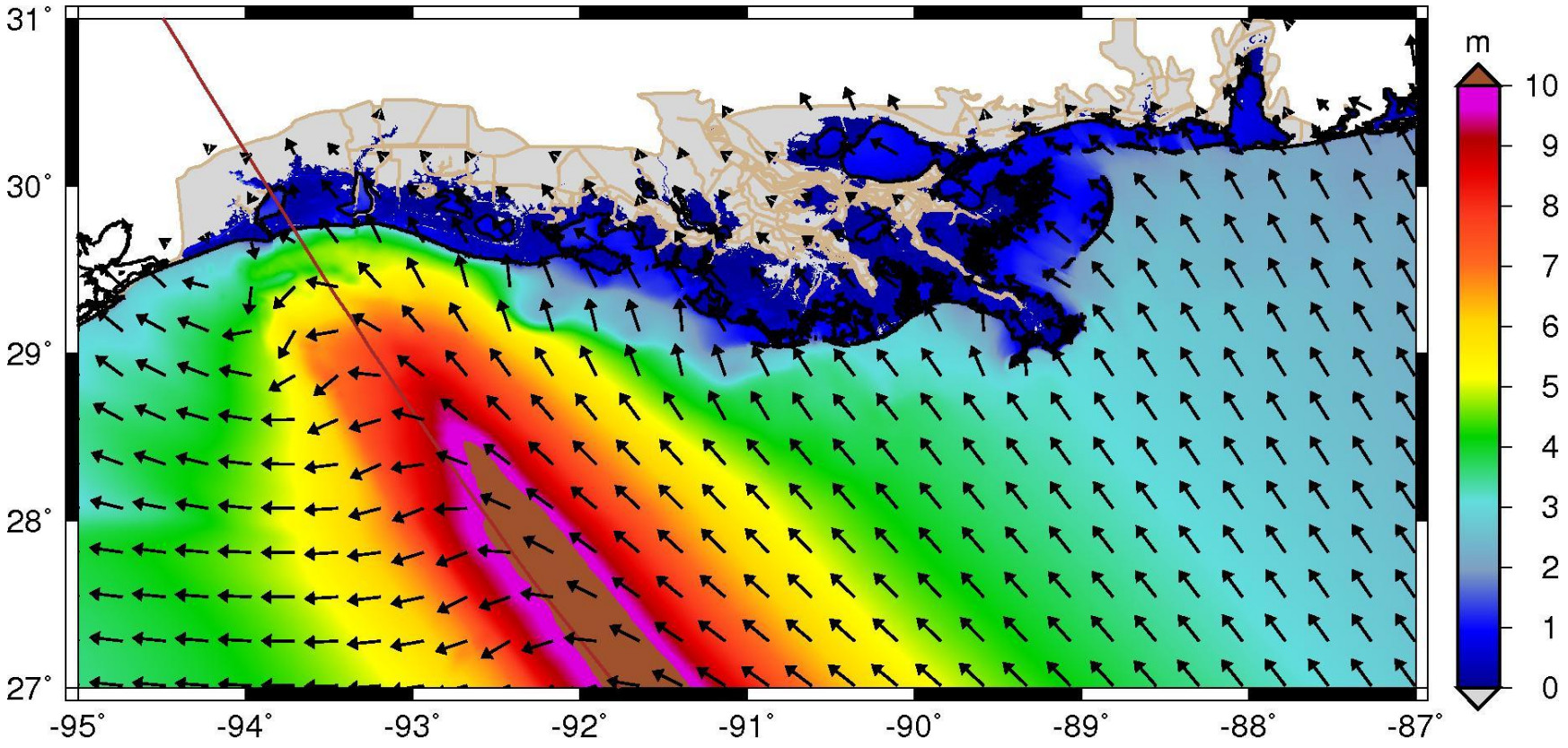
INITIAL CONDITIONS: STORM 010 MAX HS



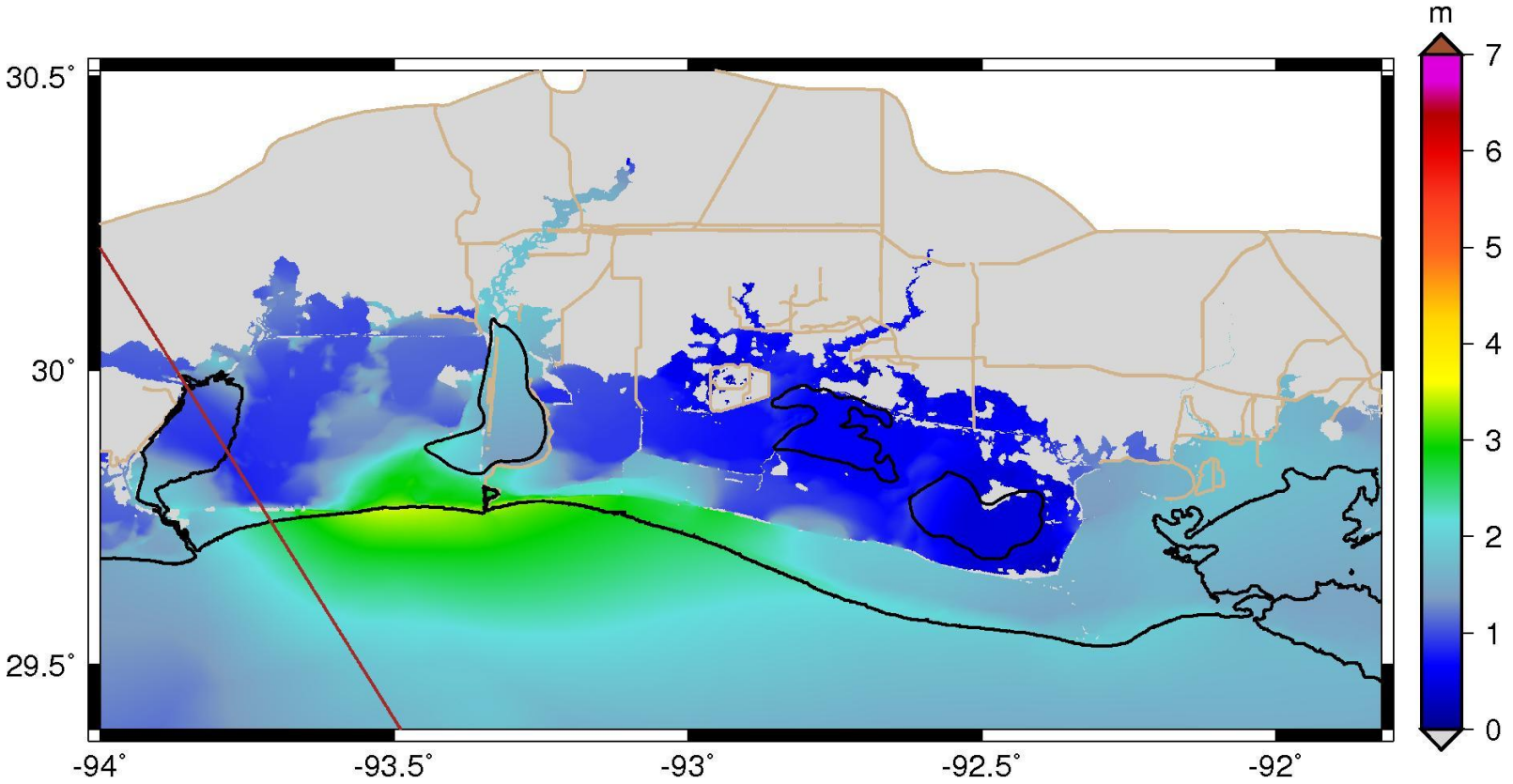
INITIAL CONDITIONS: STORM 210 MAX WSE



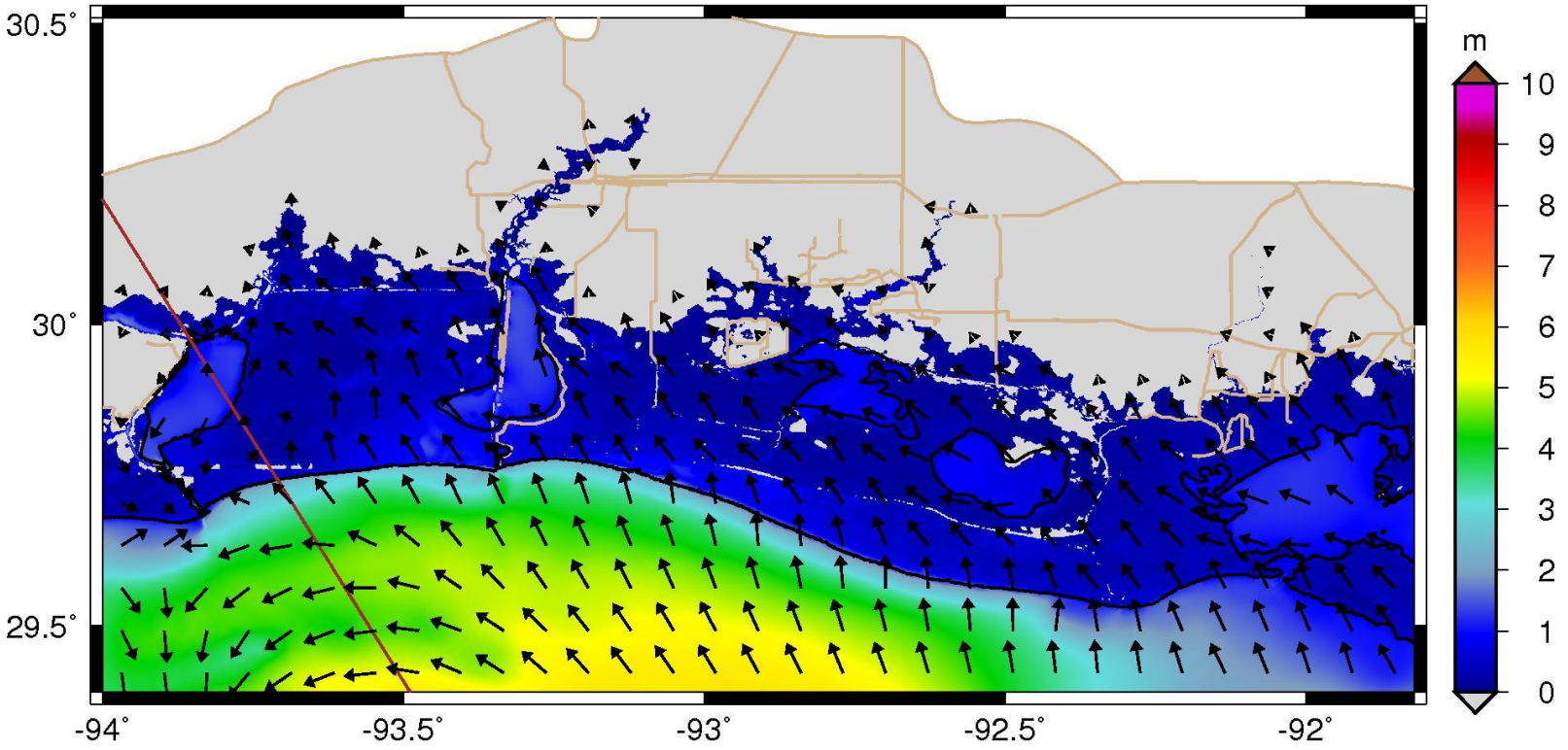
INITIAL CONDITIONS: STORM 210 MAX HS



INITIAL CONDITIONS: STORM 210 MAX WSE



INITIAL CONDITIONS: STORM 210 MAX HS

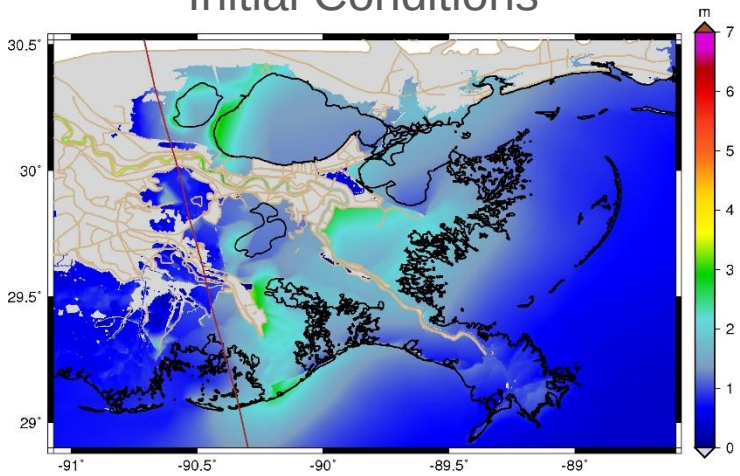


SURGE AND WAVES

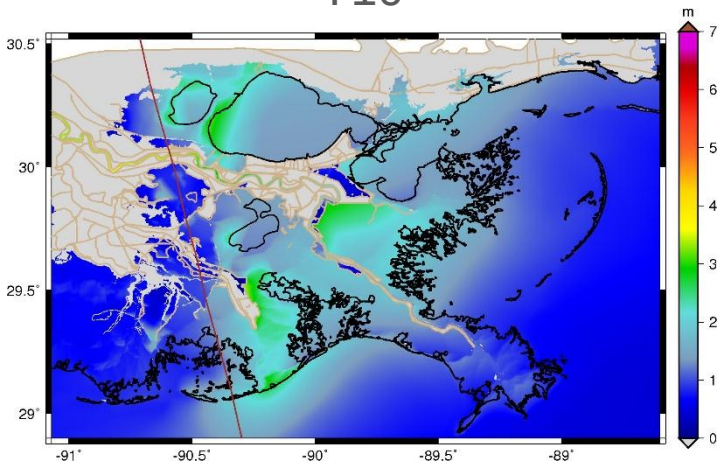
Future Without Action

FWOA LOW SCENARIO: STORM 010 WSE

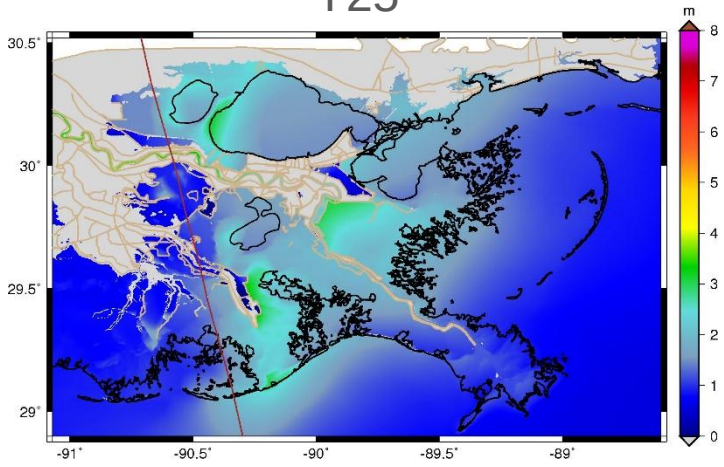
Initial Conditions



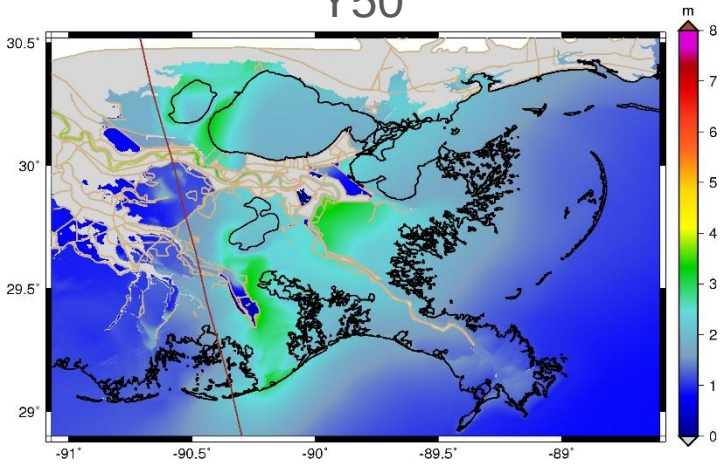
Y10



Y25

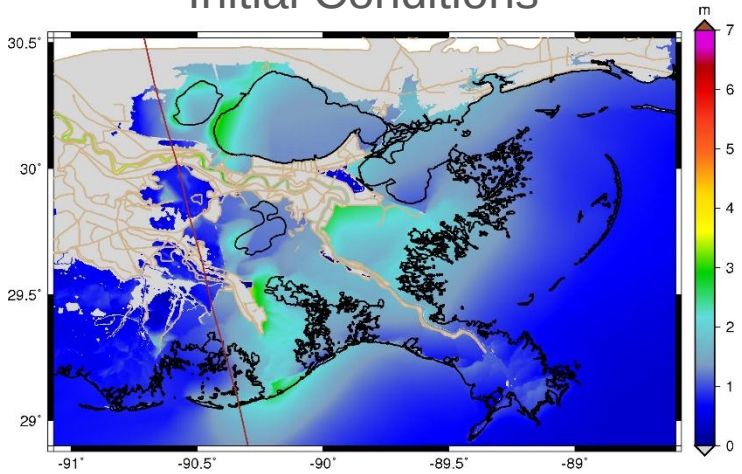


Y50

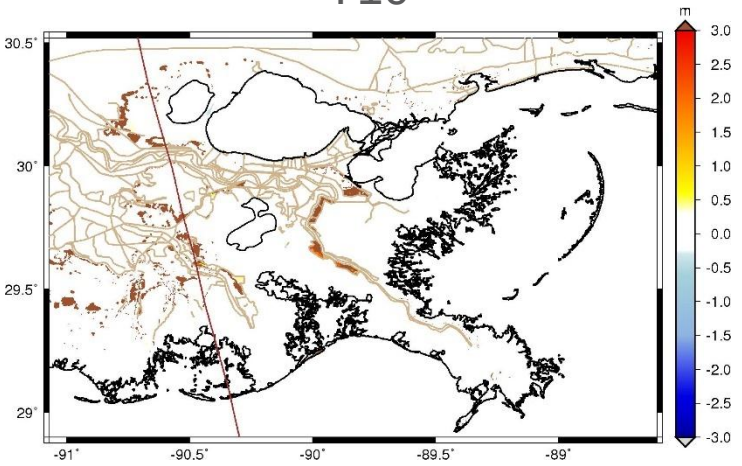


FWOA LOW SCENARIO: STORM 010 WSE

Initial Conditions



Y10



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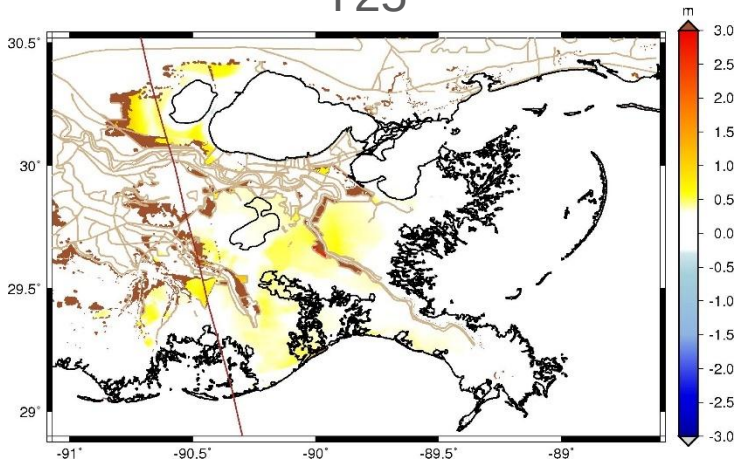

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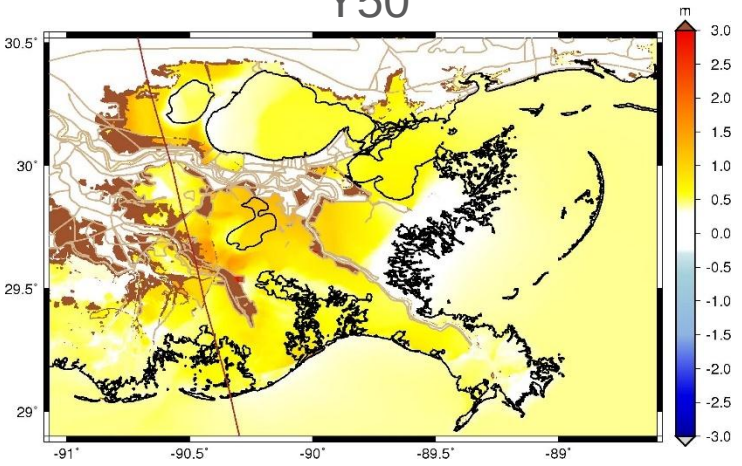
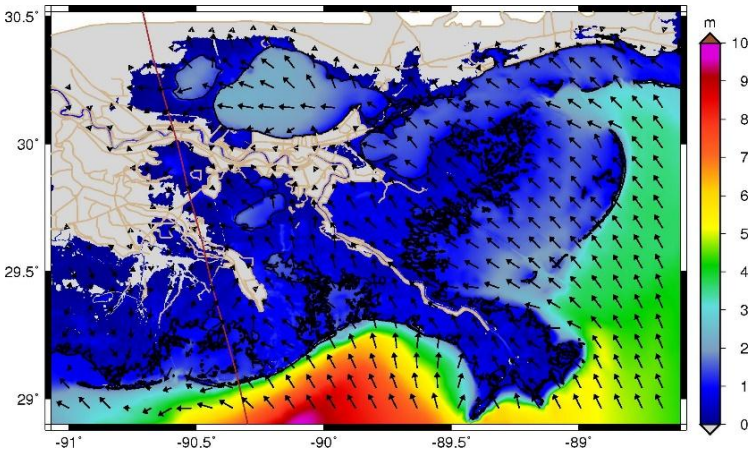


FWOA LOW SCENARIO: STORM 010 HS

Initial Conditions



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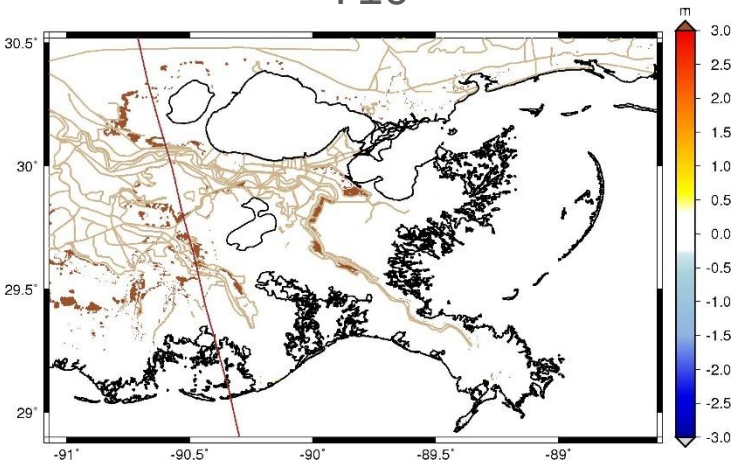

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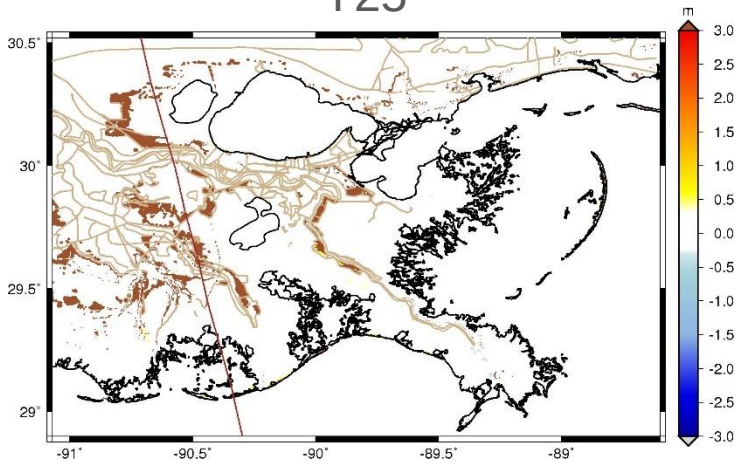

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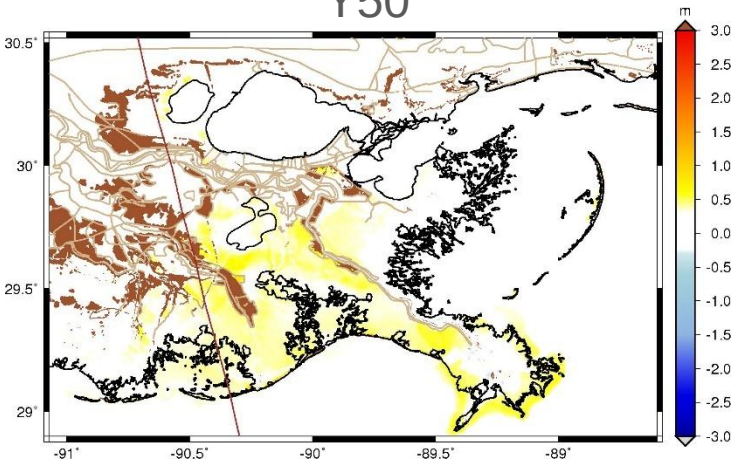
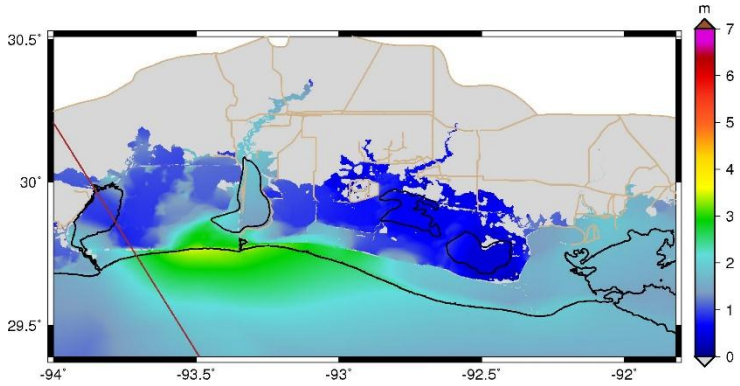


FWOA LOW SCENARIO: STORM 210 WSE

Initial Conditions



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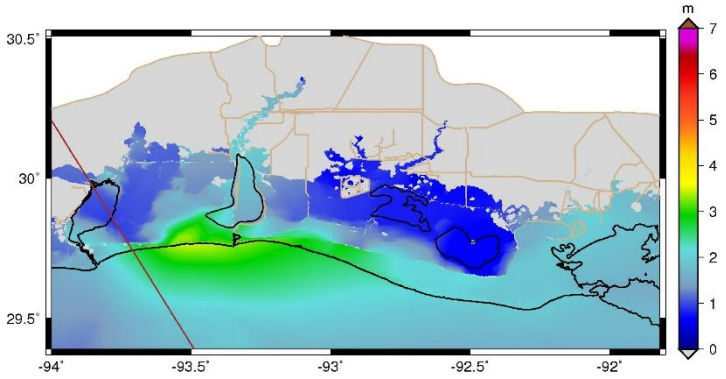

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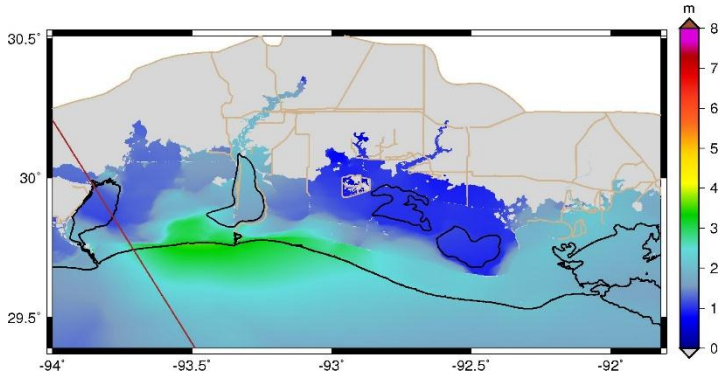

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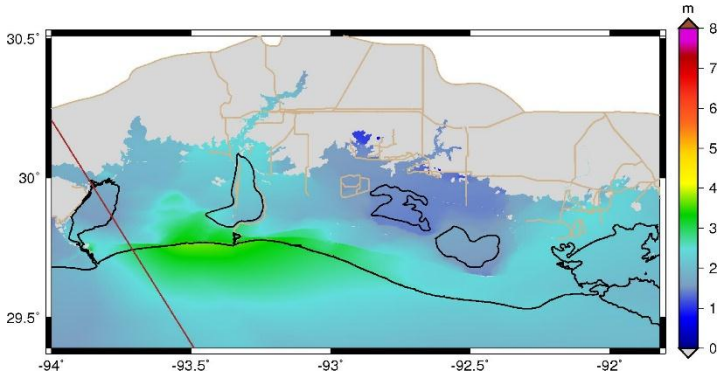
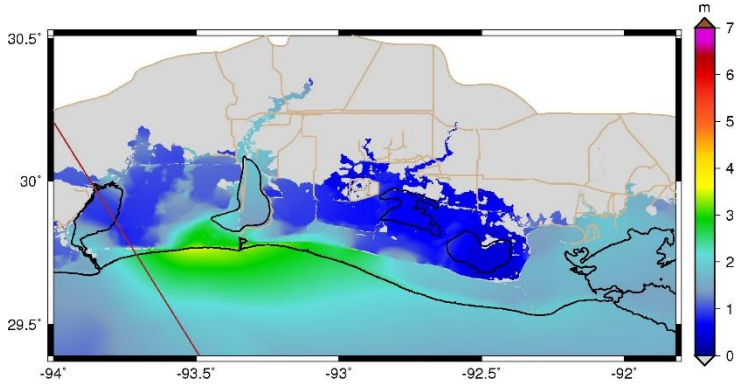


FWOA LOW SCENARIO: STORM 210 WSE

Initial Conditions



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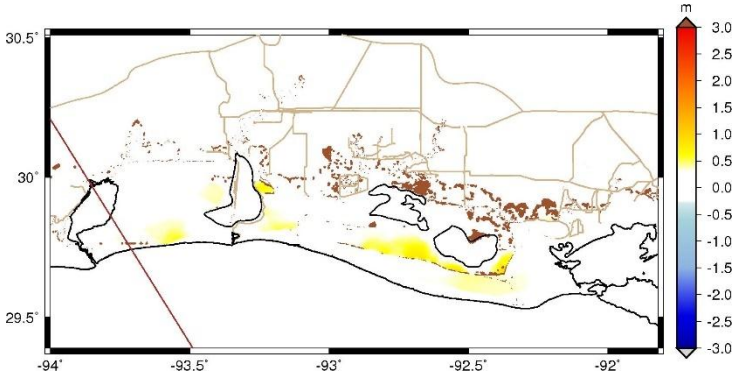

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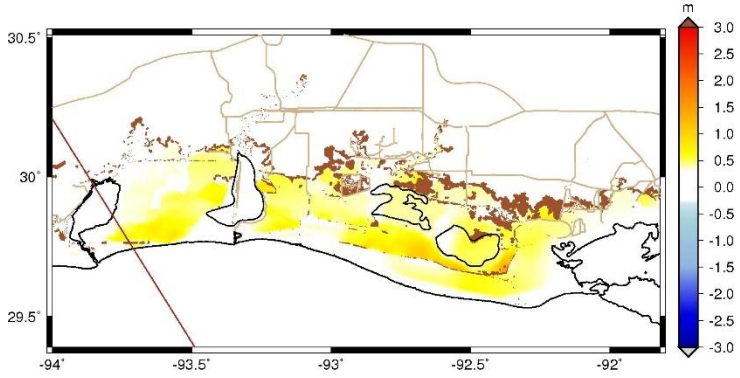

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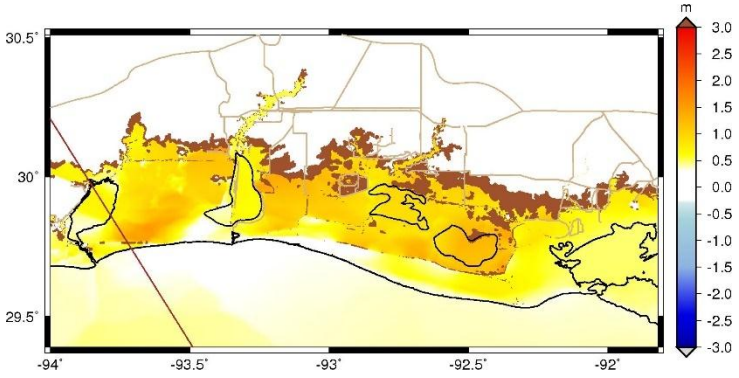
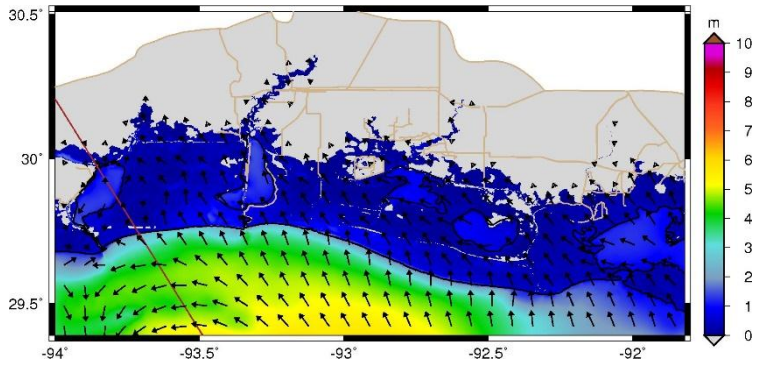


FWOA LOW SCENARIO: STORM 210 HS

Initial Conditions



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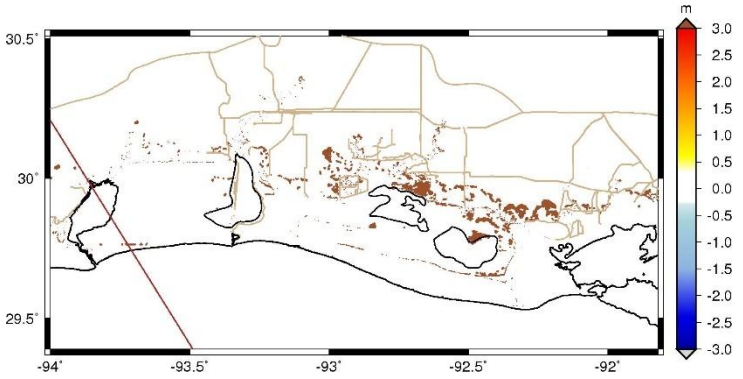

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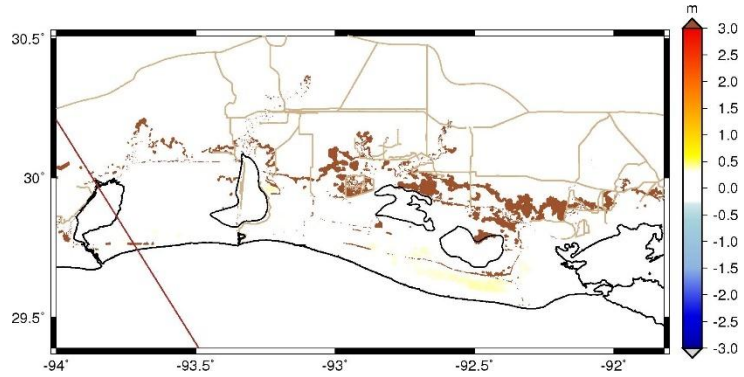

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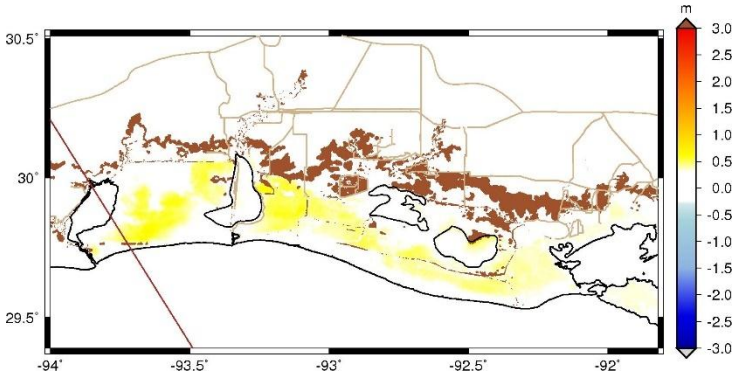
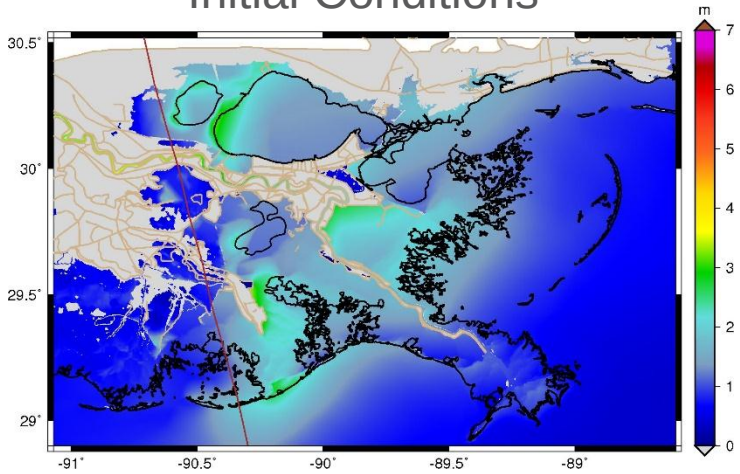


FWOA MEDIUM SCENARIO: STORM 010 WSE

Initial Conditions



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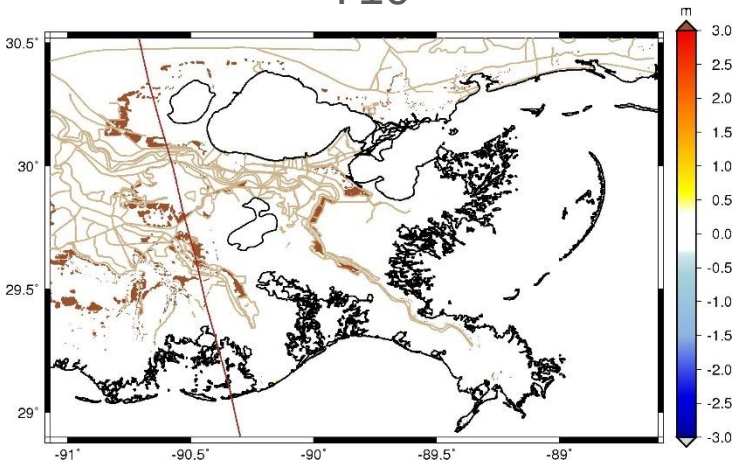

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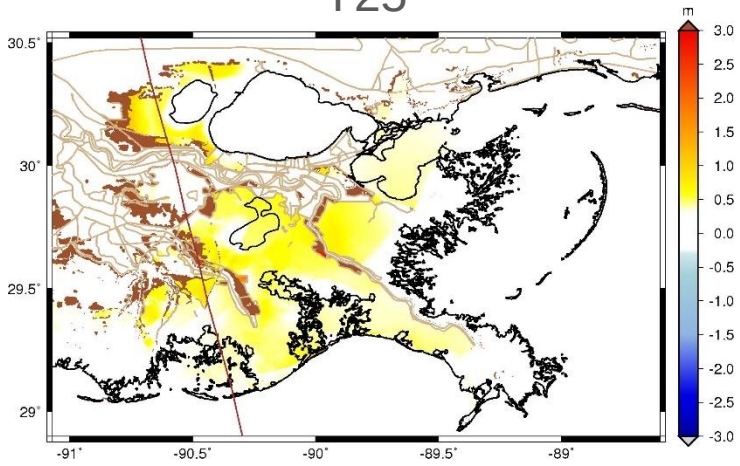

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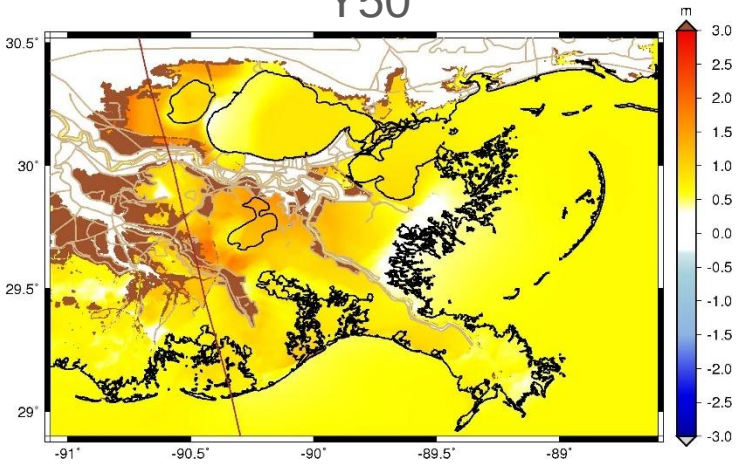
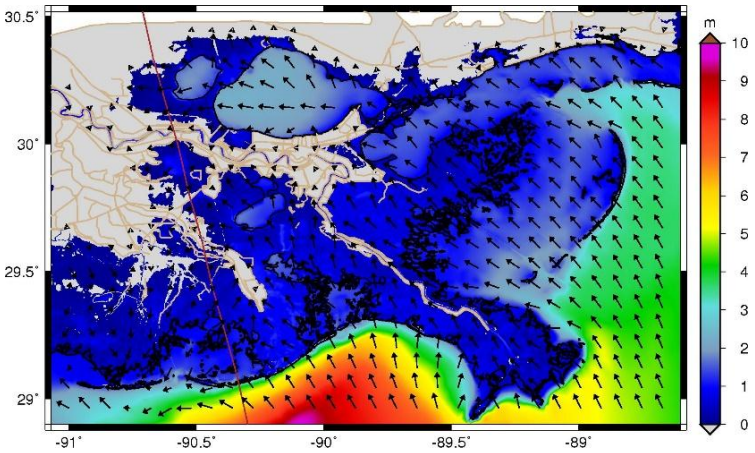


FWOA MEDIUM SCENARIO: STORM 010 HS

Initial Conditions



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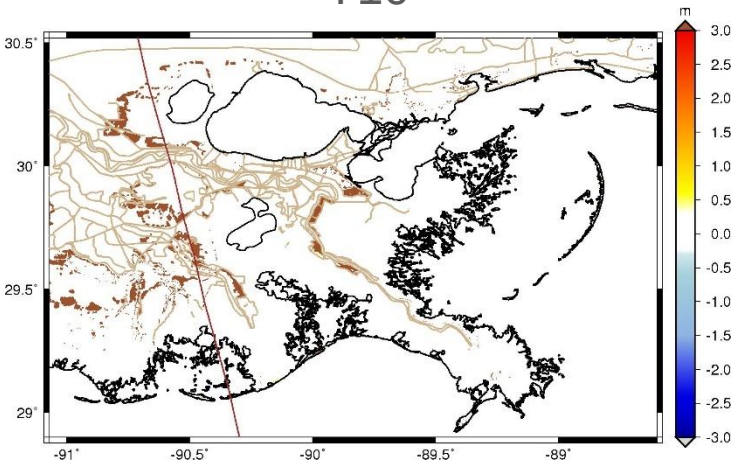

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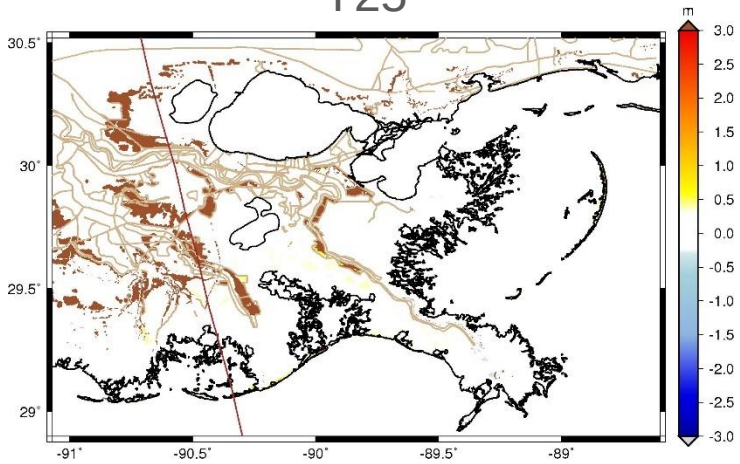

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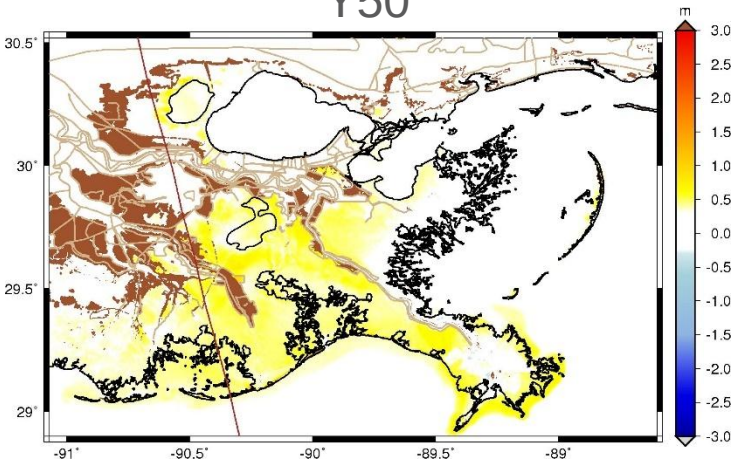
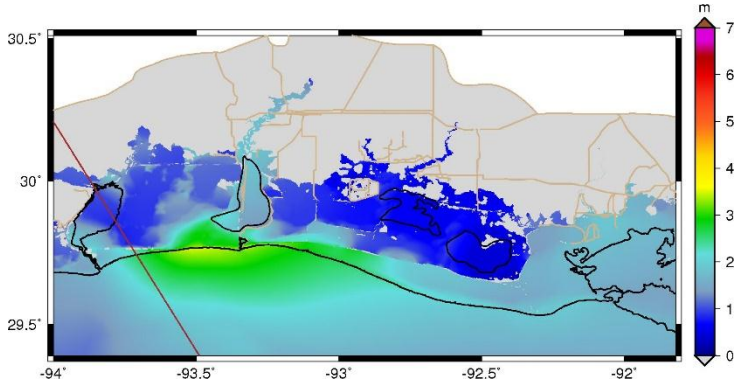


FWOA MEDIUM SCENARIO: STORM 210 WSE

Initial Conditions



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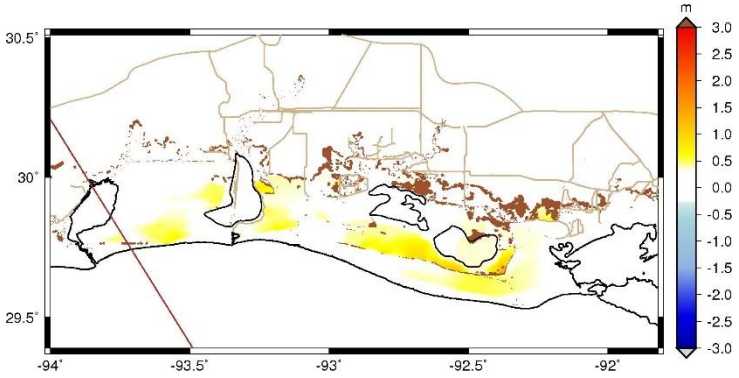

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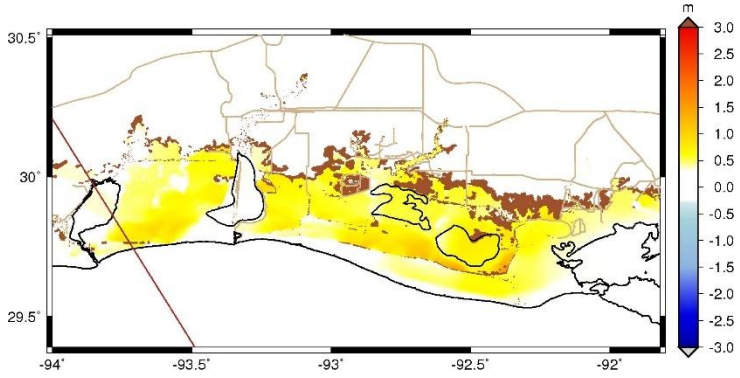

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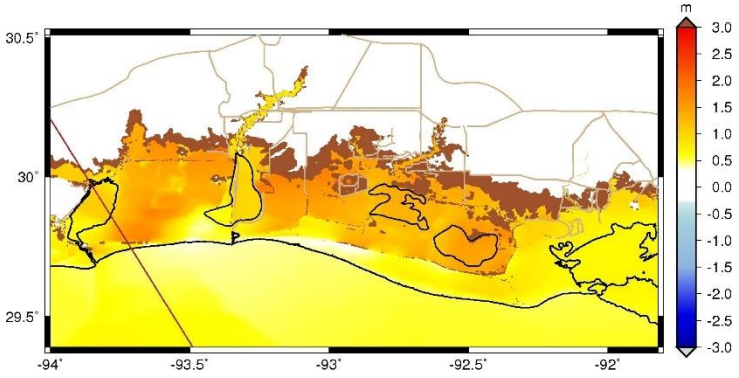
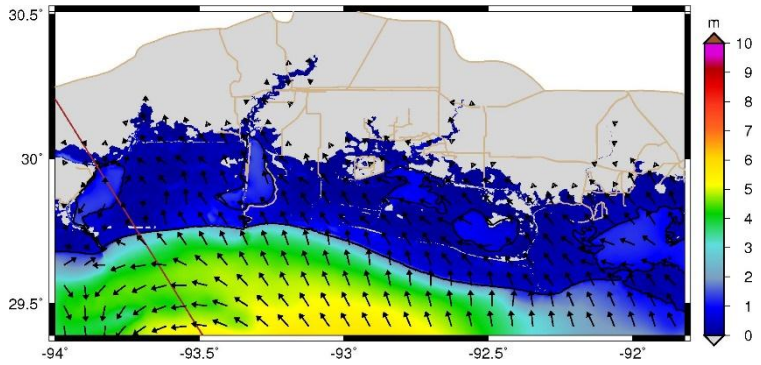


FWOA MEDIUM SCENARIO: STORM 210 HS

Initial Conditions



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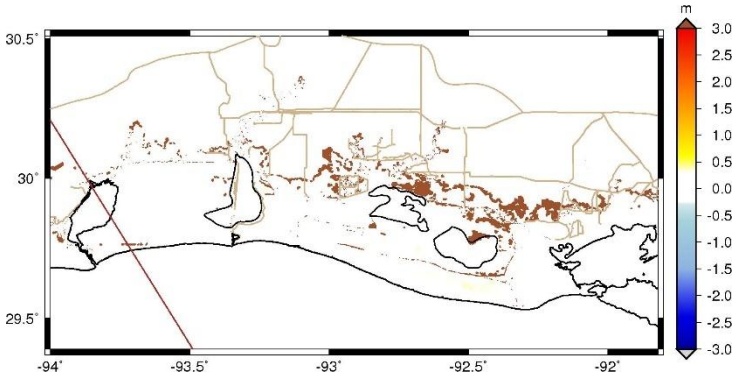

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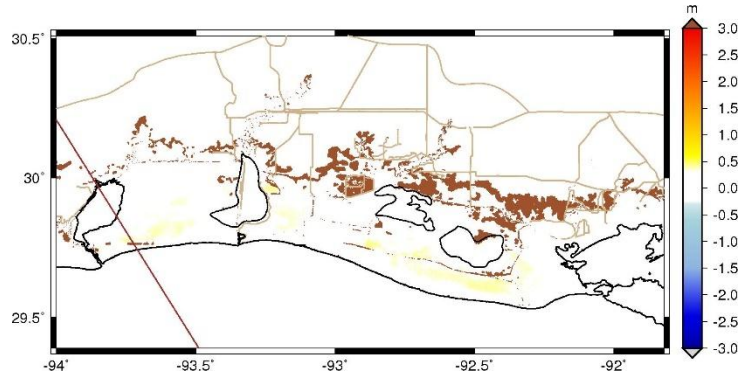

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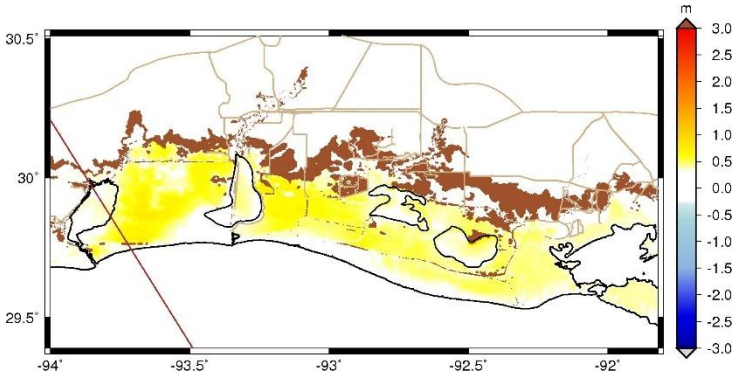
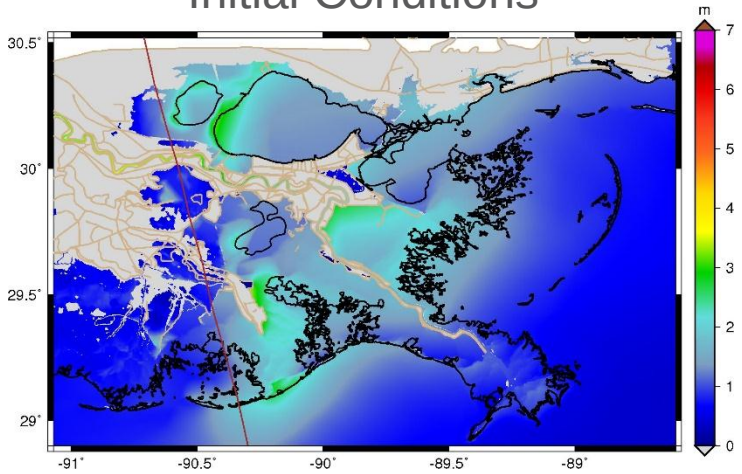


FWOA HIGH SCENARIO: STORM 010 WSE

Initial Conditions



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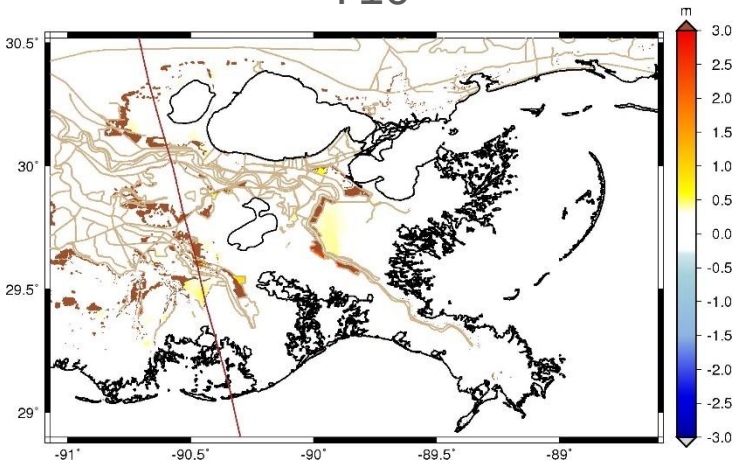

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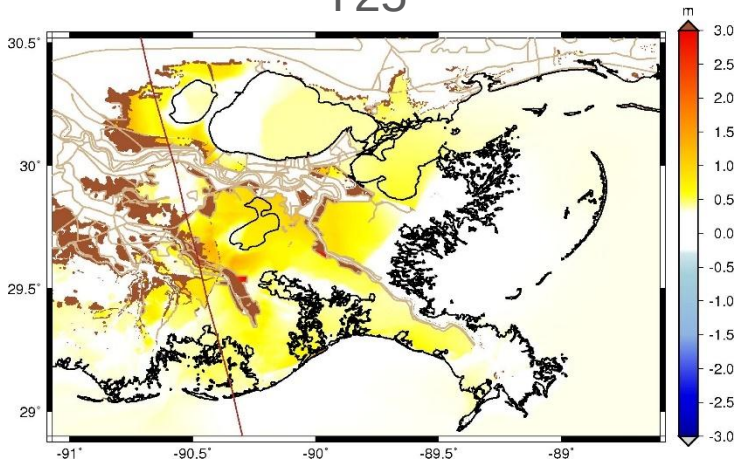

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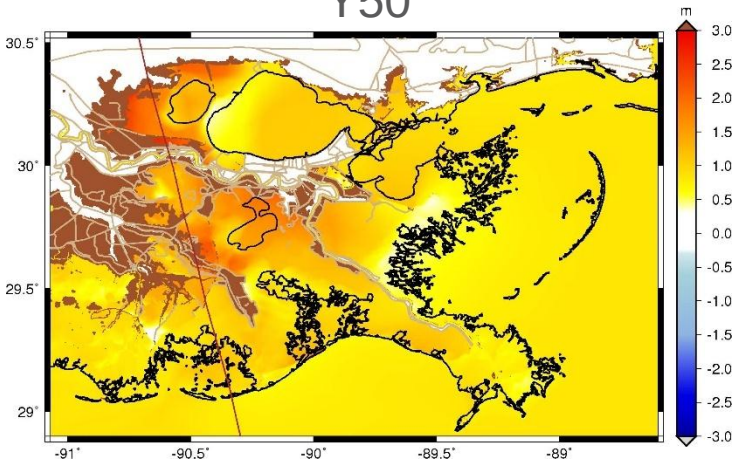
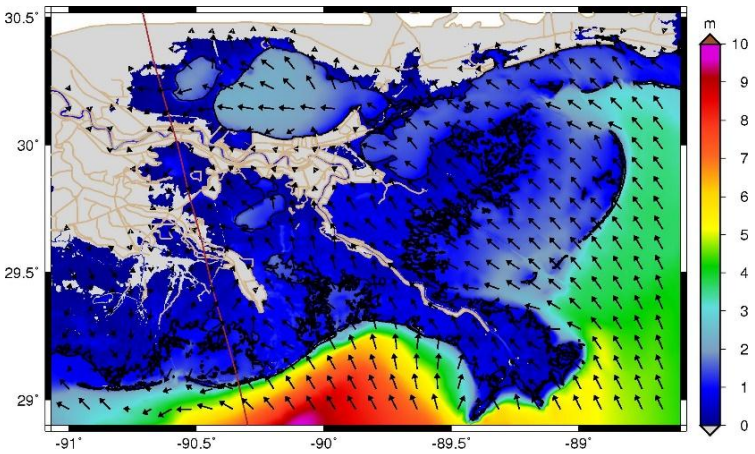


FWOA HIGH SCENARIO: STORM 010 HS

Initial Conditions



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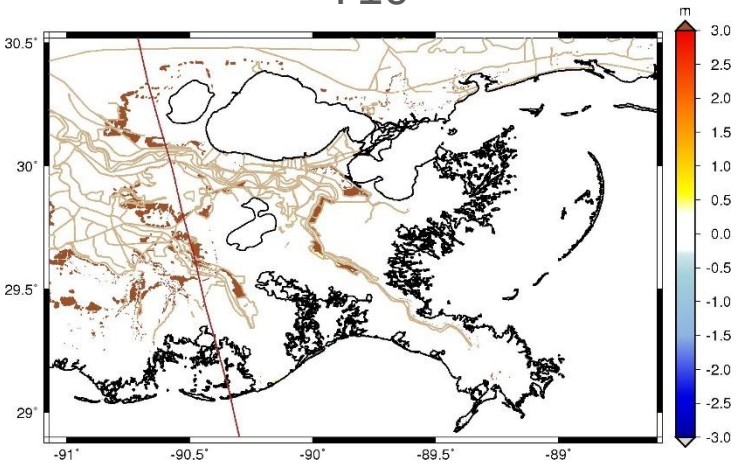

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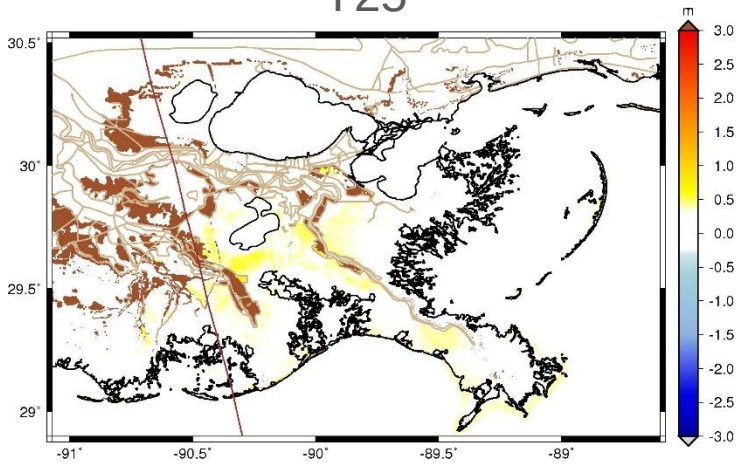

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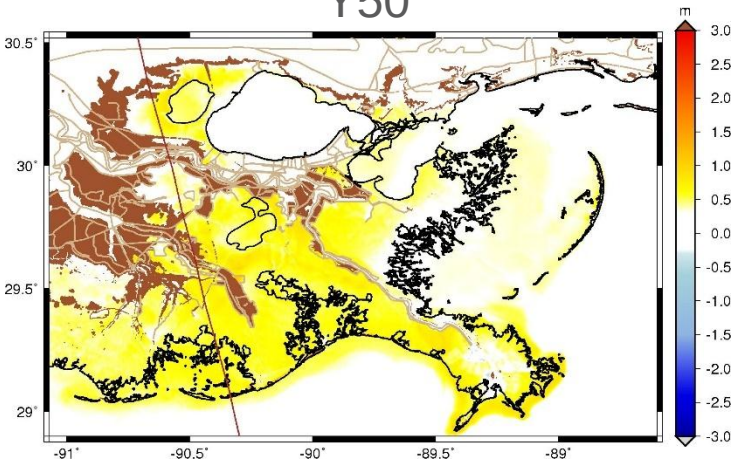
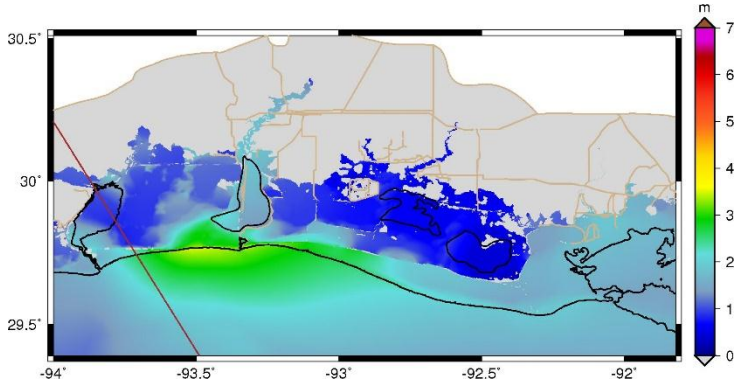


FWOA HIGH SCENARIO: STORM 210 WSE

Initial Conditions



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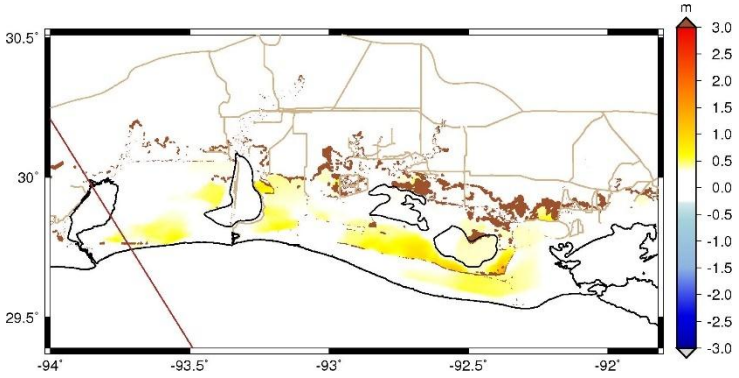

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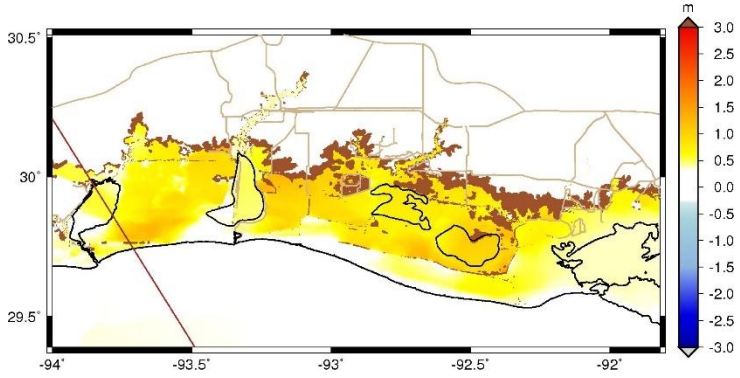

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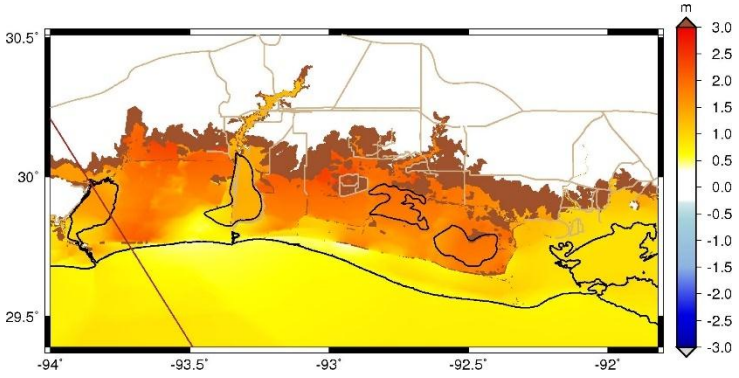
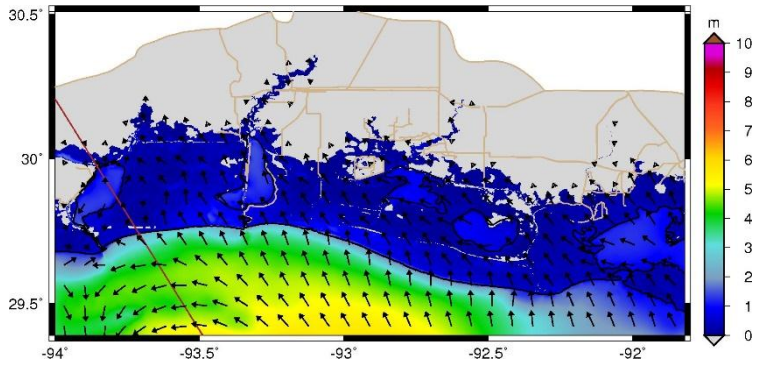


FWOA HIGH SCENARIO: STORM 210 HS

Initial Conditions



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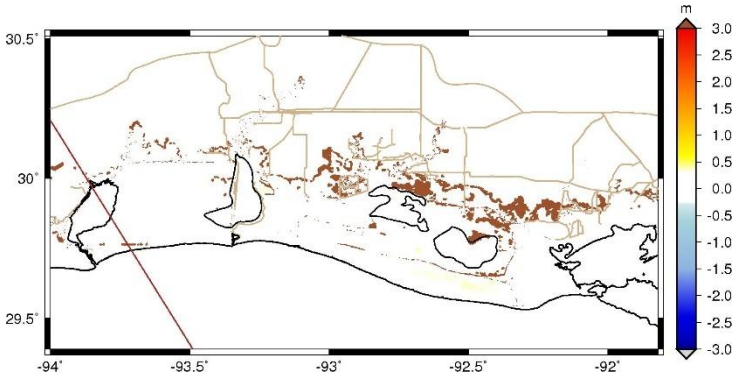

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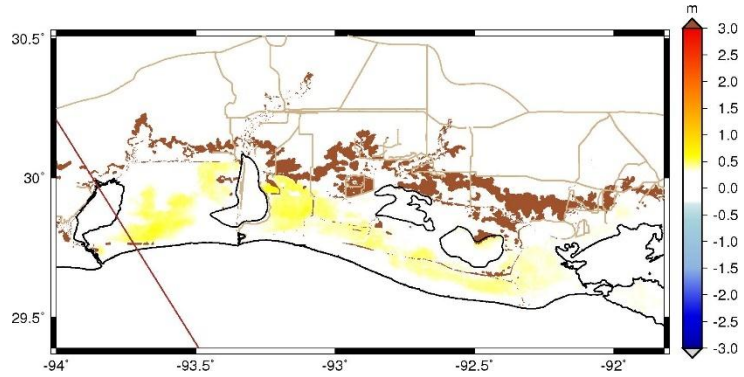

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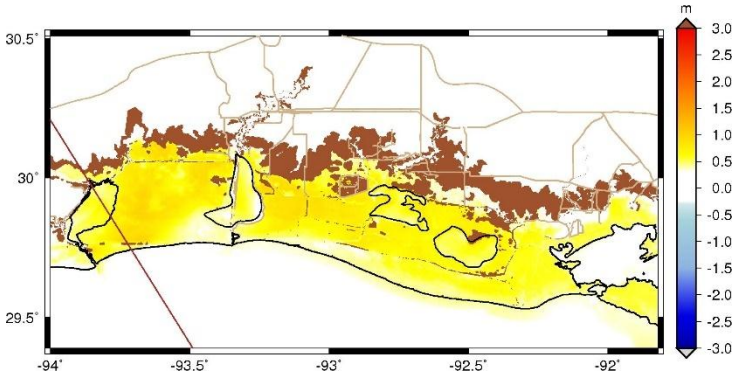


COASTAL LOUISIANA RISK ASSESSMENT (CLARA)

Model Overview

CLARA MODEL ESTIMATES DIRECT ECONOMIC DAMAGE FROM COASTAL FLOODING

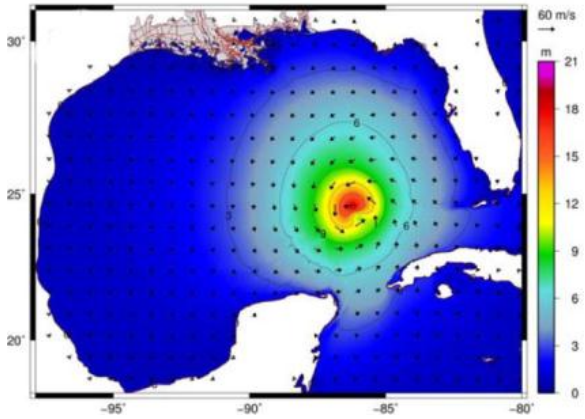
Estimates flood depths across the coast

Determines direct economic damage

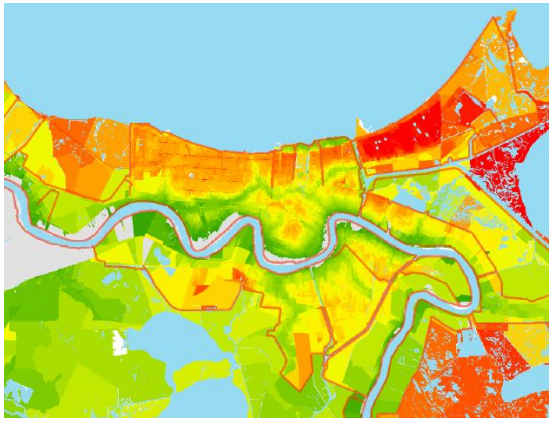
- **Builds on post-Katrina flood modeling in coastal Louisiana**
- **Provides balanced resolution for future risk estimates**
  - Estimates damage reduction from structural and nonstructural projects
  - Considers many future scenarios

CLARA CONSISTS OF THREE PRIMARY MODULES

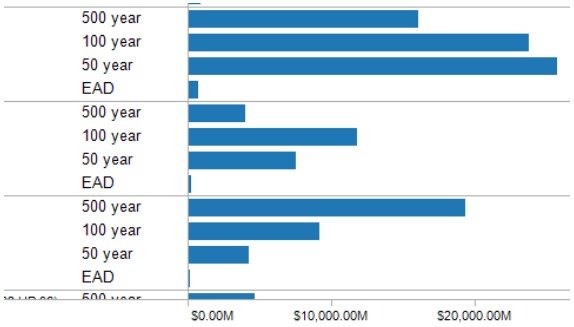
Statistical Module



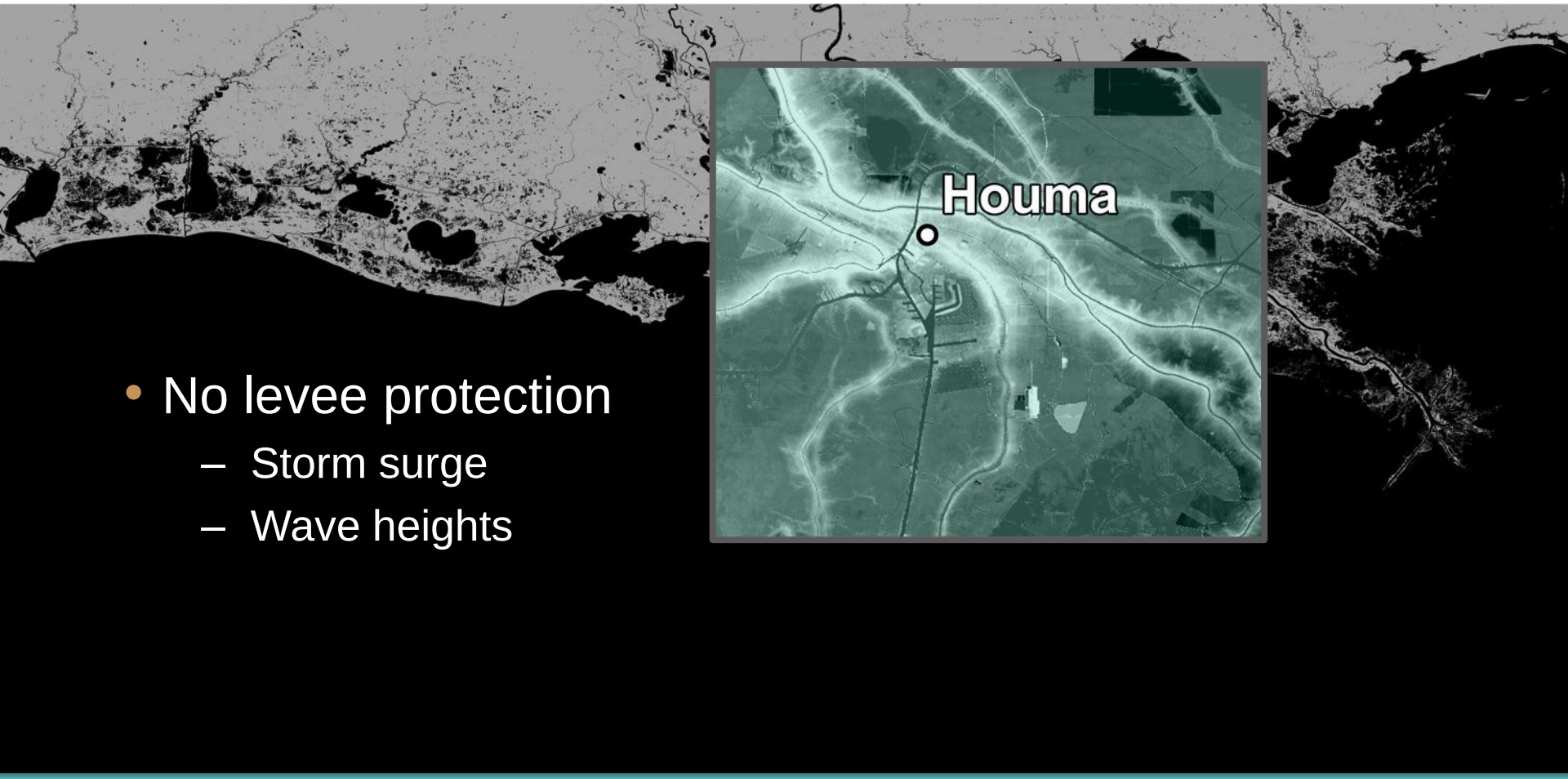
Flood Depth Module



Economic Damage Module

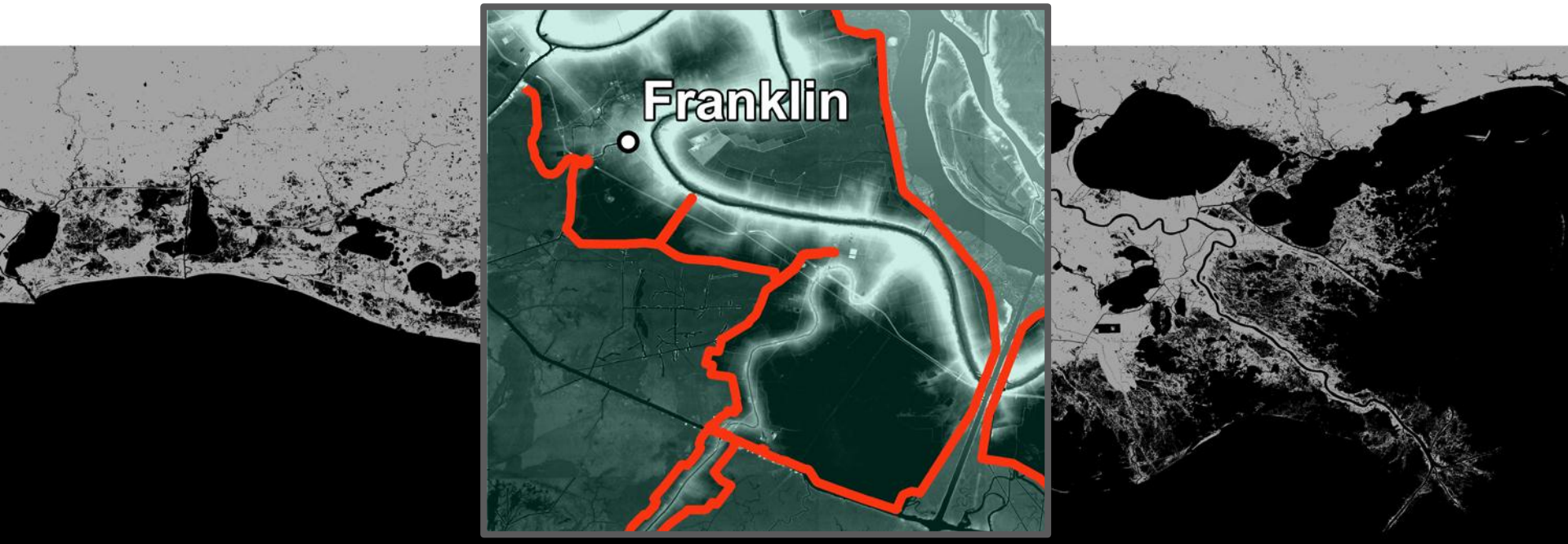


CLARA ESTIMATES FLOODING FOR UNENCLOSED AND ENCLOSED AREAS



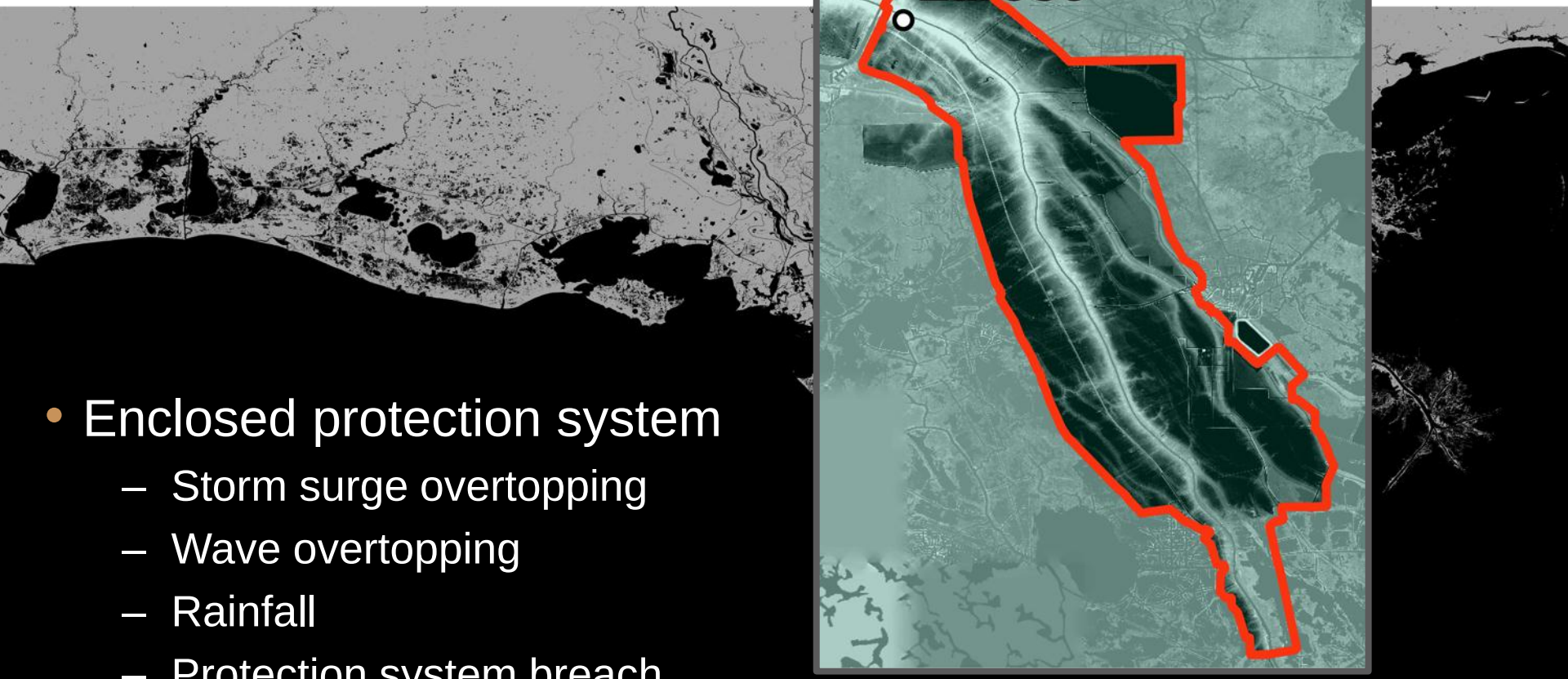
- No levee protection
  - Storm surge
  - Wave heights

CLARA ESTIMATES FLOODING FOR UNENCLOSED AND ENCLOSED AREAS



- **Unenclosed surge barrier**
  - Storm surge overtopping
  - Storm surge “run-around”

CLARA ESTIMATES FLOODING FOR UNENCLOSED AND ENCLOSED AREAS



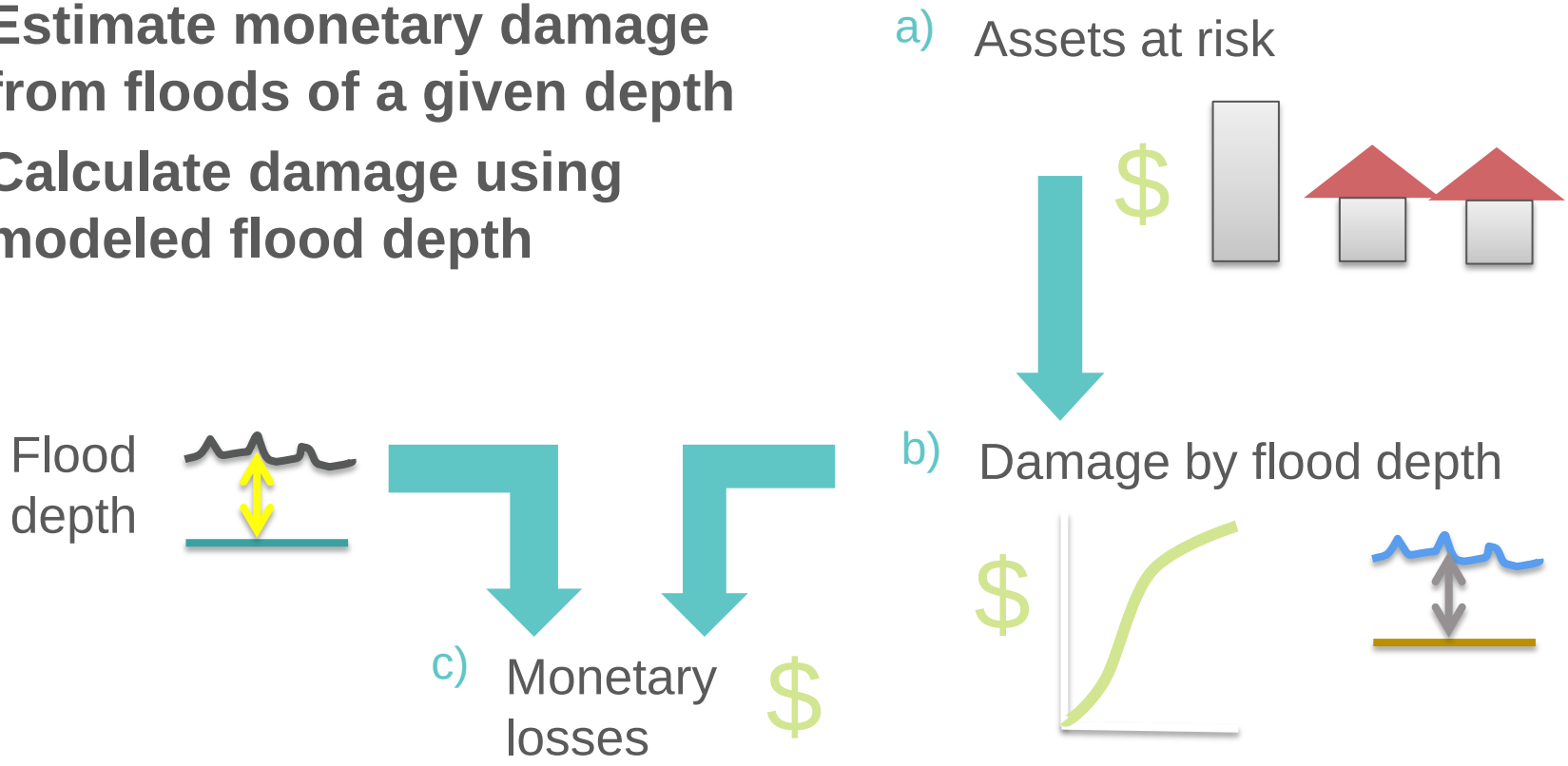
- Enclosed protection system
  - Storm surge overtopping
  - Wave overtopping
  - Rainfall
  - Protection system breach

CLARA DETERMINES DIRECT ECONOMIC DAMAGE TO PHYSICAL ASSETS

Approach based on FEMA HAZUS

a. **Project assets at risk**
b. **Estimate monetary damage from floods of a given depth**
c. **Calculate damage using modeled flood depth**

Calculations performed for each grid point



RISK ASSESSMENT

Risk Scenarios

UPDATED ANALYSIS USES 2017 MASTER PLAN ENVIRONMENTAL SCENARIOS

Scenario	Precipitation	ET	ESLR (m/50yr)	Subsidence	Overall Storm Frequency	Average Storm Intensity
	ICM Scenarios				CLARA Scenarios	
Low	>Historical	<Historical	0.43	20% of range	-28%	+10.0%
Medium	>Historical	Historical	0.63	20% of range	-14%	+12.5%
High	Historical	Historical	0.83	50% of range	0%	+15.0%

FLOOD RISK SCENARIO UNCERTAINTY APPROACH AND METHODS

Levee erosion and failure

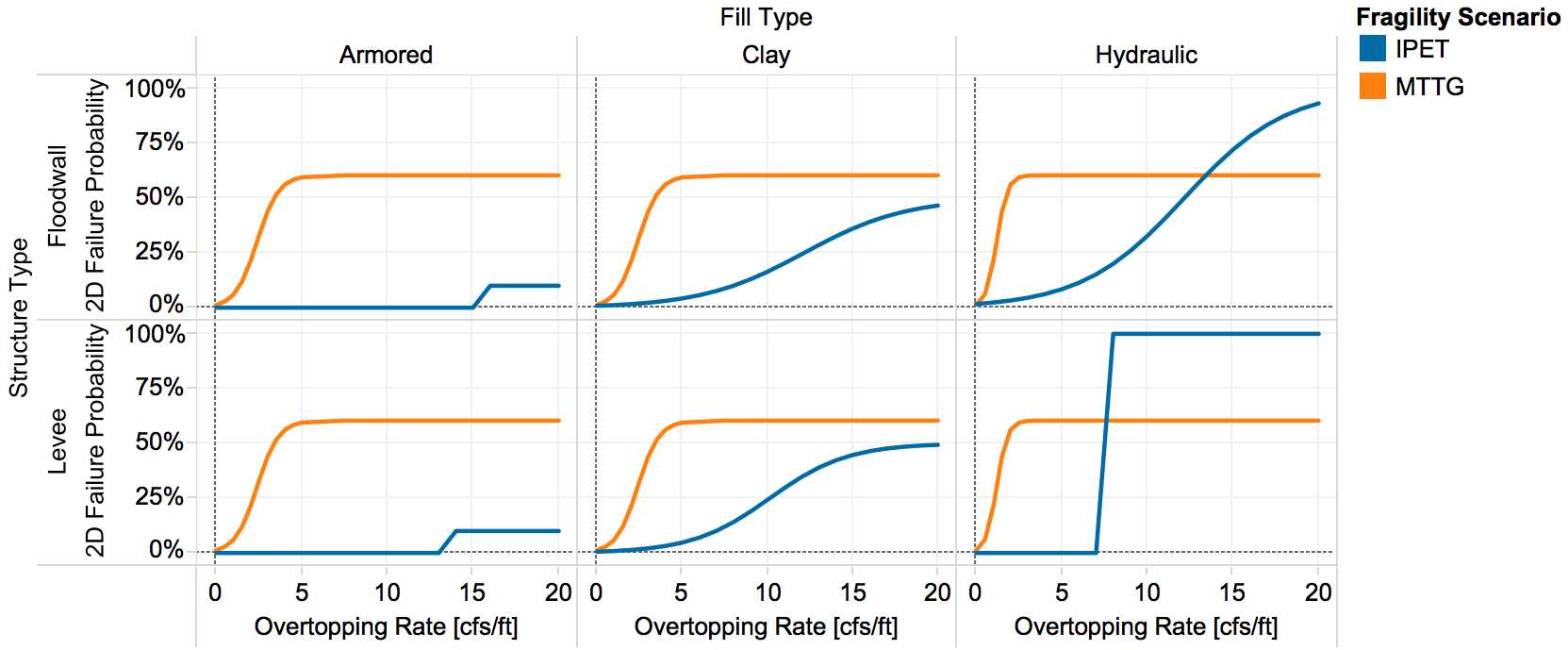
- 2012: Used Interagency Performance Evaluation Taskforce (IPET) approach
- 2017: Incorporated multiple Corps of Engineers methods for estimating erosion failure as scenarios

Future 50-year population and asset growth

- 2012: Simple coast wide population growth and urban/rural distribution assumptions
- 2017: Revised approach that considers physical changes over time (flood depth, land loss)

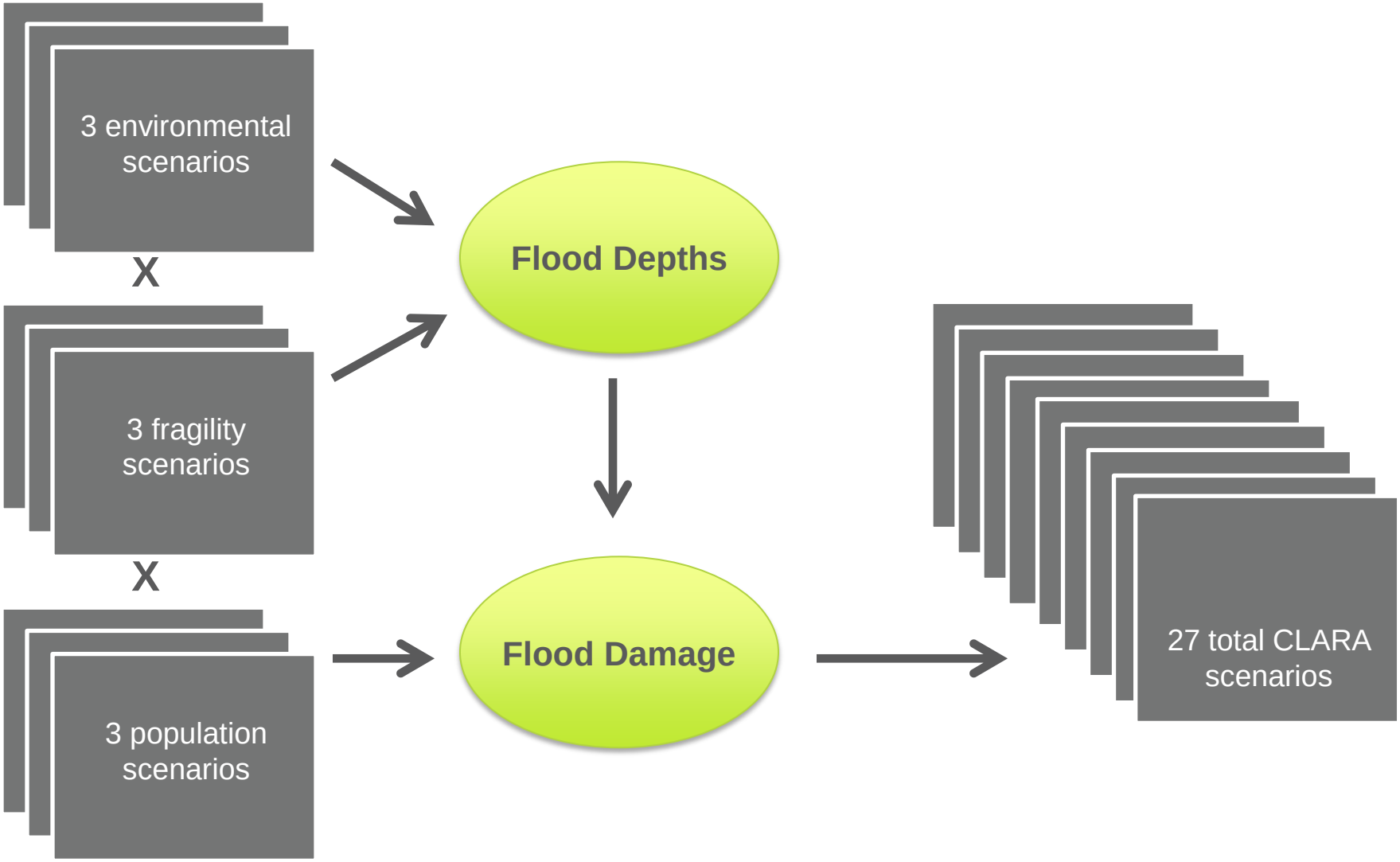
SYSTEM FRAGILITY SCENARIOS VARY THE EROSION AND SCOUR FRAGILITY CURVES

- No Fragility: no probability of failure
- IPET: IPET Risk and Reliability Model approach
- MTTG: Morganza to the Gulf Reformulation Study approach



Note: the MTTG scenario uses the same fragility curves for both levees and floodwalls, while the IPET approach uses differing assumptions by structure type. MTTG also assumes that armored and clay fill levees have the same performance characteristics.

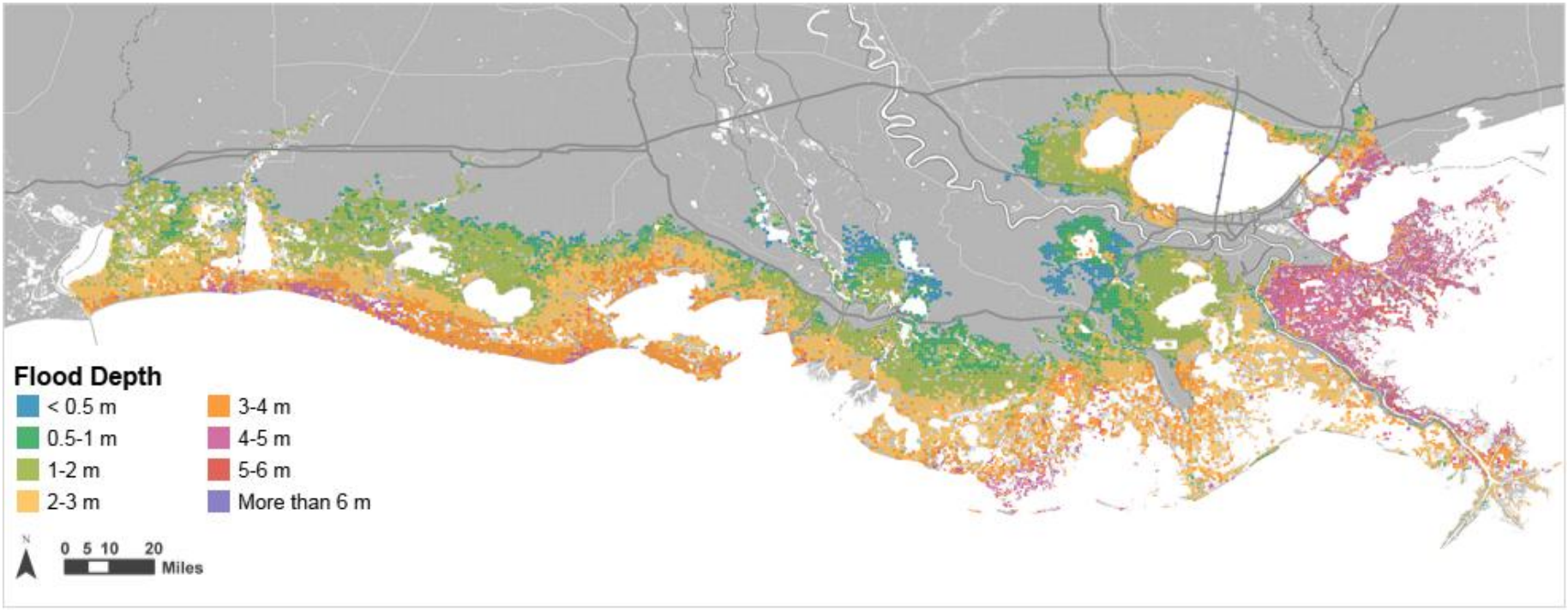
SCENARIOS REFLECT DIFFERENT COMBINATIONS OF UNCERTAIN FACTORS



RISK ASSESSMENT

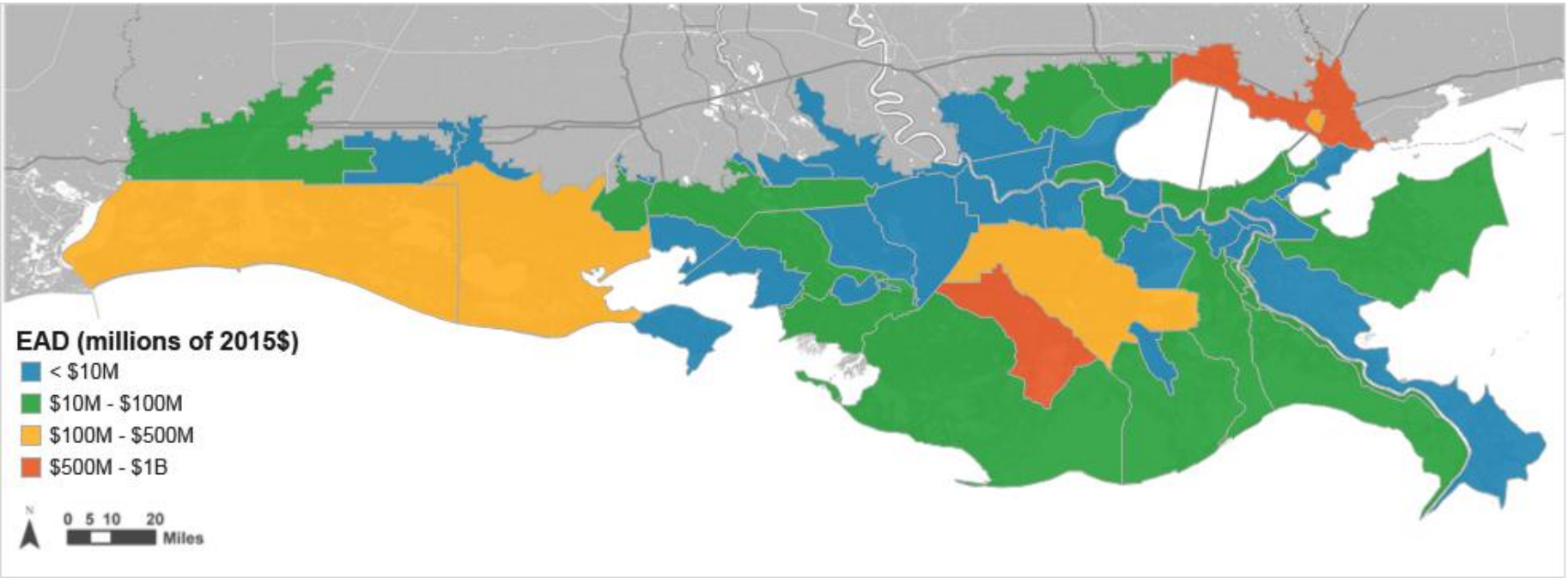
Initial Conditions

INITIAL CONDITIONS 100-YEAR (1%) FLOOD DEPTHS: IPET FRAGILITY SCENARIO



Note: 50th percentile 100-year flood depths of at least 0.2 m shown.

INITIAL CONDITIONS DAMAGE SUMMARY: EXPECTED ANNUAL DAMAGE BY "RISK REGION"



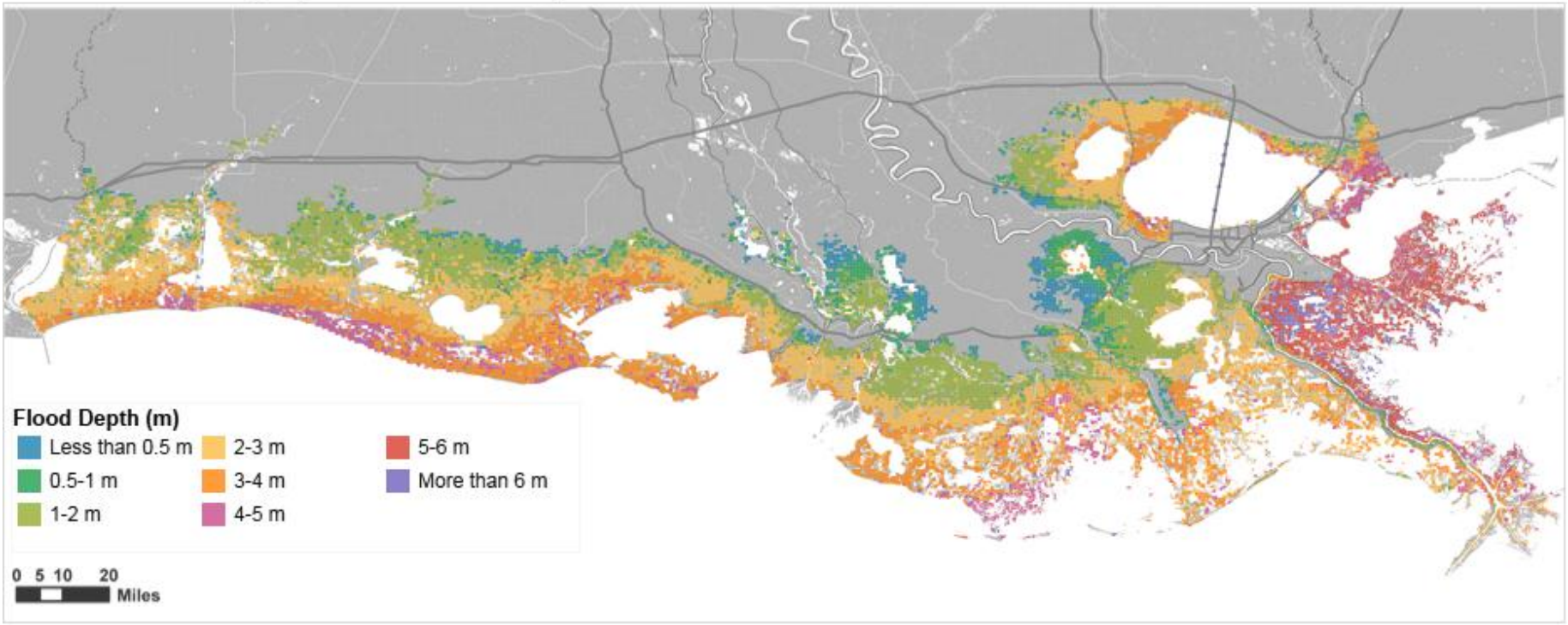
Note: Map shows mean expected annual damage for each risk region in the IPET fragility scenario.

RISK ASSESSMENT

Future Without Action: Low Scenario Flood Depths

FWOA 100-YEAR (1%) FLOOD DEPTHS: LOW SCENARIO, YEAR 10

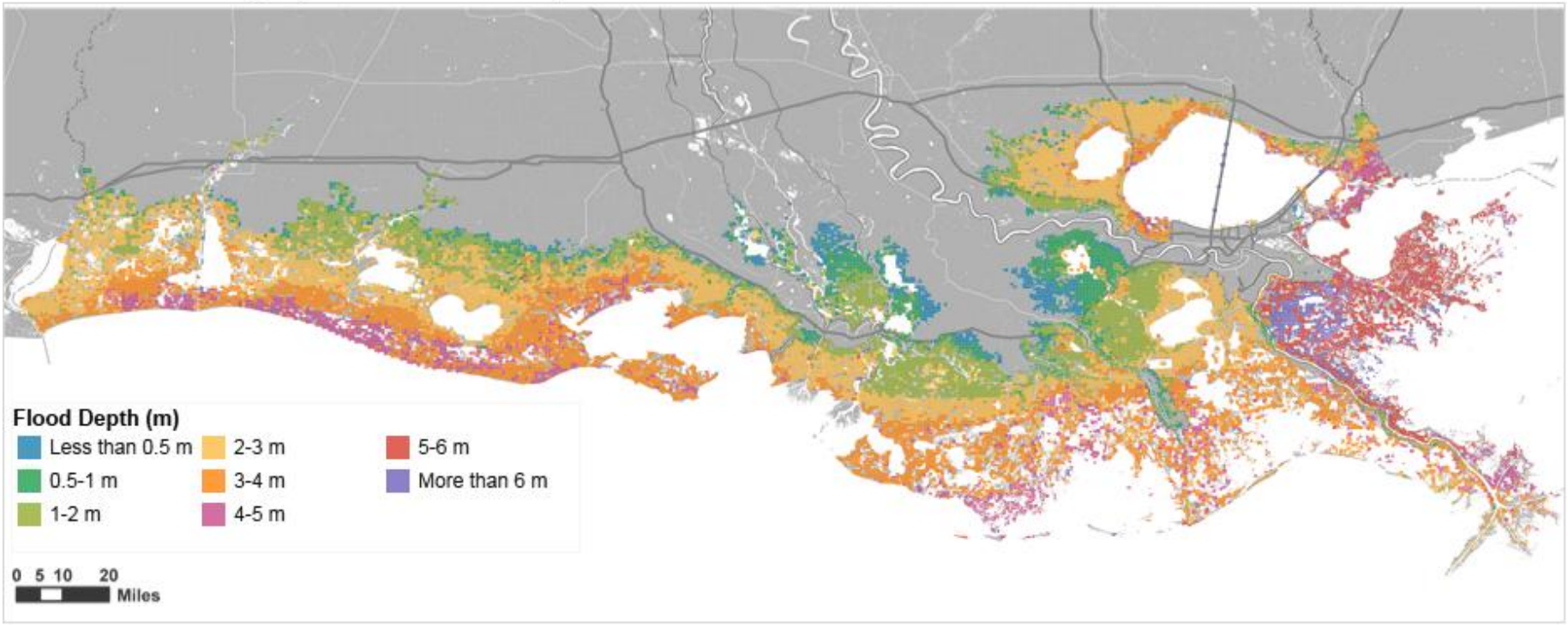
Year 10, IPET Fragility Scenario, 50th percentile



Note: Only grid points with flood depths greater than 0.2 m shown.

FWOA 100-YEAR (1%) FLOOD DEPTHS: LOW SCENARIO, YEAR 25

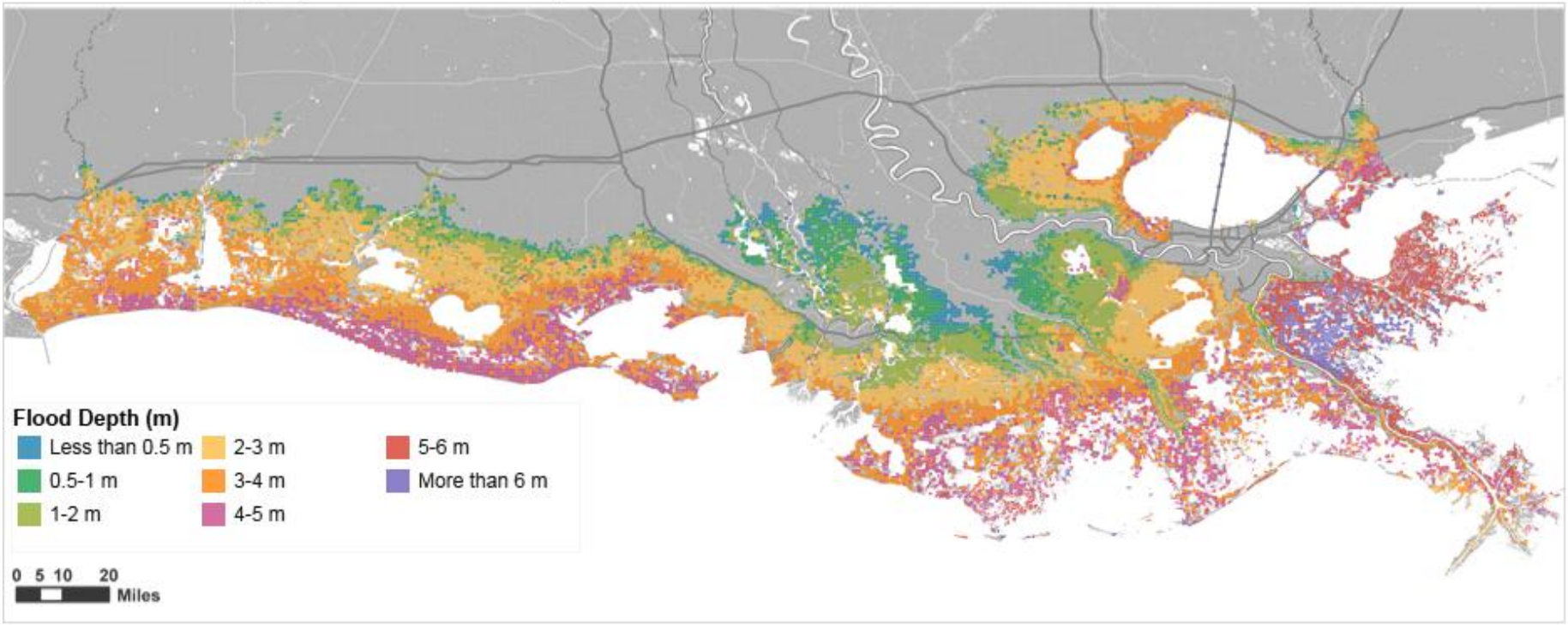
Year 25, IPET Fragility Scenario, 50th percentile



Note: Only grid points with flood depths greater than 0.2 m shown.

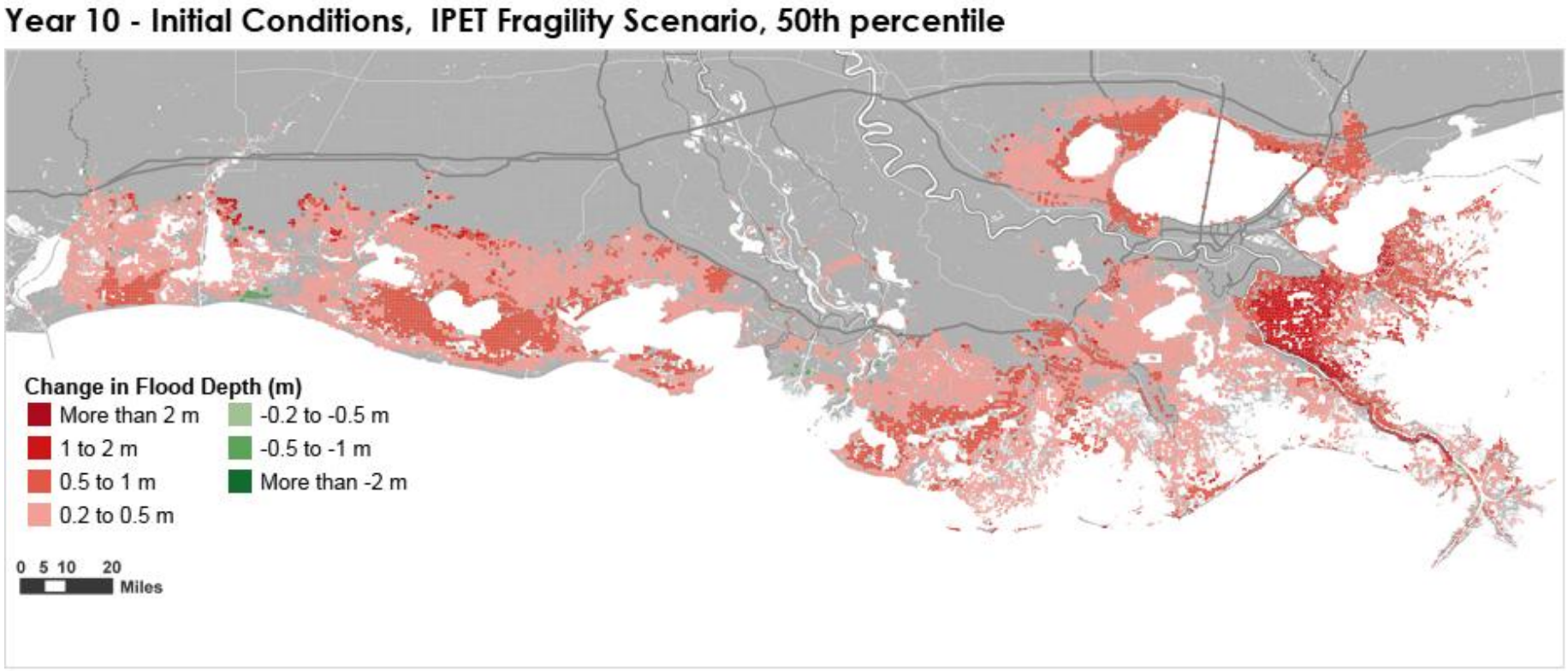
FWOA 100-YEAR (1%) FLOOD DEPTHS: LOW SCENARIO, YEAR 50

Year 50, IPET Fragility Scenario, 50th percentile



Note: Only grid points with flood depths greater than 0.2 m shown.

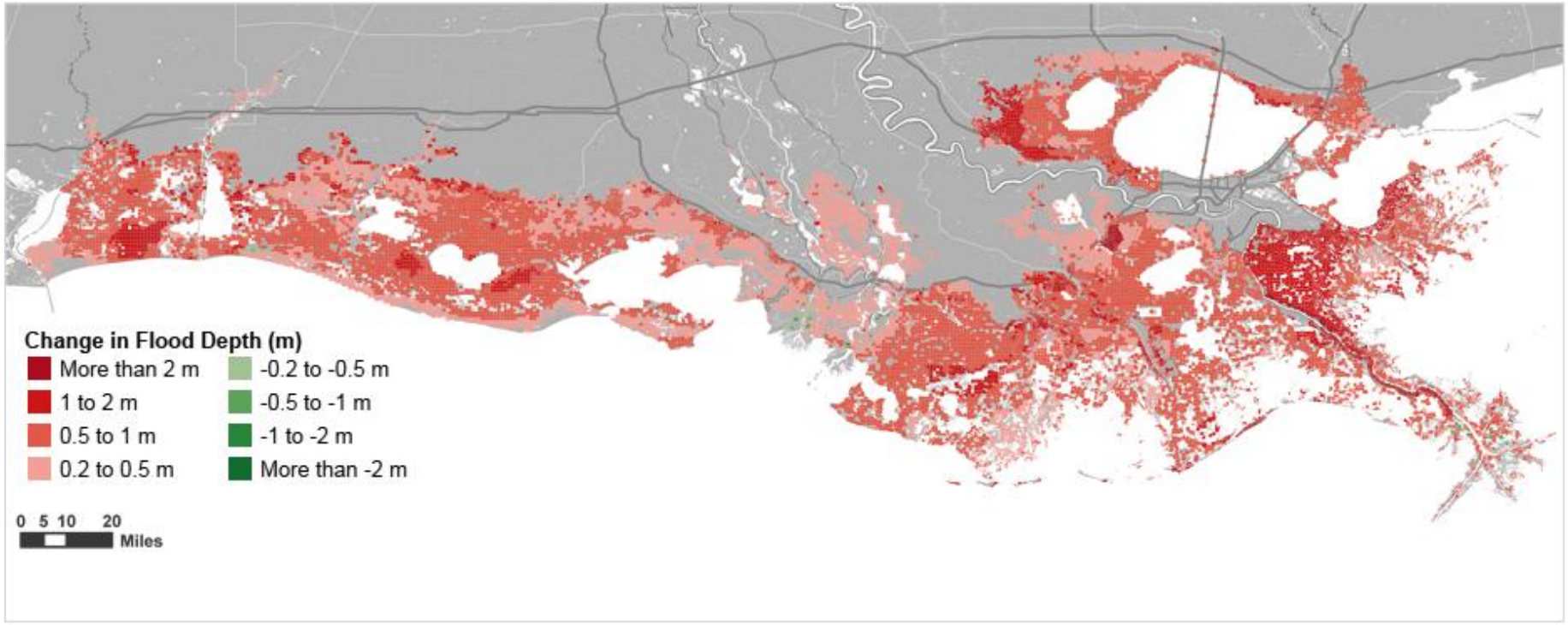
FWOA 100-YEAR DEPTH CHANGE: LOW SCENARIO, YEAR 10 - INITIAL CONDITIONS



Note: Change in 50th percentile 100-year flood depths from Initial Conditions to future year. Only grid points with an increase of at least 0.2 m are shown.

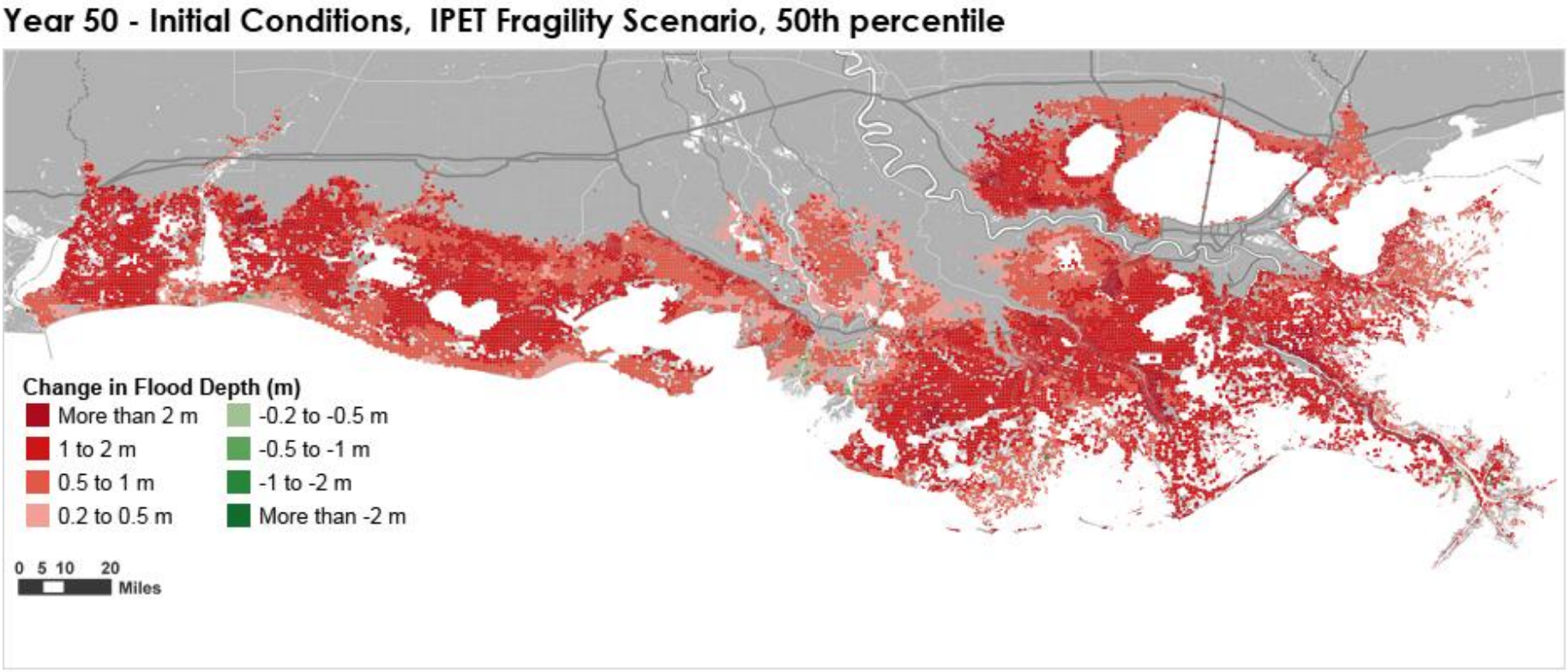
FWOA 100-YEAR DEPTH CHANGE: LOW SCENARIO, YEAR 25 - INITIAL CONDITIONS

Year 25 - Initial Conditions, IPET Fragility Scenario, 50th percentile



Note: Change in 50th percentile 100-year flood depths from Initial Conditions to future year. Only grid points with an increase of at least 0.2 m are shown.

FWOA 100-YEAR DEPTH CHANGE: LOW SCENARIO, YEAR 50 - INITIAL CONDITIONS



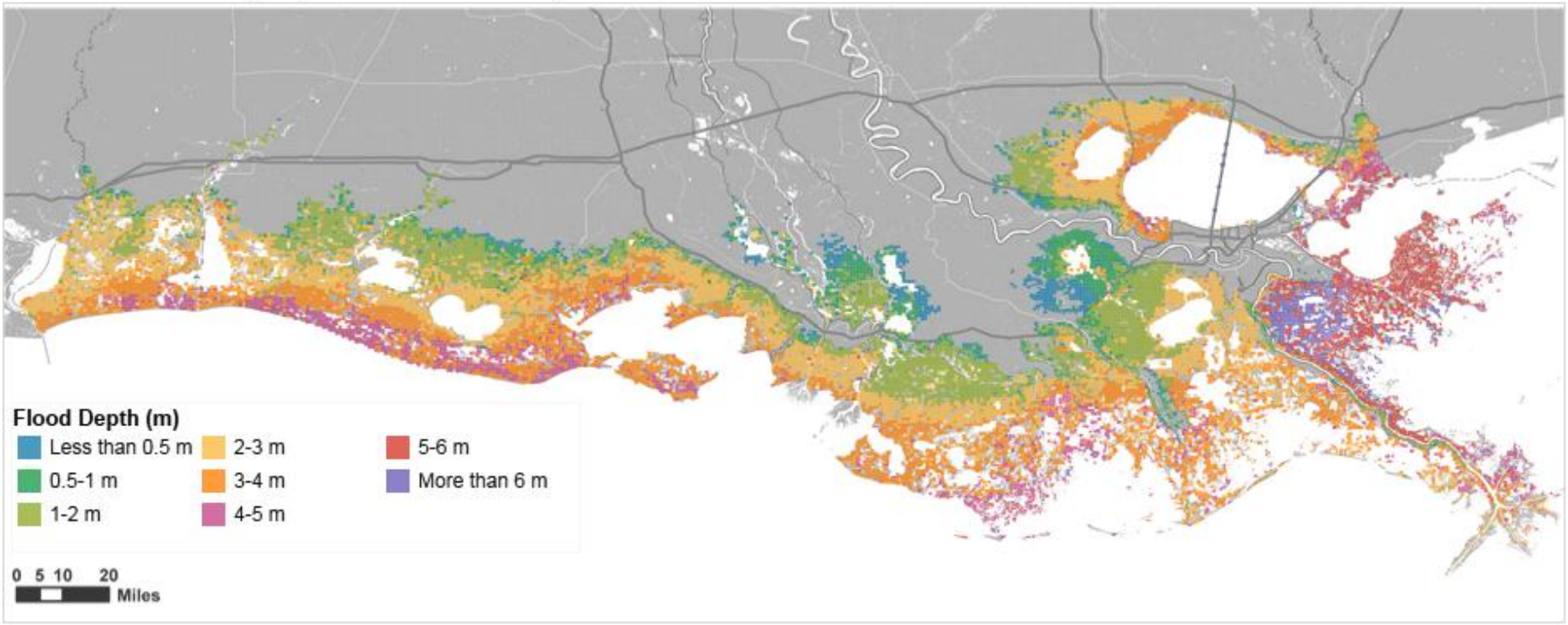
Note: Change in 50th percentile 100-year flood depths from Initial Conditions to future year. Only grid points with an increase of at least 0.2 m are shown.

RISK ASSESSMENT

Future Without Action: High Scenario Flood Depths

FWOA 100-YEAR (1%) FLOOD DEPTHS: HIGH SCENARIO, YEAR 10

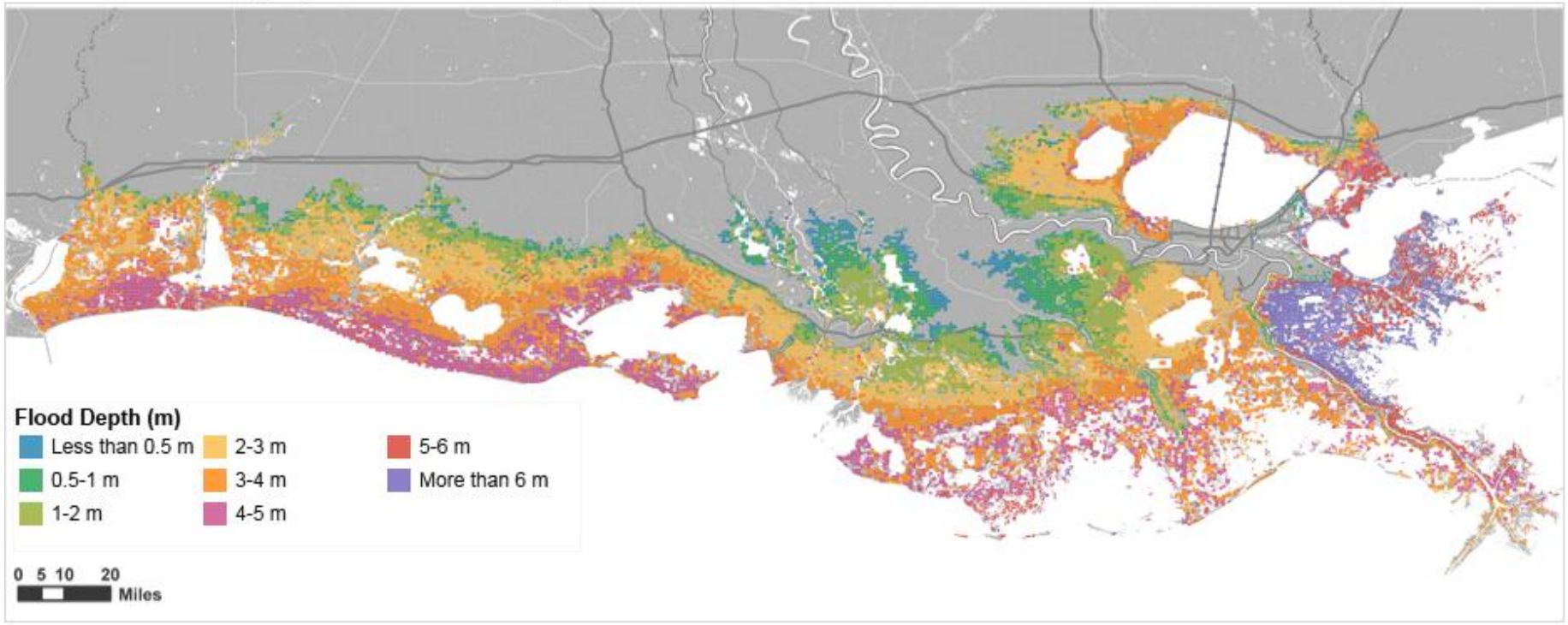
Year 10, IPET Fragility Scenario, 50th percentile



Note: Only grid points with flood depths greater than 0.2 m shown.

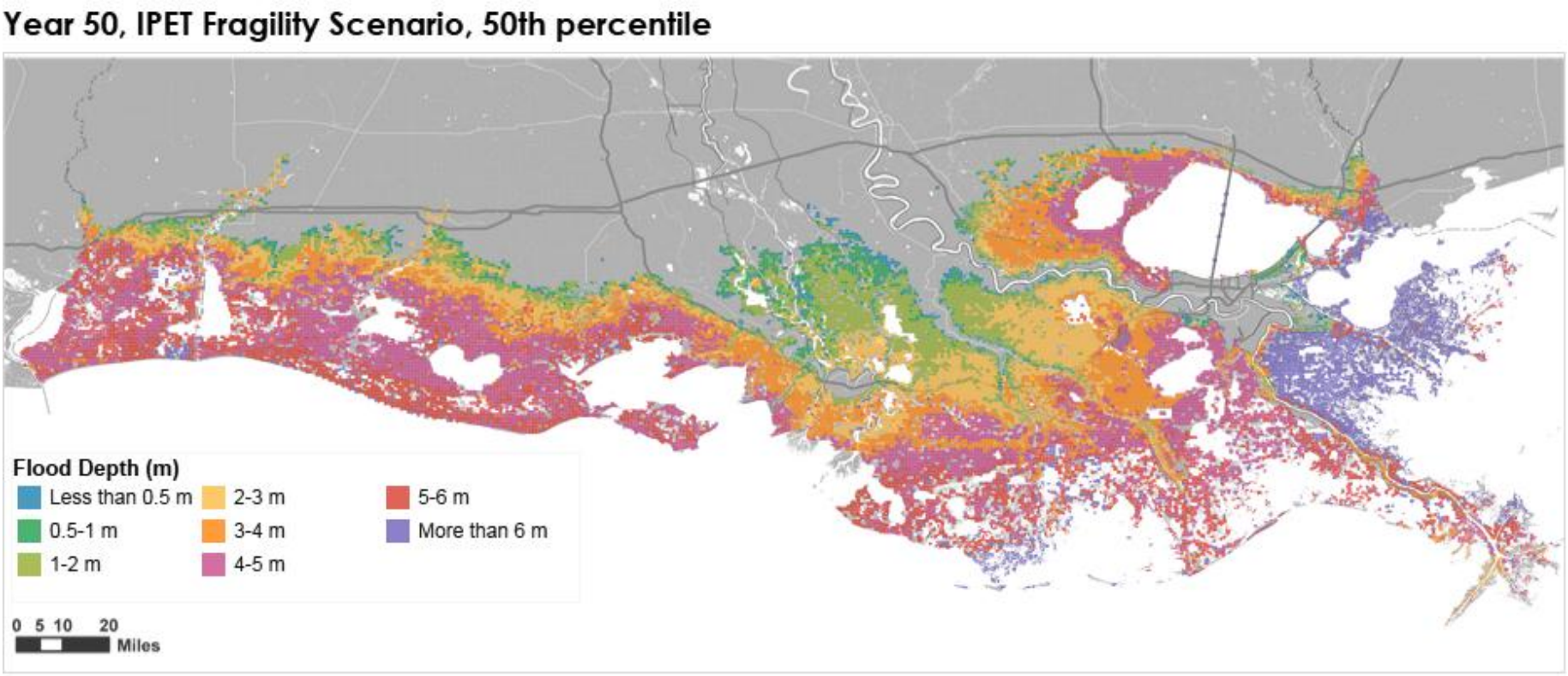
FWOA 100-YEAR (1%) FLOOD DEPTHS: HIGH SCENARIO, YEAR 25

Year 25, IPET Fragility Scenario, 50th percentile



Note: Only grid points with flood depths greater than 0.2 m shown.

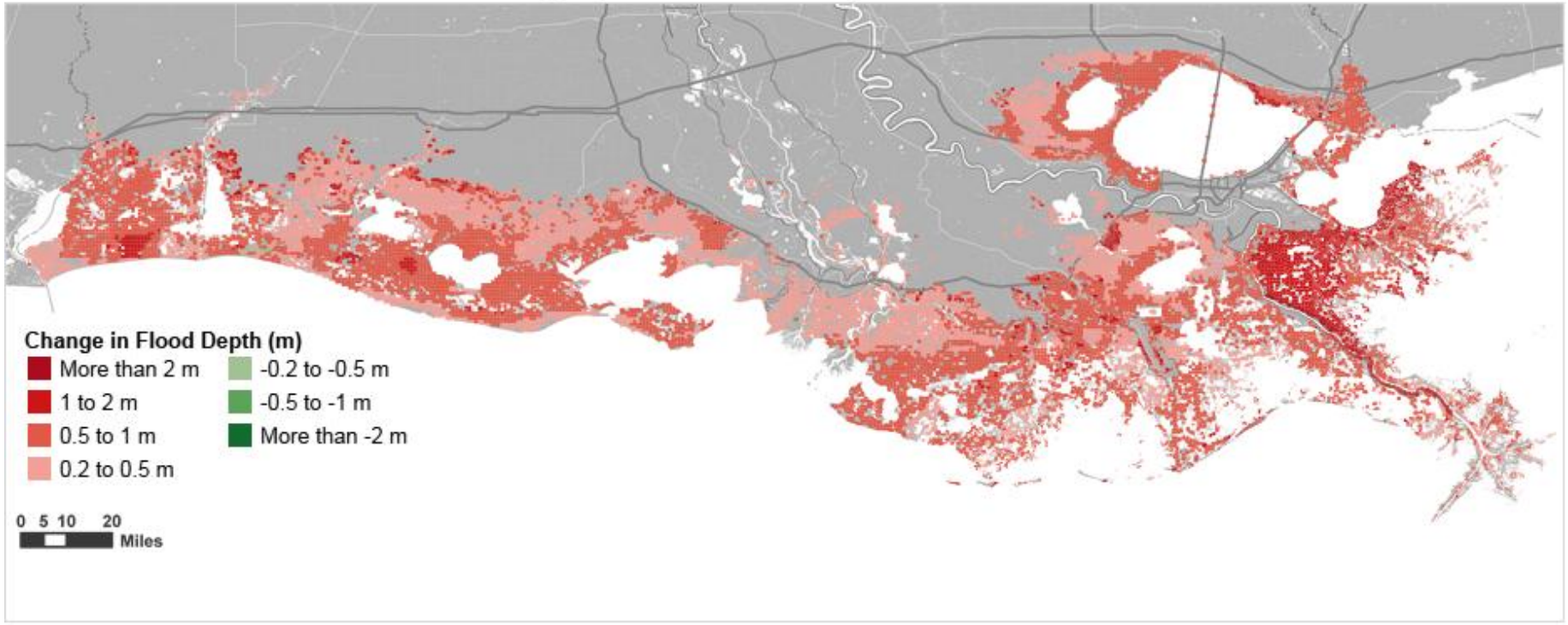
FWOA 100-YEAR (1%) FLOOD DEPTHS: HIGH SCENARIO, YEAR 50



Note: Only grid points with flood depths greater than 0.2 m shown.

FWOA 100-YEAR DEPTH CHANGE: HIGH SCENARIO, YEAR 10 - INITIAL CONDITIONS

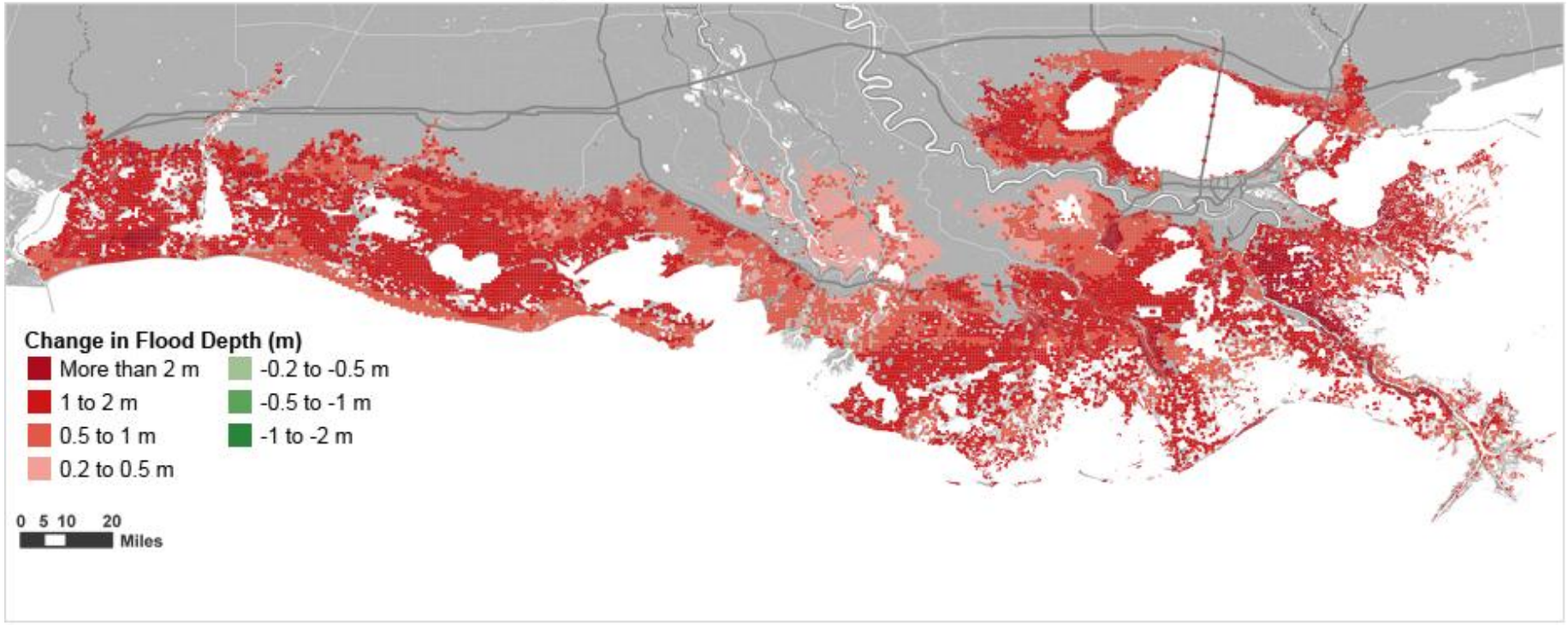
Year 10 - Initial Conditions, IPET Fragility Scenario, 50th percentile



Note: Change in 50th percentile 100-year flood depths from Initial Conditions to future year. Only grid points with an increase of at least 0.2 m are shown.

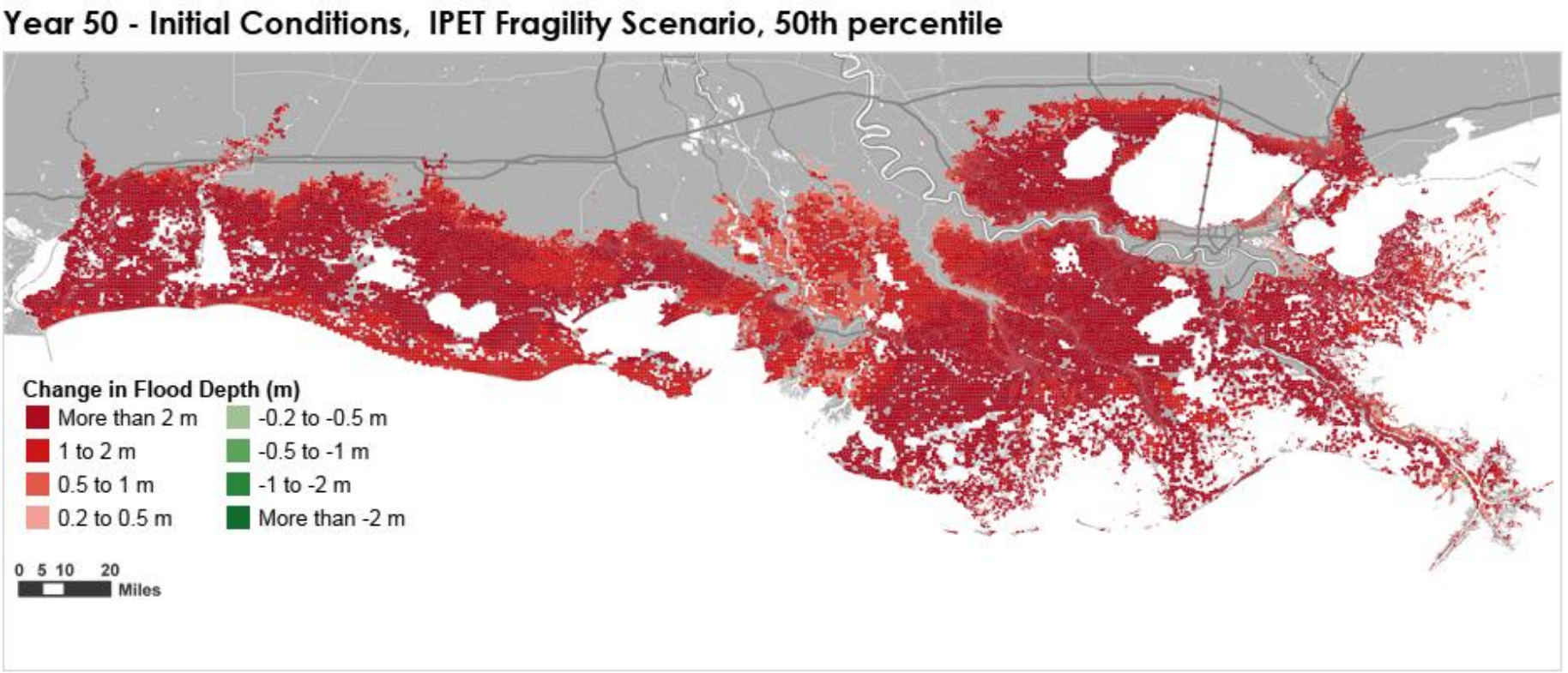
FWOA 100-YEAR DEPTH CHANGE: HIGH SCENARIO, YEAR 25 - INITIAL CONDITIONS

Year 25 - Initial Conditions, IPET Fragility Scenario, 50th percentile



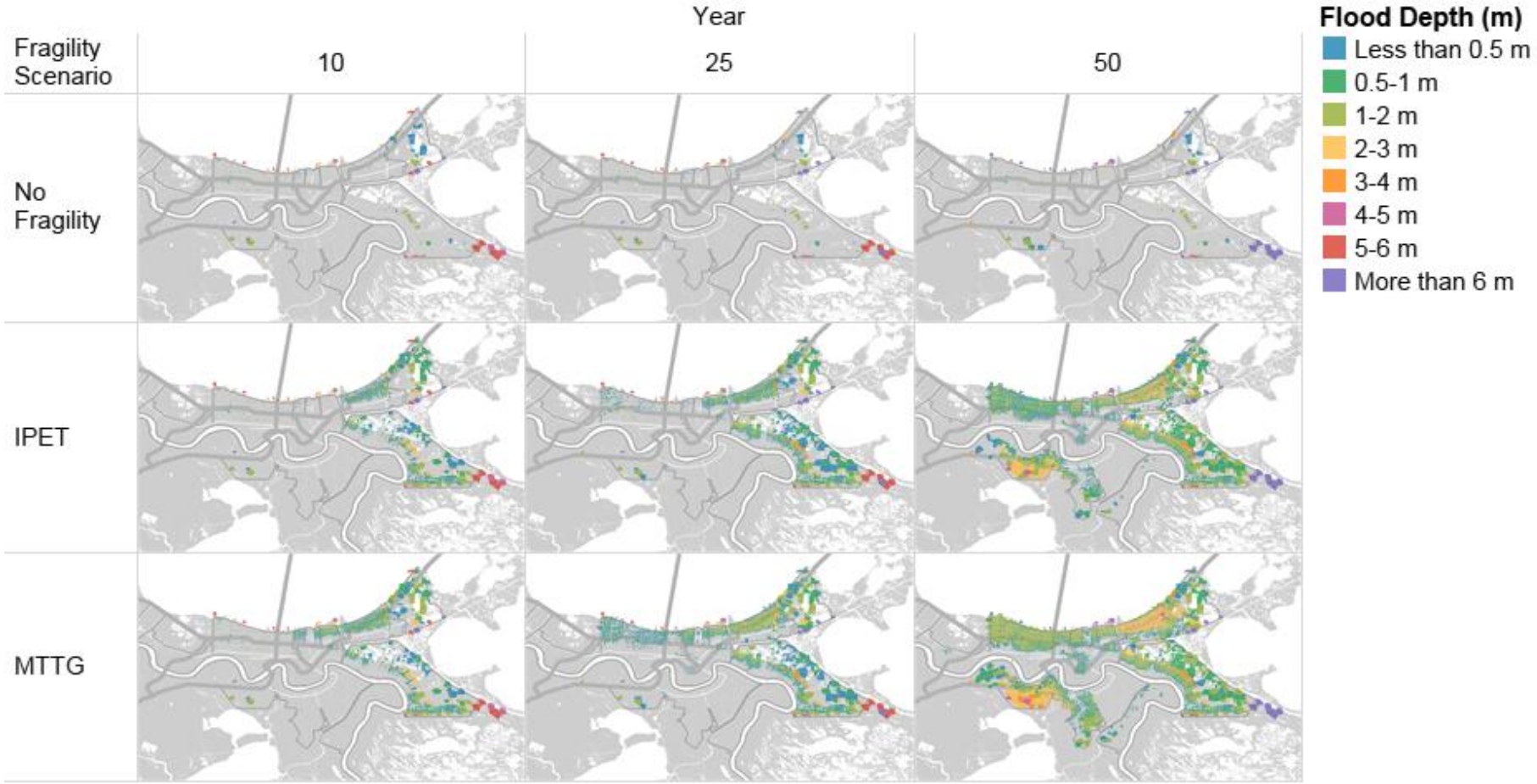
Note: Change in 50th percentile 100-year flood depths from Initial Conditions to future year. Only grid points with an increase of at least 0.2 m are shown.

FWOA 100-YEAR DEPTH CHANGE: HIGH SCENARIO, YEAR 50 - INITIAL CONDITIONS



Note: Change in 50th percentile 100-year flood depths from Initial Conditions to future year. Only grid points with an increase of at least 0.2 m are shown.

FWOA 500-YEAR FLOOD DEPTHS: GREATER NEW ORLEANS

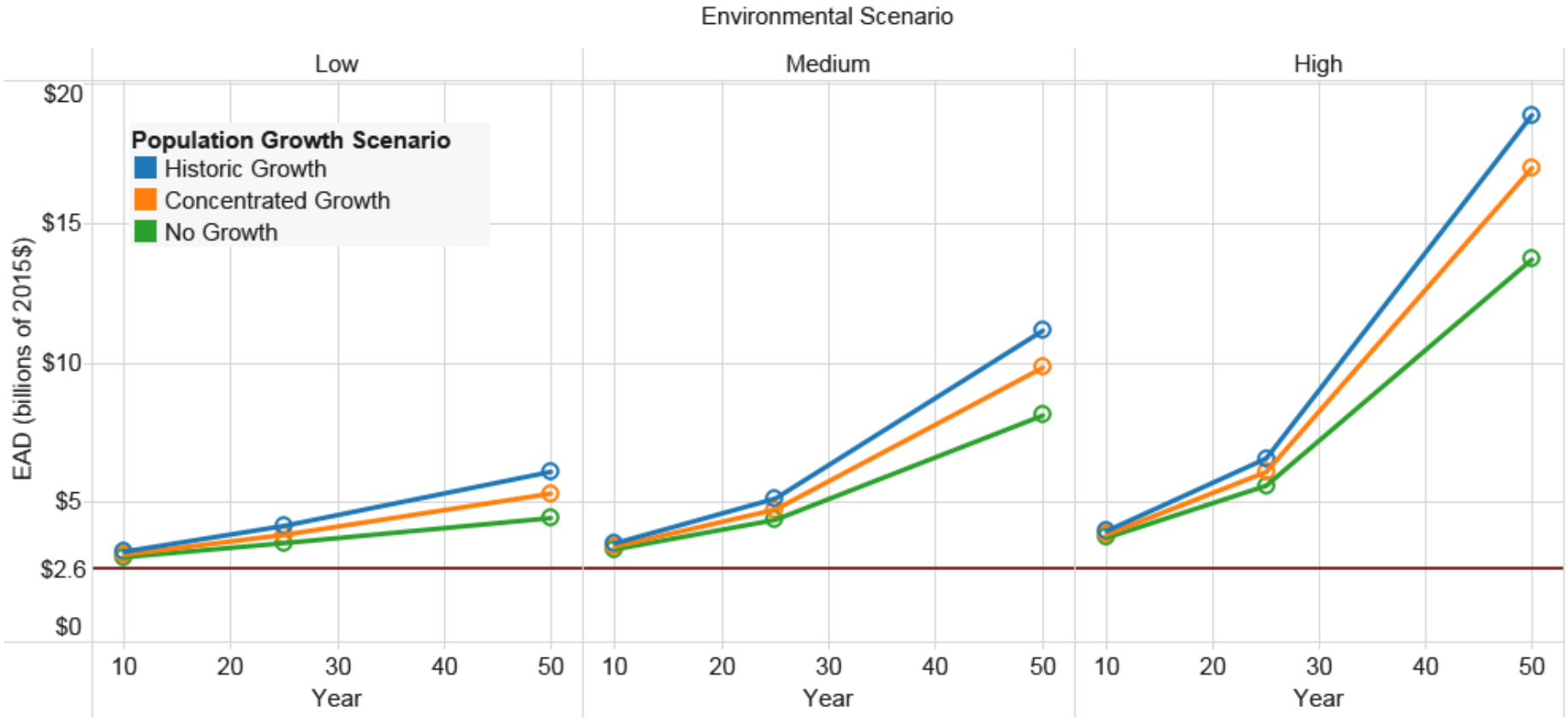


Note: Only grid points with flood depths greater than 0.2 m shown.

RISK ASSESSMENT

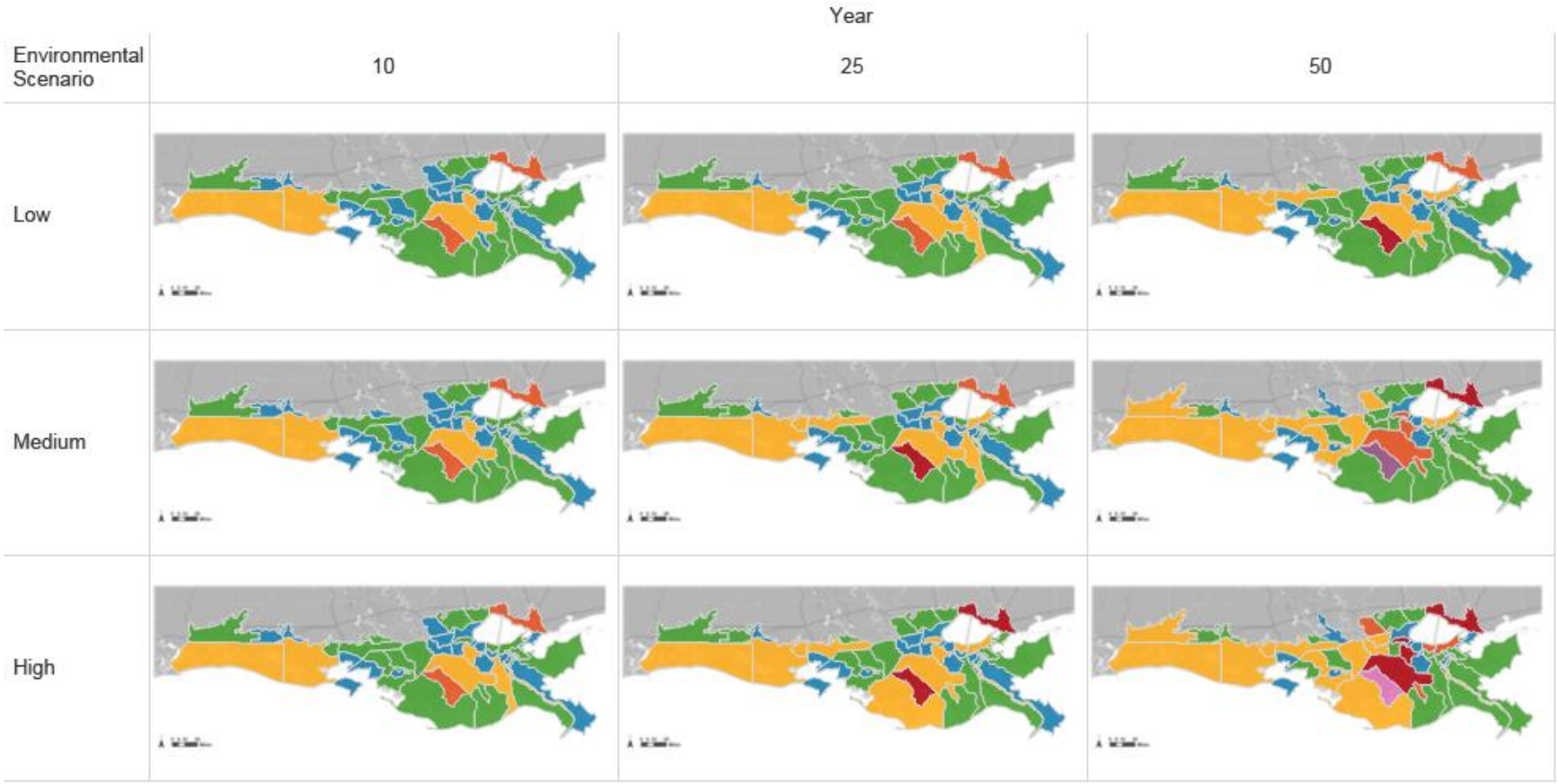
Future Without Action: Expected Annual Damage (EAD)

FWOA EXPECTED ANNUAL DAMAGE BY SCENARIO



Note: Mean values; IPET fragility scenario shown. Red line shows Initial Conditions EAD for comparison.

FWOA EXPECTED ANNUAL DAMAGE BY SCENARIO AND RISK REGION



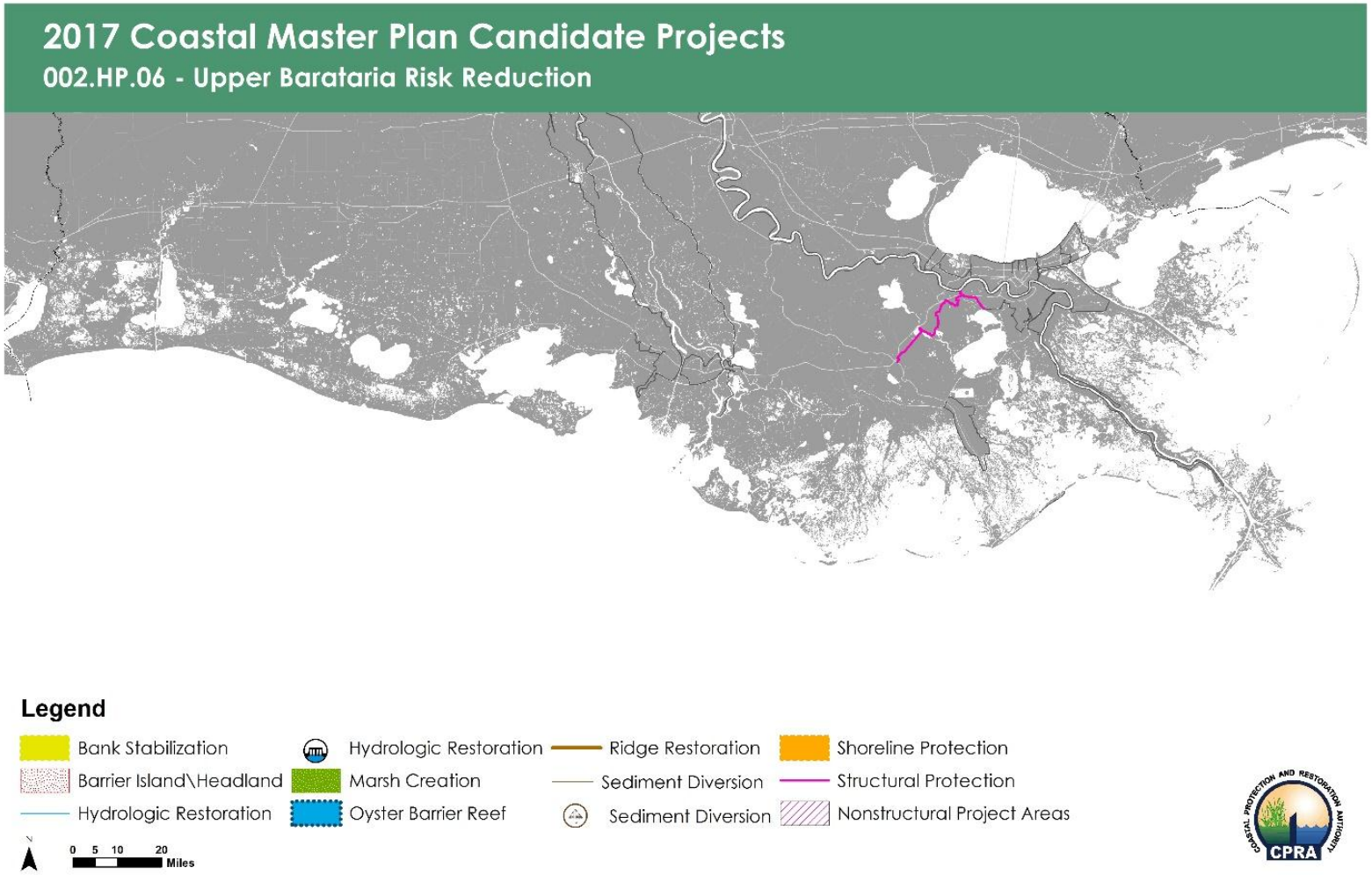
PROJECT RESULTS

Surge and Waves

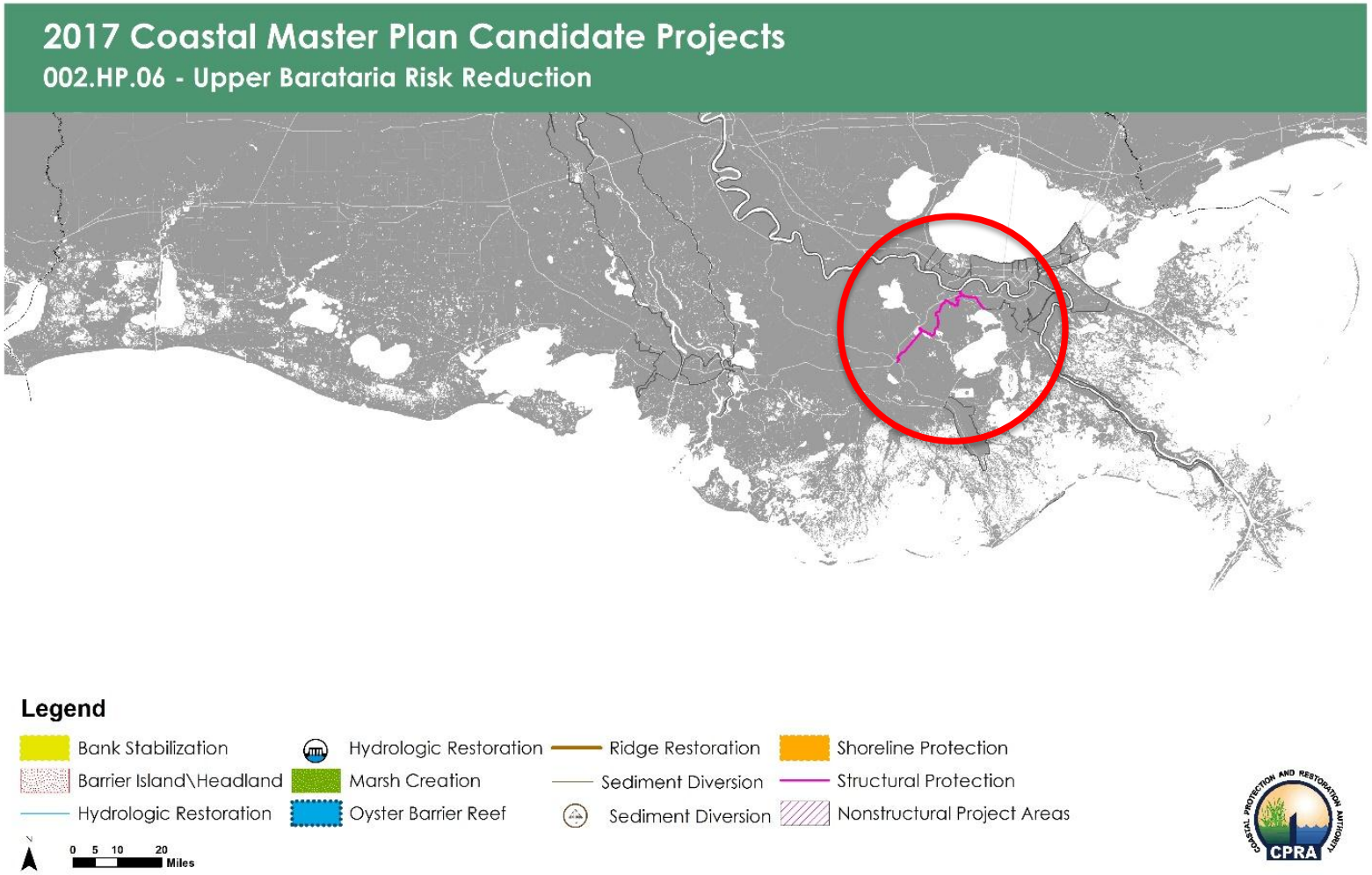
UPPER BARATARIA RISK REDUCTION (002.HP.06)

- **Hurricane protection levee along Highway 90**
  - Alignment between West Bank and Larose
- **Implementation year 11**

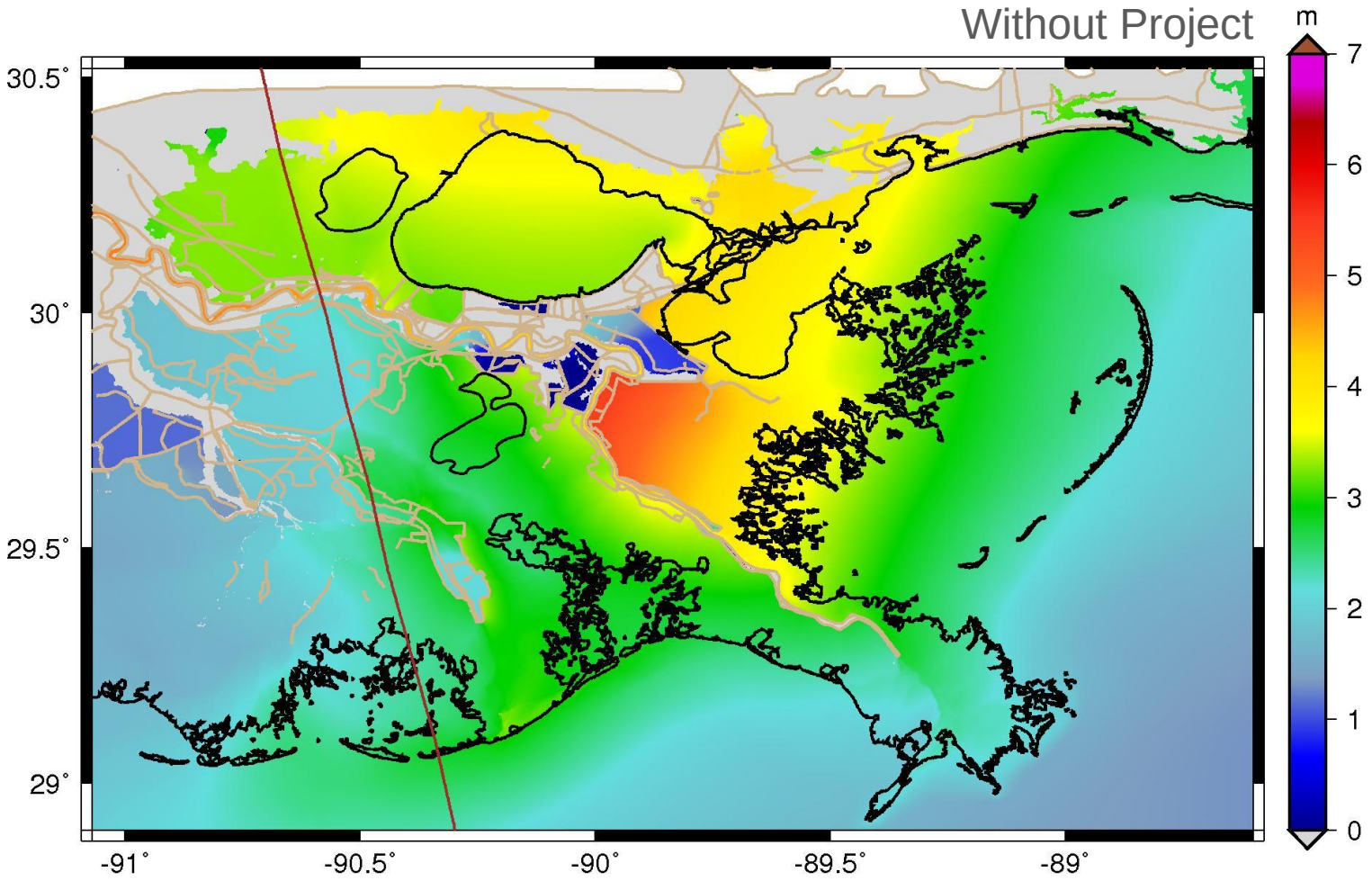
UPPER BARATARIA RISK REDUCTION (002.HP.06)



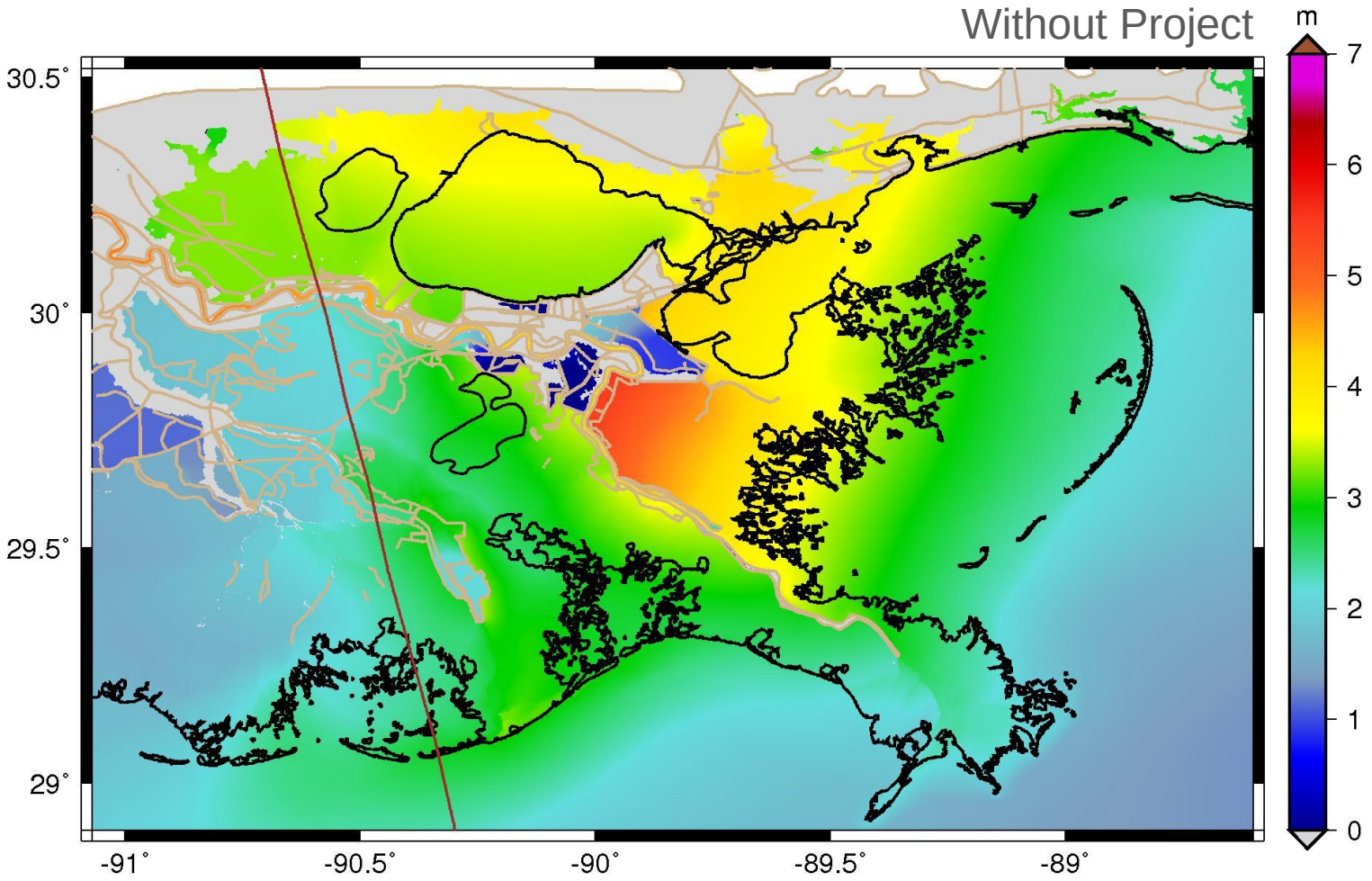
UPPER BARATARIA RISK REDUCTION (002.HP.06)



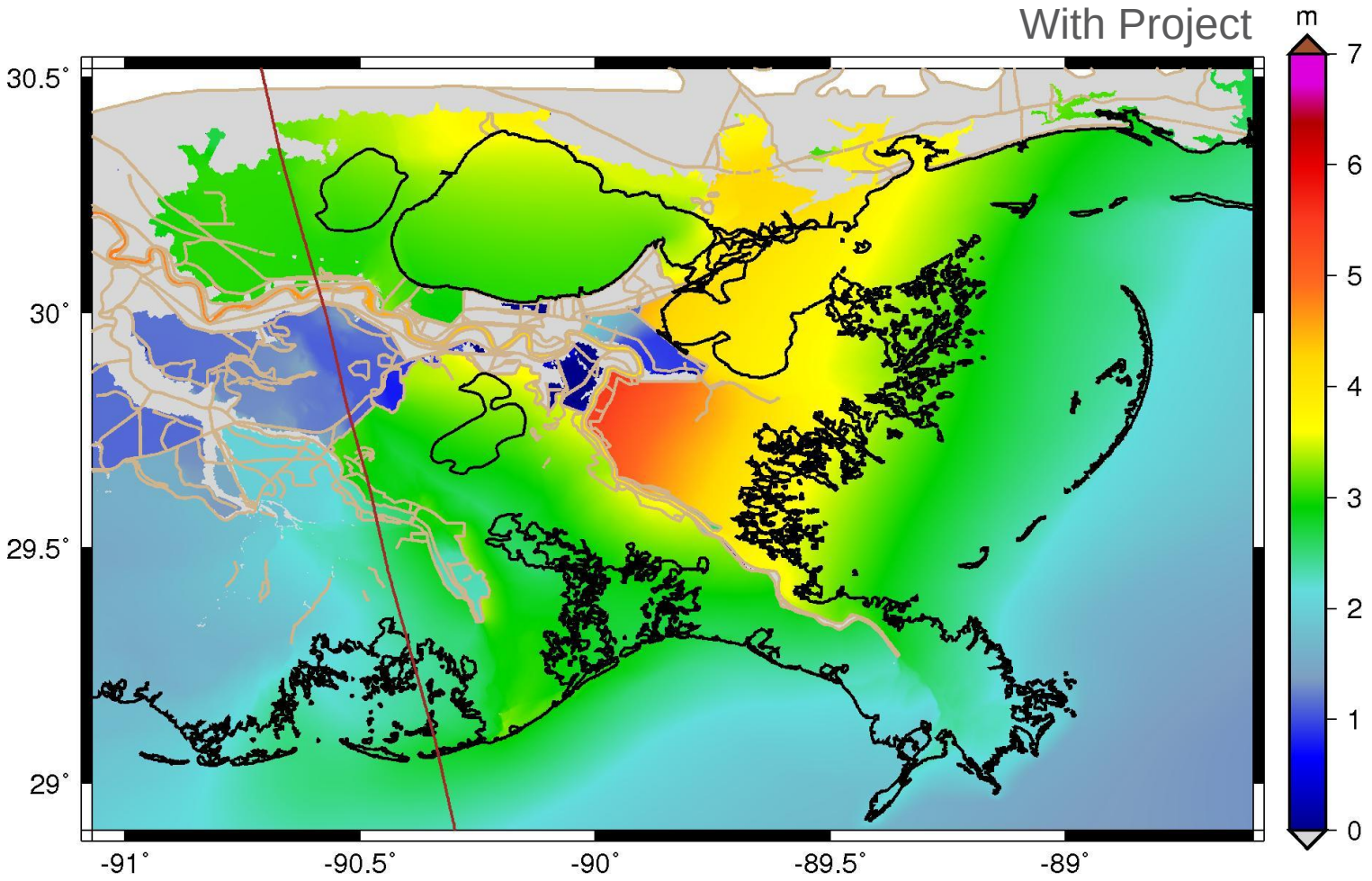
UPPER BARATARIA RISK REDUCTION STORM 012



UPPER BARATARIA RISK REDUCTION STORM 012

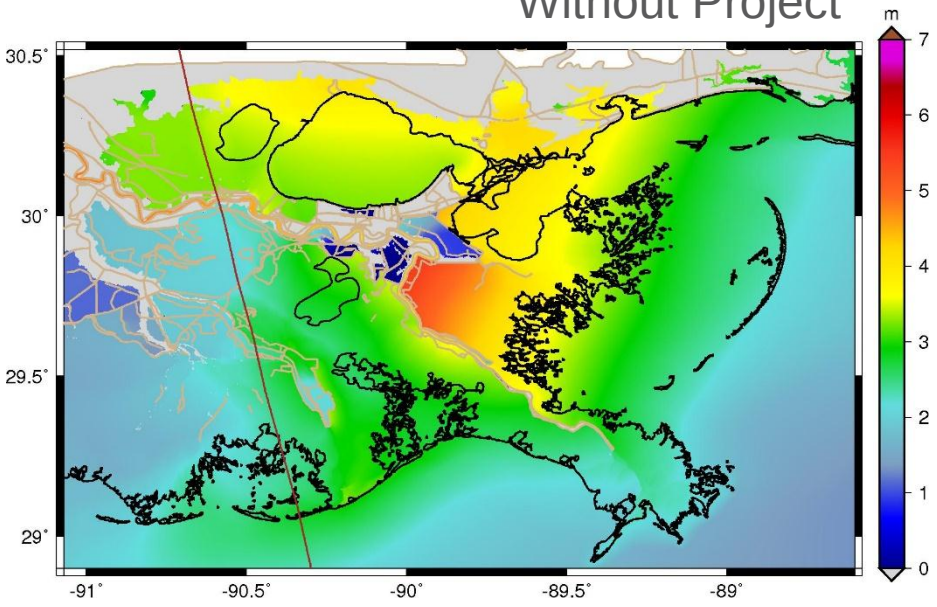


UPPER BARATARIA RISK REDUCTION STORM 012

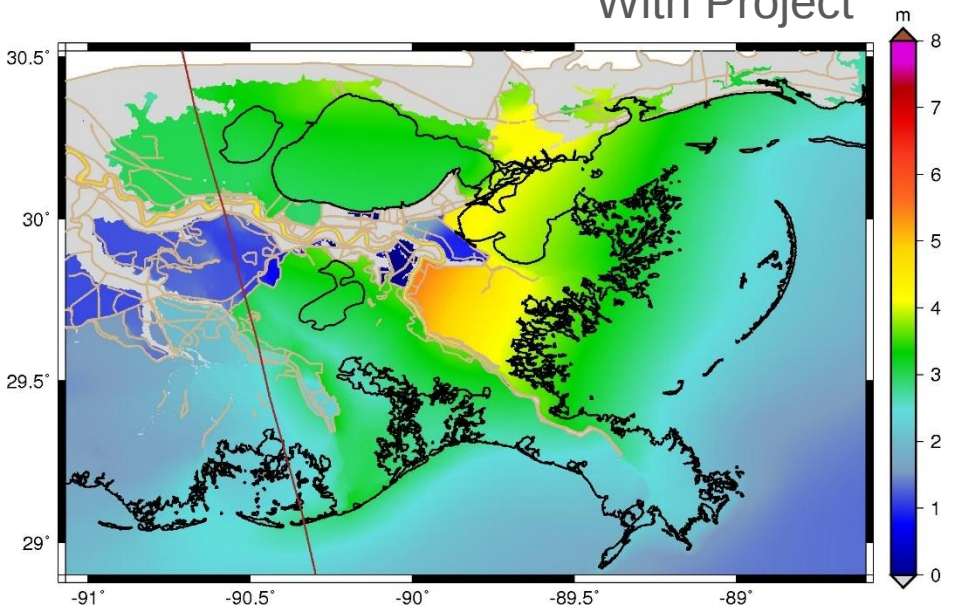


UPPER BARATARIA RISK REDUCTION STORM 012

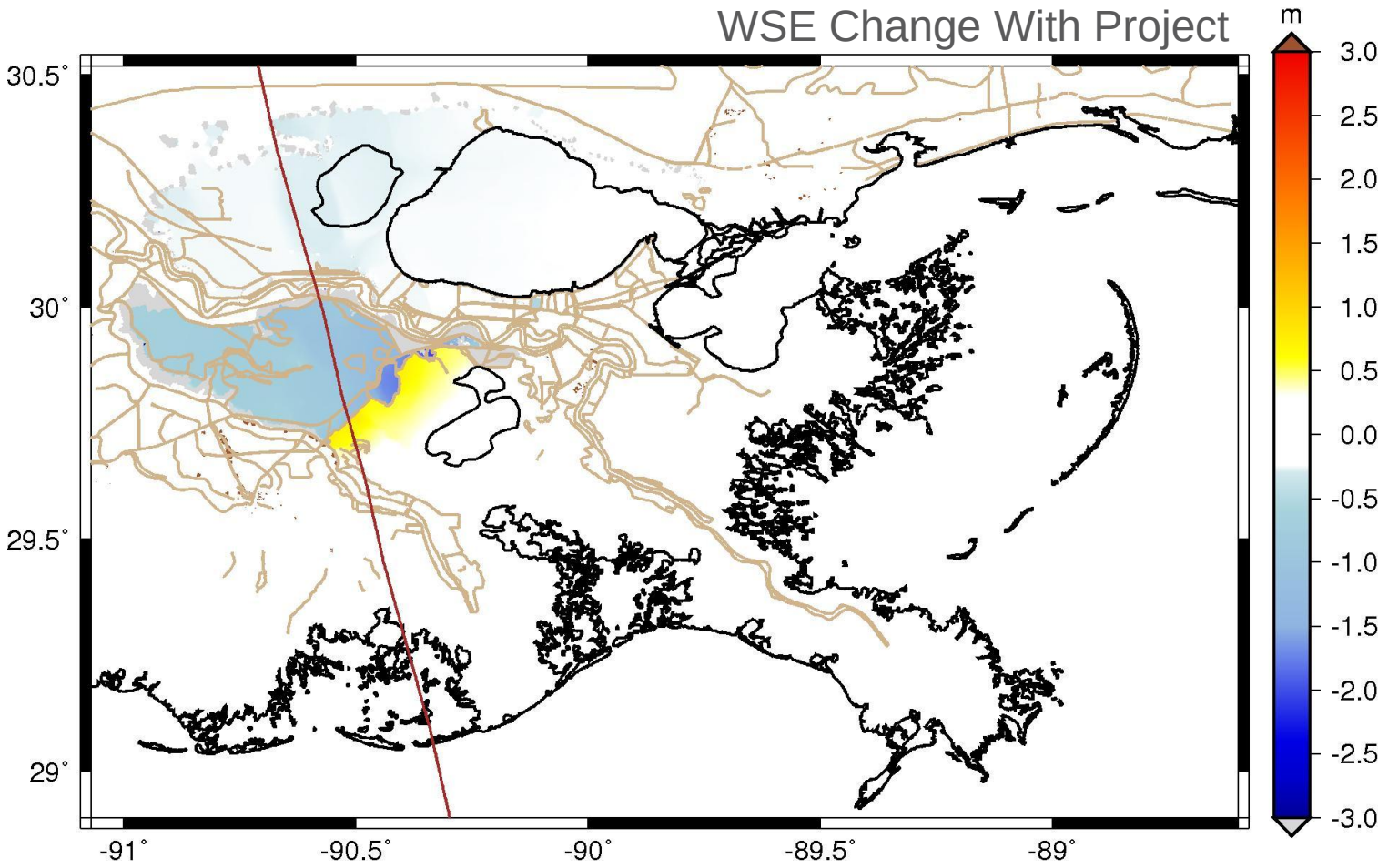
Without Project



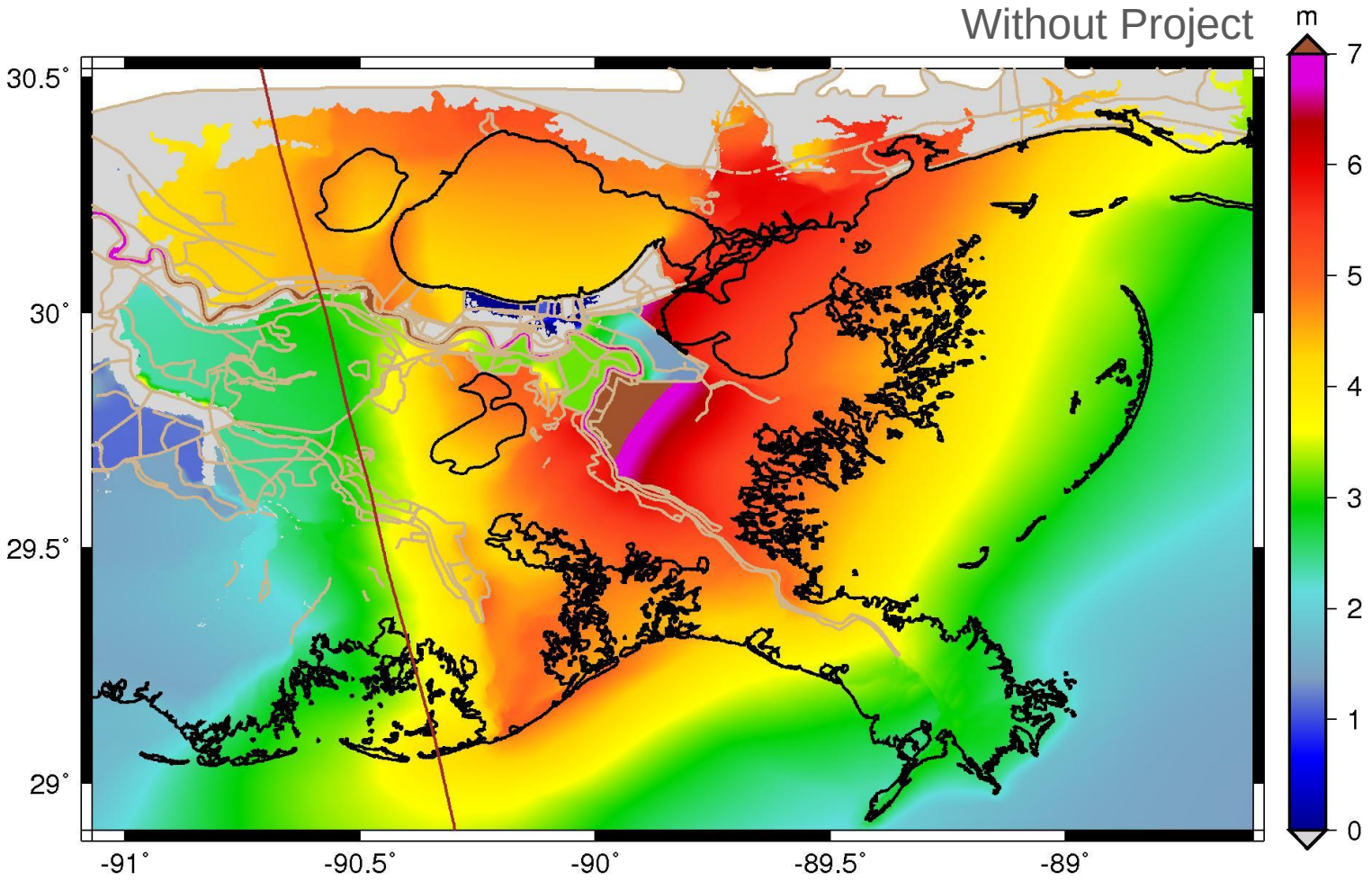
With Project



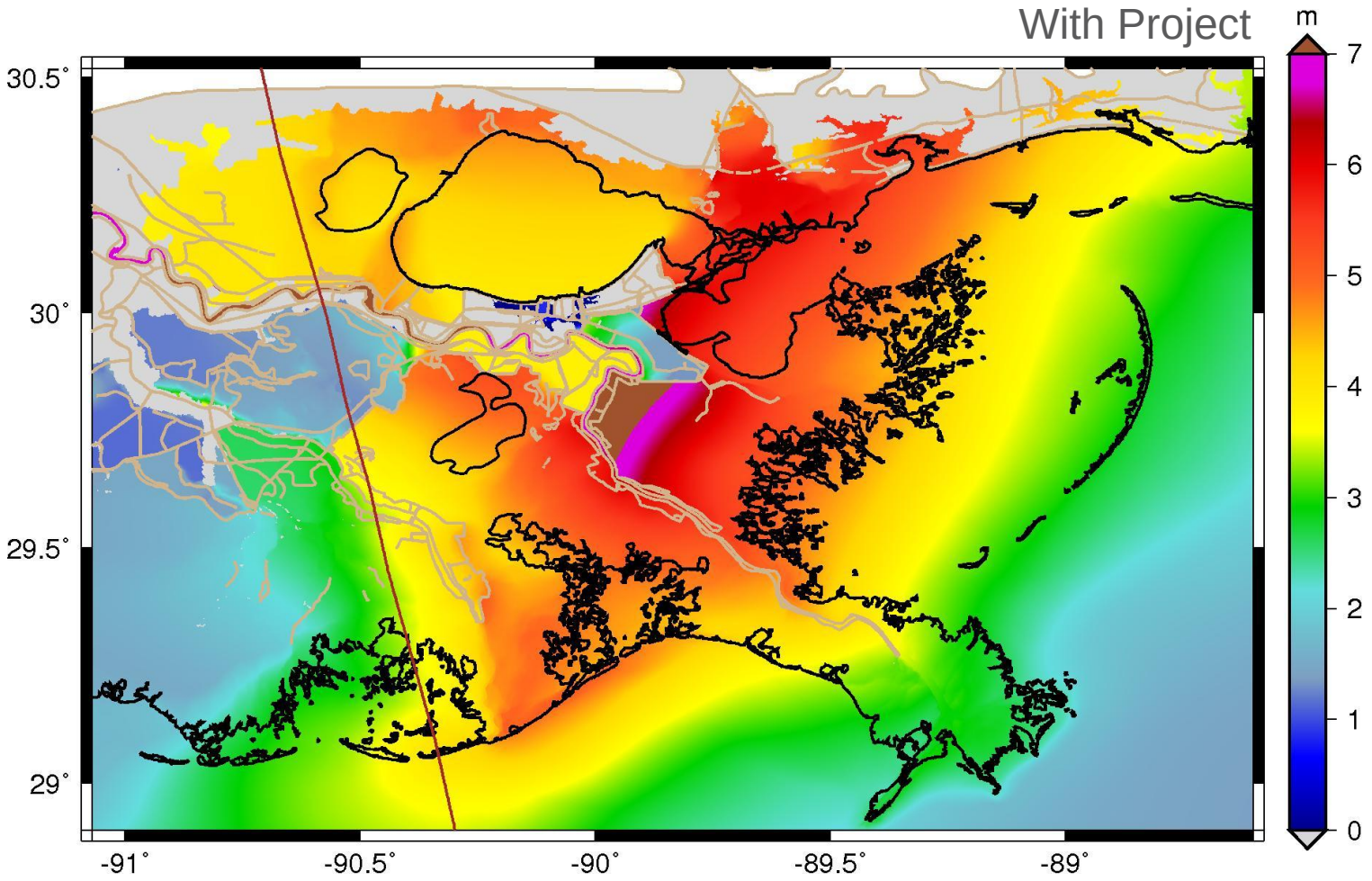
UPPER BARATARIA RISK REDUCTION STORM 012



UPPER BARATARIA RISK REDUCTION STORM 018

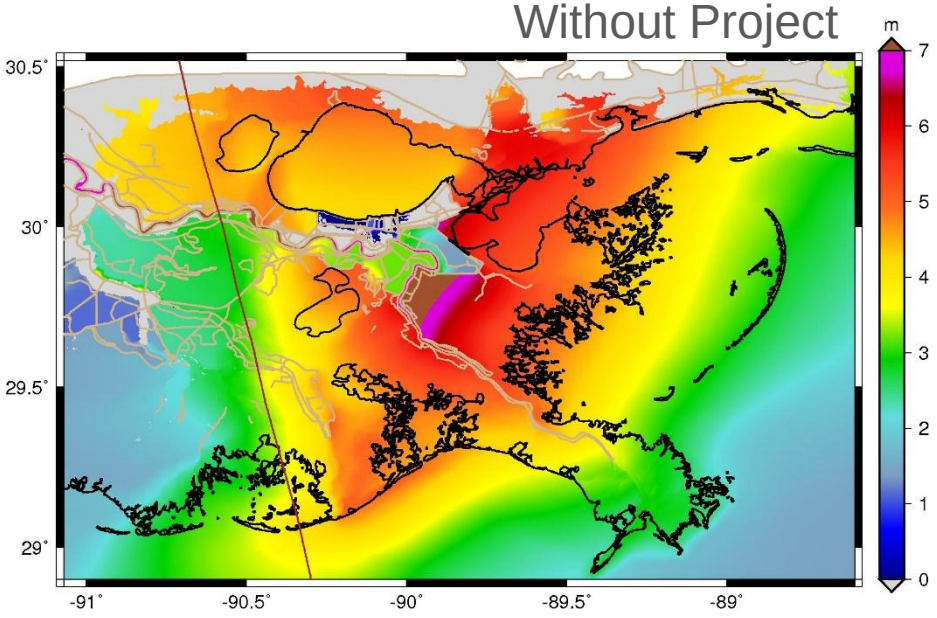


UPPER BARATARIA RISK REDUCTION STORM 018

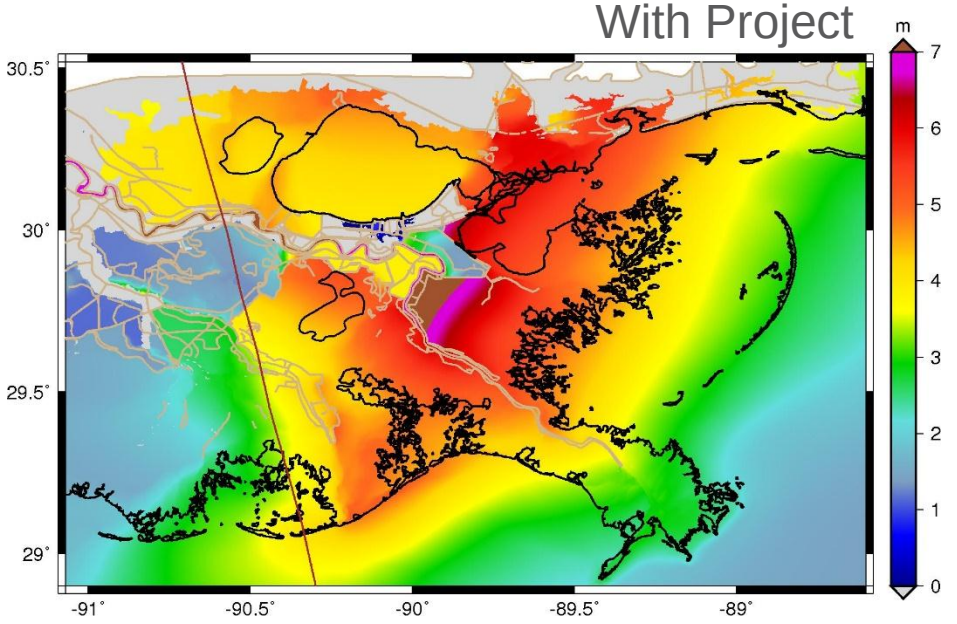


UPPER BARATARIA RISK REDUCTION STORM 018

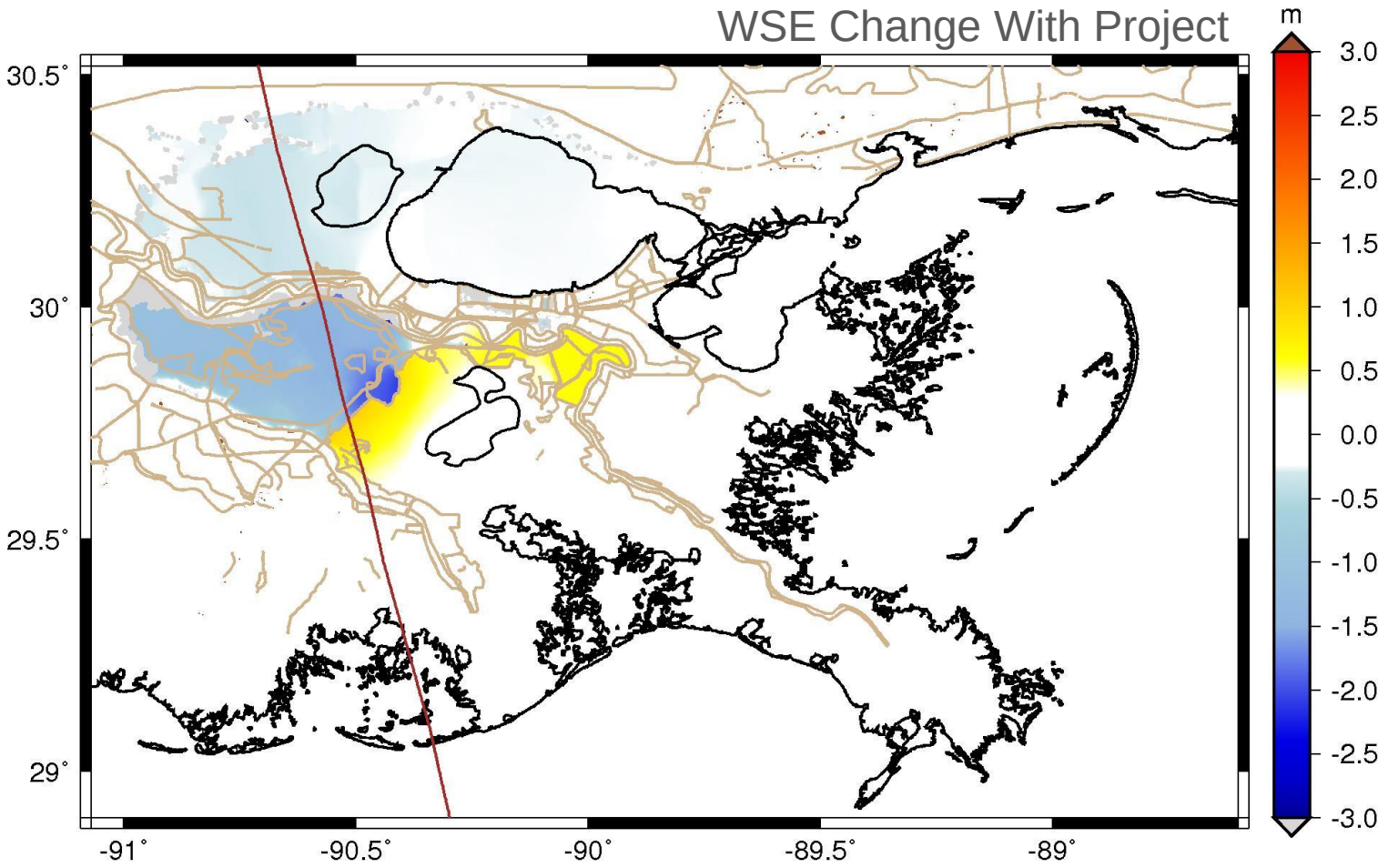
Without Project



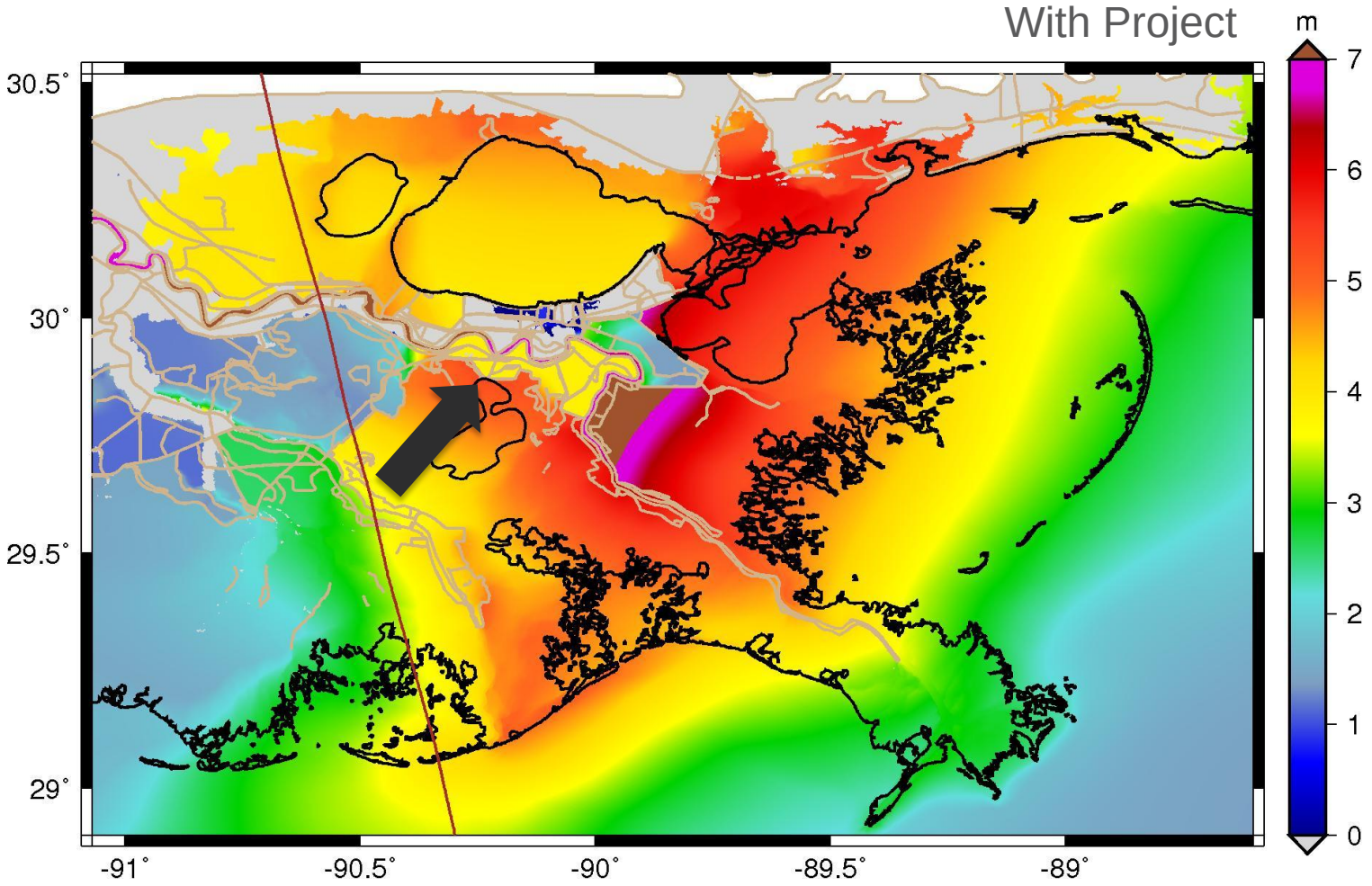
With Project



UPPER BARATARIA RISK REDUCTION STORM 018



UPPER BARATARIA RISK REDUCTION STORM 018



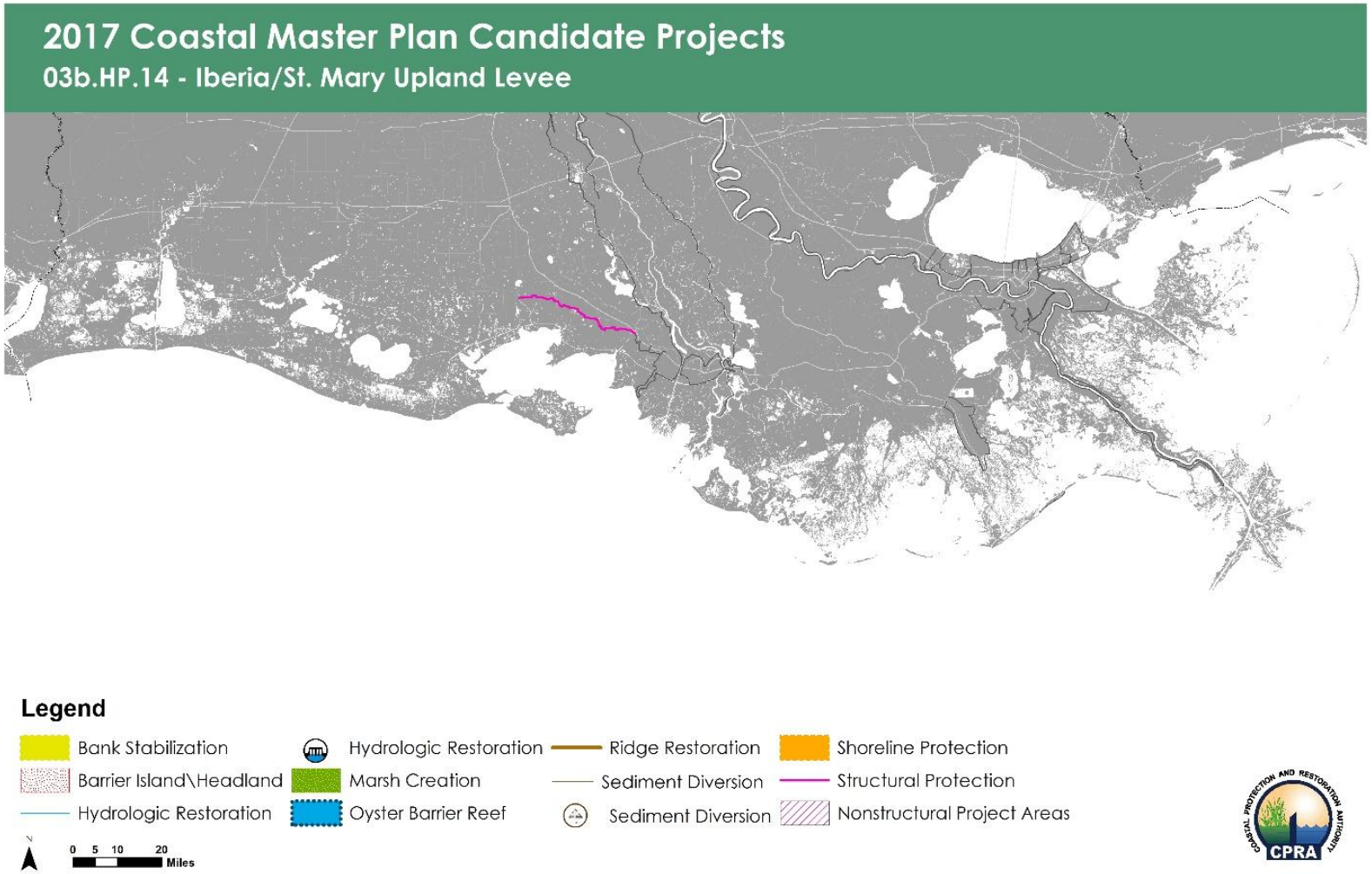
UPPER BARATARIA CONCLUSIONS

- **Project can help reduce surge elevations for communities behind barrier**
- **For large storms under high sea level rise, project can increase flooding in West Bank region**
  - These areas already experienced significant flooding without project in place for these events

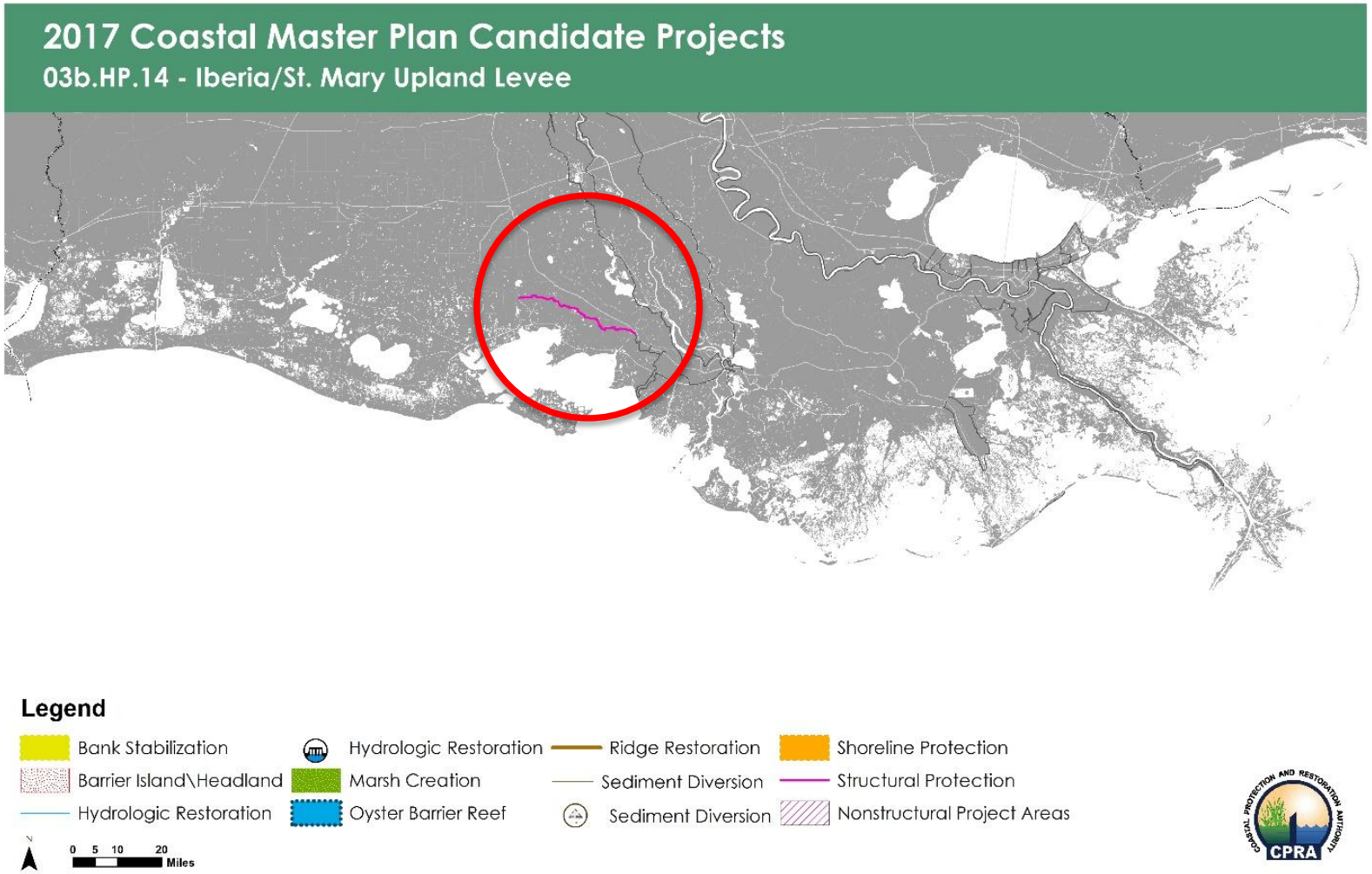
ST. MARY/IBERIA UPLAND LEVEE (03B.HP.14)

- **Hurricane Protection levee in Iberia and St. Mary**
  - Alignment between Delcambre Canal and Charenton Canal
- **Implementation year 11**

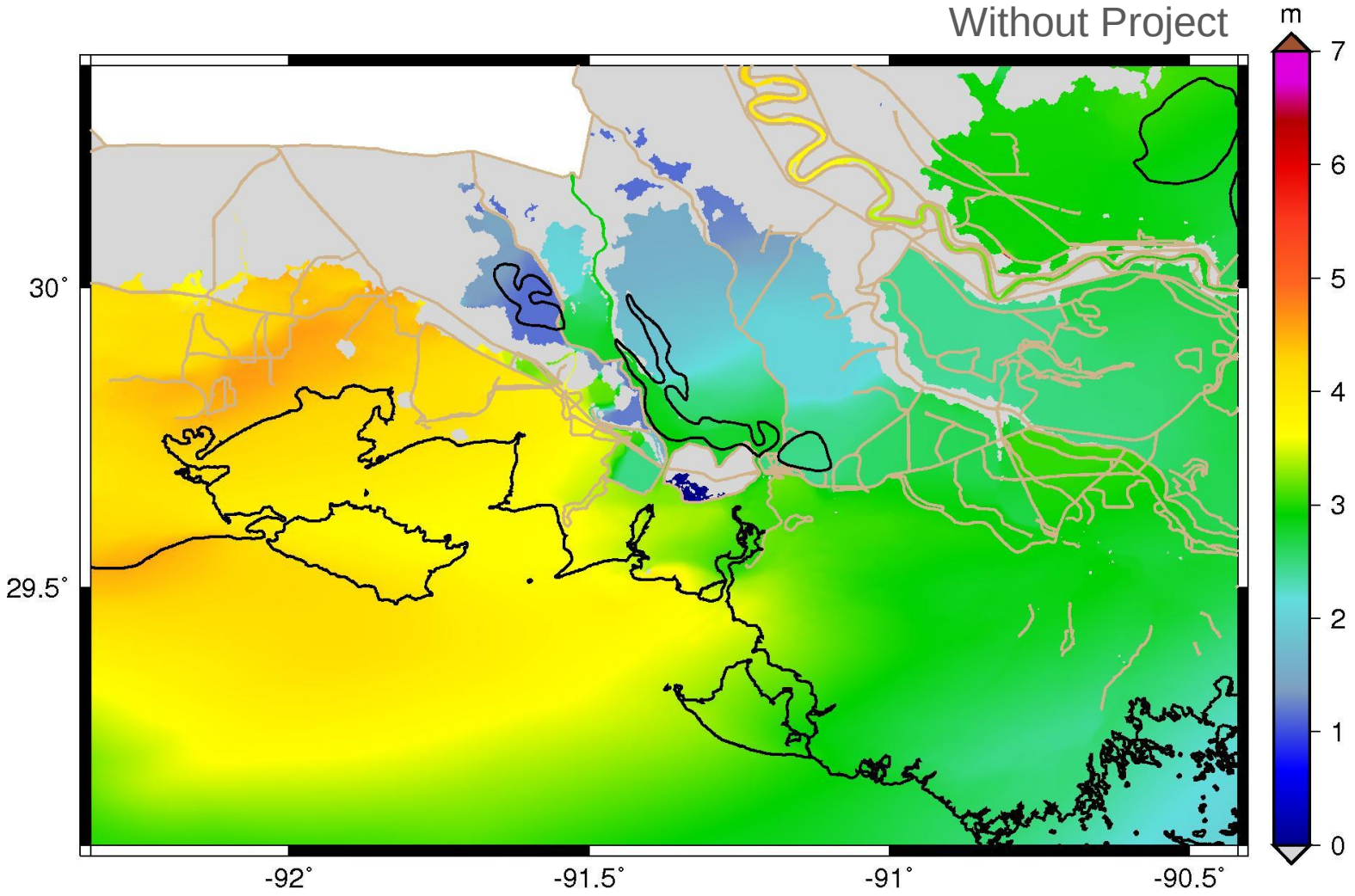
ST. MARY/IBERIA UPLAND LEVEE (03B.HP.14)



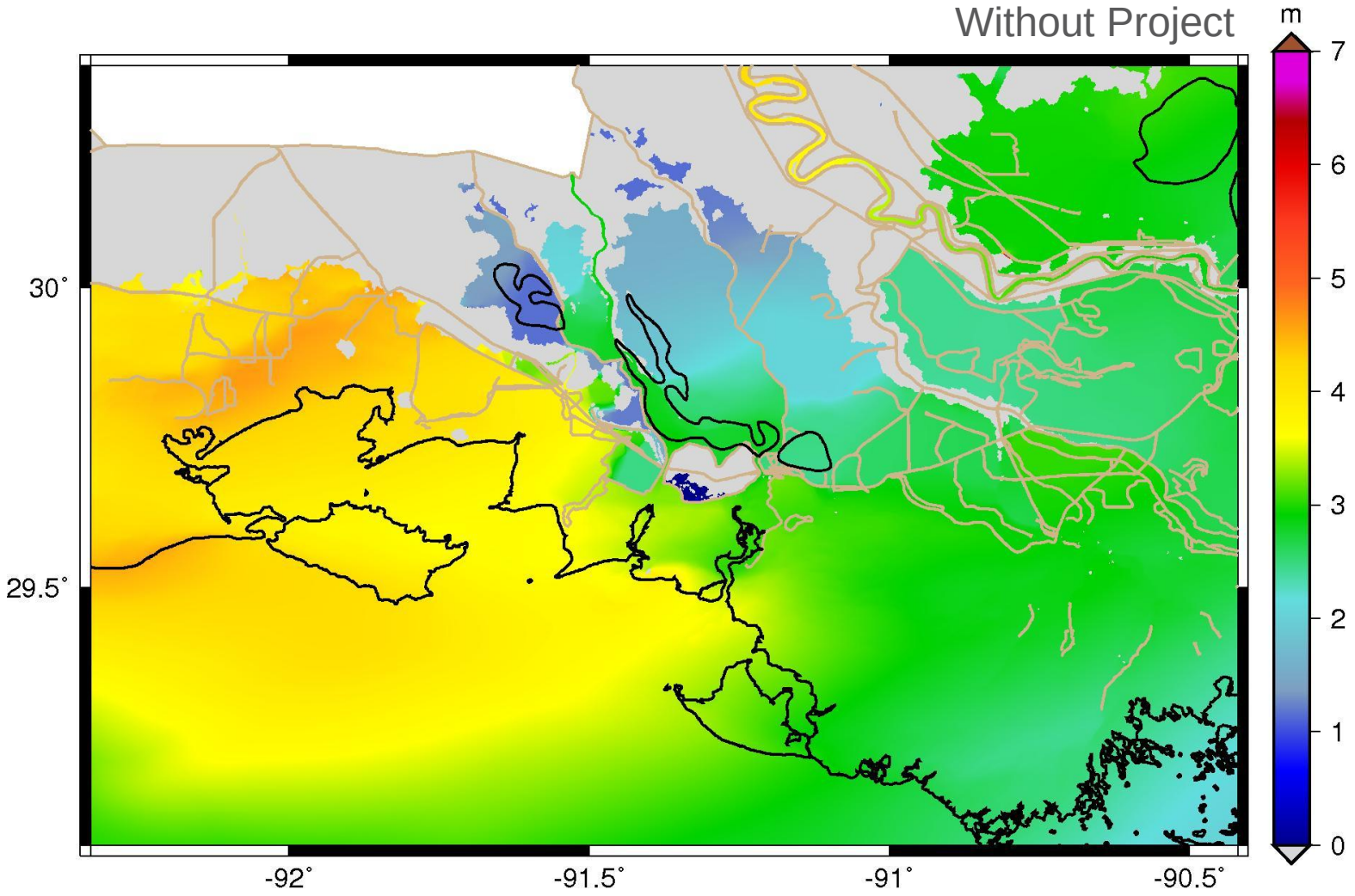
ST. MARY/IBERIA UPLAND LEVEE (03B.HP.14)



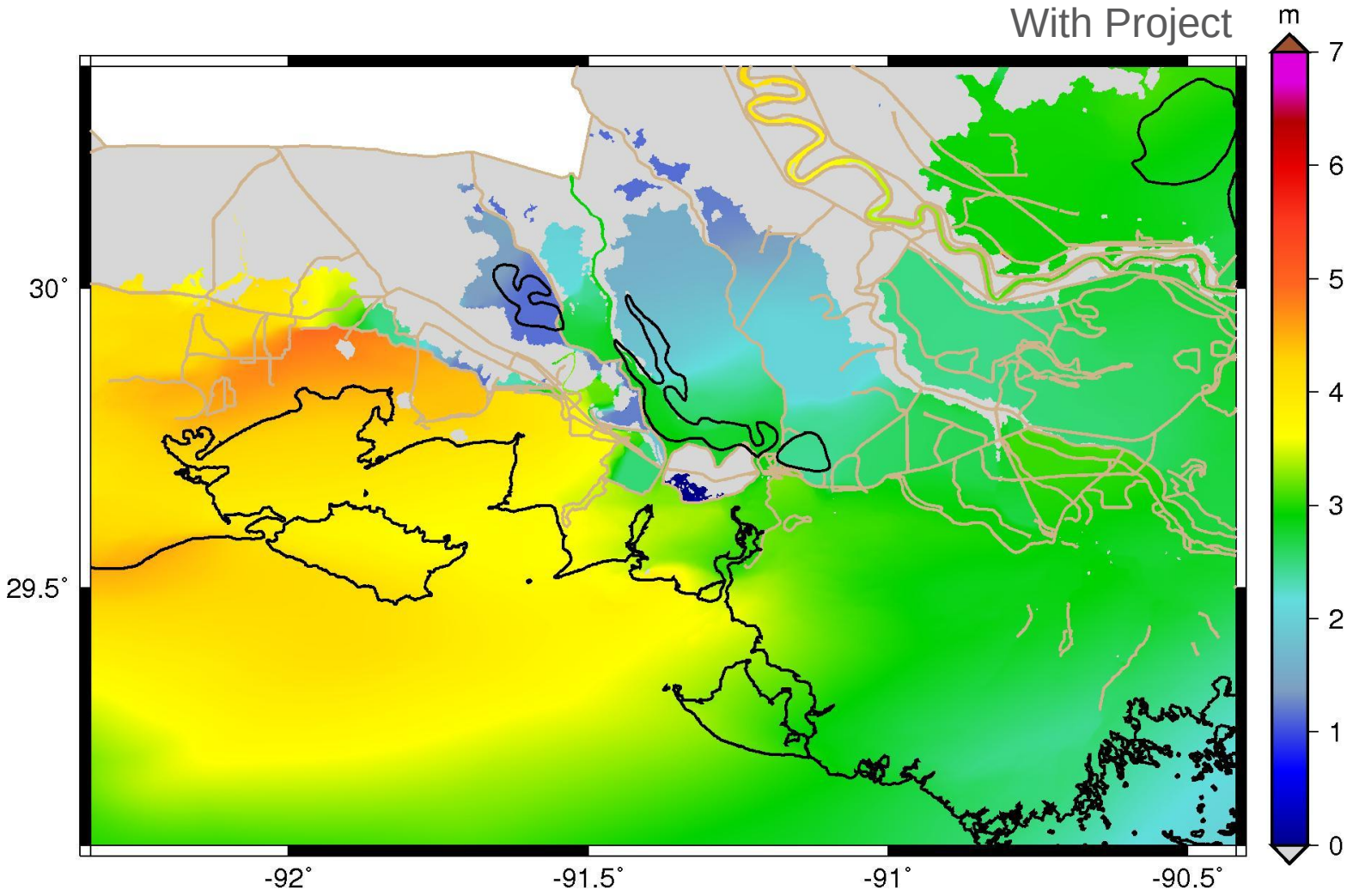
ST. MARY/IBERIA UPLAND LEVEE
STORM 223



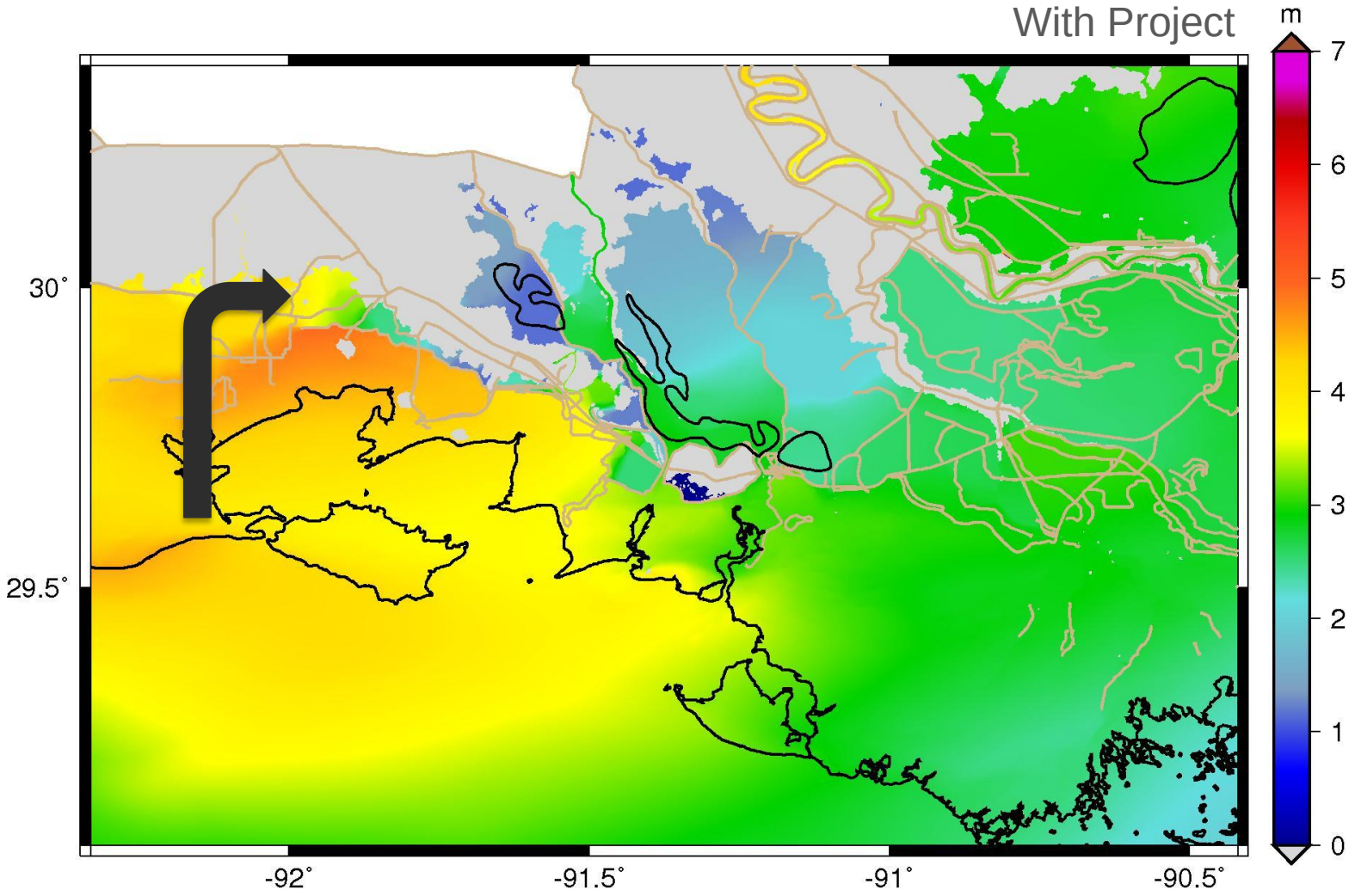
ST. MARY/IBERIA UPLAND LEVEE
STORM 223



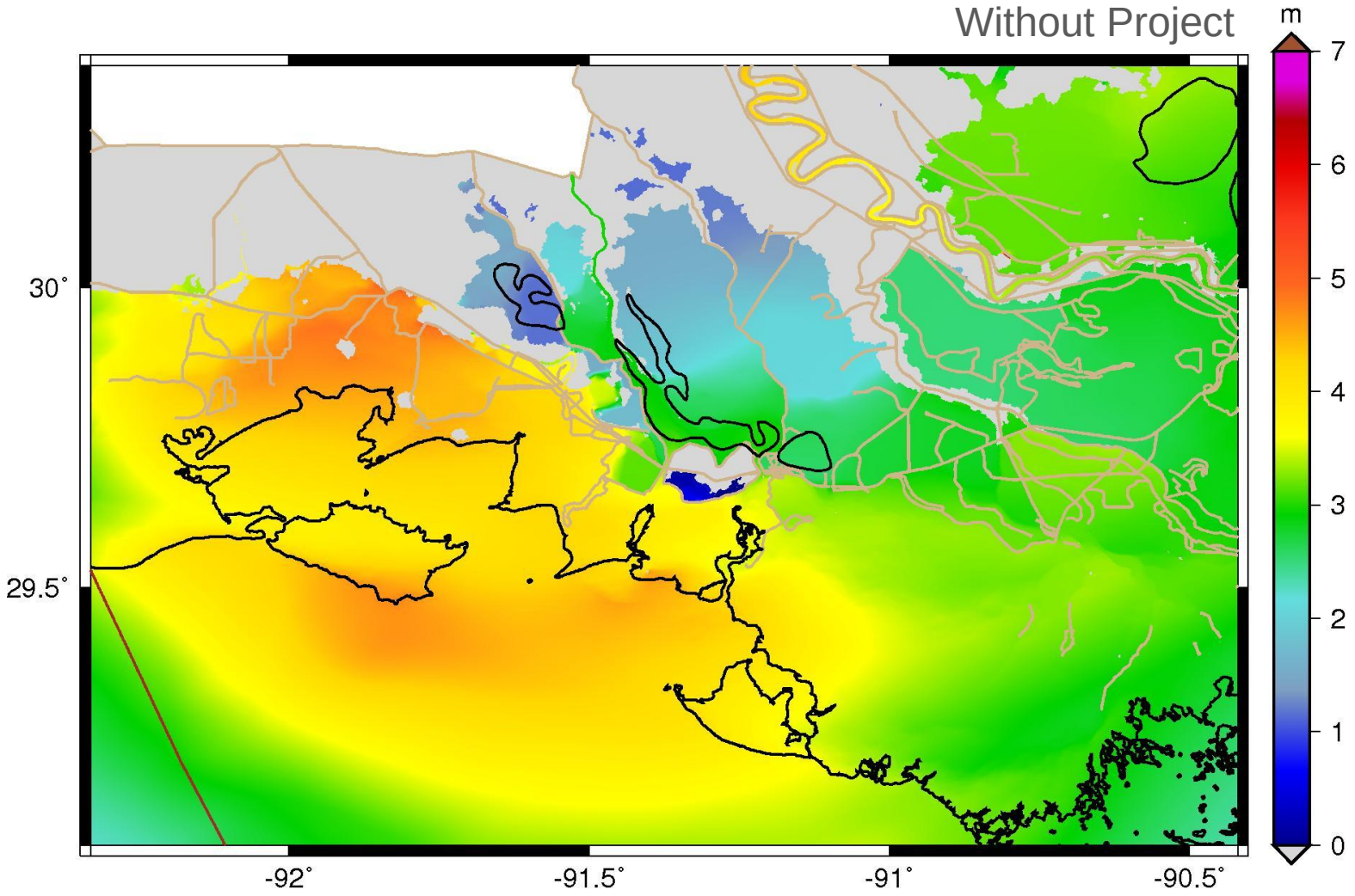
ST. MARY/IBERIA UPLAND LEVEE
STORM 223



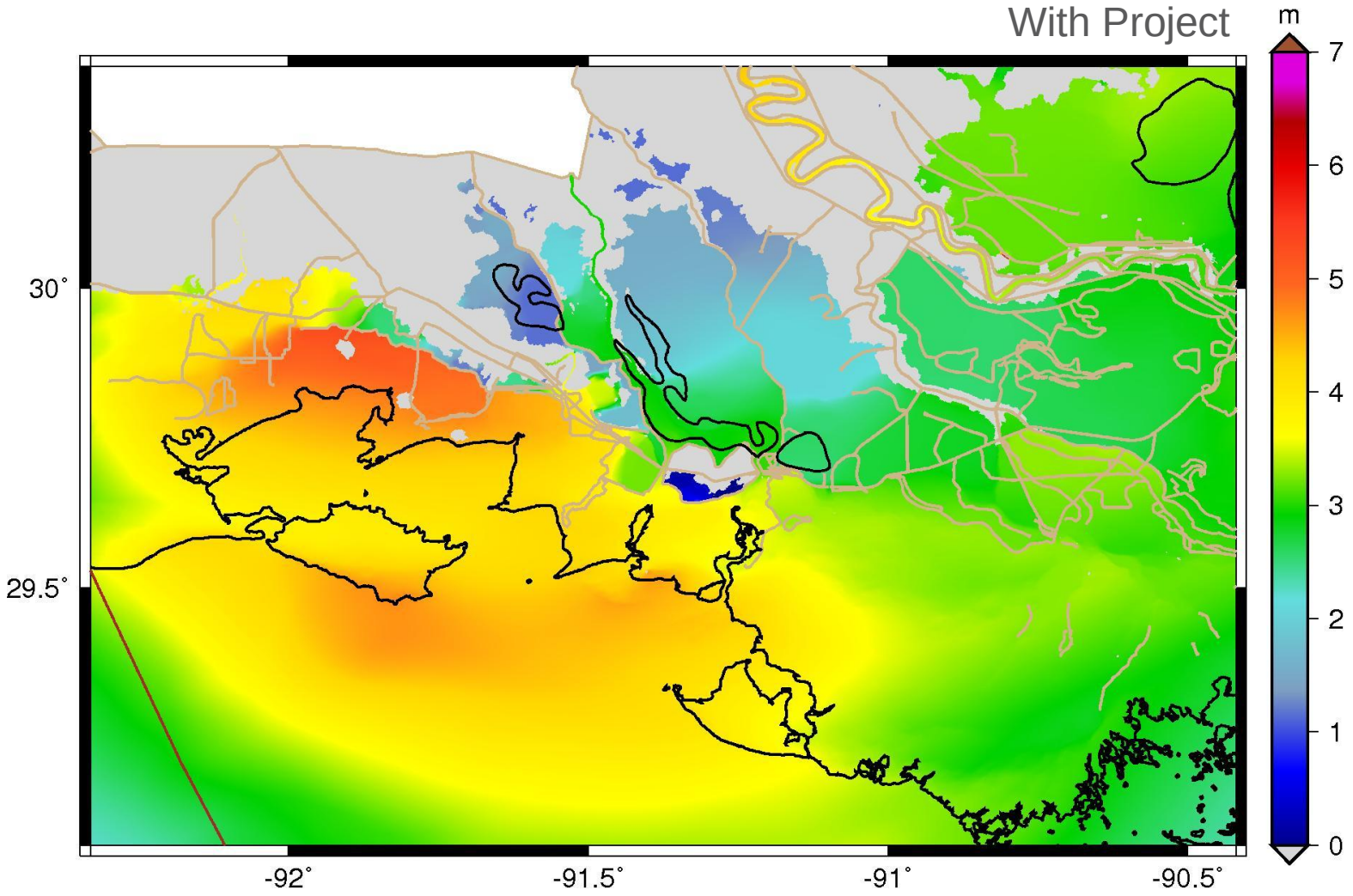
ST. MARY/IBERIA UPLAND LEVEE
STORM 223



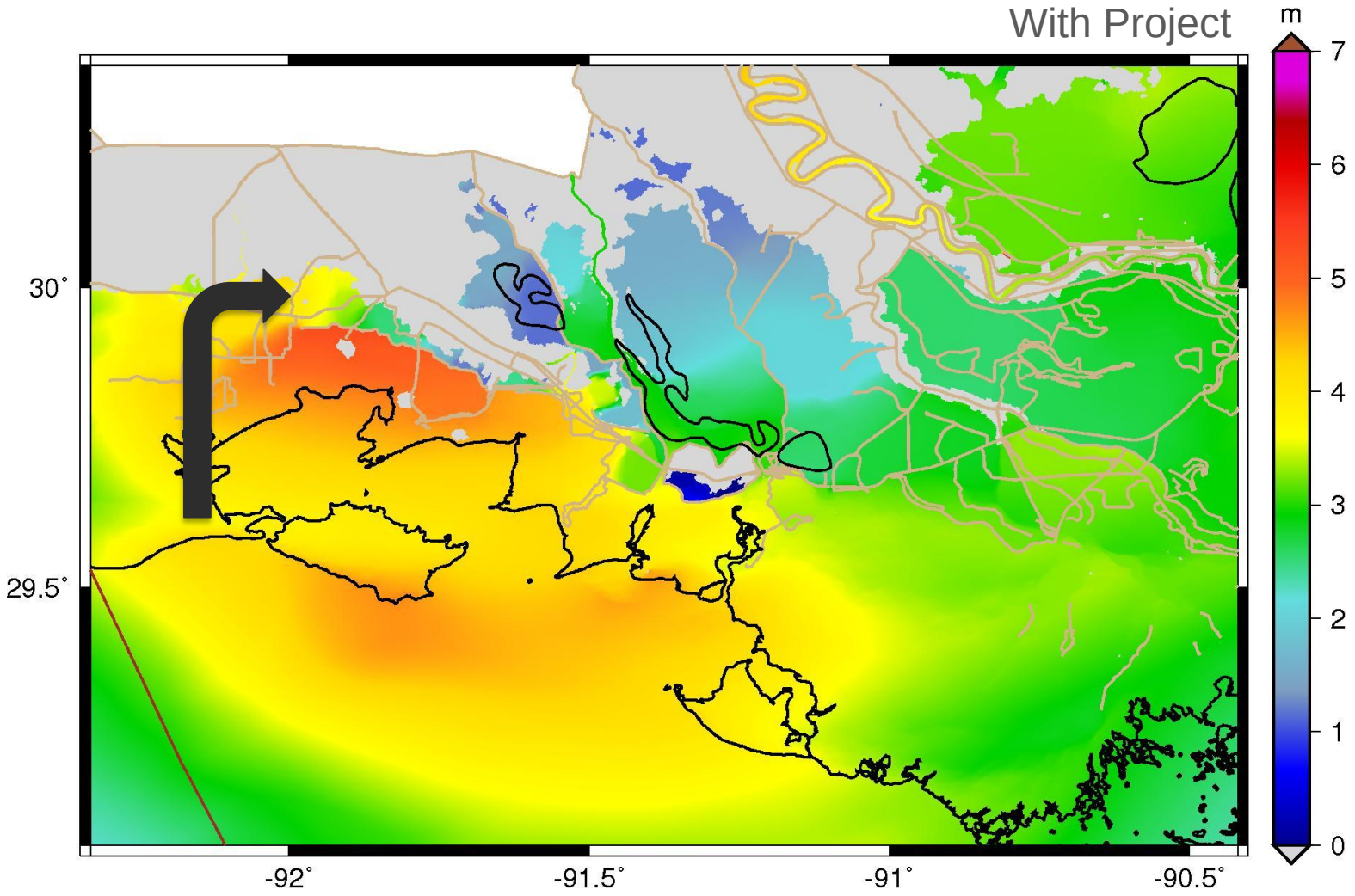
ST. MARY/IBERIA UPLAND LEVEE
STORM 232



ST. MARY/IBERIA UPLAND LEVEE
STORM 232



ST. MARY/IBERIA UPLAND LEVEE
STORM 232



ST. MARY/IBERIA UPLAND LEVEE CONCLUSIONS

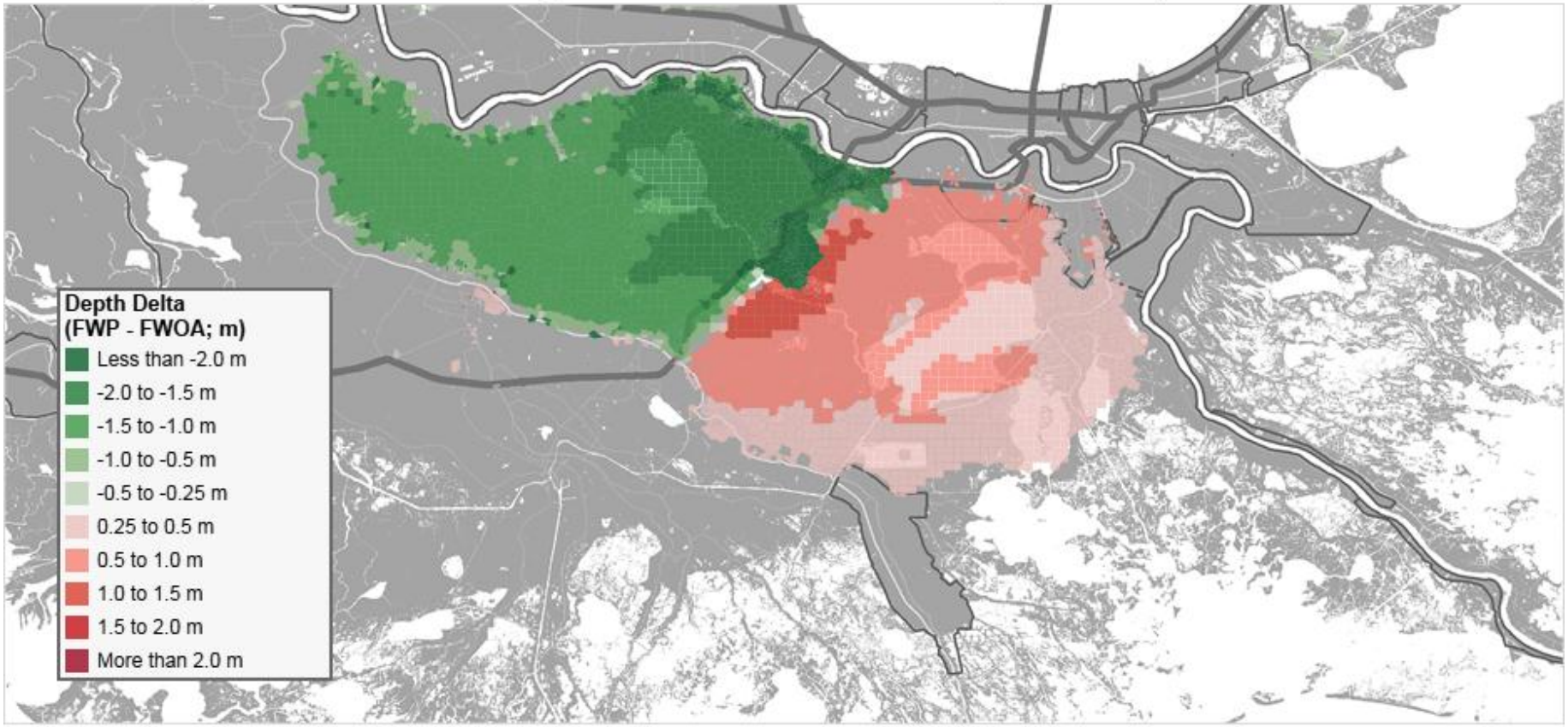
- **Levee can help provide protection especially in the eastern reaches**
- **Lack of tie in to elevated feature allows for significant surge runaround**

PROJECT RESULTS

Risk Assessment

UPPER BARATARIA RISK REDUCTION (002.HP.06): CHANGE IN 100-YEAR FLOOD DEPTHS

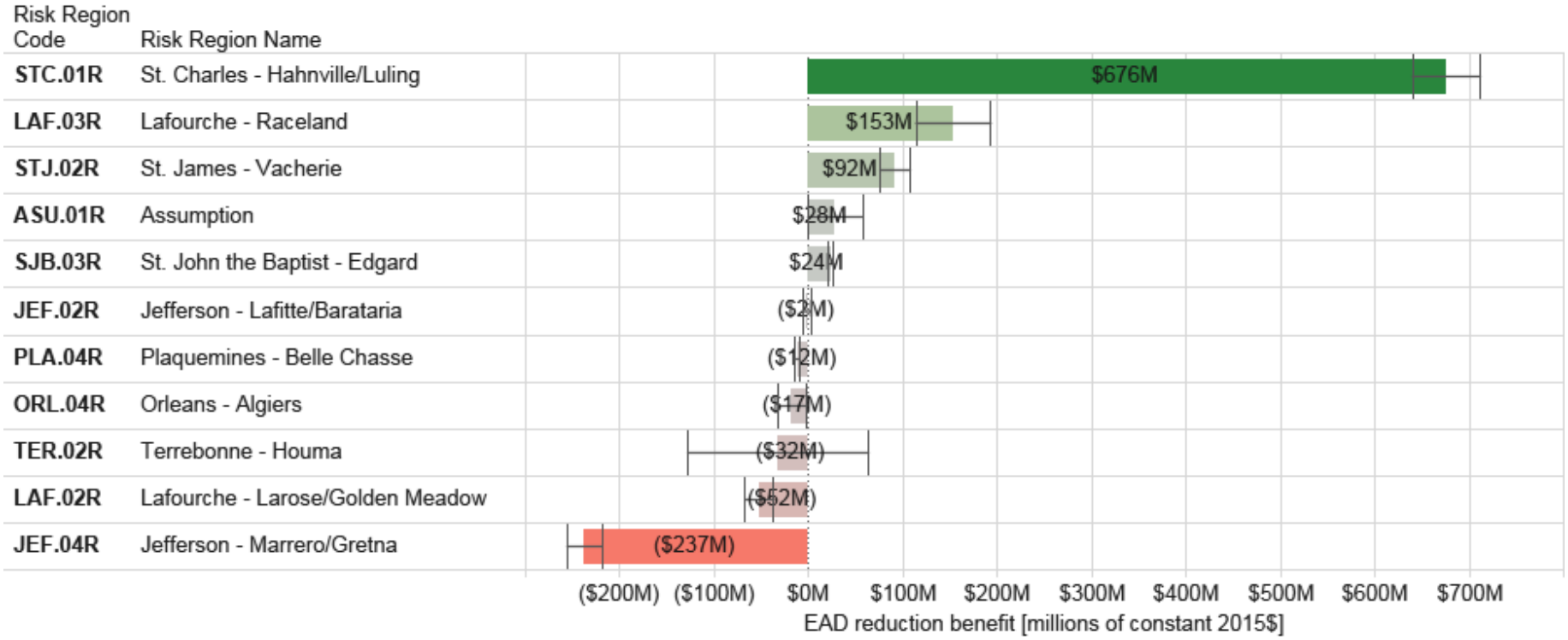
100-Year Depth Delta: 002.HP.06, High Scenario, Year 50, IPET Fragility, 50th percentile



Note: Only grid points with flood depth deltas greater than 0.2 m shown.

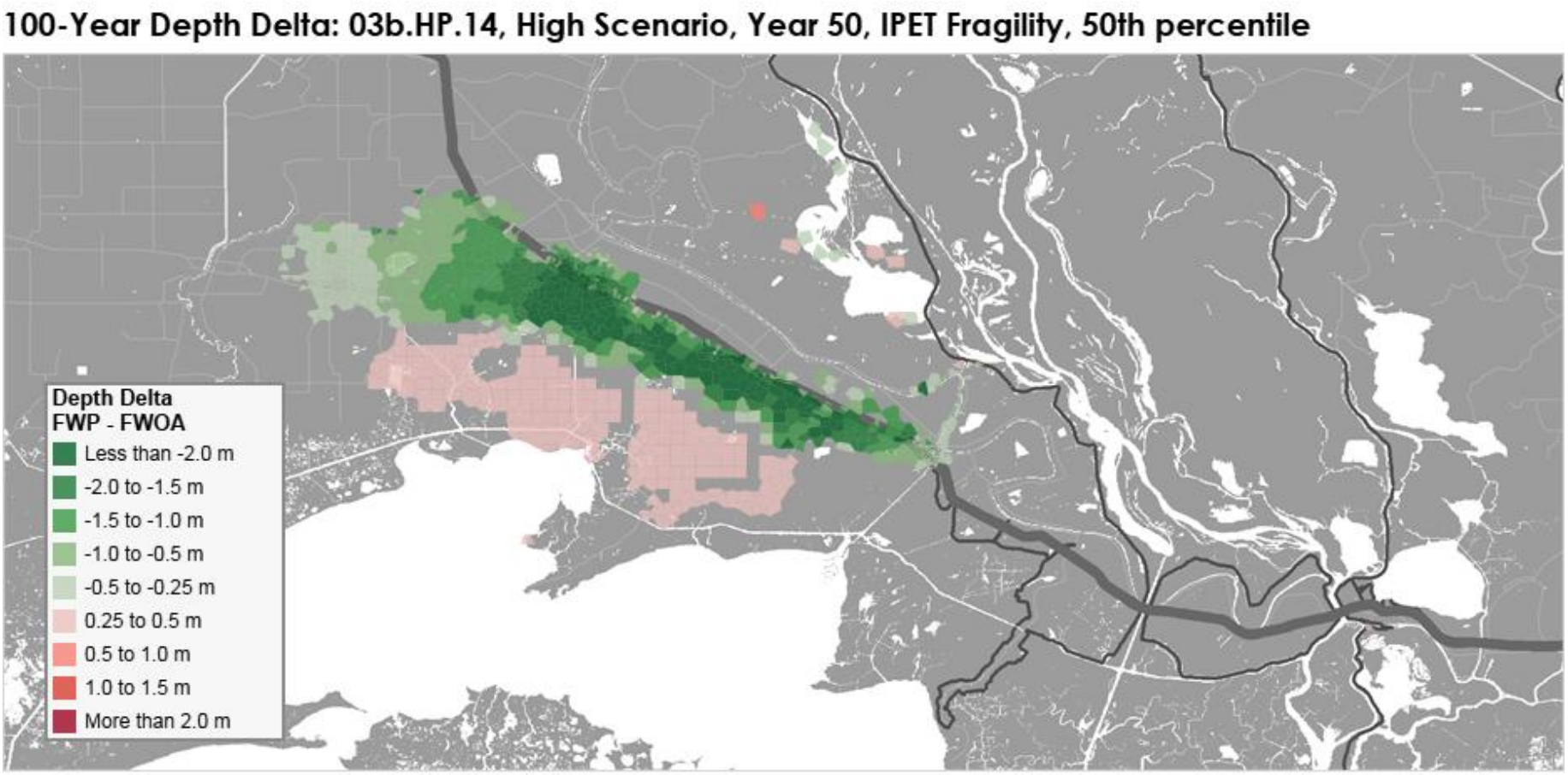
UPPER BARATARIA RISK REDUCTION (002.HP.06): DAMAGE REDUCTION

EAD Reduction Benefits by Risk Region: 002.HP.06
High Scenario, Year 50, IPET Fragility Scenario, Historic Growth Population Scenario



NOTE: Lines show an estimate of the 95 percent confidence interval. Results within $1M of 0 are omitted for clarity.

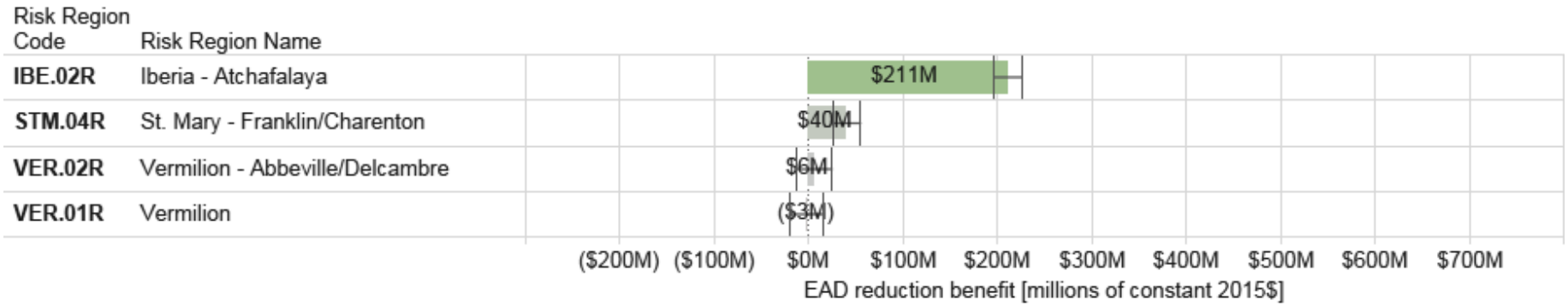
IBERIA/ST. MARY UPLAND LEVEE (03B.HP.14): CHANGE IN 100-YEAR FLOOD DEPTHS



Note: Only grid points with flood depth deltas greater than 0.2 m shown.

IBERIA/ST. MARY UPLAND LEVEE (03B.HP.14): DAMAGE REDUCTION

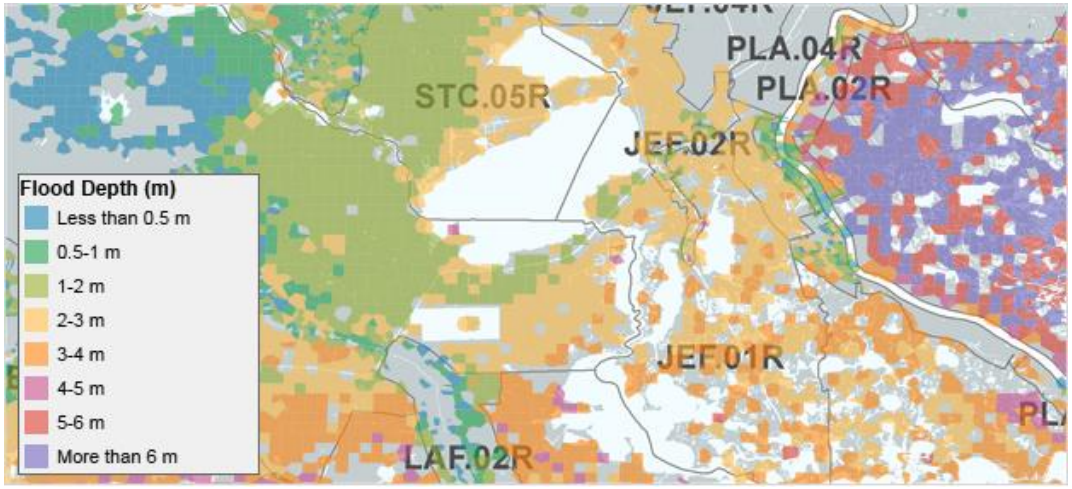
EAD Reduction Benefits by Risk Region: 03b.HP.14
High Scenario, Year 50, IPET Fragility Scenario, Historic Growth Population Scenario



NOTE: Lines show an estimate of the 95 percent confidence interval. Results within $1M of 0 are omitted for clarity.

NONSTRUCTURAL RISK REDUCTION: JEF.02N (JEFFERSON PARISH-LAFITTE/BARATARIA)

Flood elevation target: 100-year, High Scenario, Year 10
+0.6 m [2 ft] freeboard



Mean EAD Reduction
High Scenario, Historic Growth

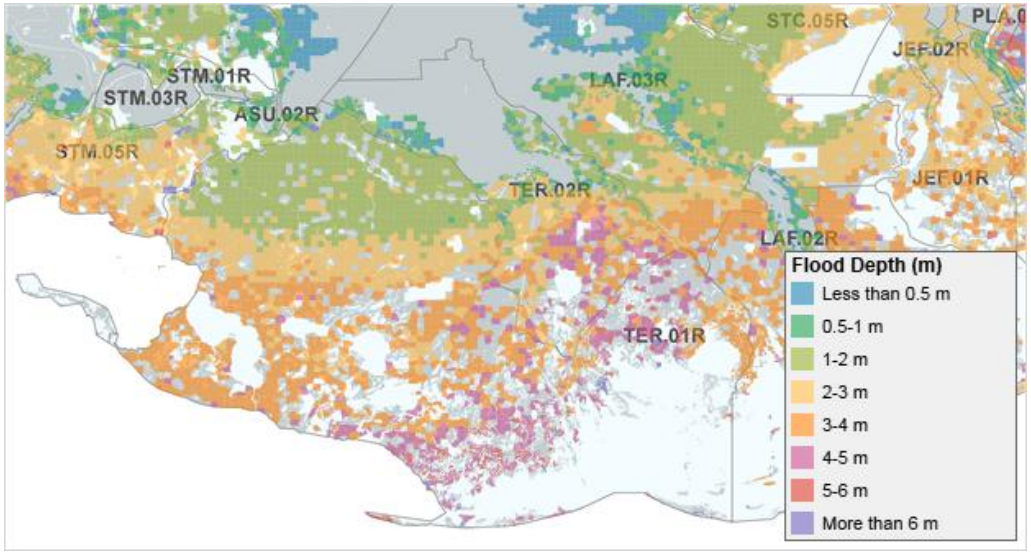
Year 10	Year 25	Year 50
$24 million	$27 million	$16 million

Project characteristics

Structures elevated	1,234
Structures floodproofed	9
Structures acquired	3
Percent mitigated	60%
Total cost (2015$)	$201 million
Construction time	5 years

NONSTRUCTURAL RISK REDUCTION: TER.01N (LOWER TERREBONNE)

Flood elevation target: 100-year, High Scenario, Year 10
+0.6 m [2 ft] freeboard



Mean EAD Reduction
High Scenario, Historic Growth

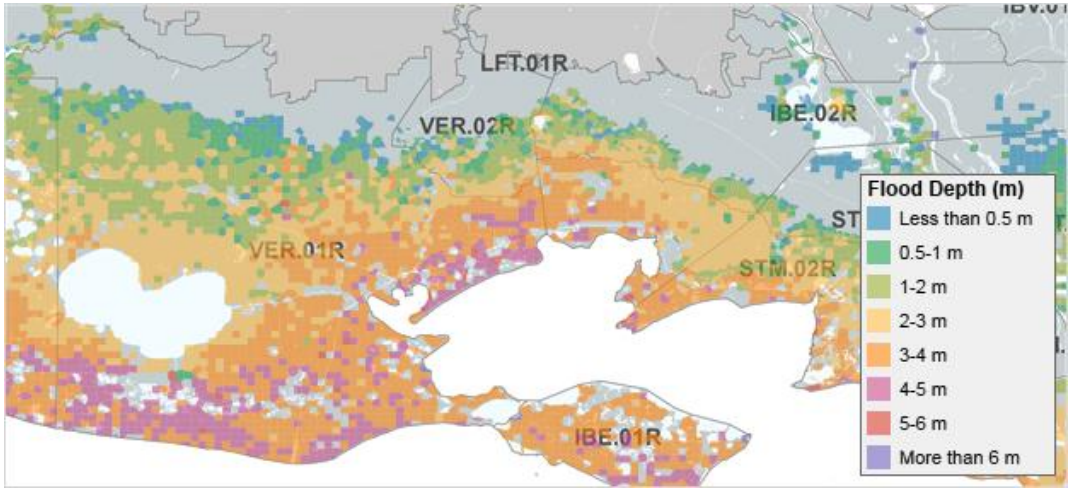
Year 10	Year 25	Year 50
$8 million	$9 million	$9 million

Project characteristics

Structures elevated	261
Structures floodproofed	2
Structures acquired	119
Percent mitigated	44%
Total cost (2015$)	$88 million
Construction time	3 years

NONSTRUCTURAL RISK REDUCTION: VER.02N (VERMILION - ABBEVILLE/DELCAMBRE)

Flood elevation target: 100-year, High Scenario, Year 10
+0.6 m [2 ft] freeboard



Mean EAD Reduction
High Scenario, Historic Growth

Year 10	Year 25	Year 50
$24 million	$38 million	$46 million

Project characteristics

Structures elevated	638
Structures floodproofed	116
Structures acquired	15
Percent mitigated	30%
Total cost (2015$)	$191 million
Construction time	4 years

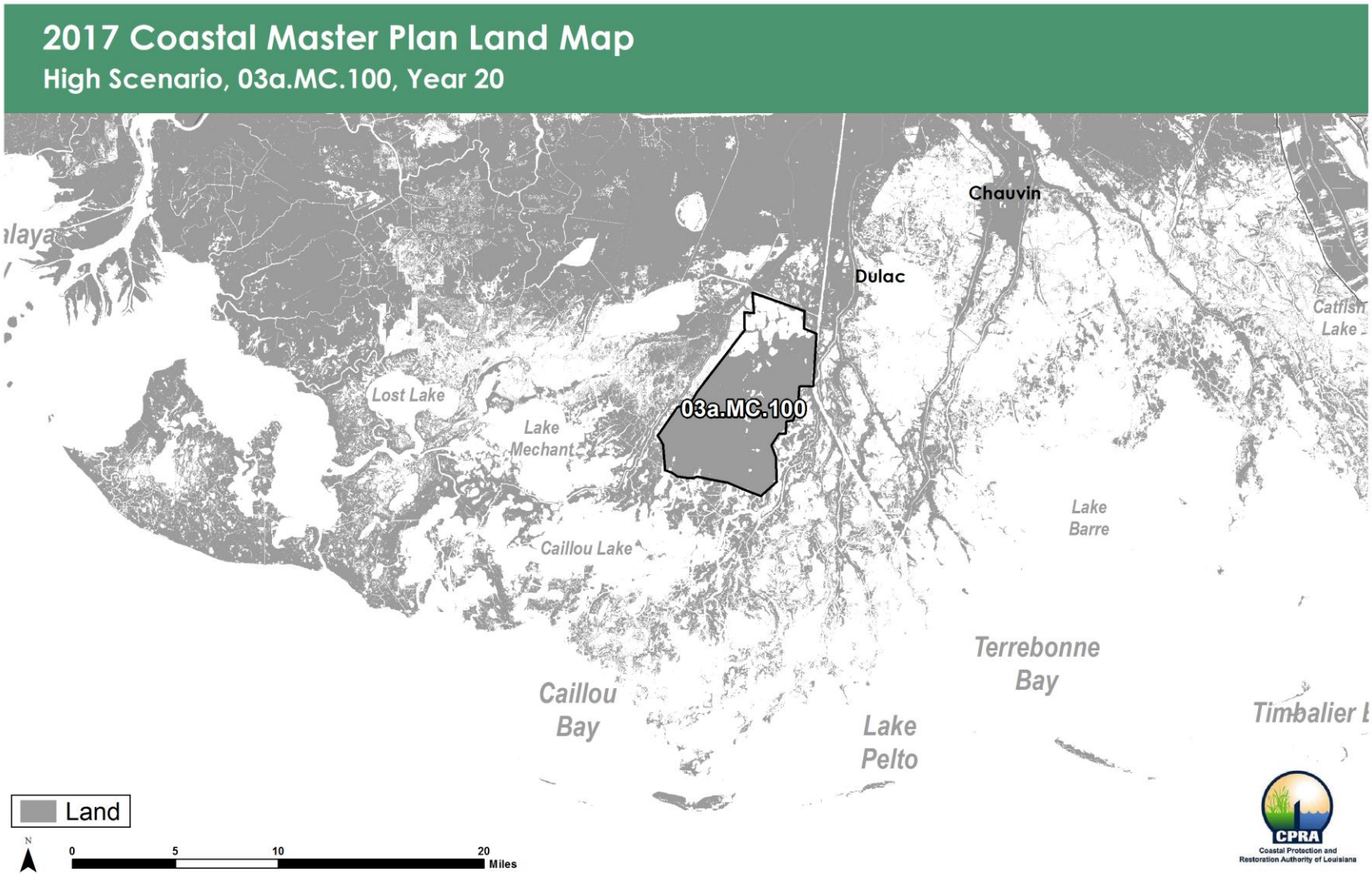
PROJECT RESULTS

Landscape / Ecosystem

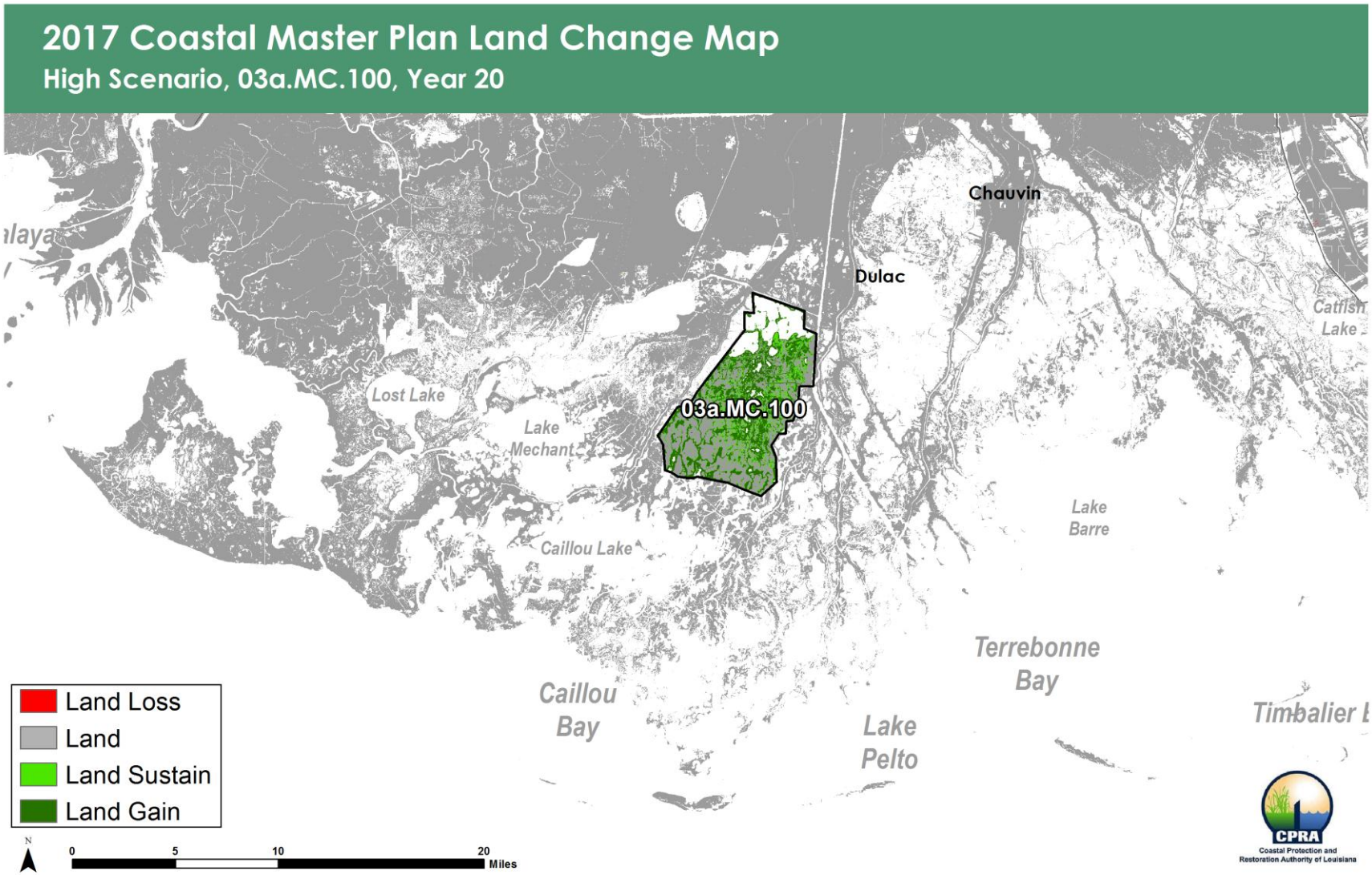
SOUTH TERREBONNE MARSH CREATION (03A.MC.100)

- Creation of 23,000 acres of marsh between Bayou du Large and Houma Navigation Canal to create new wetland habitat and restore degraded marsh
- Implementation Year - 19

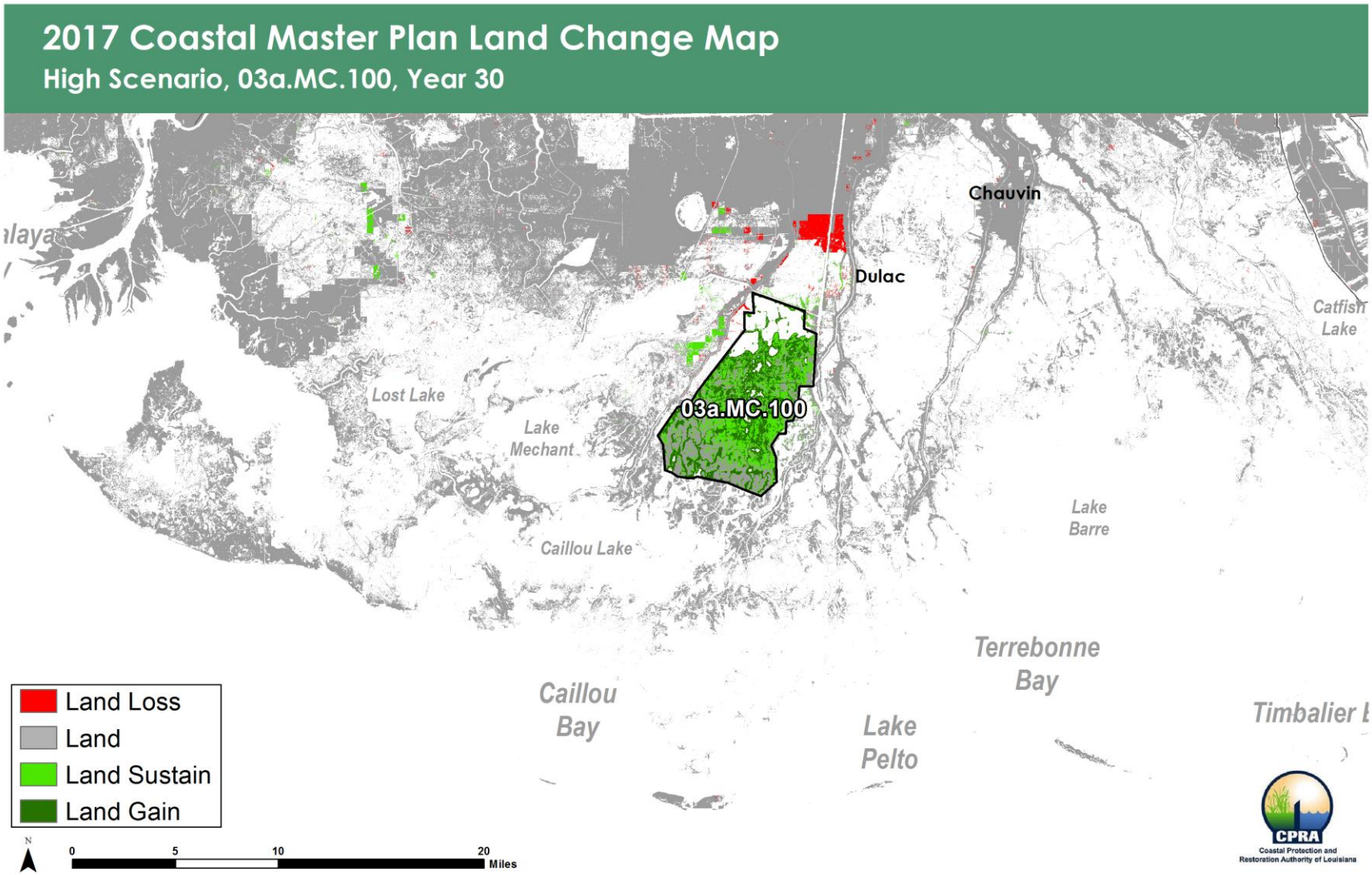
SOUTH TERREBONNE MARSH CREATION (03A.MC.100)



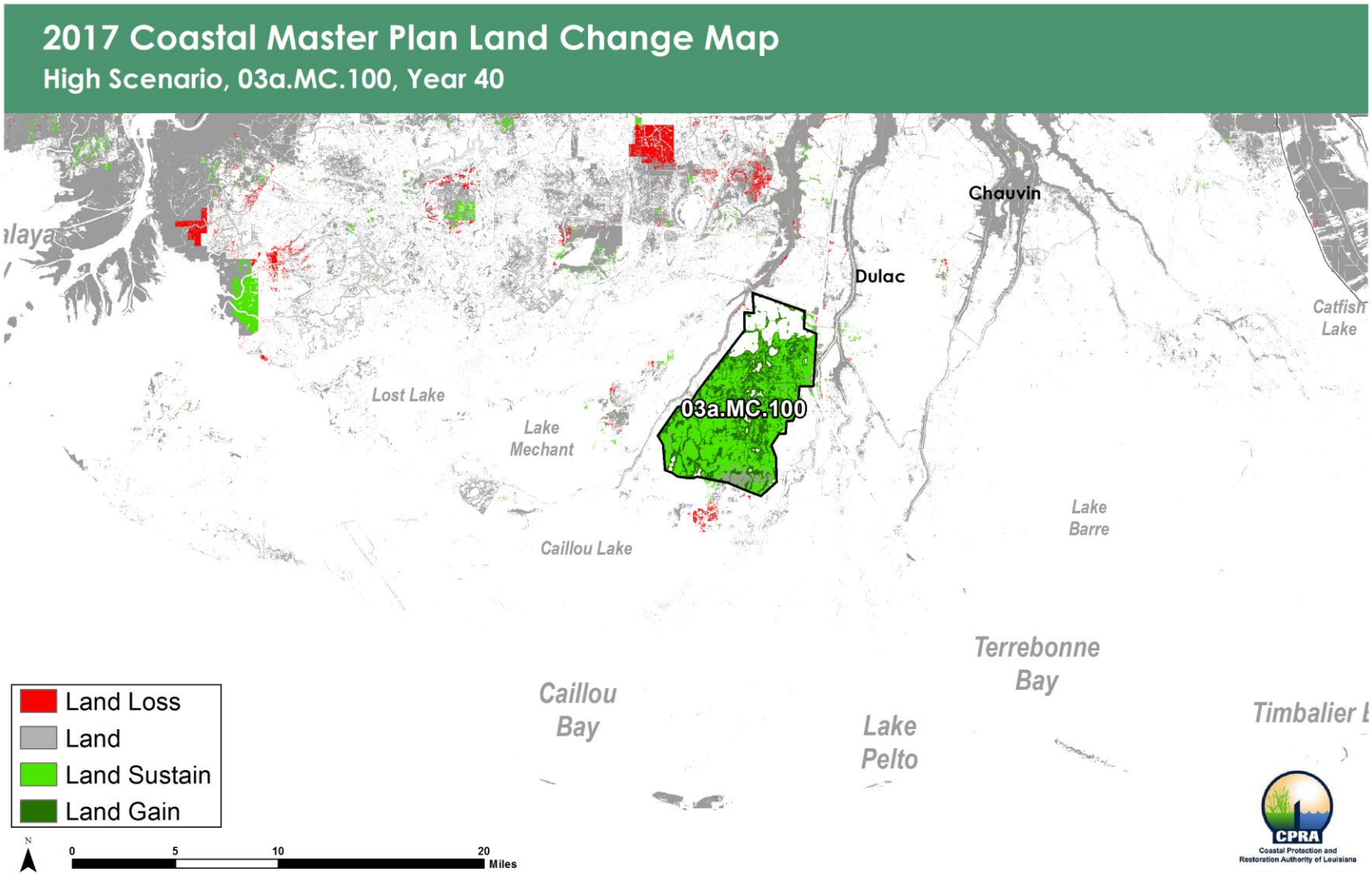
SOUTH TERREBONNE MARSH CREATION (03A.MC.100)



SOUTH TERREBONNE MARSH CREATION (03A.MC.100)



SOUTH TERREBONNE MARSH CREATION (03A.MC.100)



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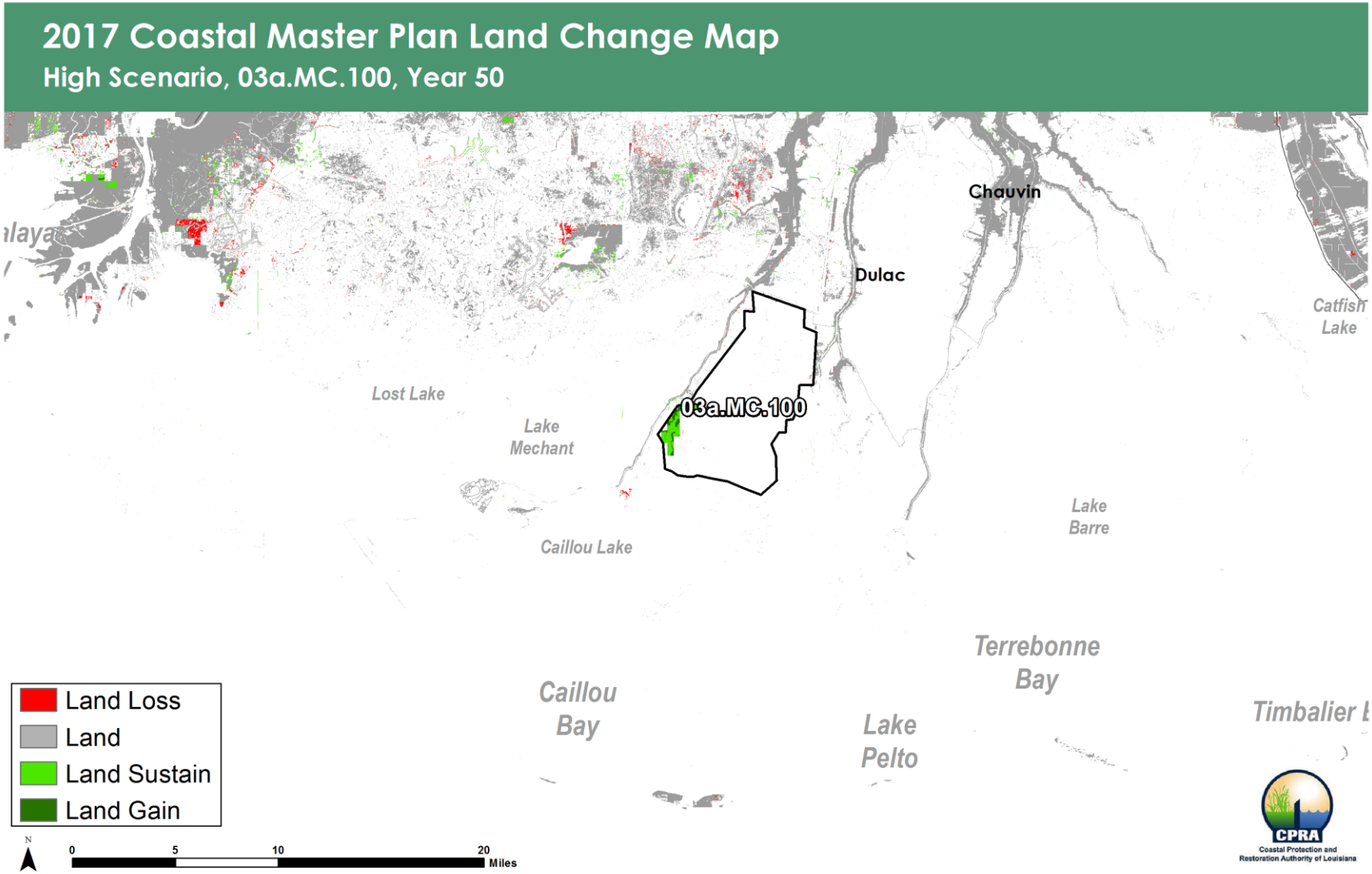

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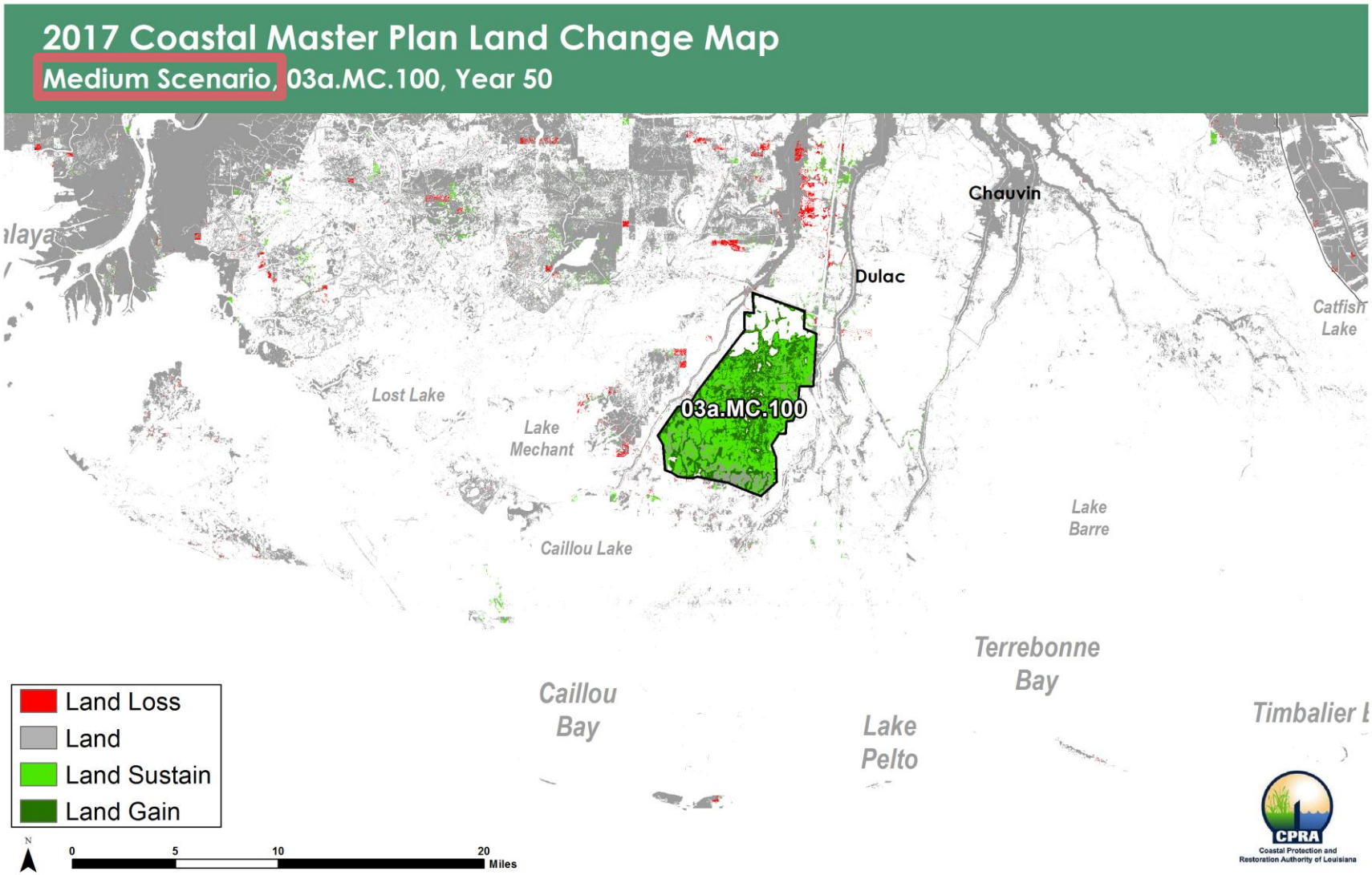
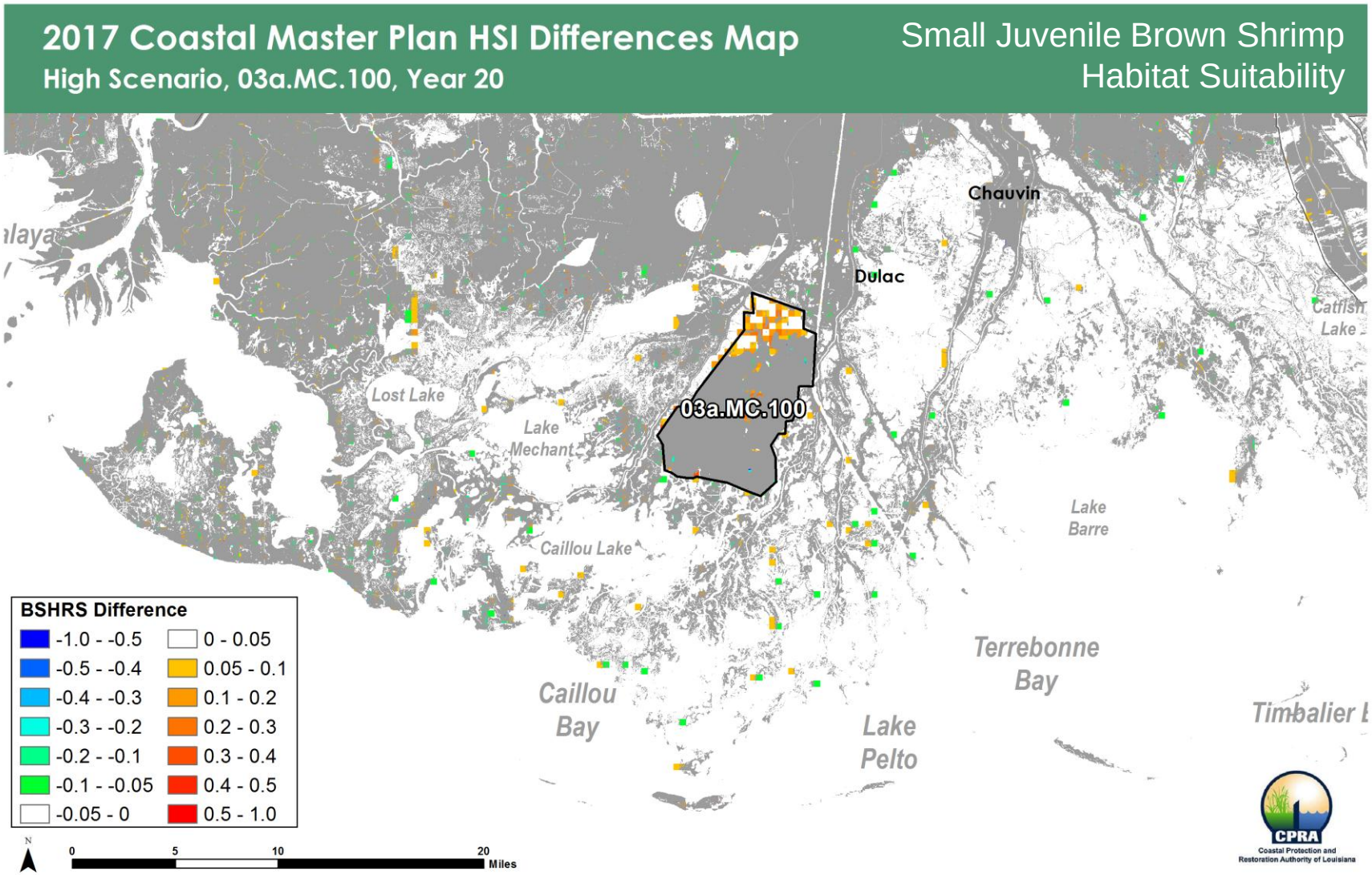
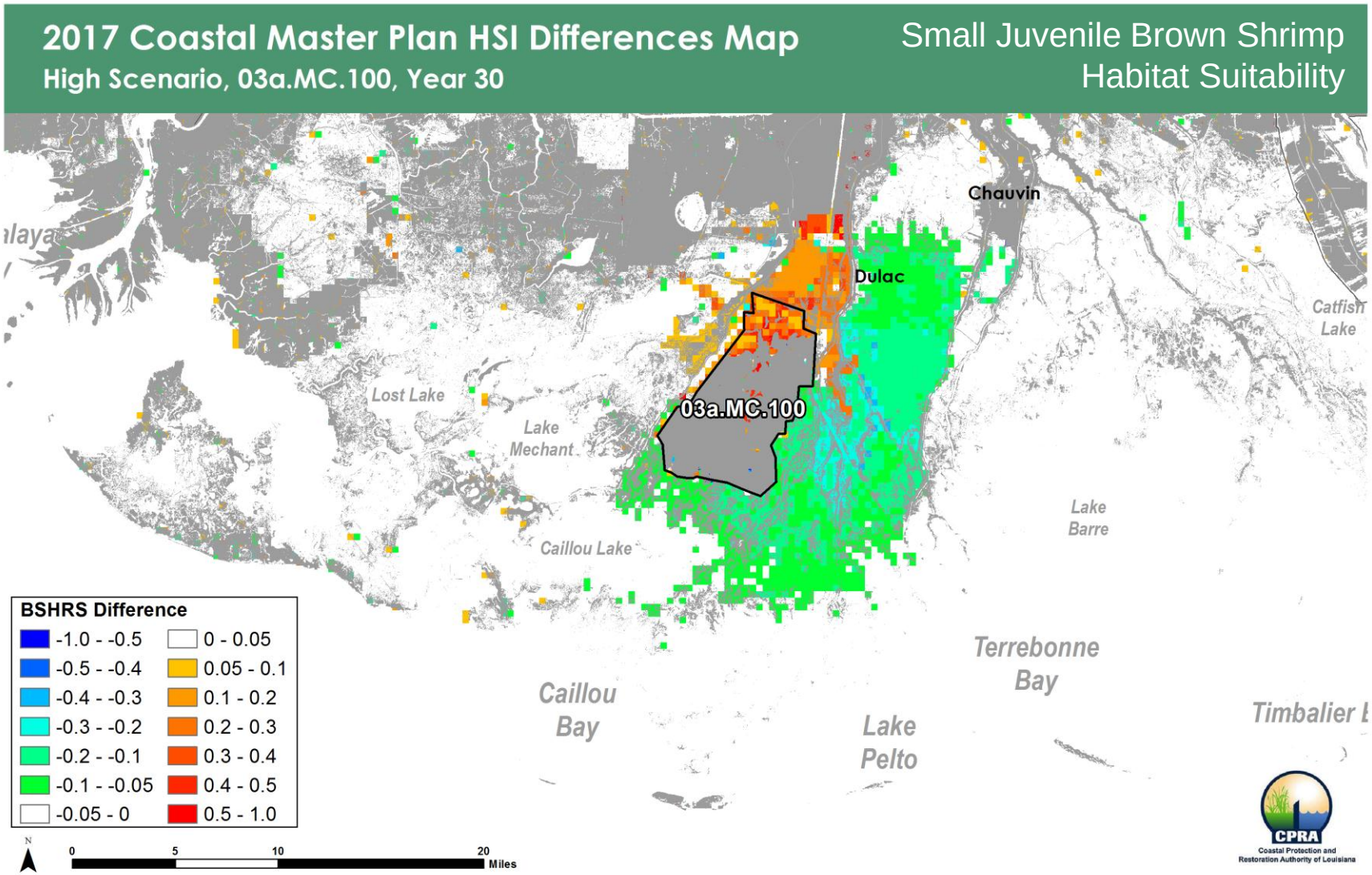


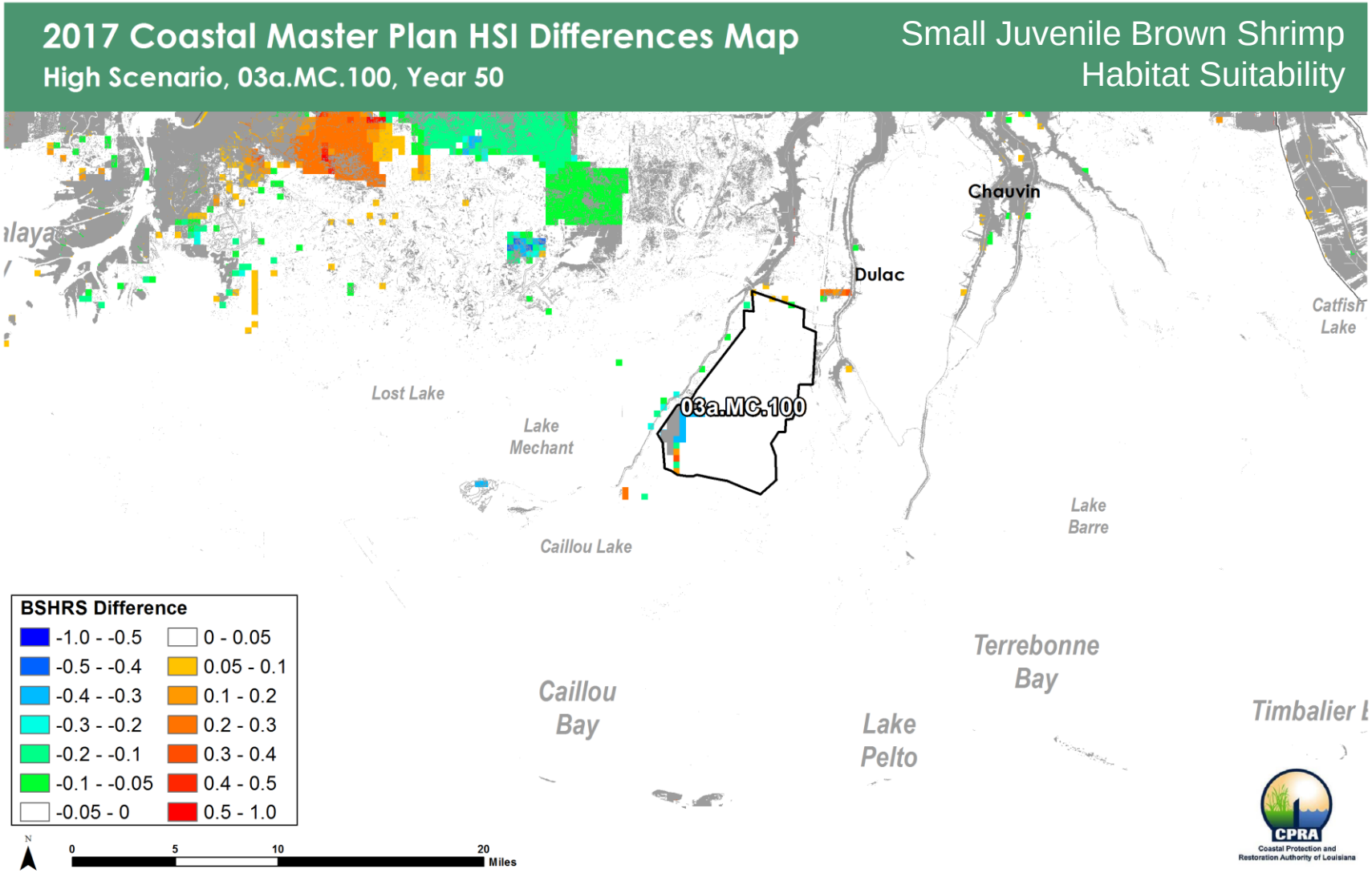
SOUTH TERREBONNE MARSH CREATION (03A.MC.100)



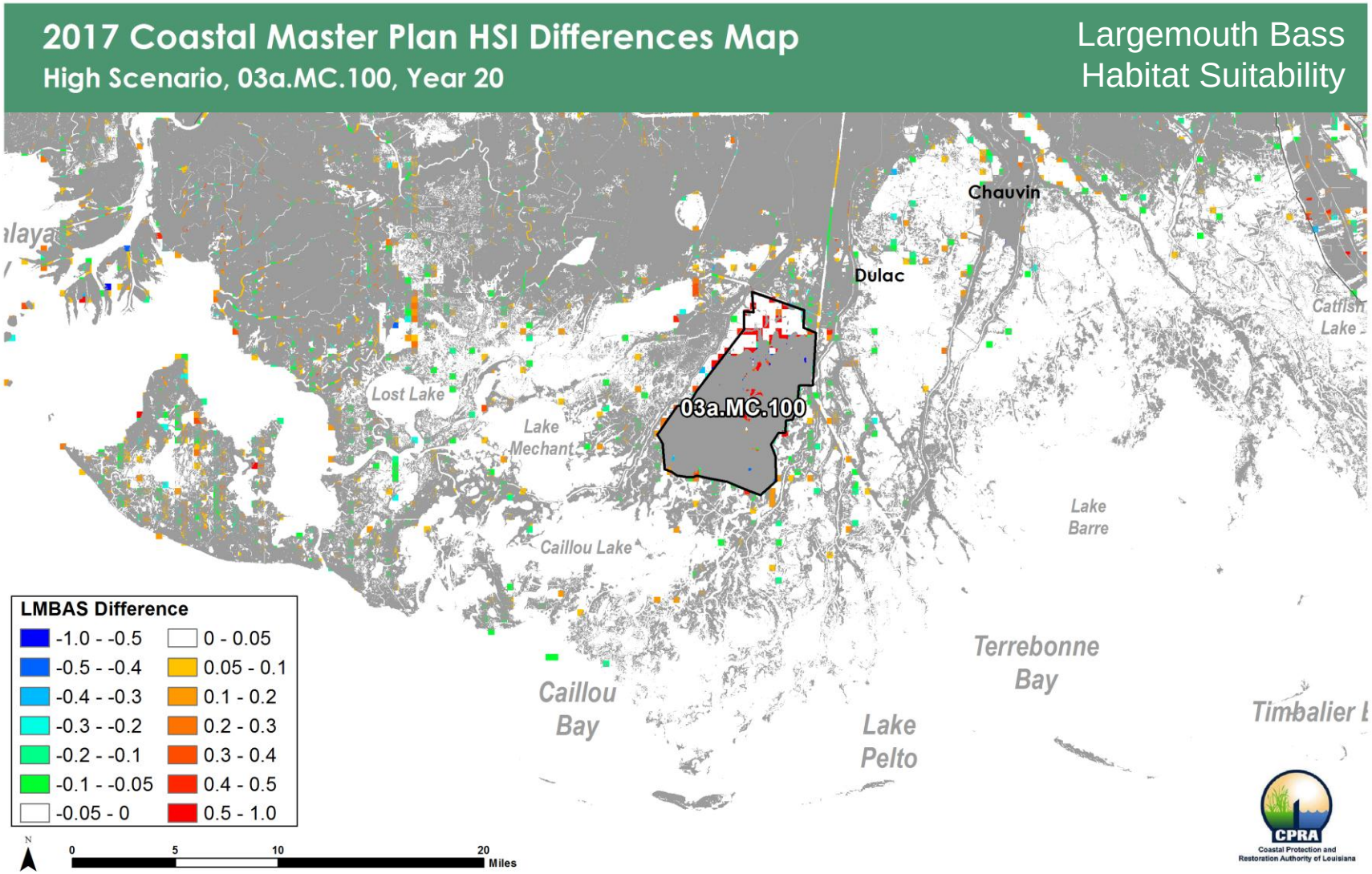
SOUTH TERREBONNE MARSH CREATION (03A.MC.100)



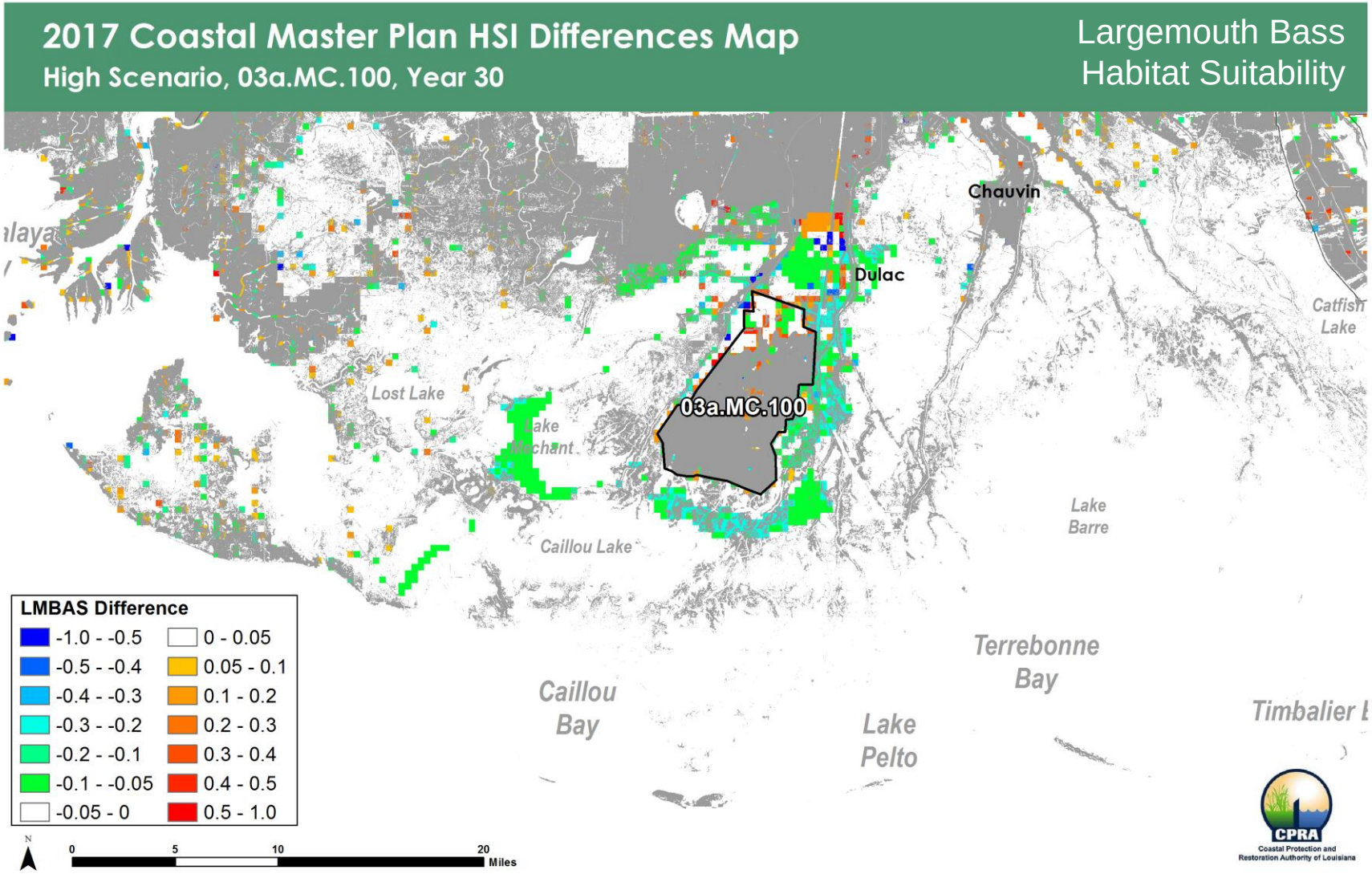
SOUTH TERREBONNE MARSH CREATION (03A.MC.100)



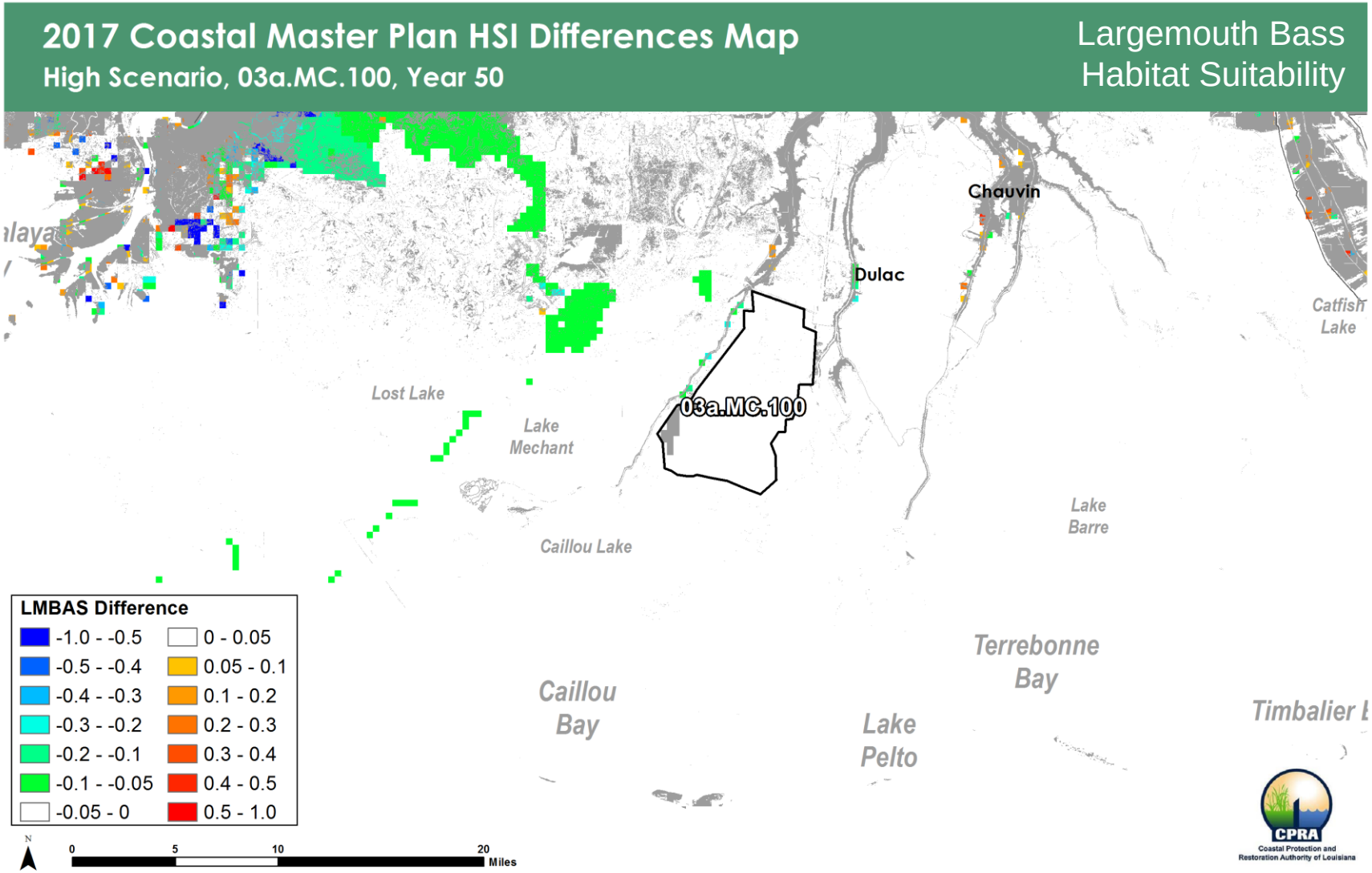
SOUTH TERREBONNE MARSH CREATION (03A.MC.100)



SOUTH TERREBONNE MARSH CREATION (03A.MC.100)



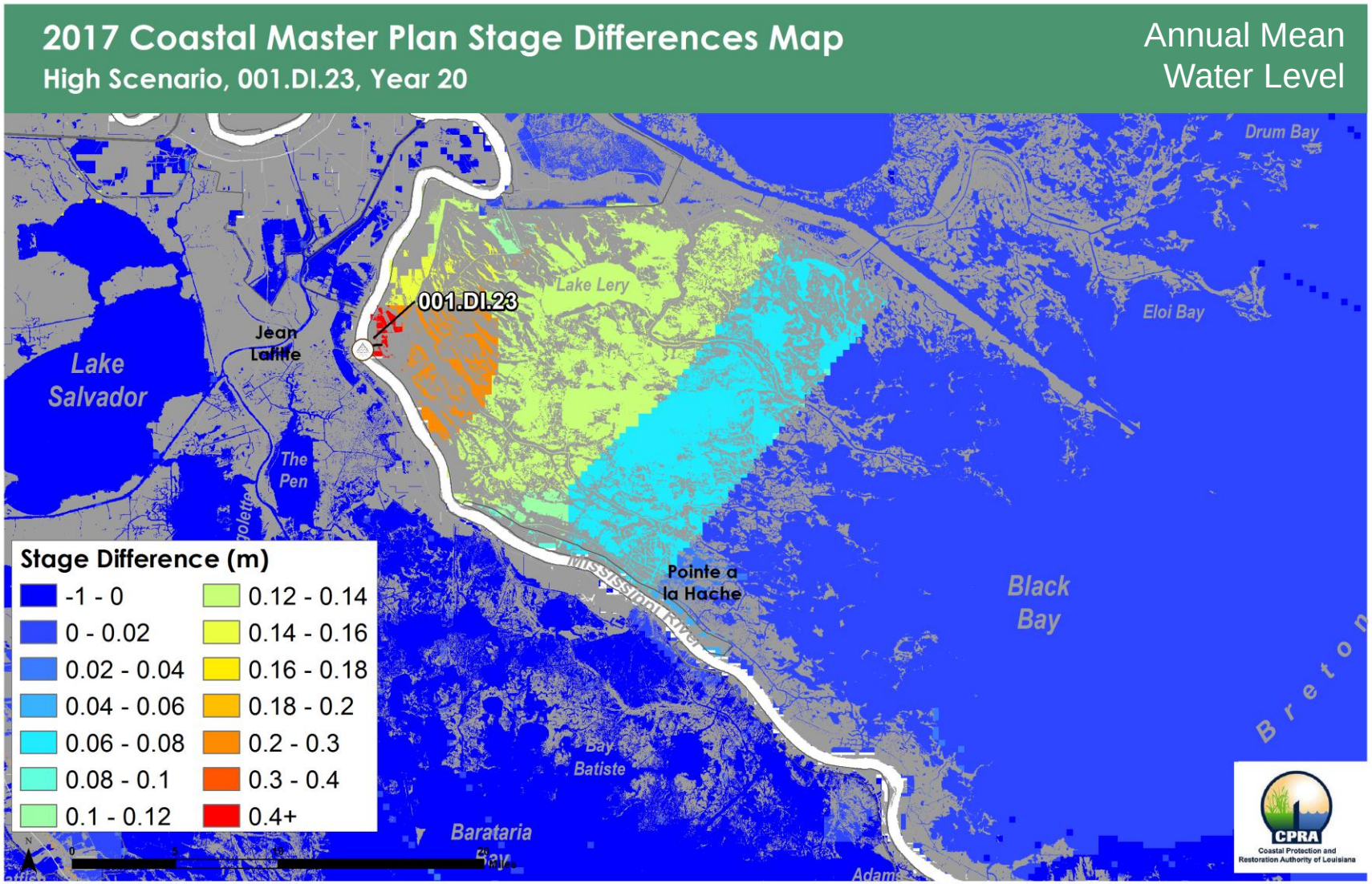
SOUTH TERREBONNE MARSH CREATION (03A.MC.100)



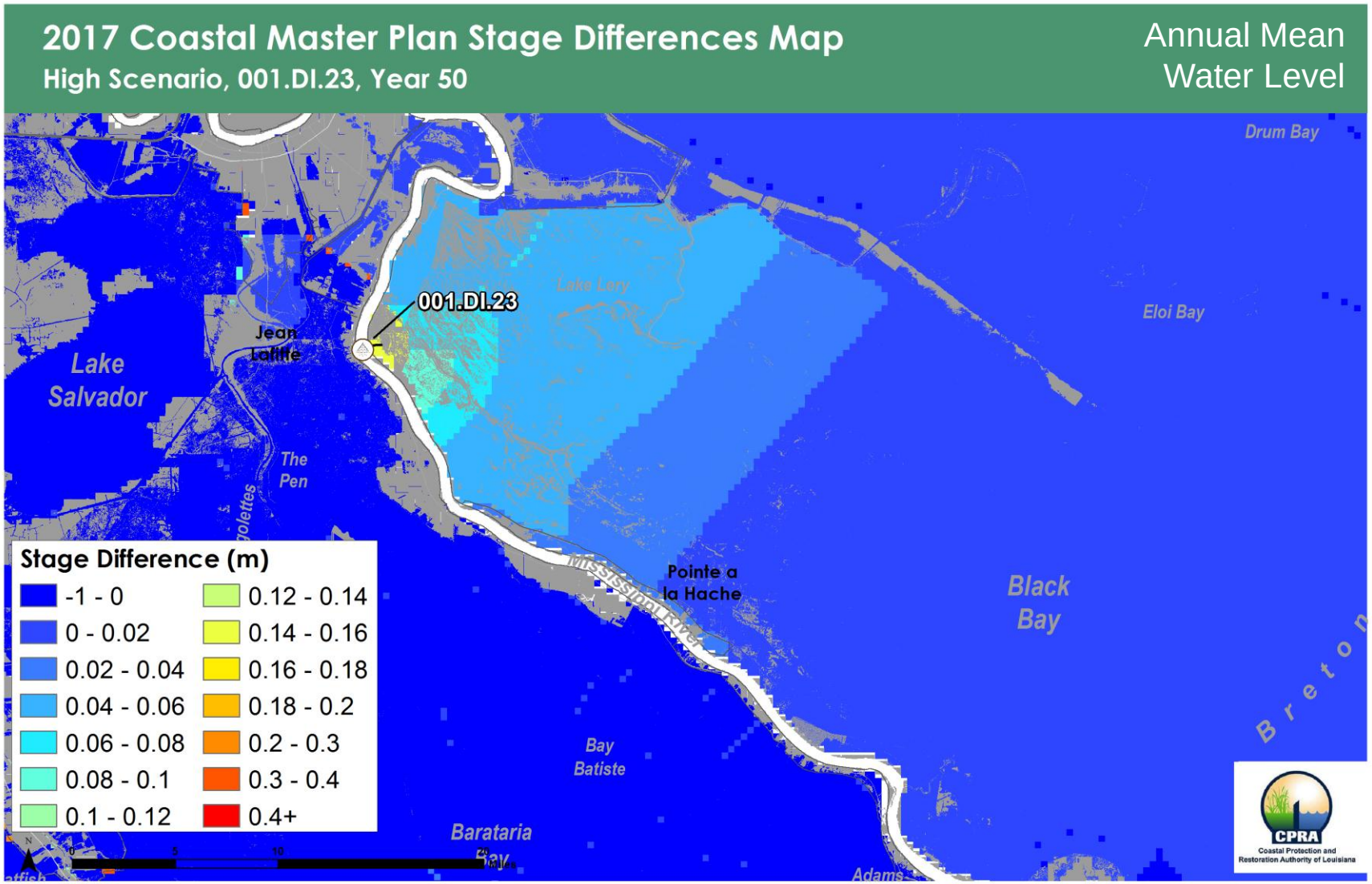
MID-BRETON SOUND DIVERSION (001.DI.23)

- Sediment diversion into Mid-Breton Sound in the vicinity of Woodlawn to build and maintain land, 35,000 cfs capacity
  - modeled at 35,000 cfs when Mississippi River flow equals 1,000,000 cfs
  - no operation when river flow is below 200,000 cfs
  - variable flow rate calculated using a linear function for river flow between 200,000 cfs and 1,000,000 cfs and for river flow above 1,000,000 cfs
- Implementation Year - 7

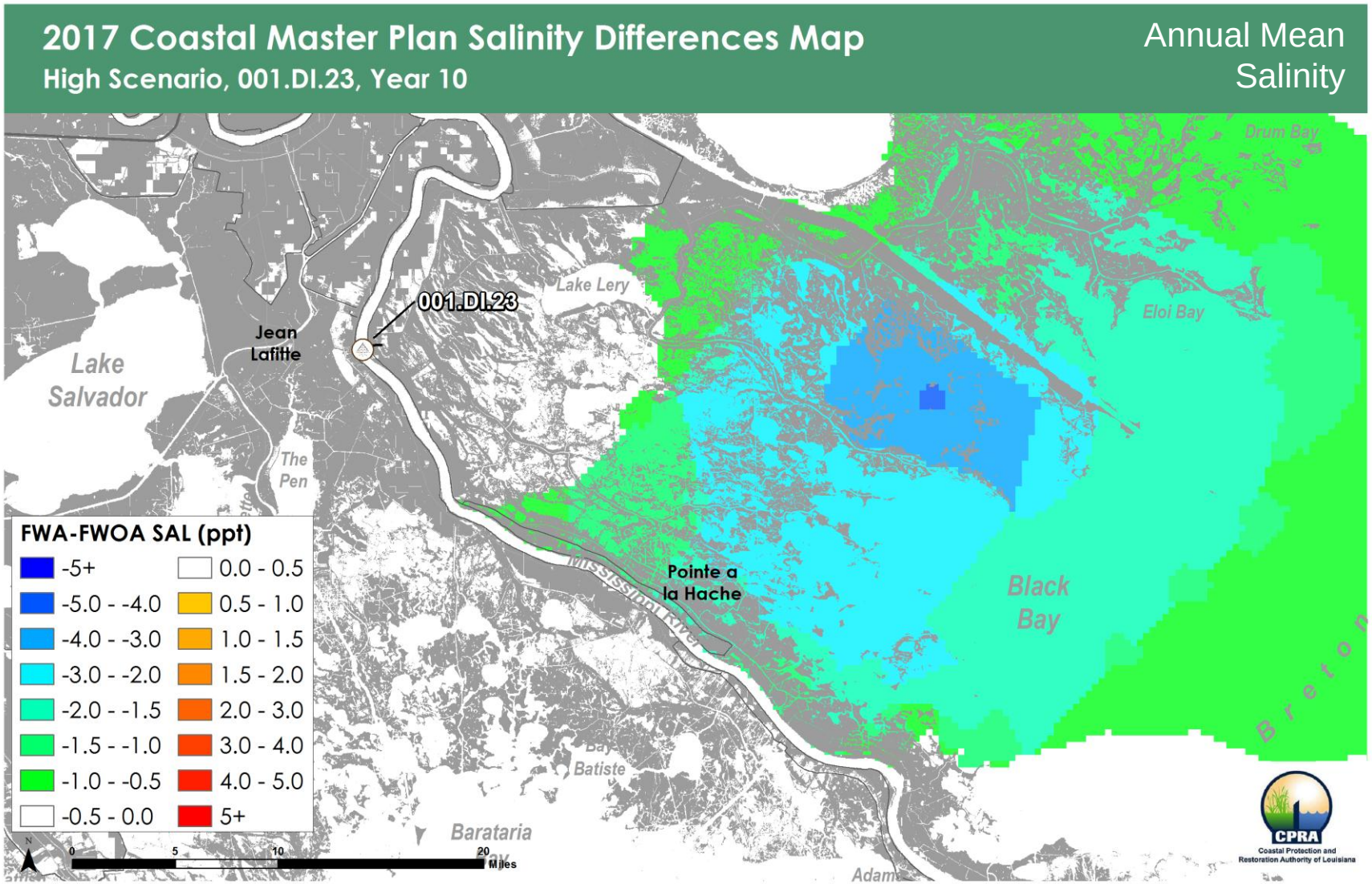
MID-BRETON SOUND DIVERSION (001.DI.23)



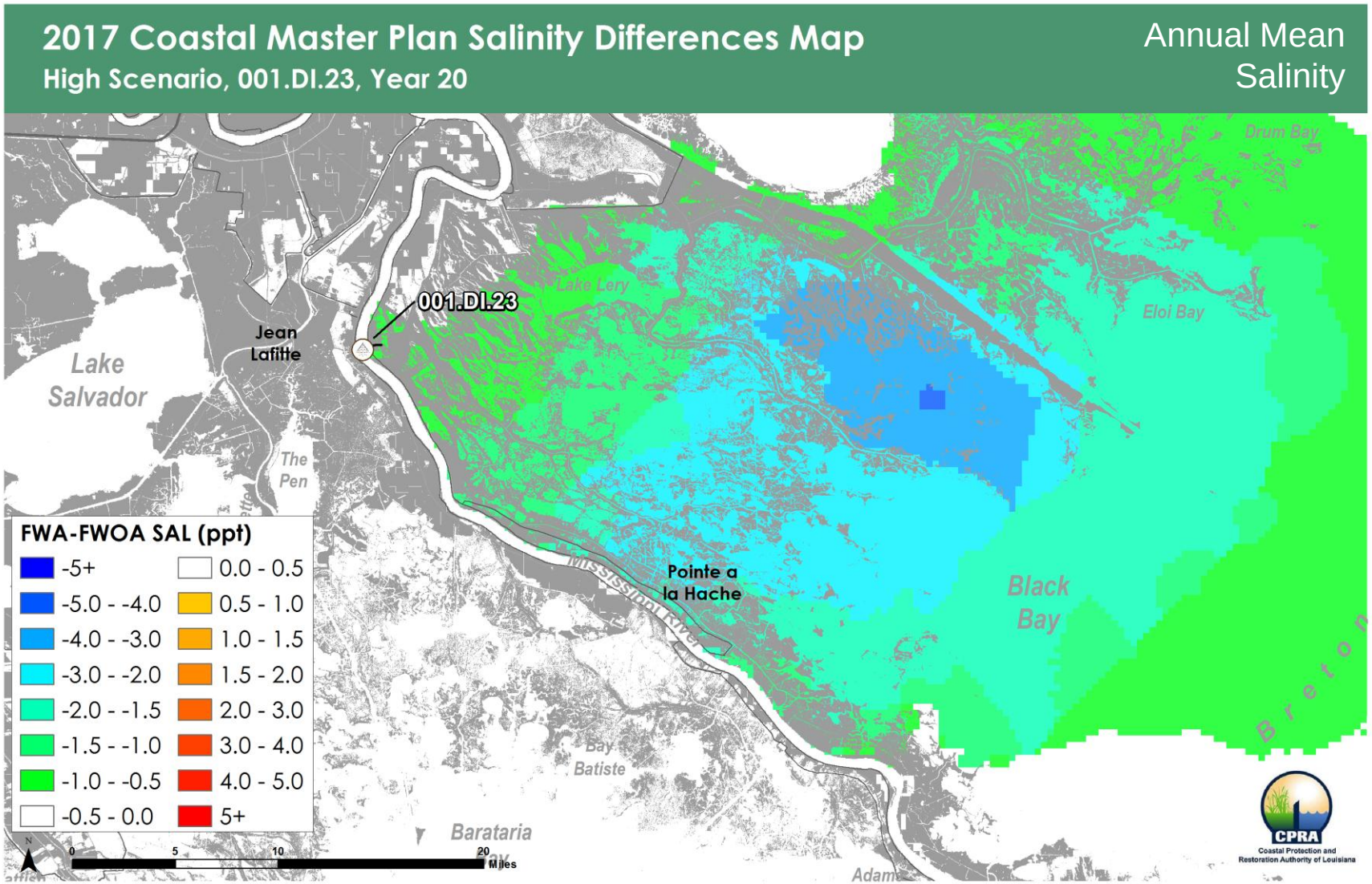
MID-BRETON SOUND DIVERSION (001.DI.23)



MID-BRETON SOUND DIVERSION (001.DI.23)



MID-BRETON SOUND DIVERSION (001.DI.23)



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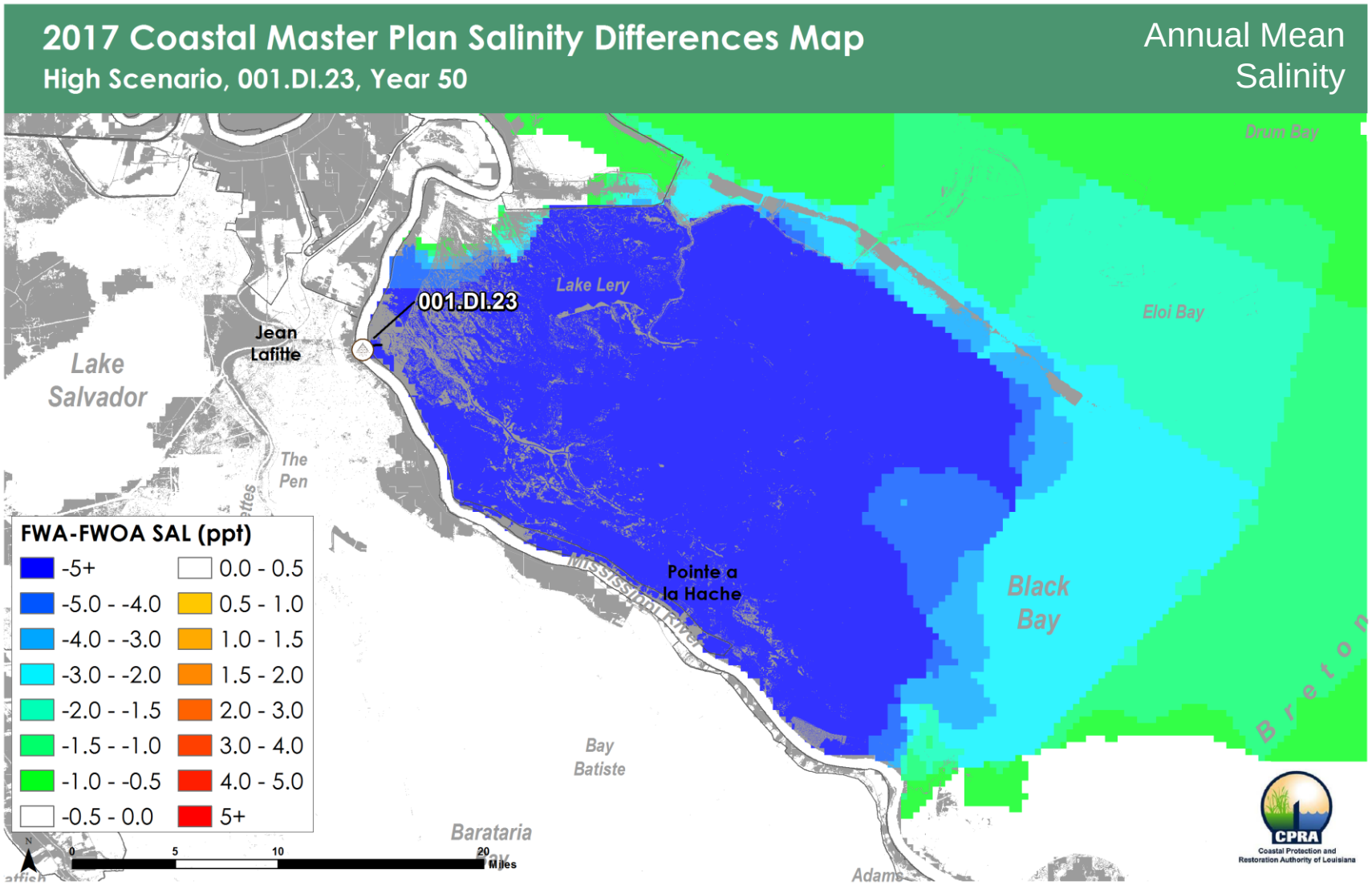

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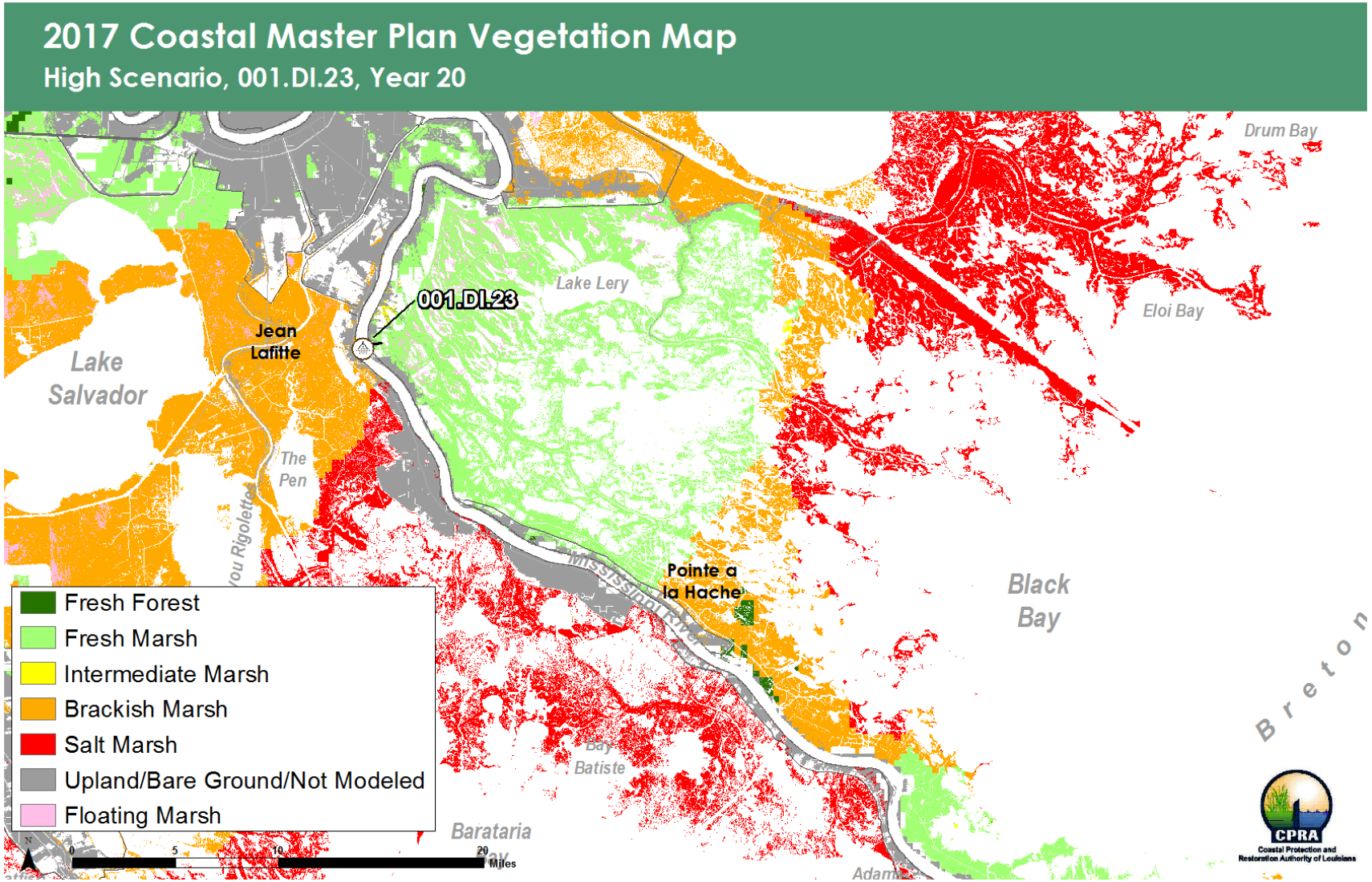

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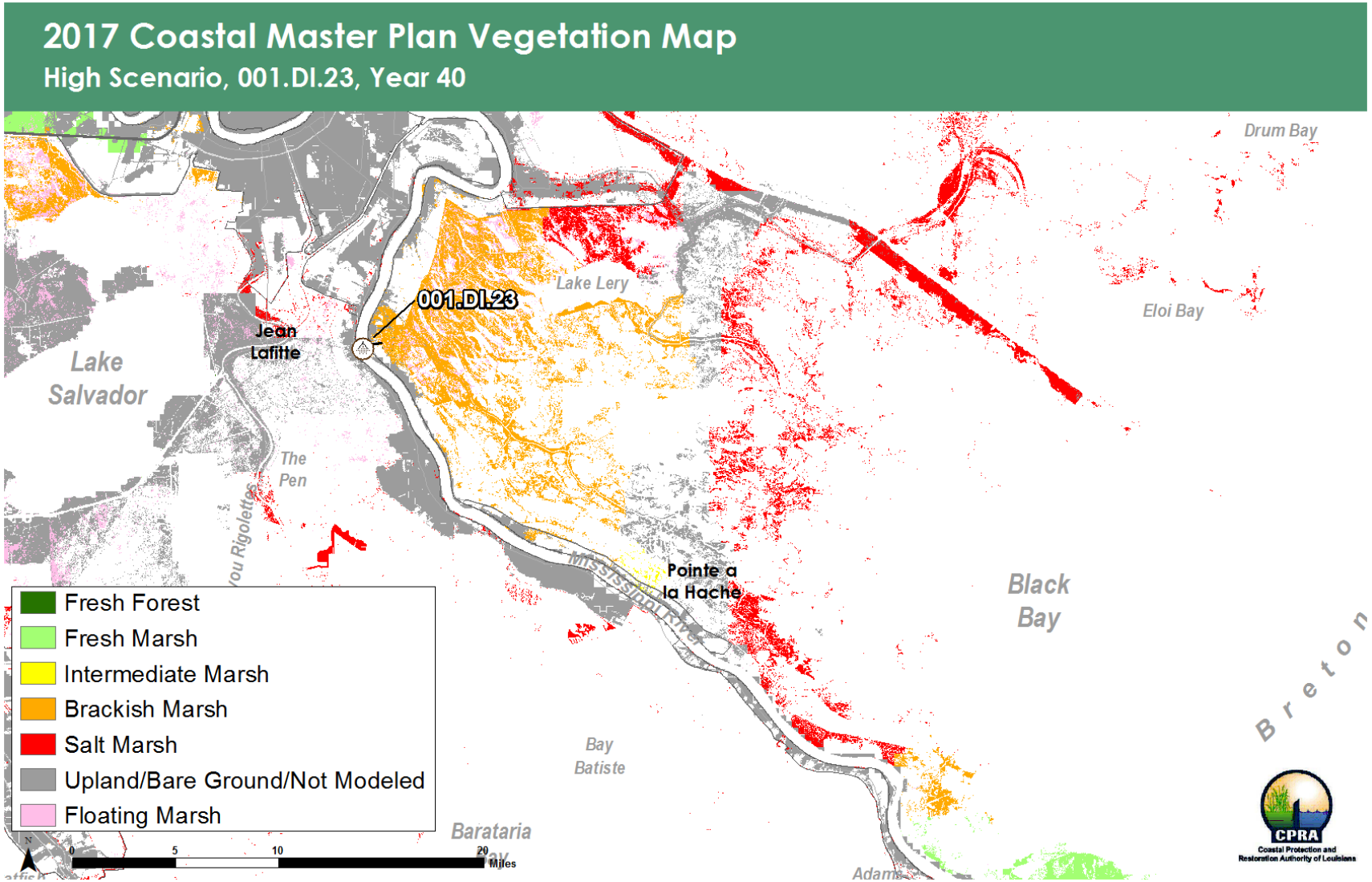

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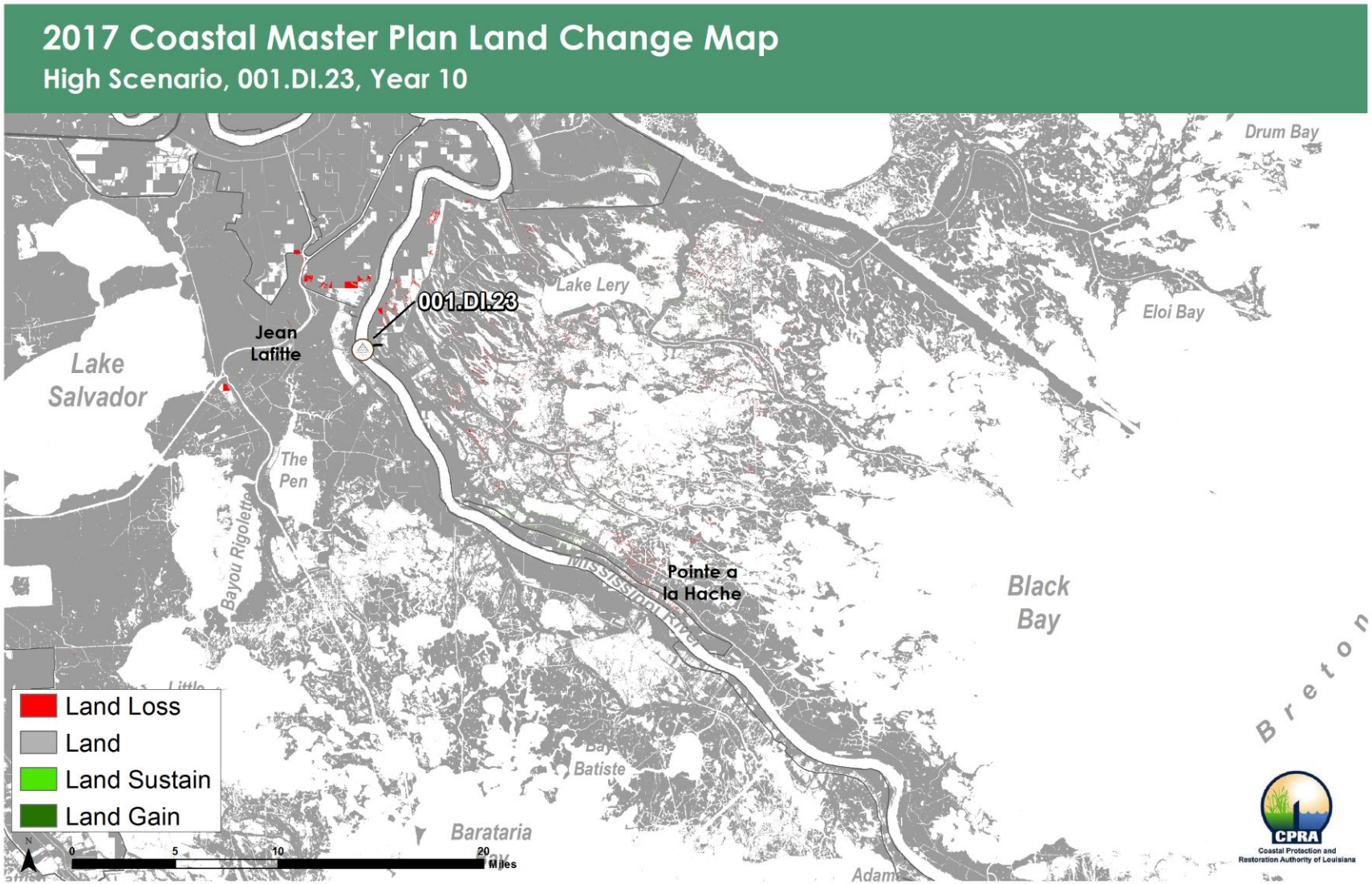

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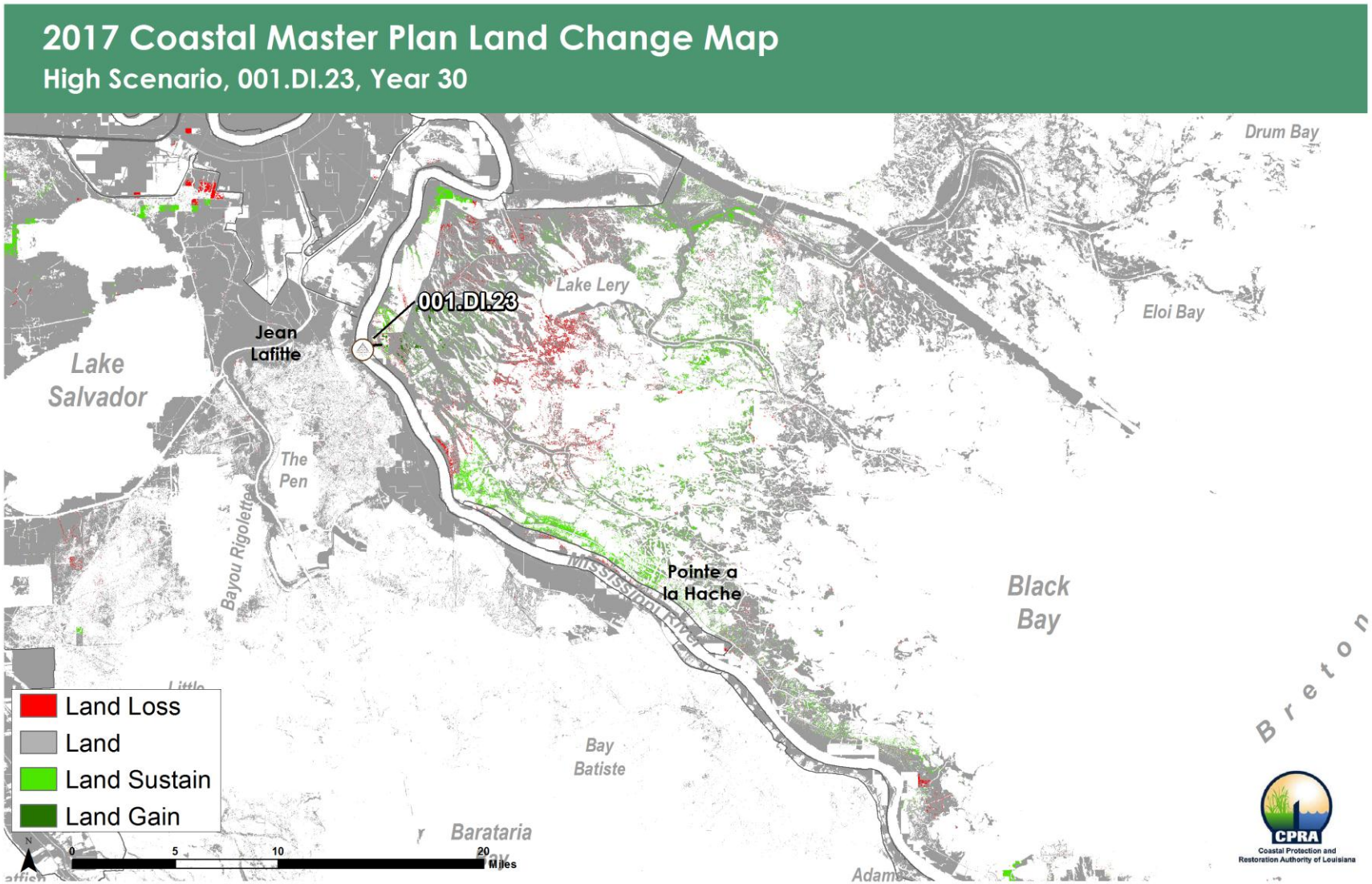

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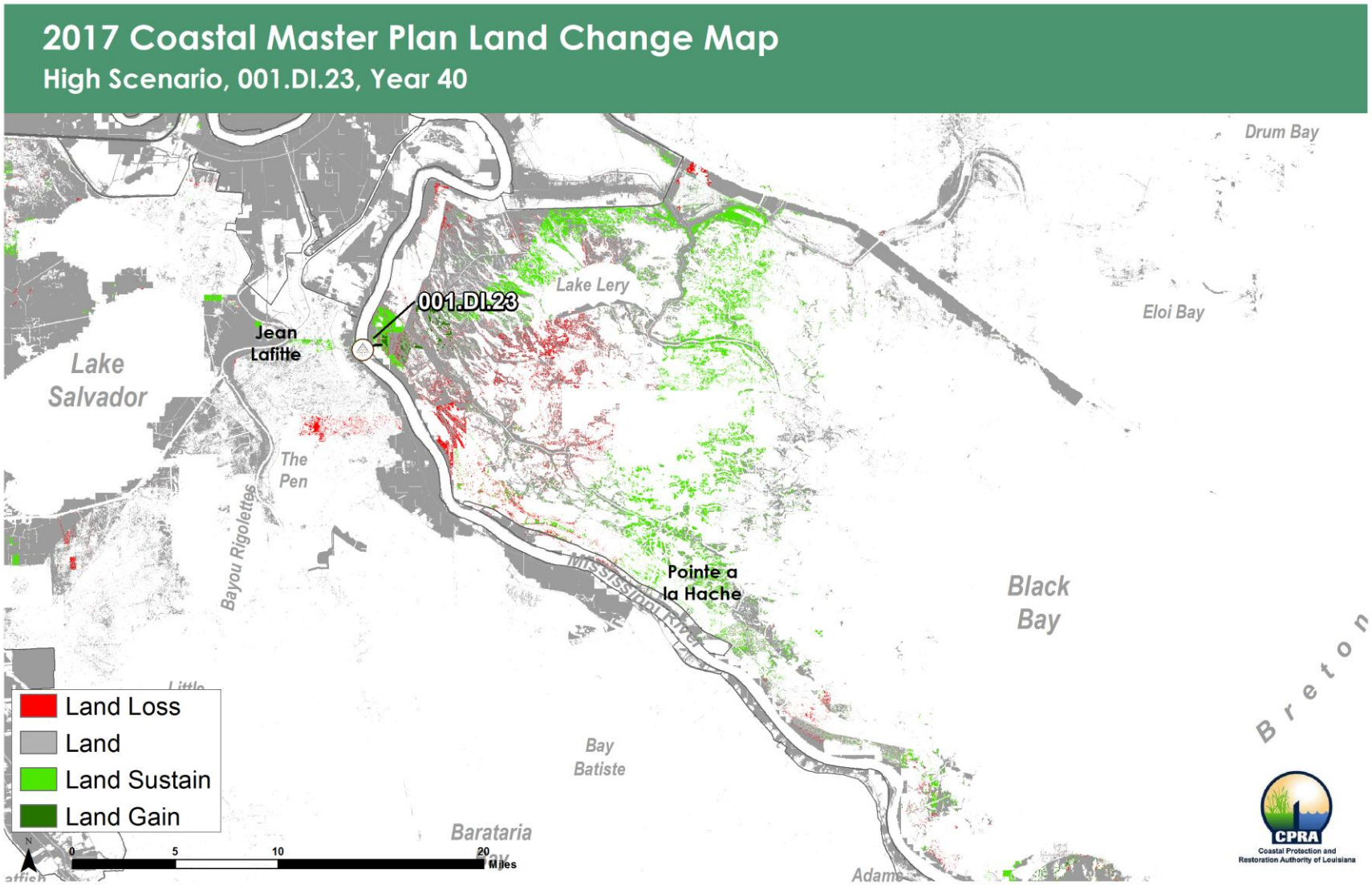

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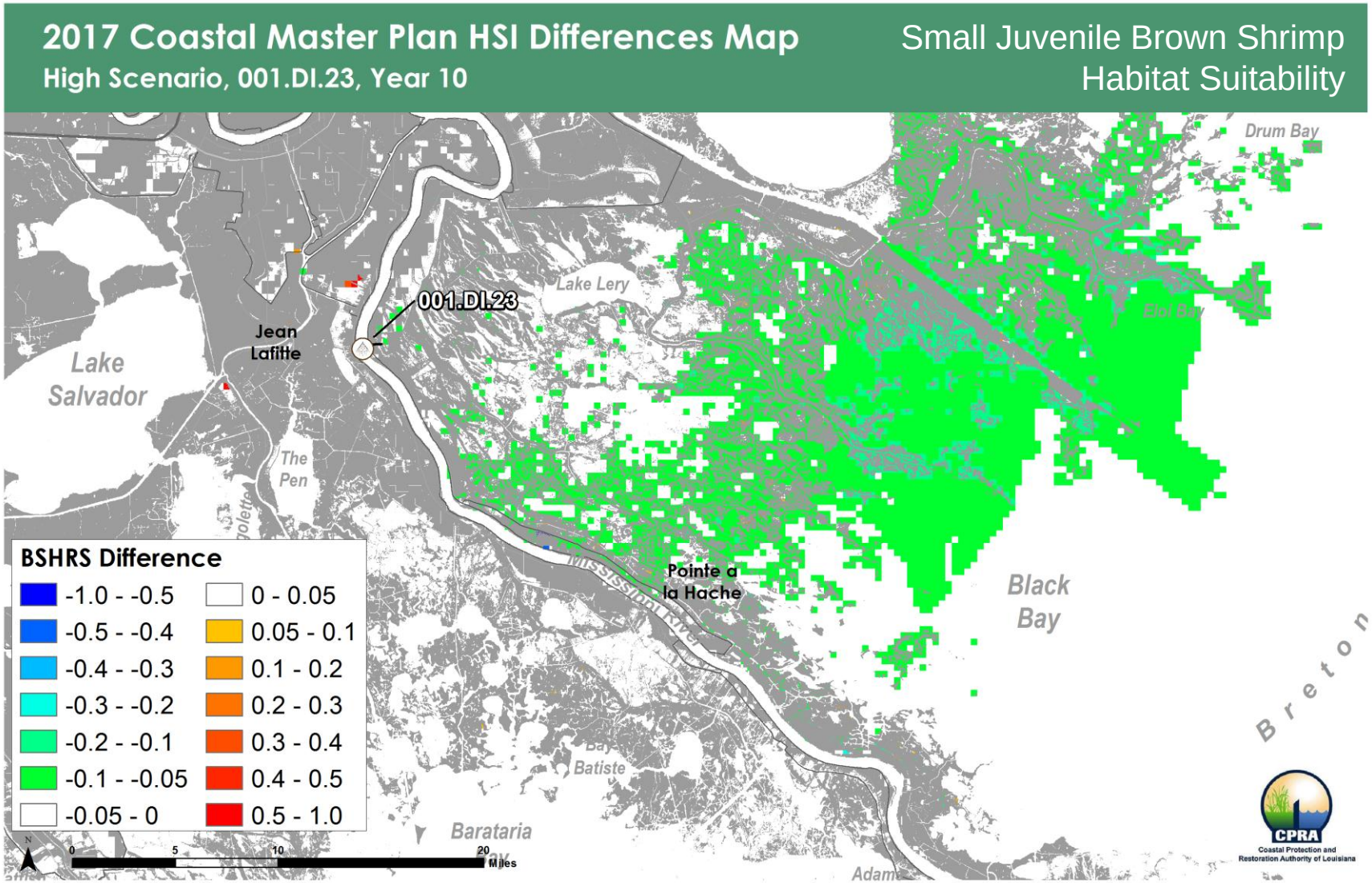

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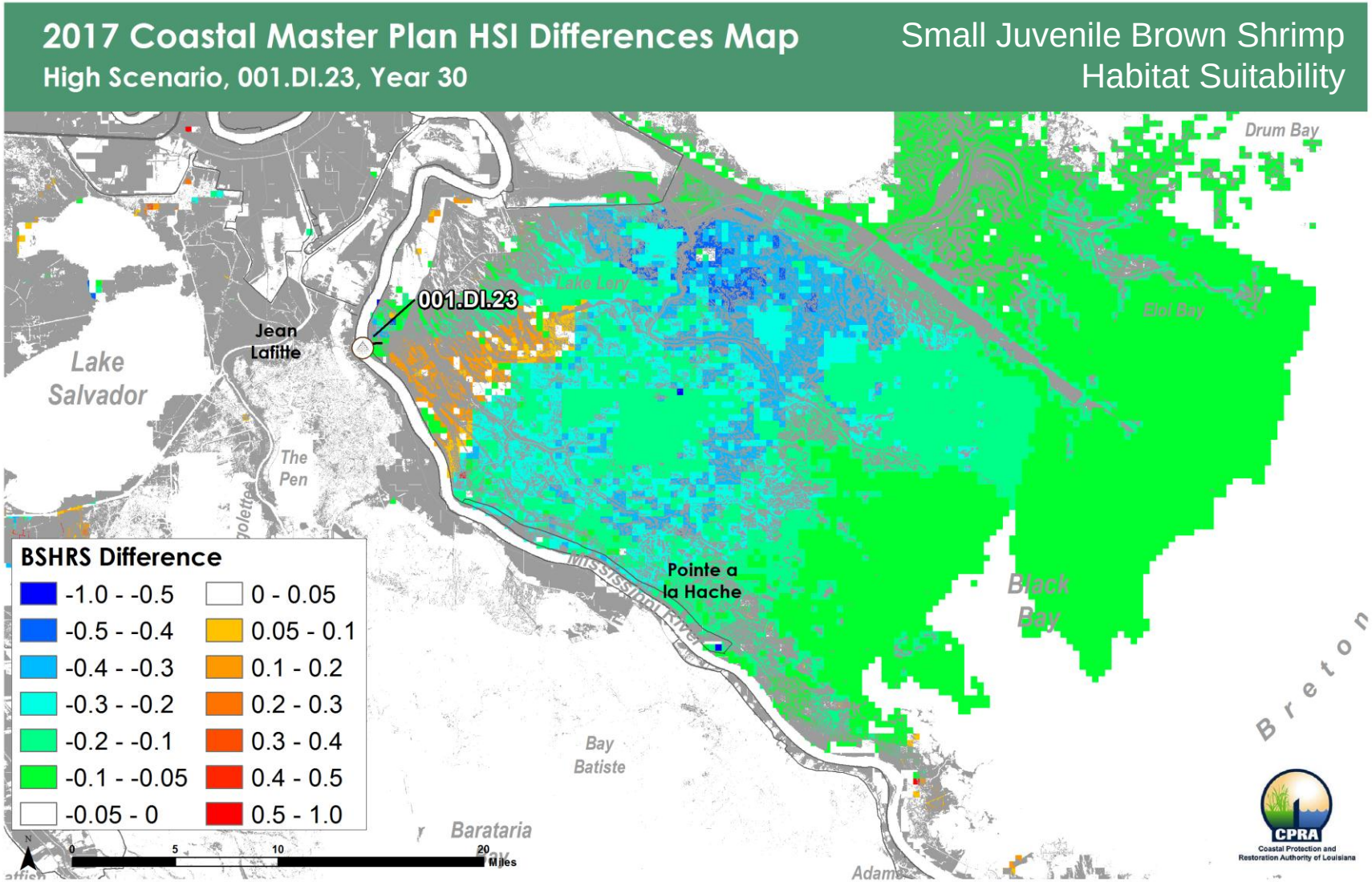

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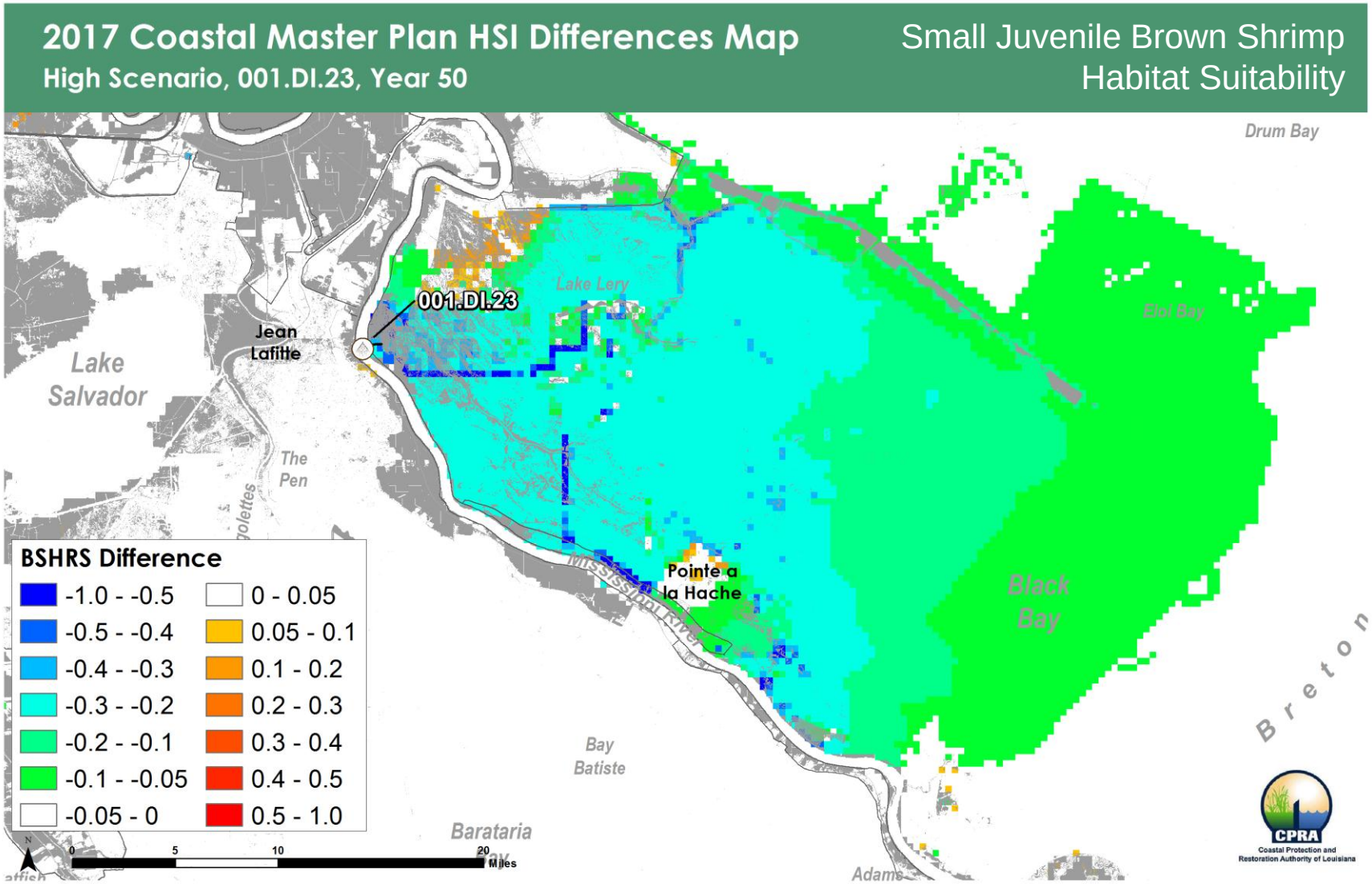

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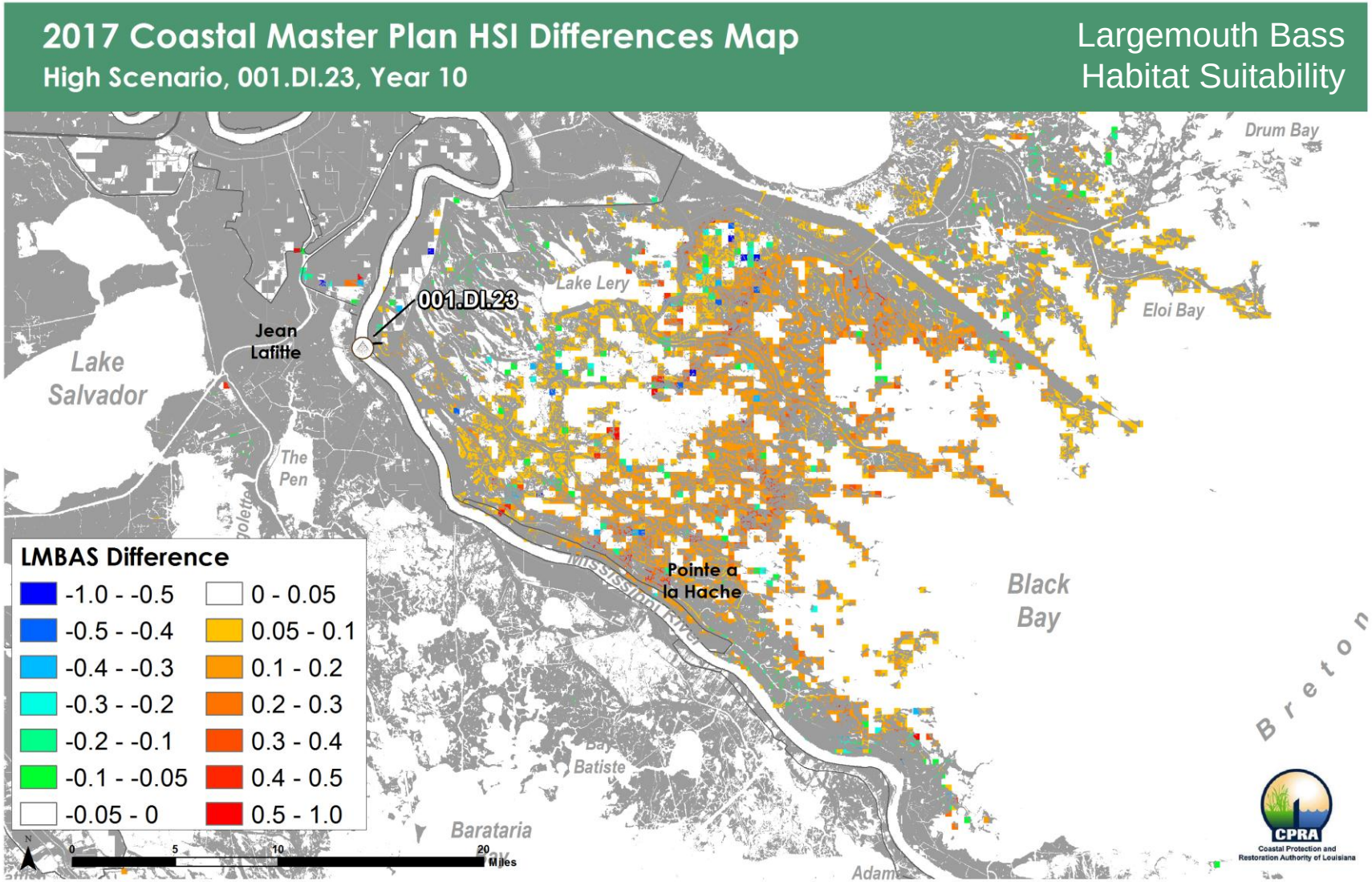

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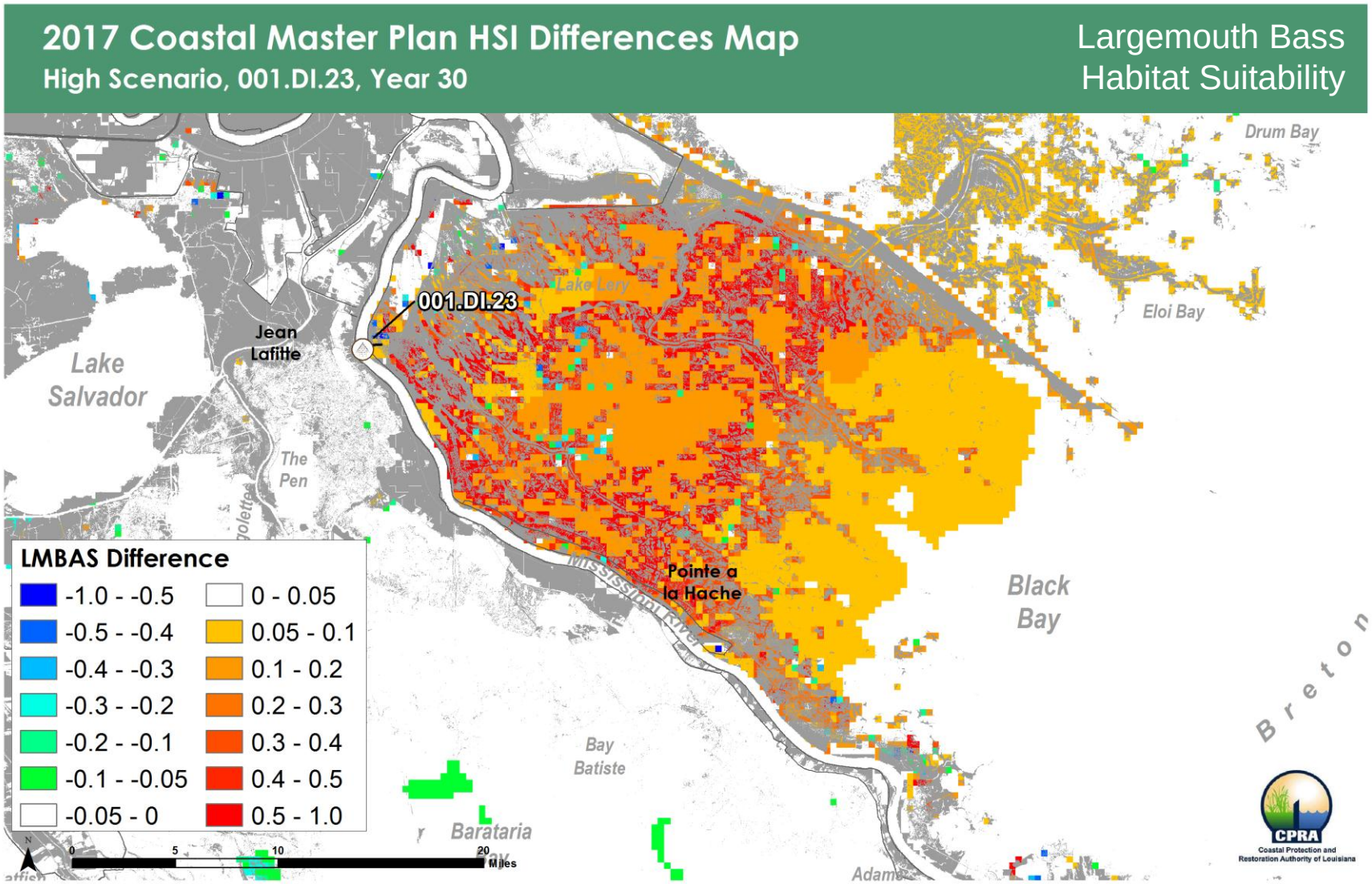

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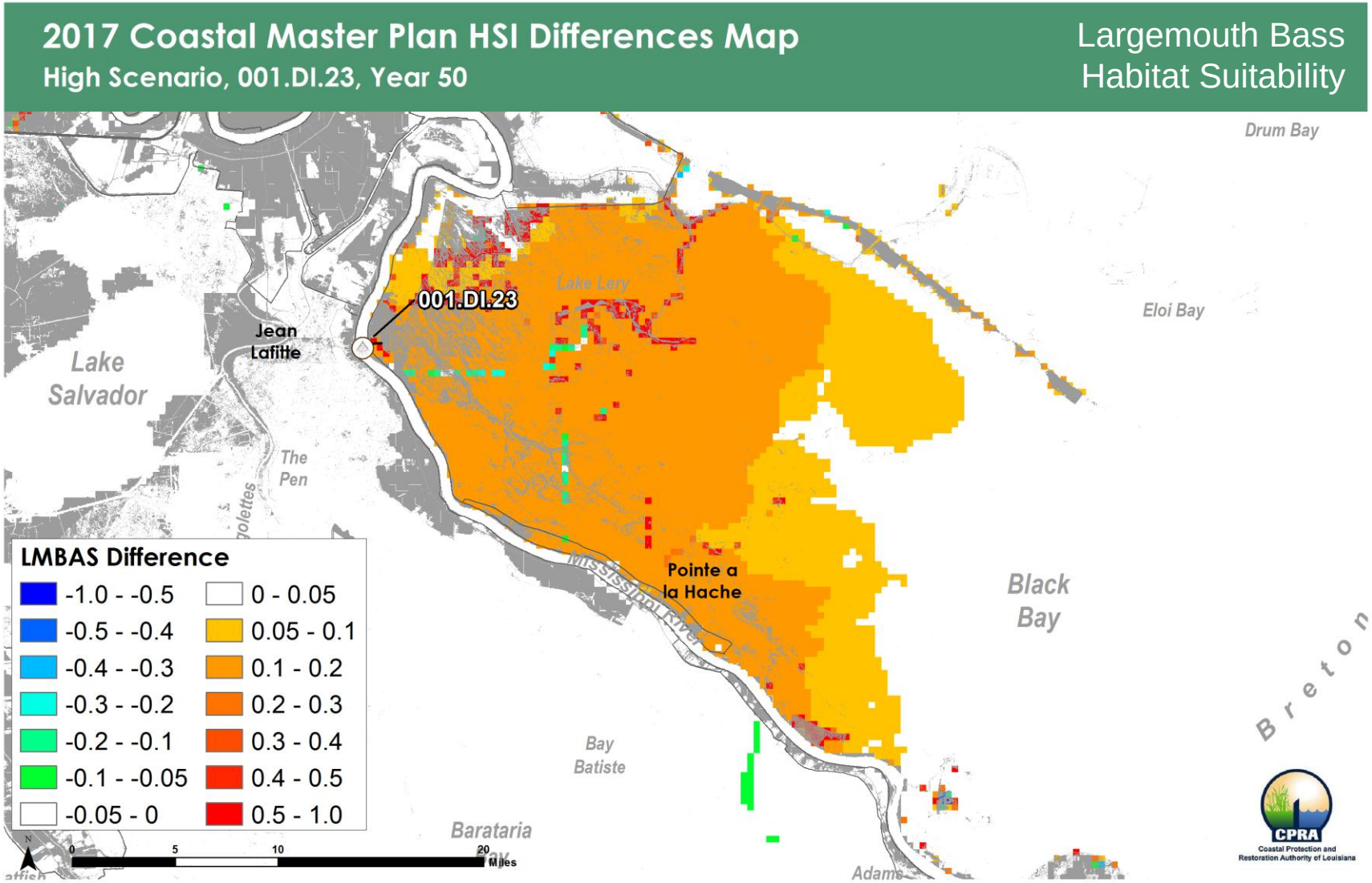

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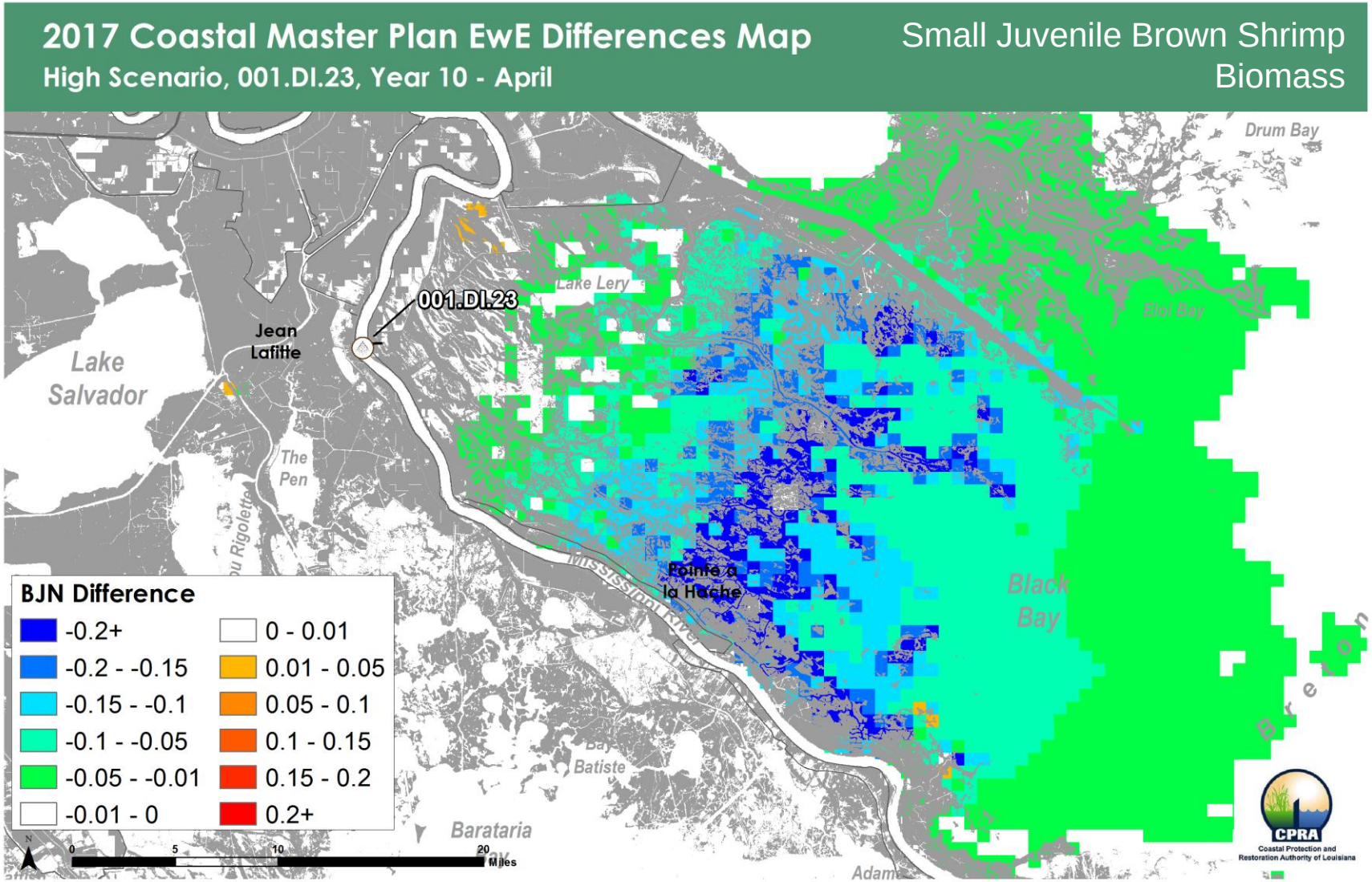
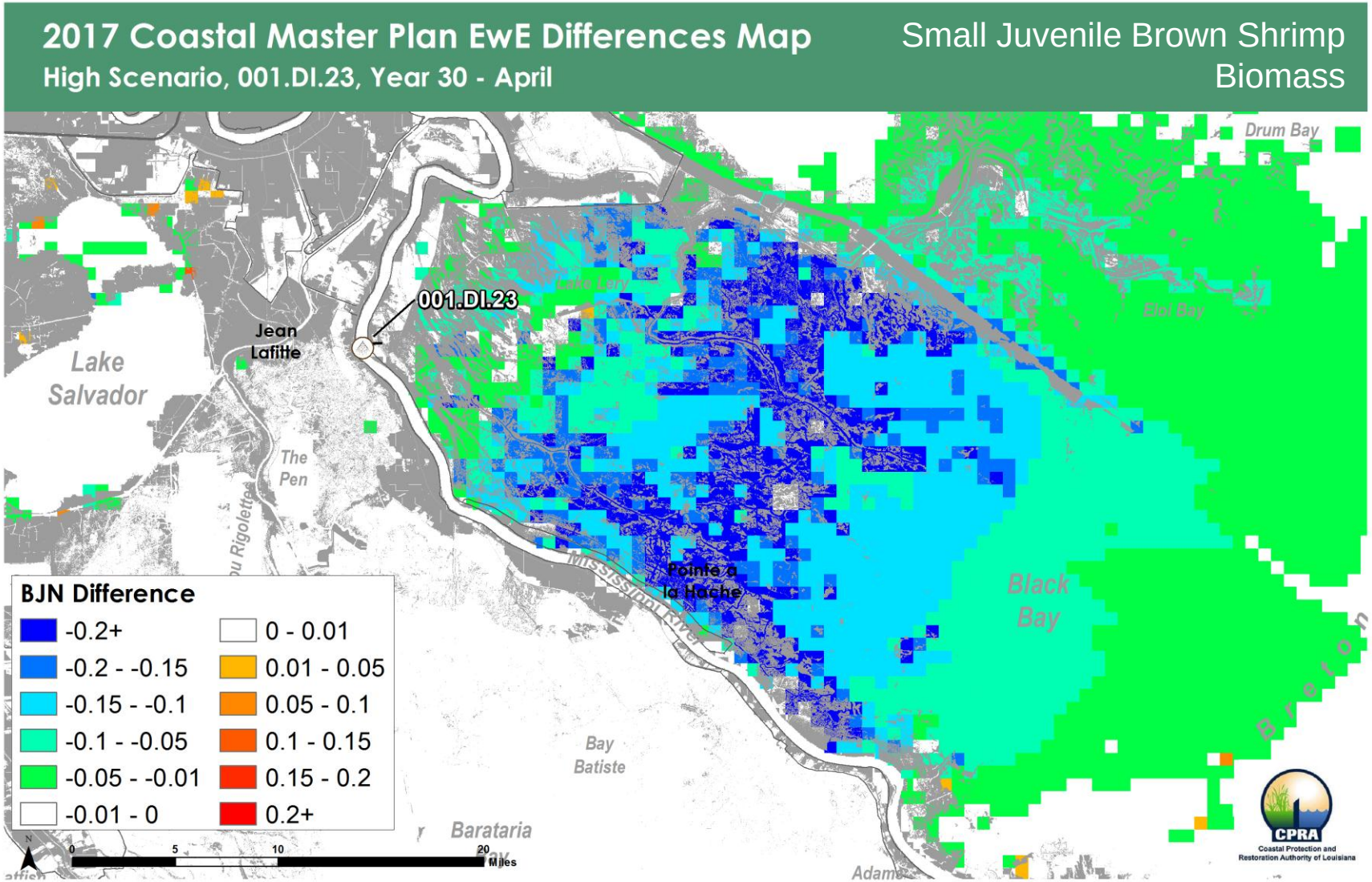
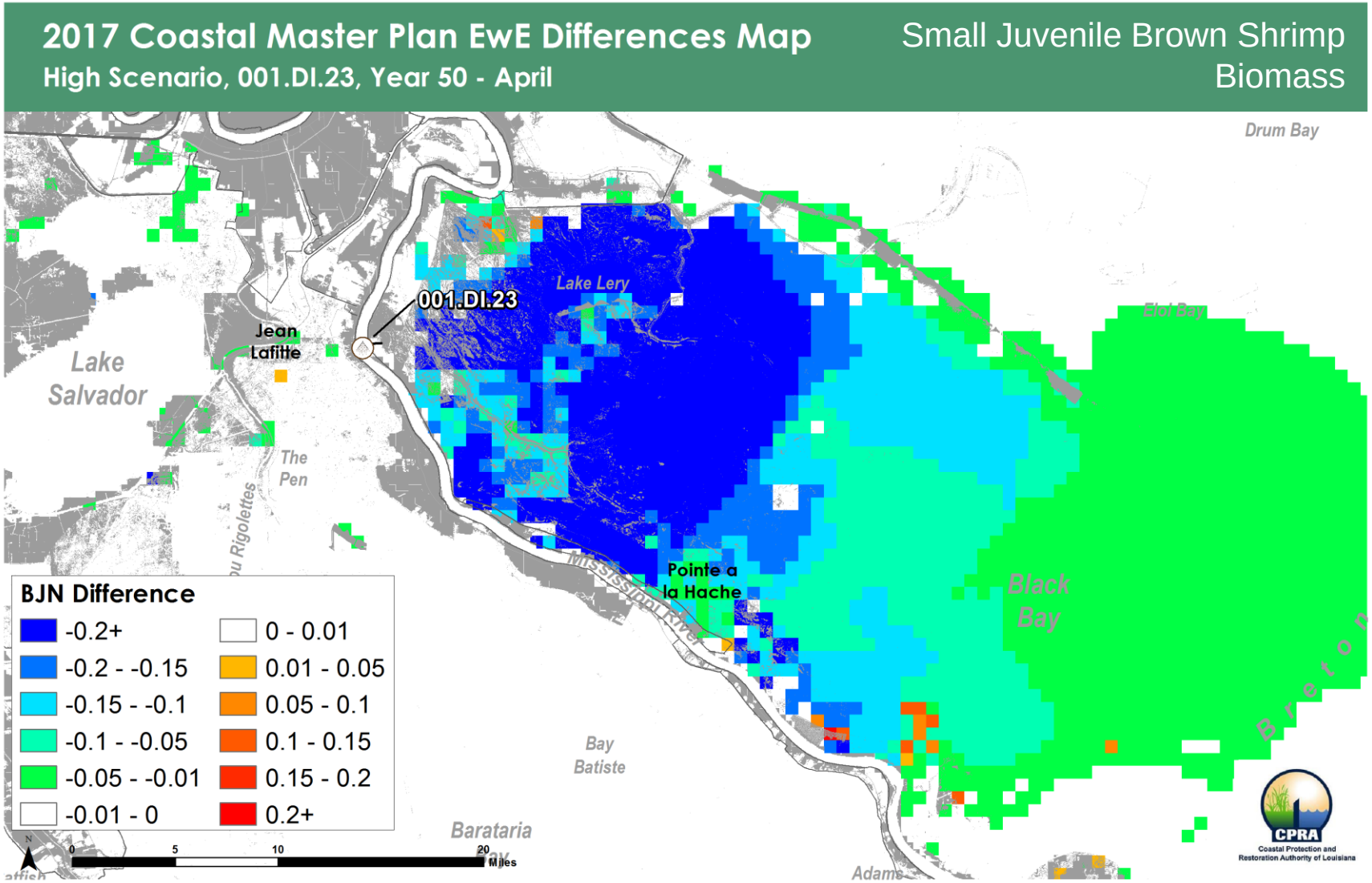


MID-BRETON SOUND DIVERSION (001.DI.23)



MID-BRETON SOUND DIVERSION (001.DI.23)



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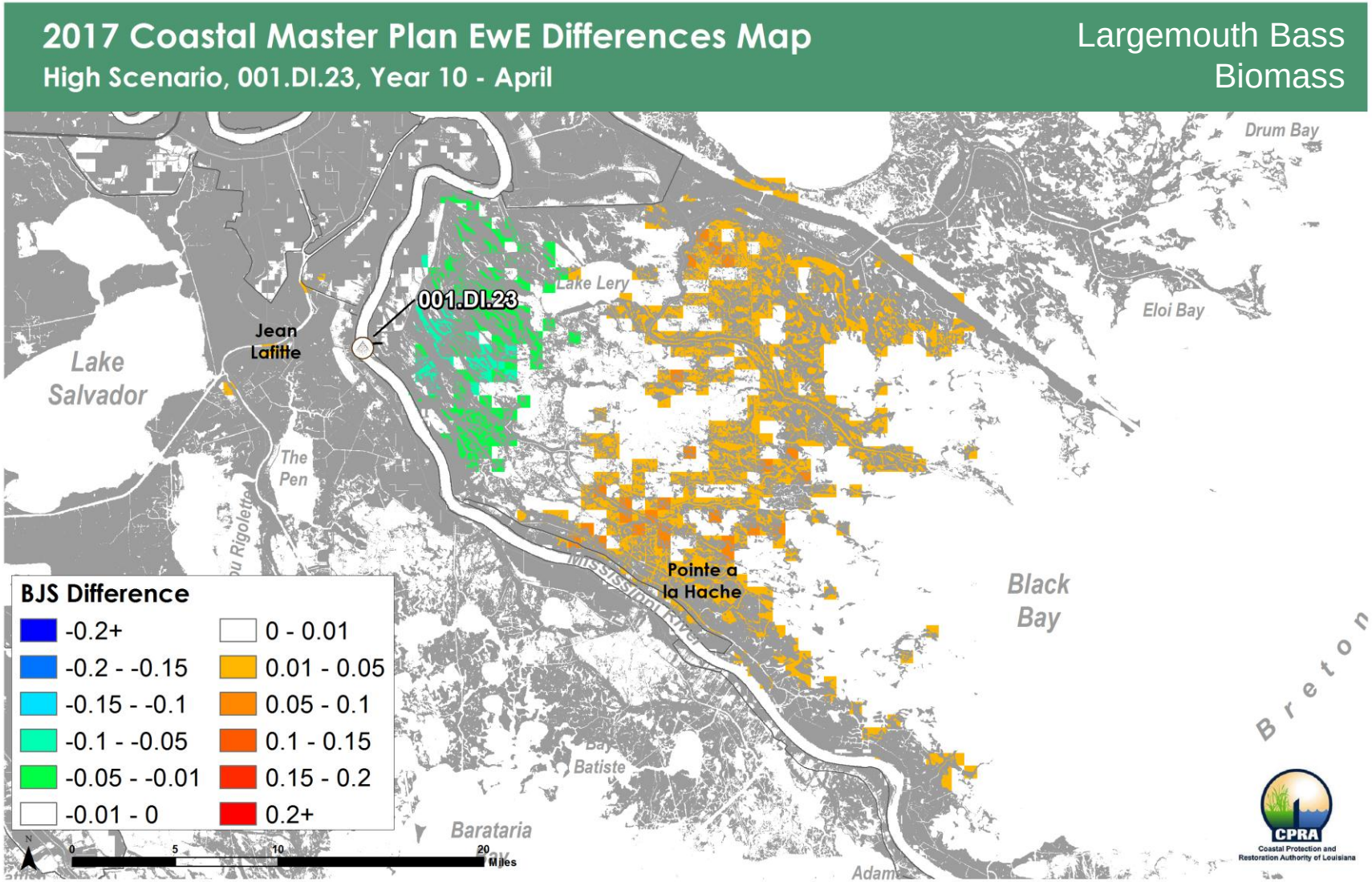
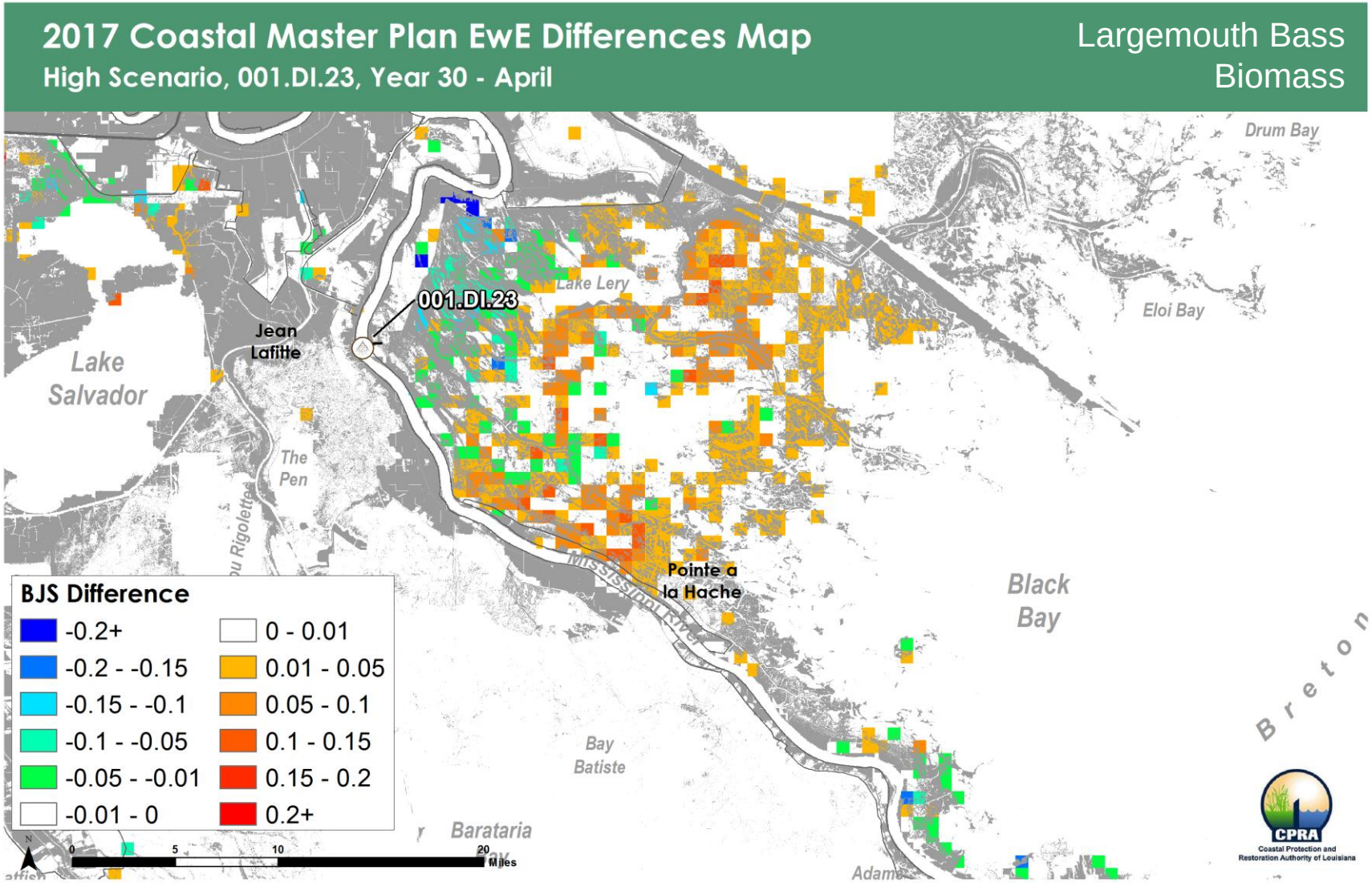


MID-BRETON SOUND DIVERSION (001.DI.23)



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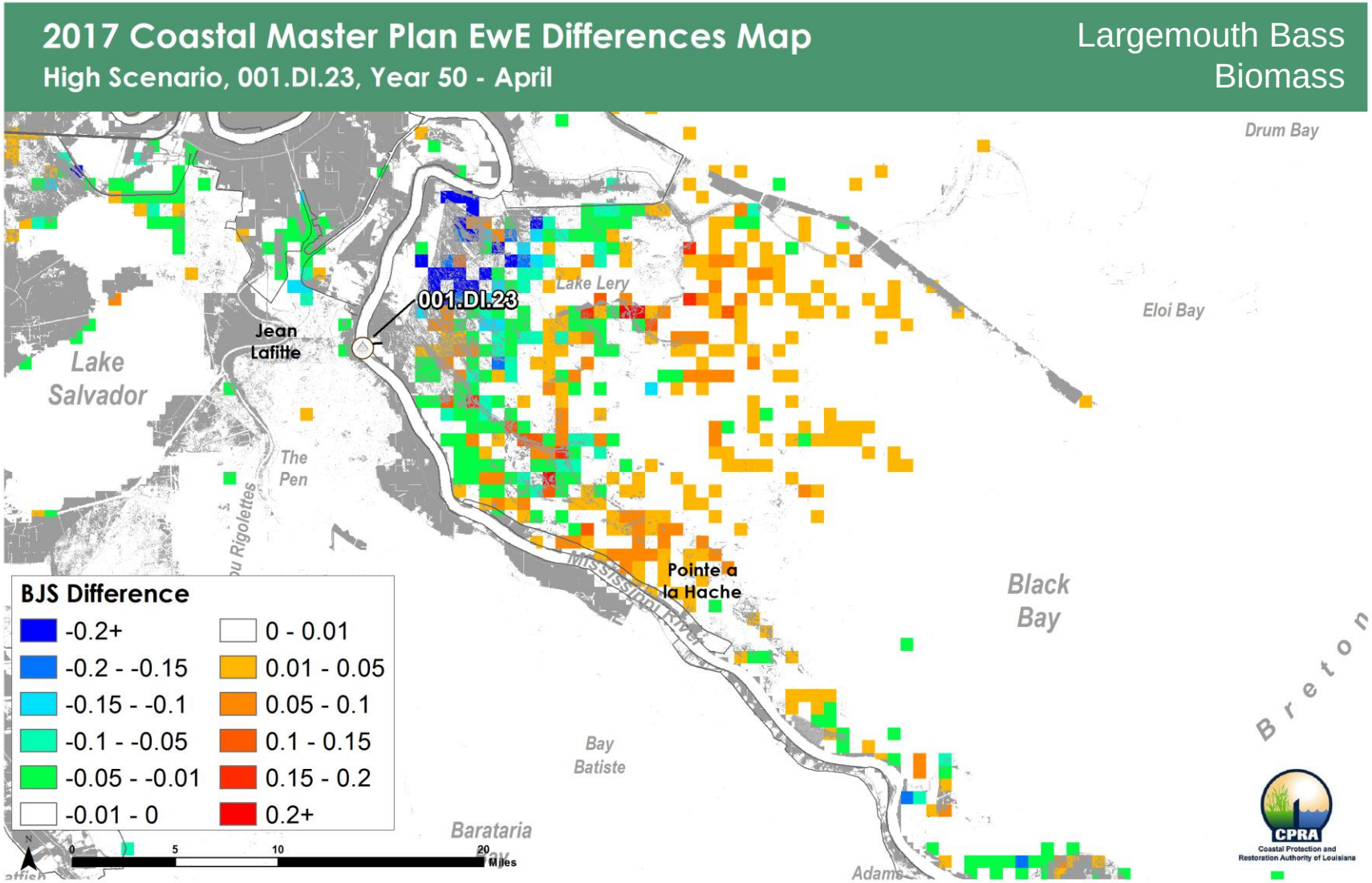
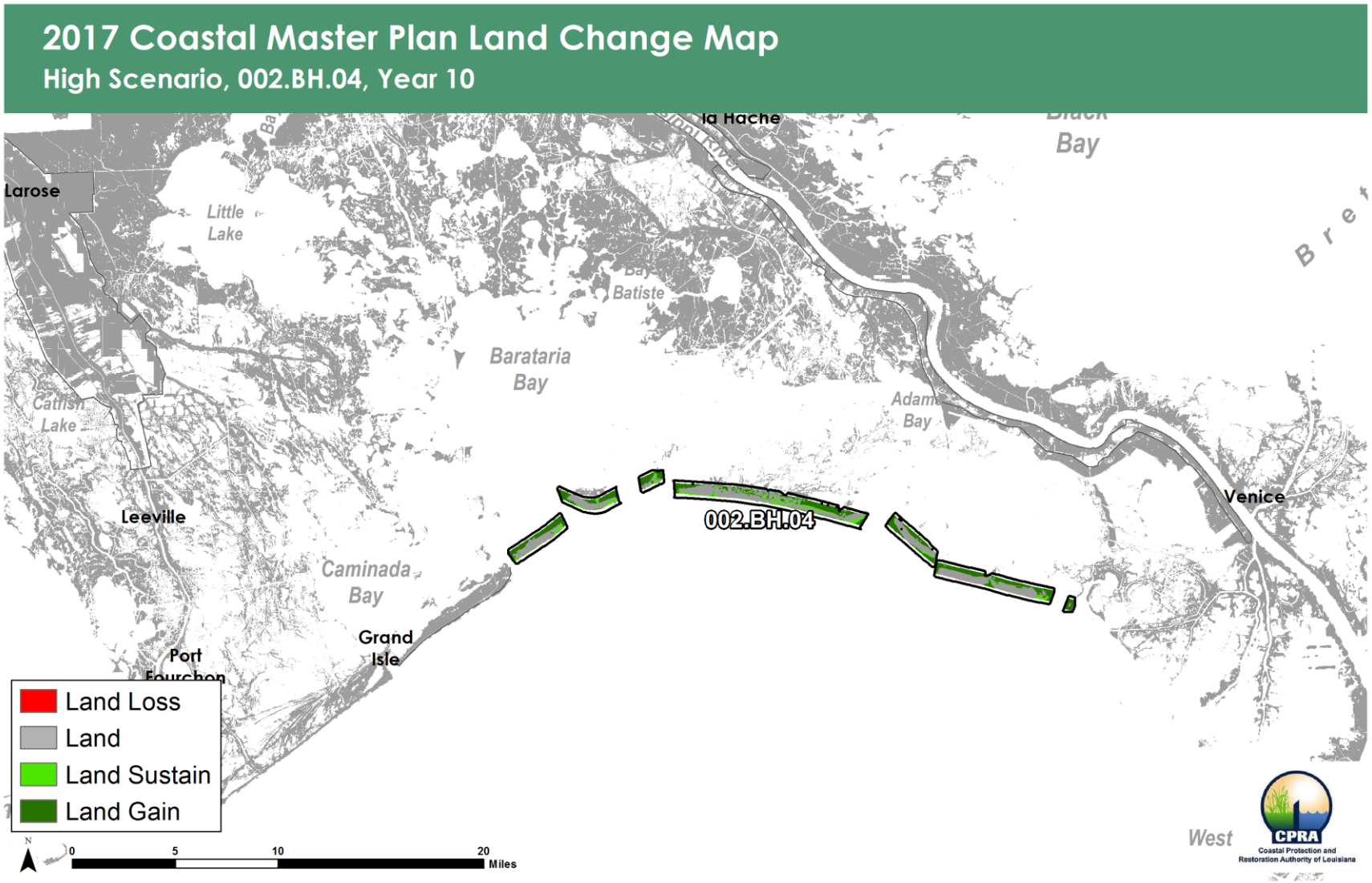


BARATARIA PASS TO SANDY POINT BARRIER ISLAND RESTORATION (002.BH.04)

- Restoration of Barataria Bay barrier islands between Barataria Pass and Sandy Point to provide beach, dune, and back barrier marsh habitat and to provide storm surge and wave attenuation for the Barataria Basin.
- Implementation Year - 7

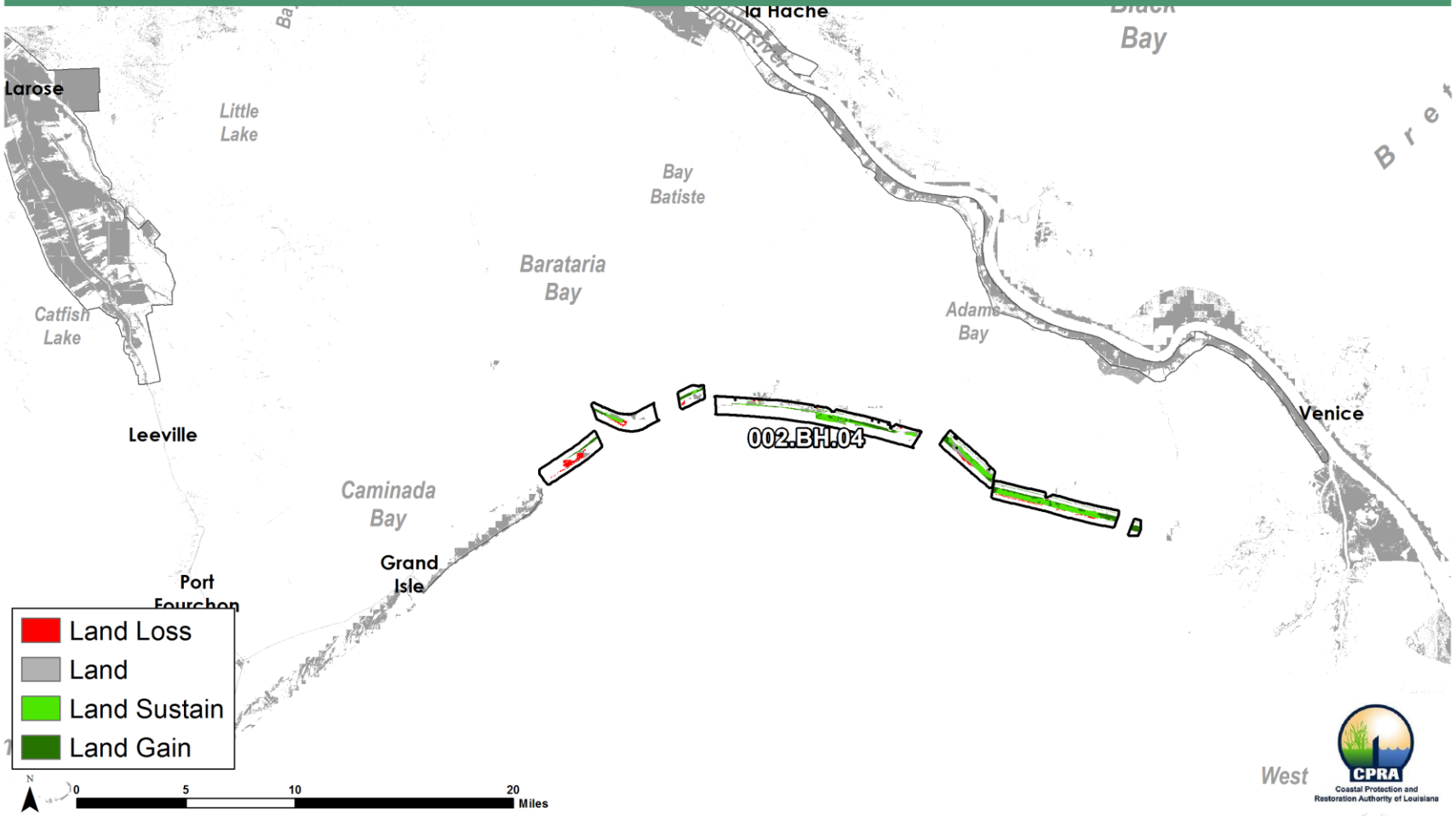
BARATARIA PASS TO SANDY POINT BARRIER ISLAND RESTORATION (002.BH.04)



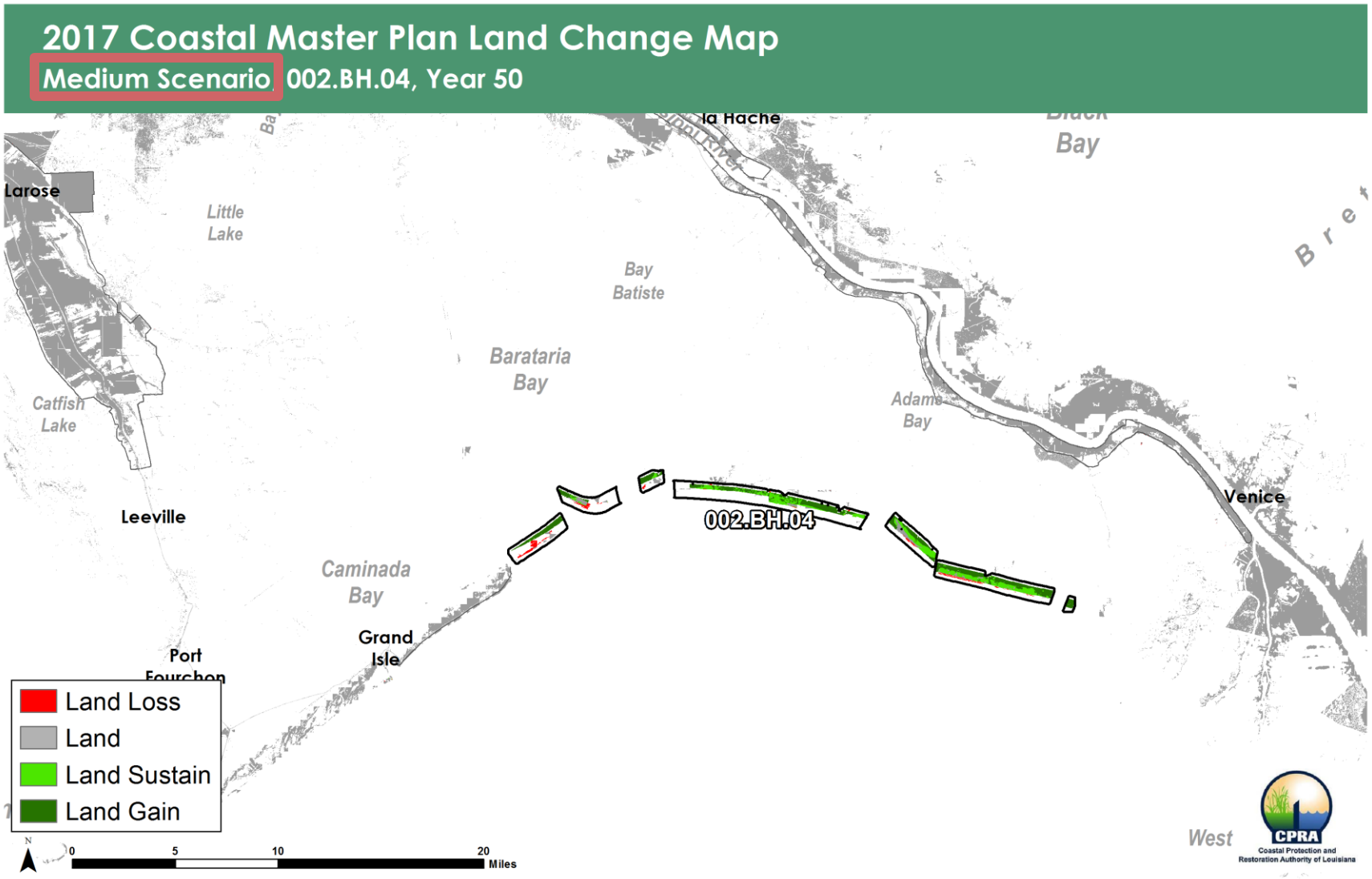
BARATARIA PASS TO SANDY POINT BARRIER ISLAND RESTORATION (002.BH.04)

2017 Coastal Master Plan Land Change Map

High Scenario, 002.BH.04, Year 50



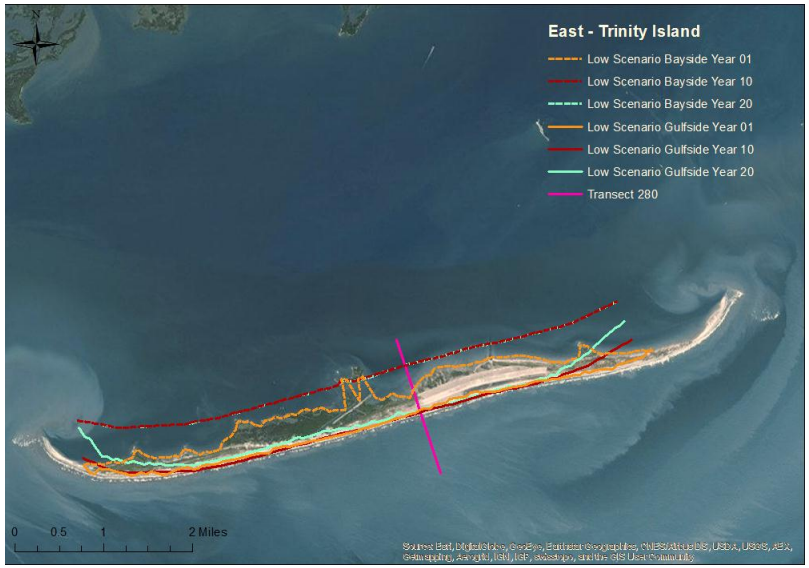
BARATARIA PASS TO SANDY POINT BARRIER ISLAND RESTORATION (002.BH.04)

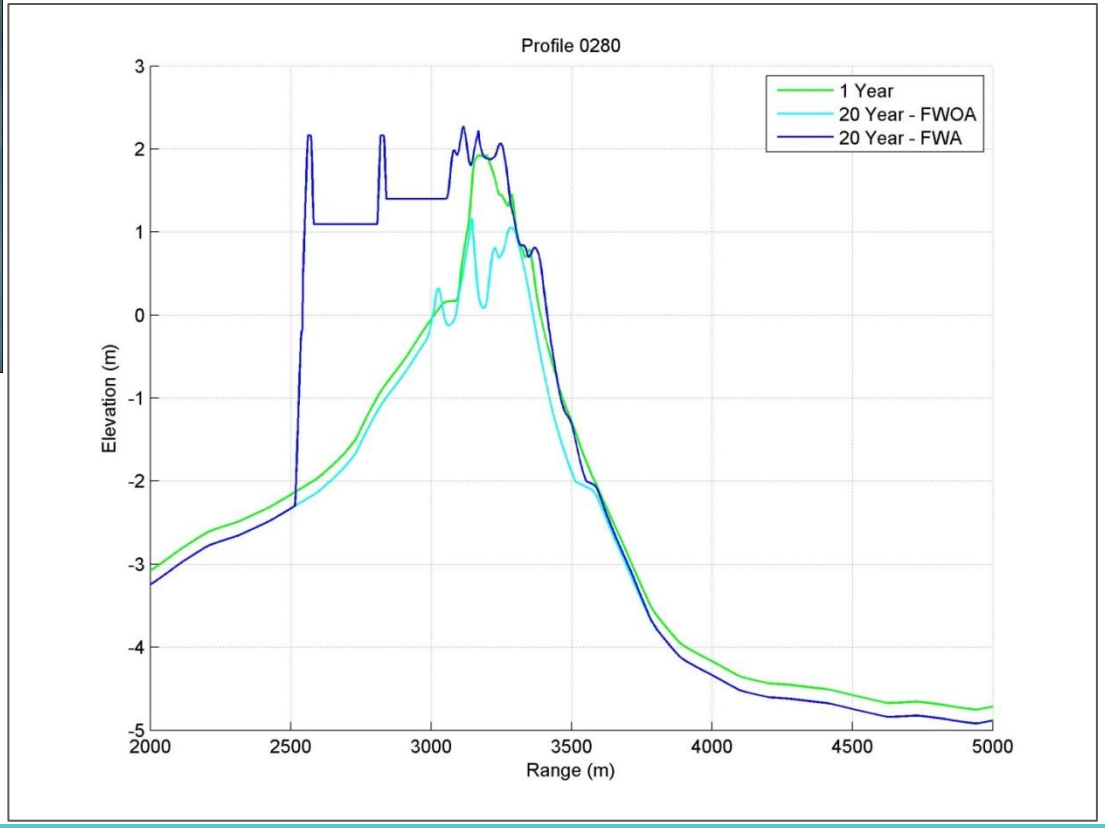


ISLES DERNIERES BARRIER ISLAND RESTORATION (03A.BH.03)

- Restoration of the Isles Dernieres barrier islands to provide dune, beach, and back barrier marsh habitat and to provide storm surge and wave attenuation in the Terrebonne Basin.
- Implementation Year - 7

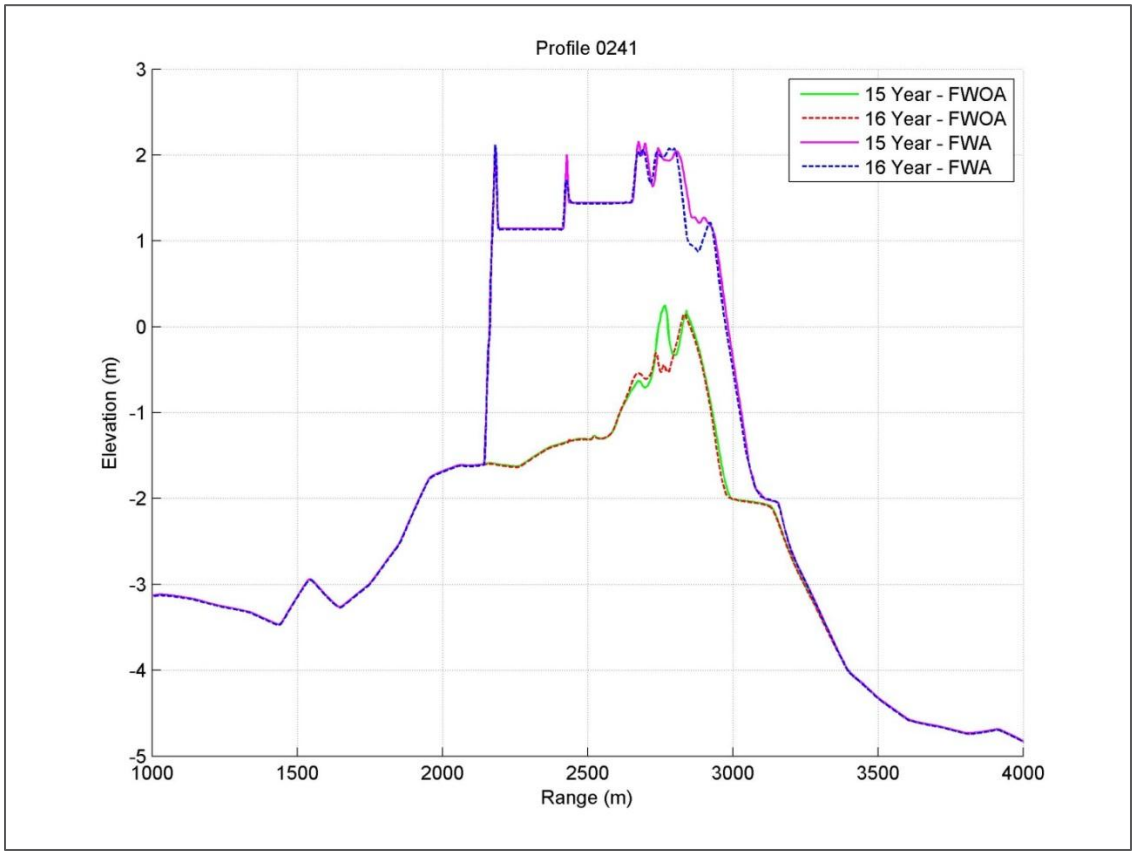
ISLES DERNIERES BARRIER ISLAND RESTORATION (03A.BH.03) - EAST/TRINITY ISLAND





ISLES DERNIERES BARRIER ISLAND RESTORATION (03A.BH.03) - EAST/TRINITY ISLAND

Pre- and post-storm profiles

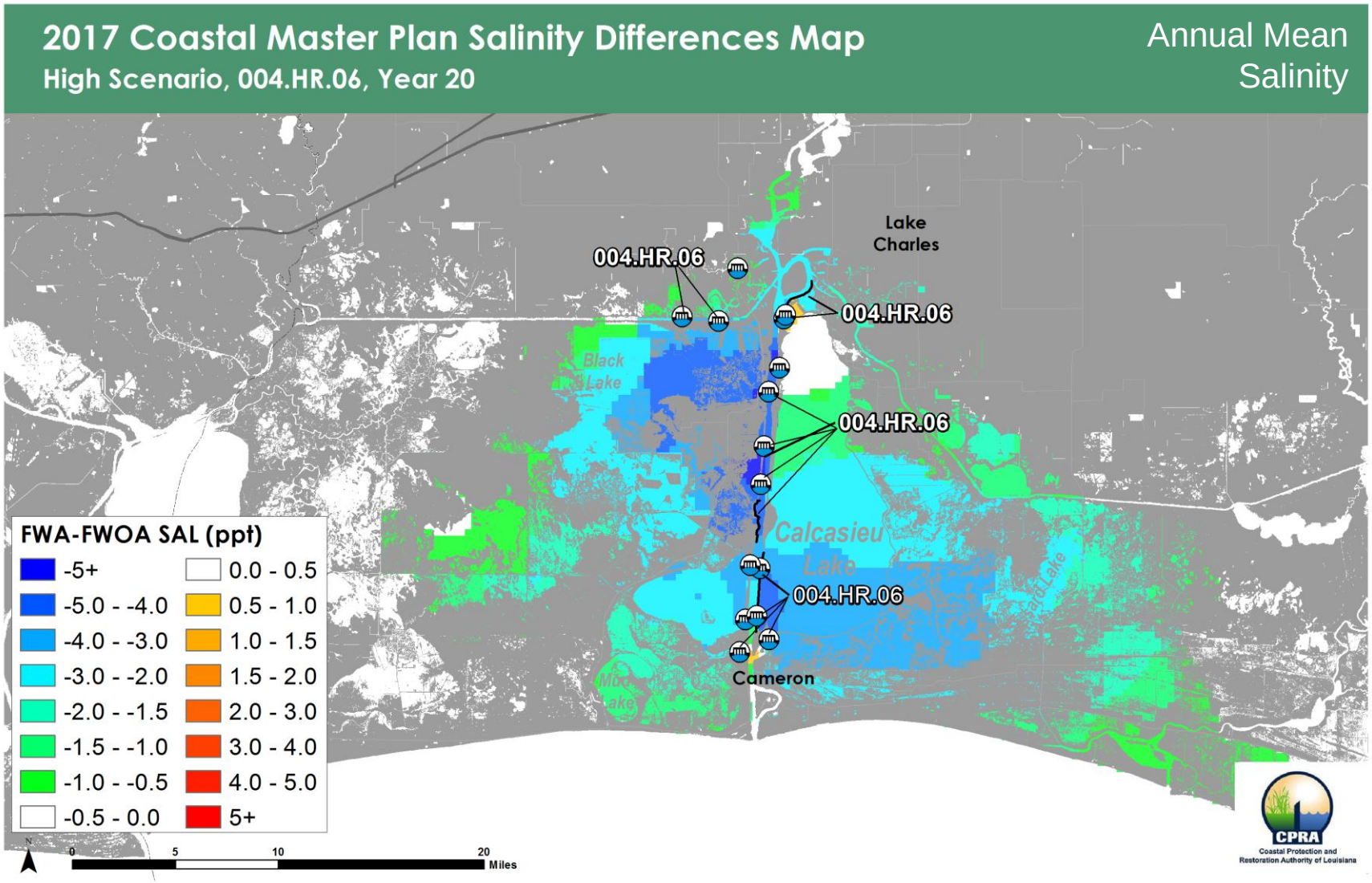


- Storm #569 (equivalent to Hurricane Bob in 1979) was modeled in Year 16
- Passed within approximately 10 km of East-Trinity Island

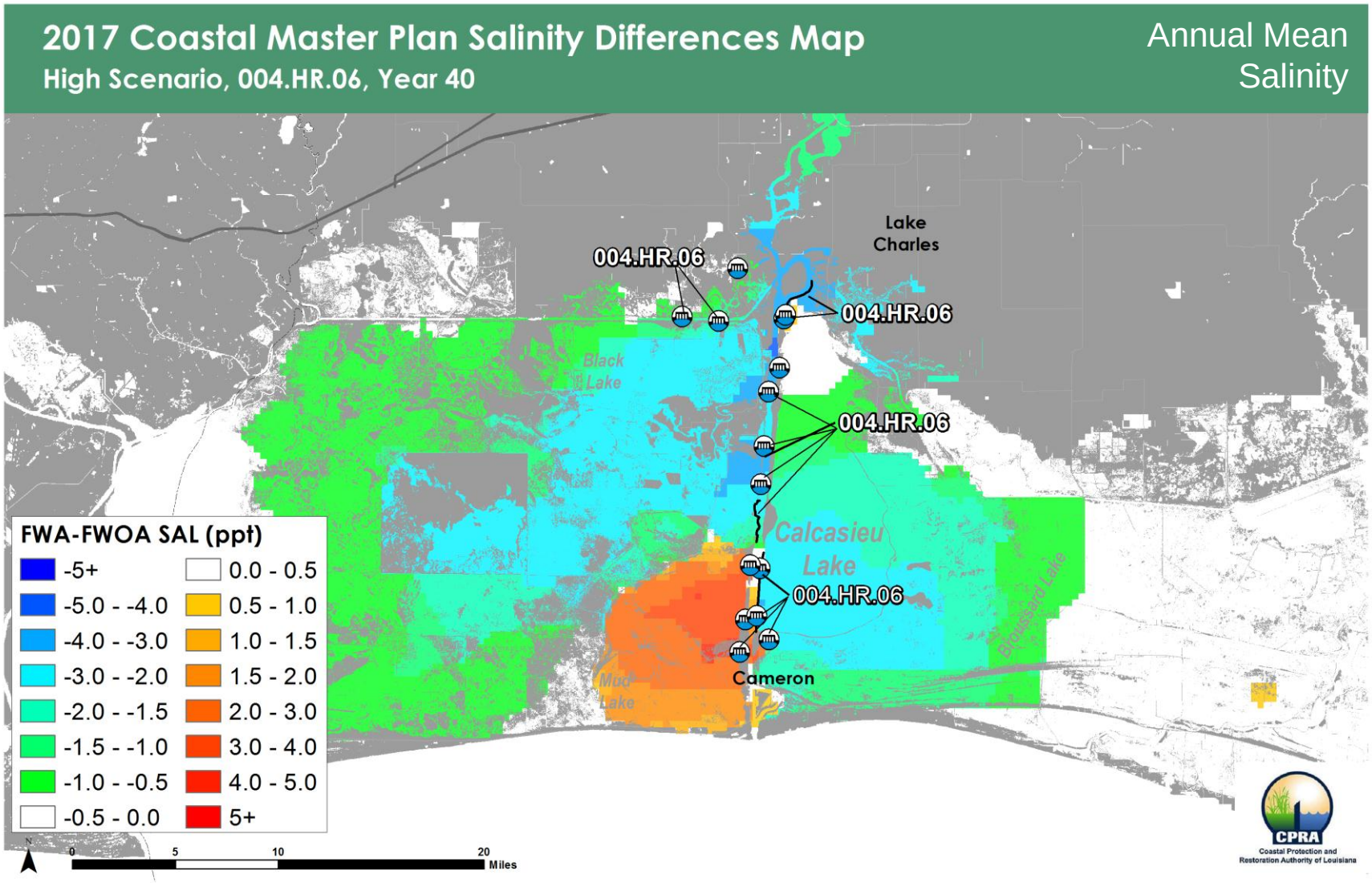
CALCASIEU SHIP CHANNEL SALINITY CONTROL MEASURES (004.HR.06)

- Construction of a series of measures (sills, boat bays, stop log gates, rock dikes) along the Calcasieu Ship Channel and the GIWW designed to prevent saltwater from entering Calcasieu Lake
- Implementation Year - 4

CALCASIEU SHIP CHANNEL SALINITY CONTROL MEASURES (004.HR.06)



CALCASIEU SHIP CHANNEL SALINITY CONTROL MEASURES (004.HR.06)



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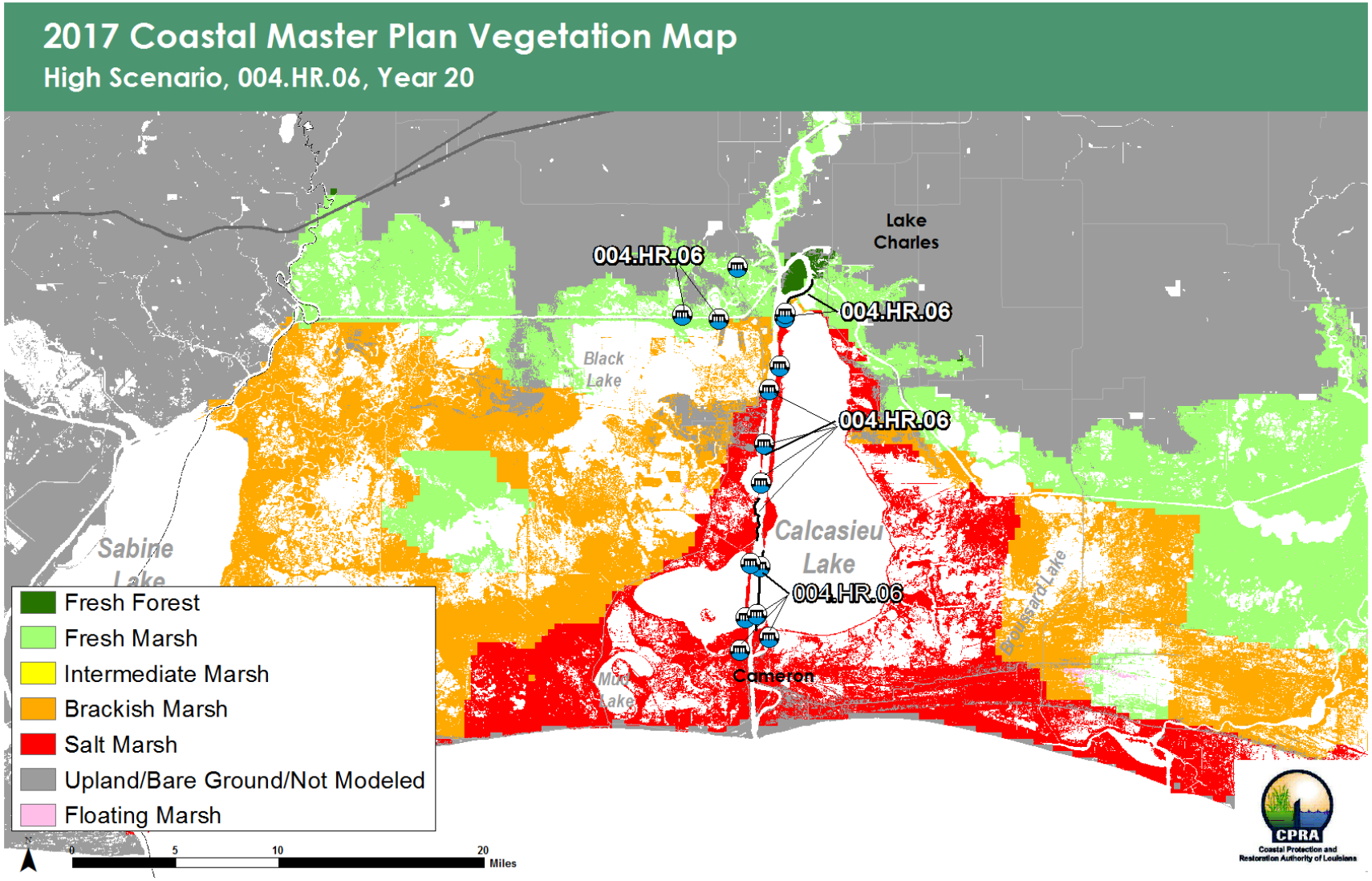

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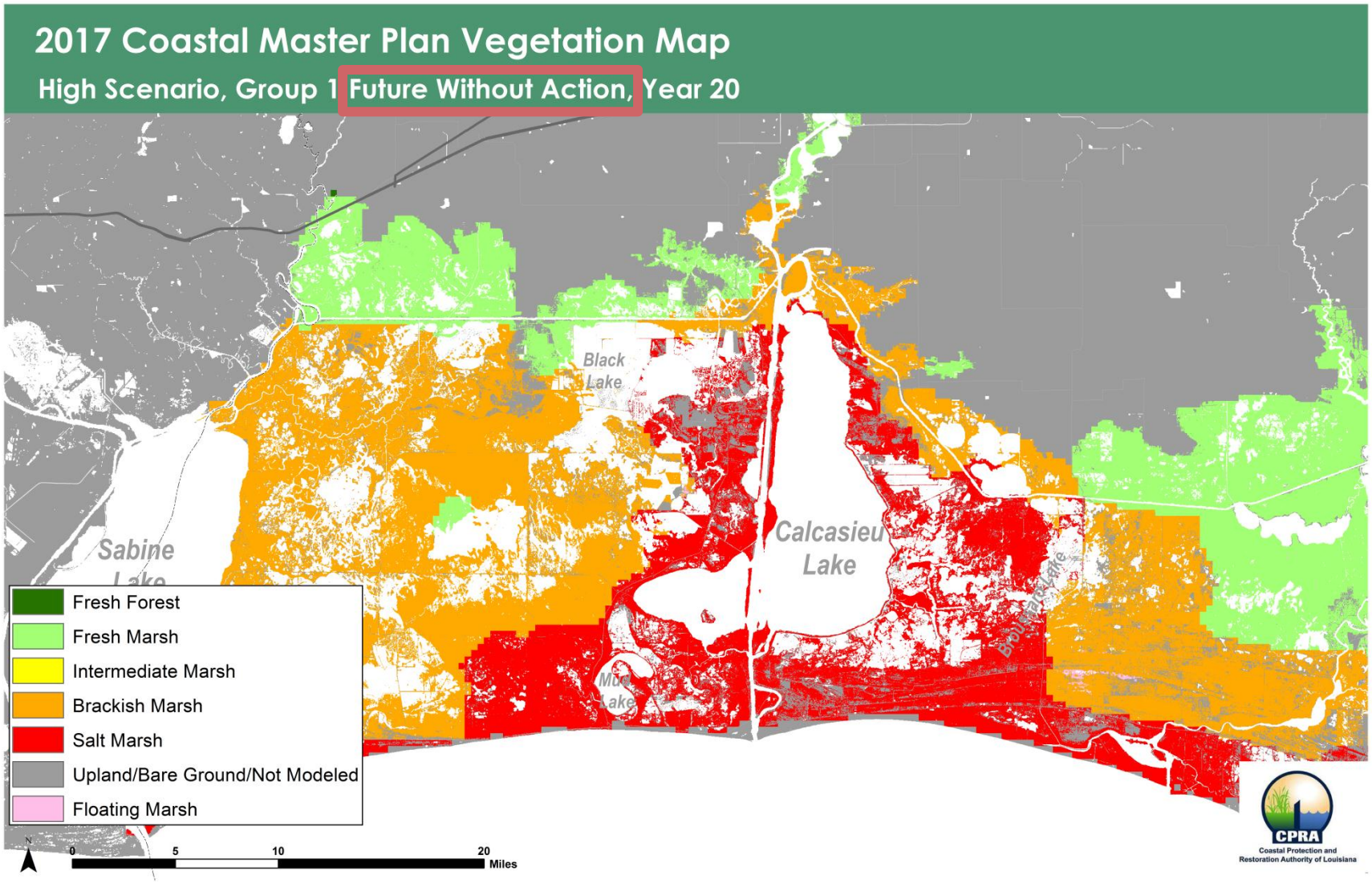

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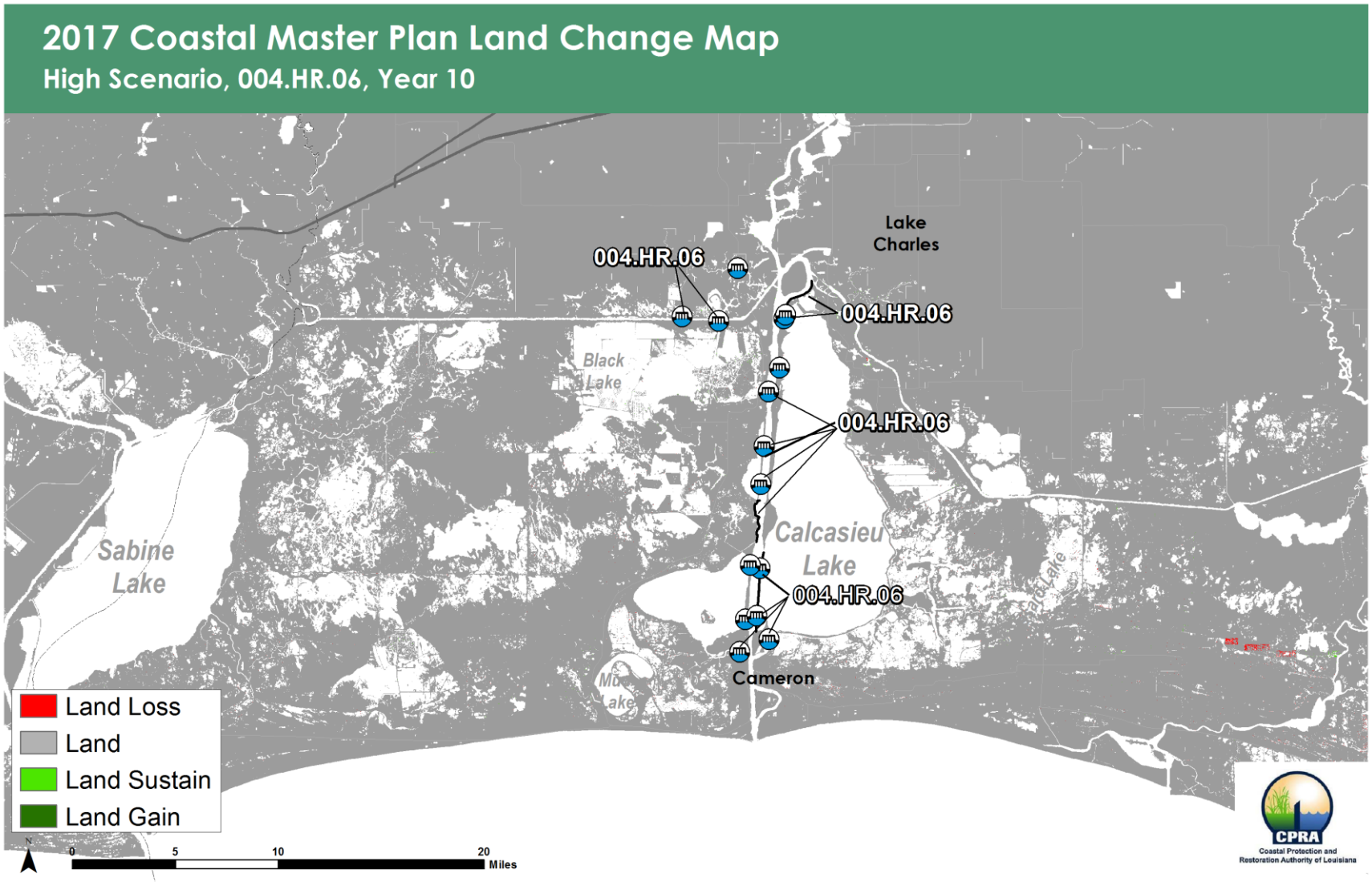

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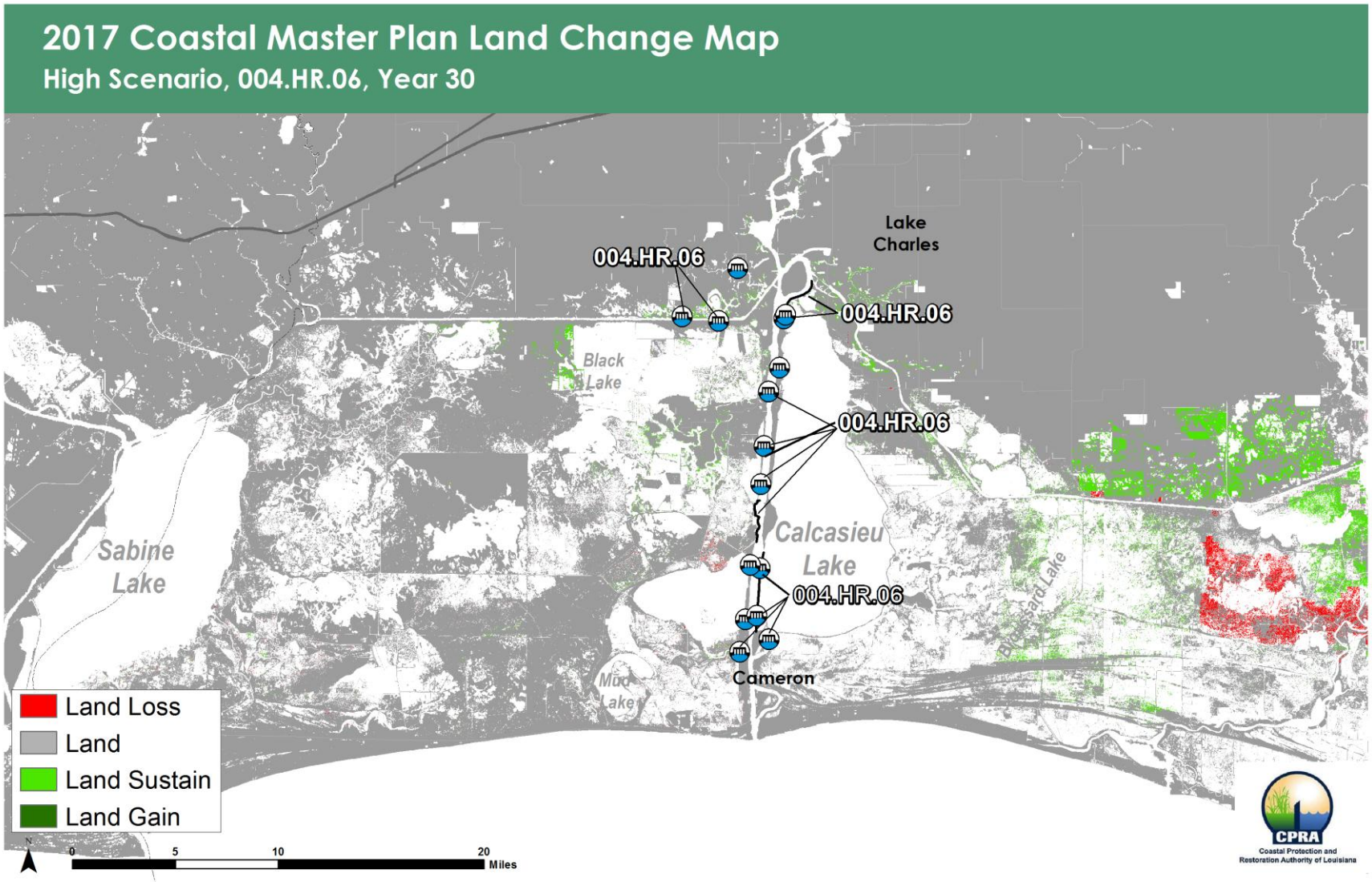

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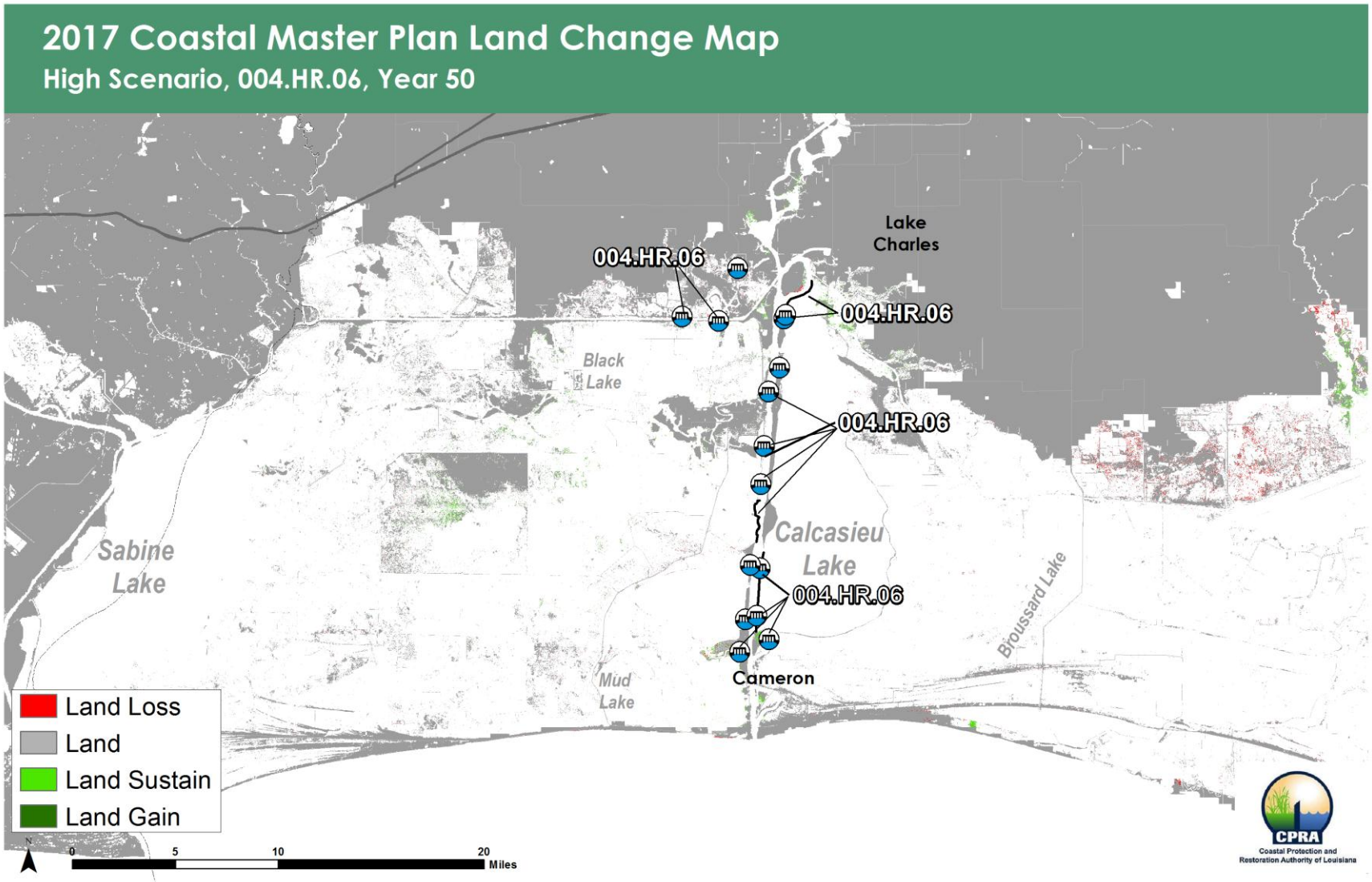

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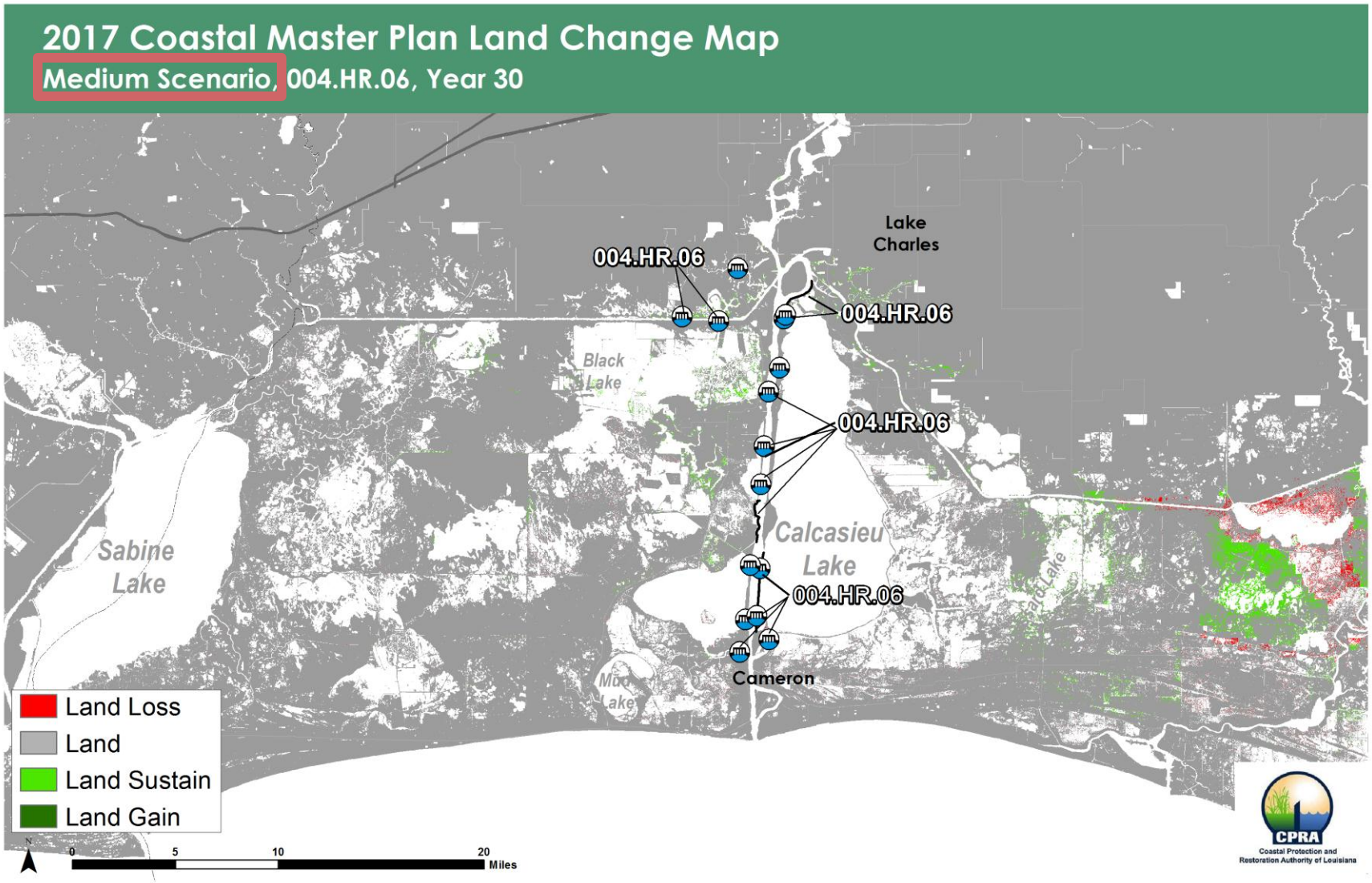

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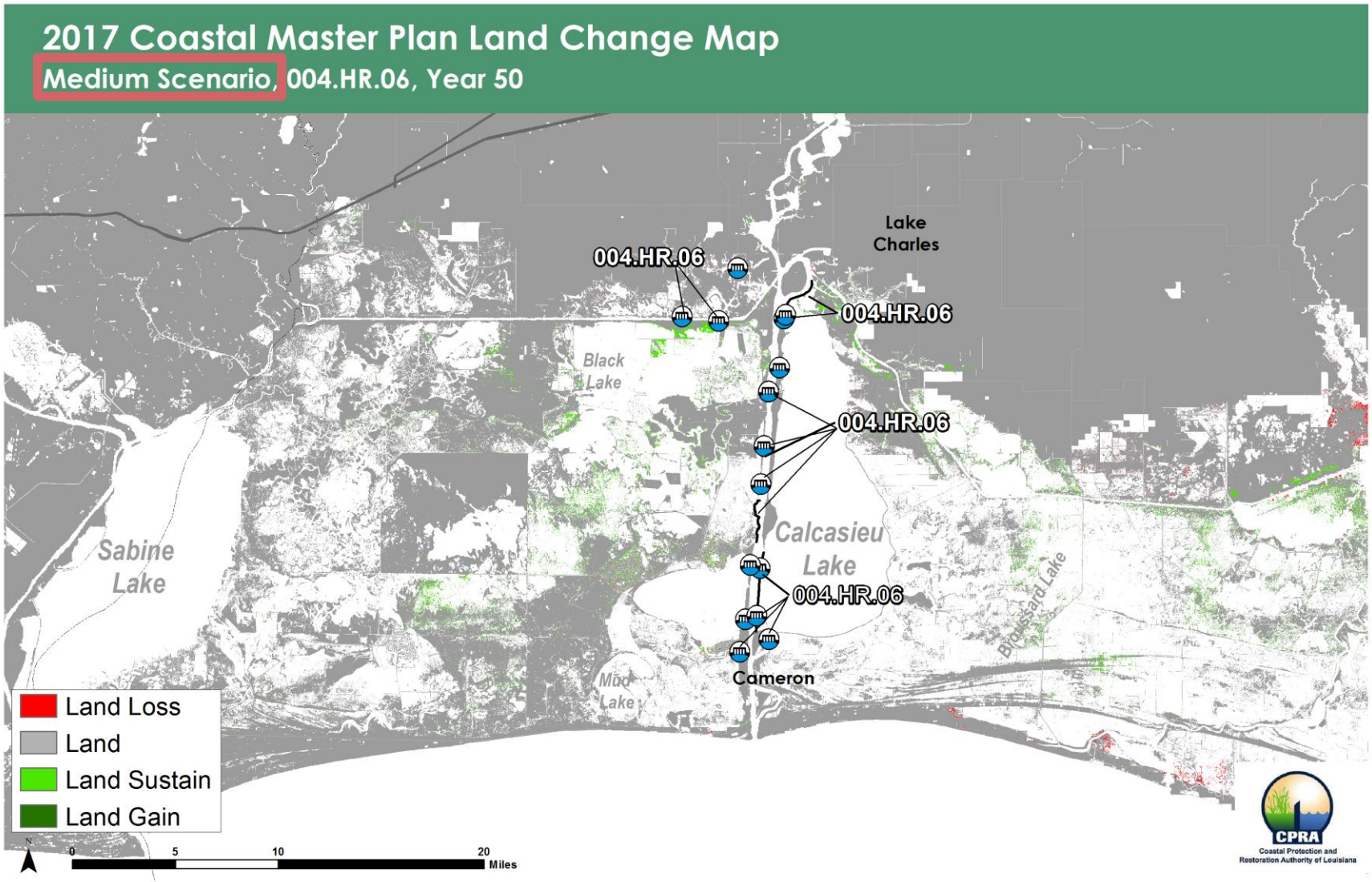

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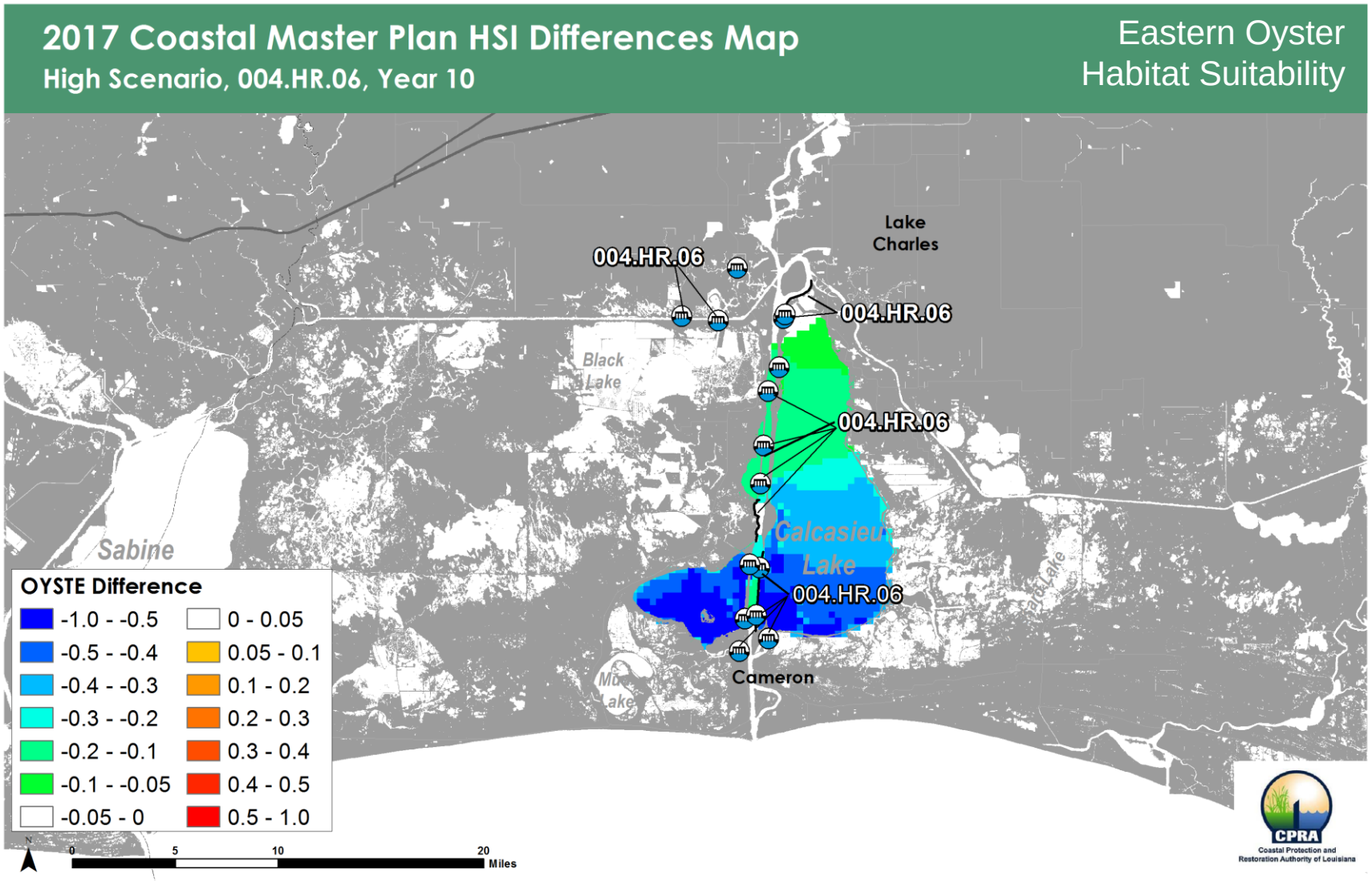

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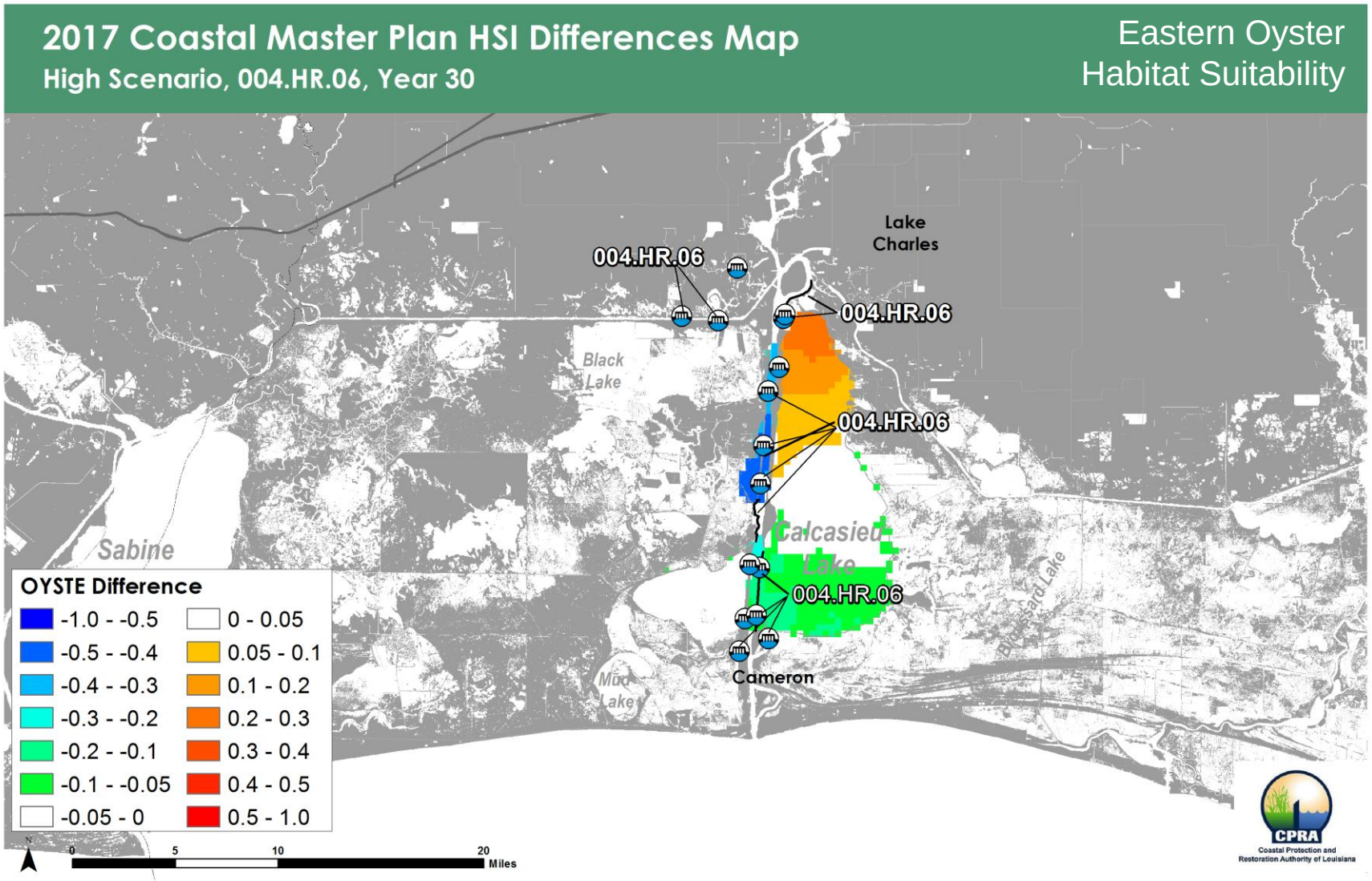

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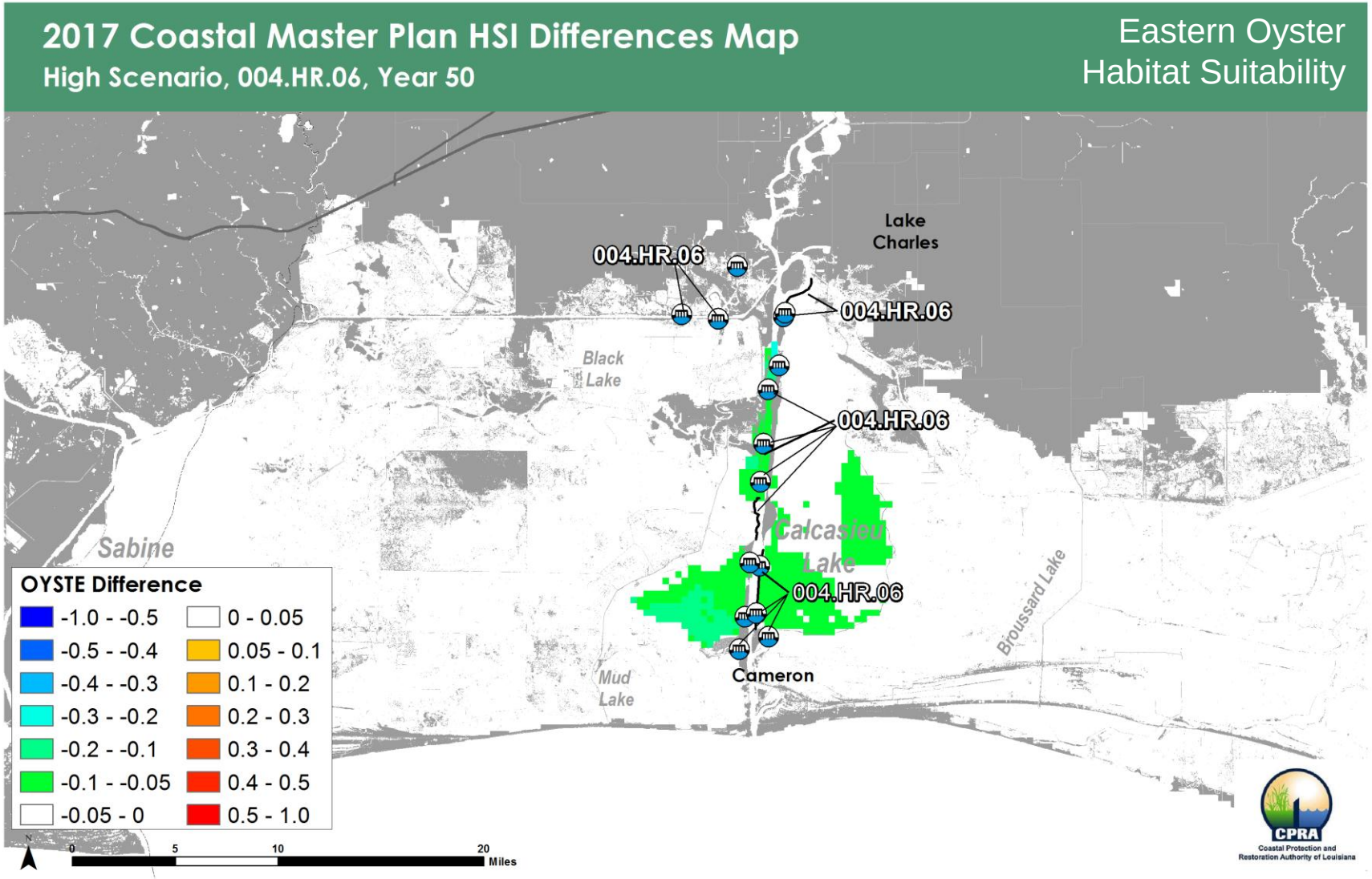

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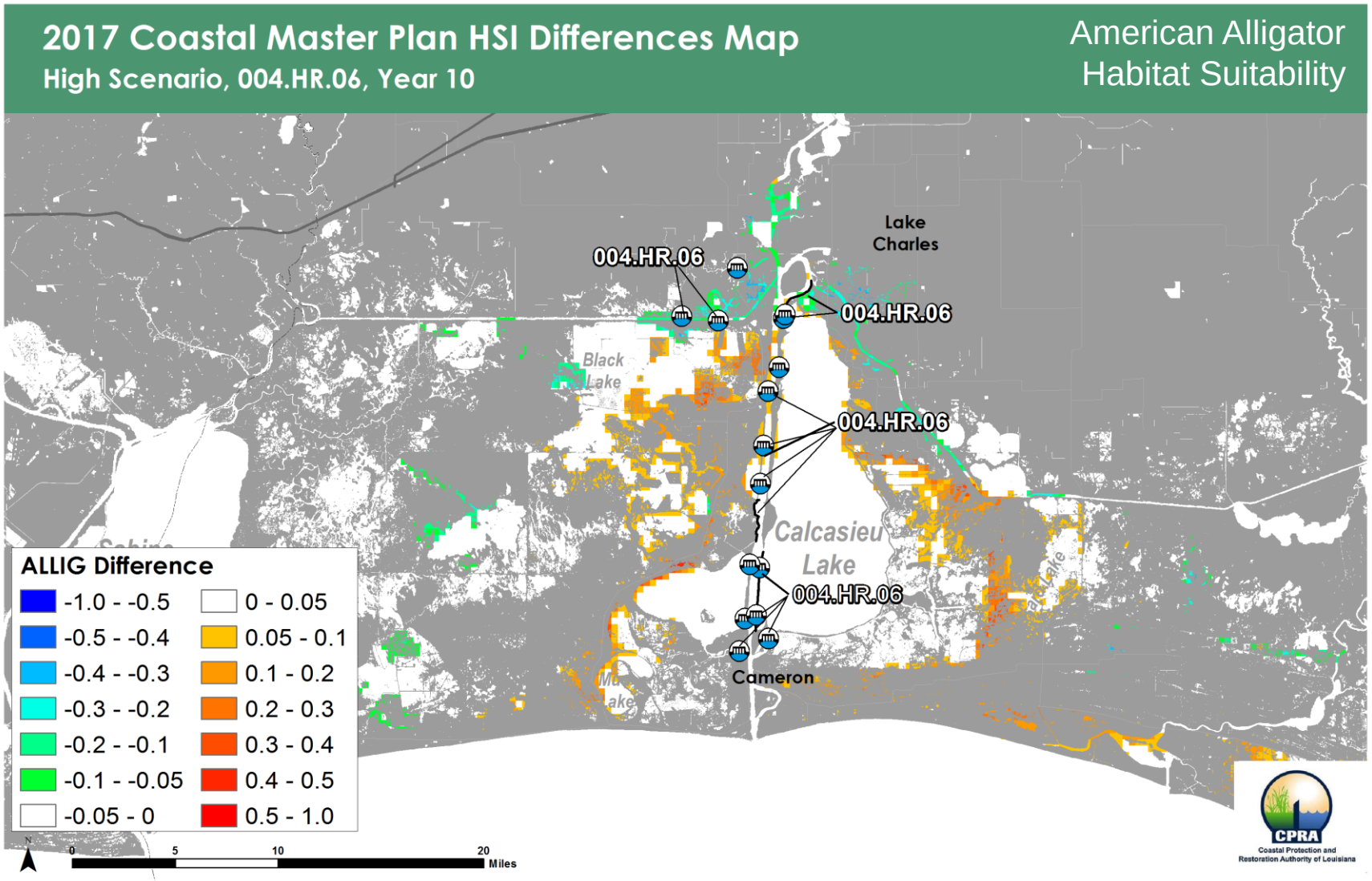

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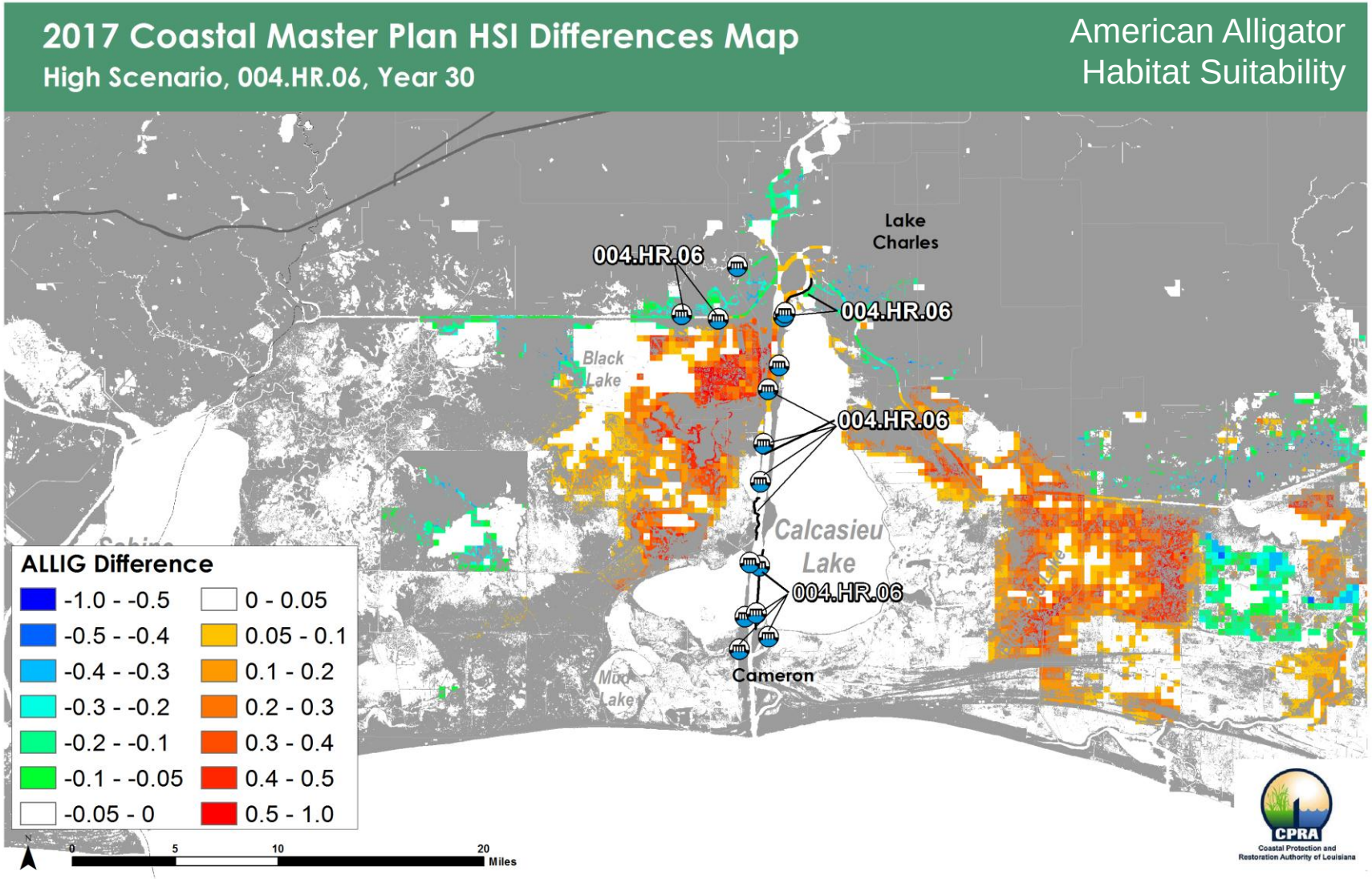

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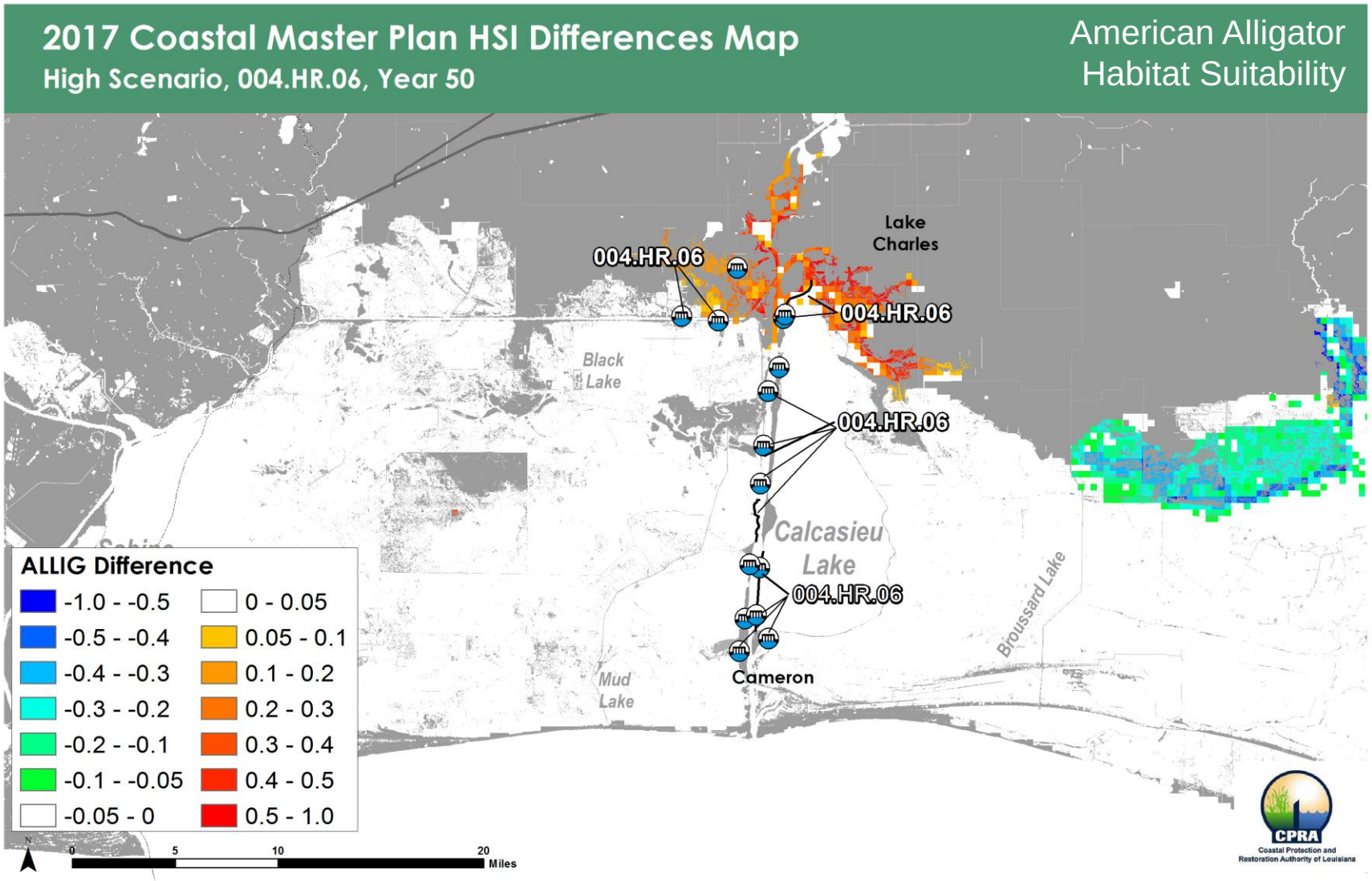
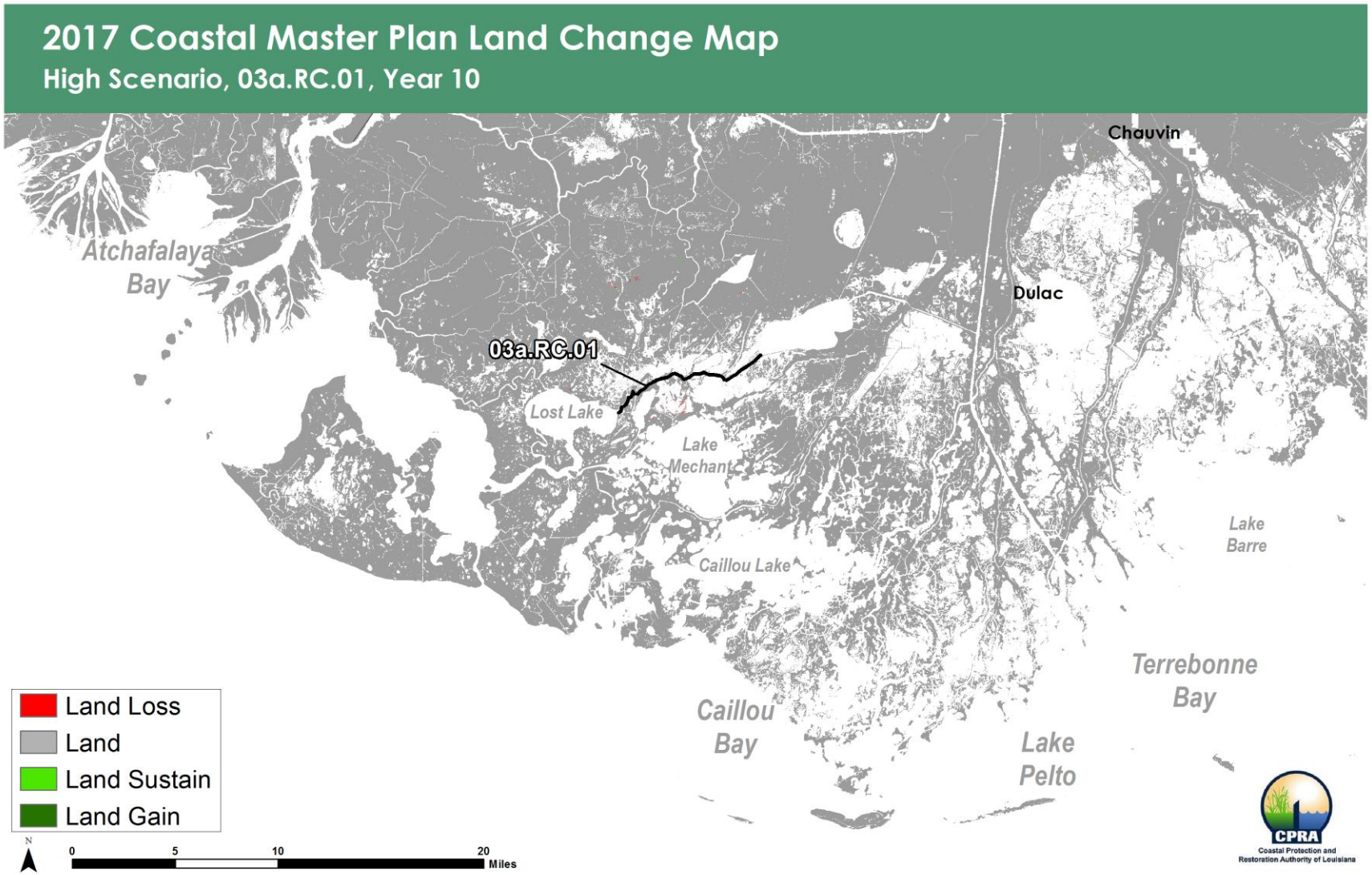


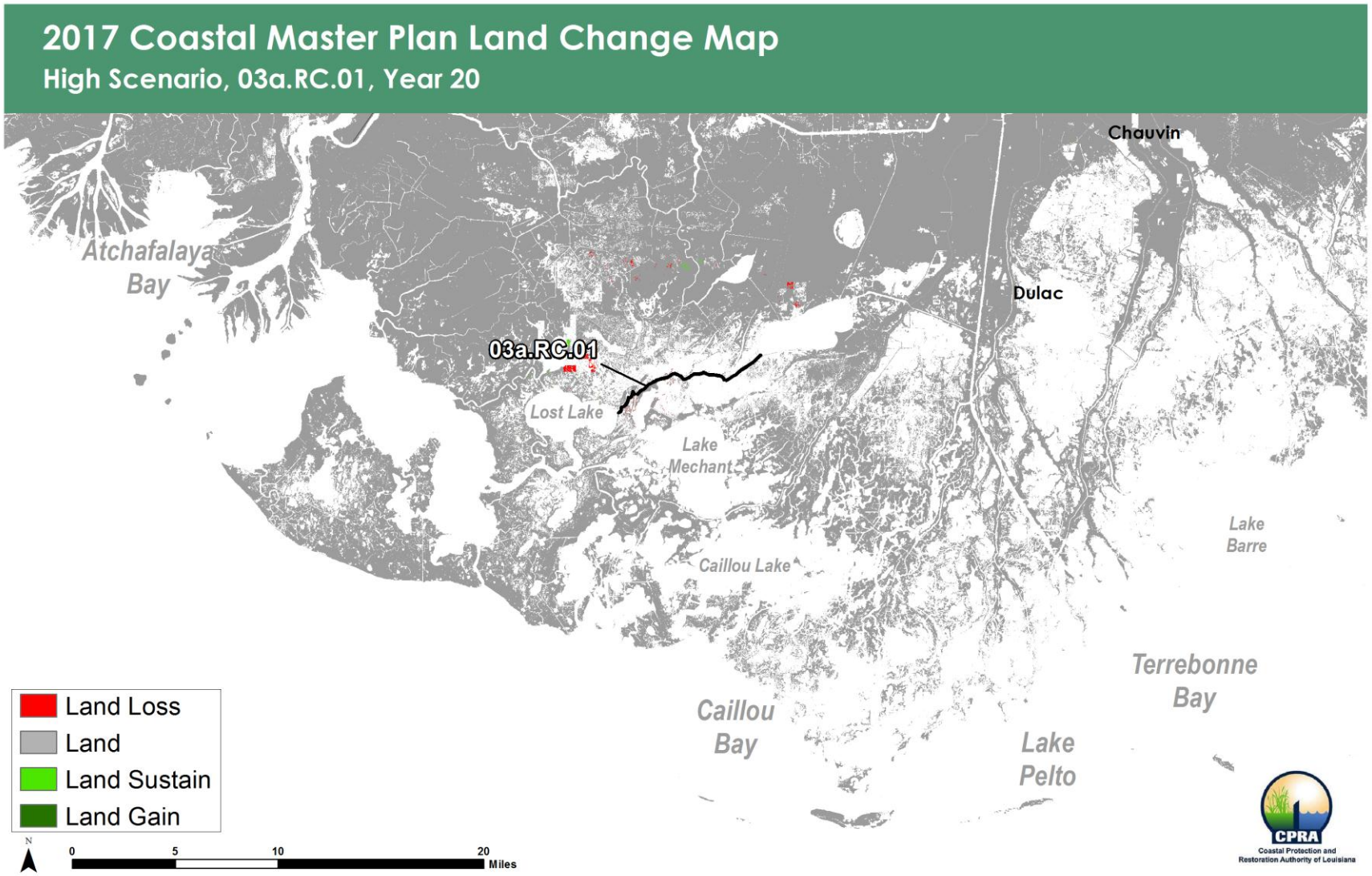
BAYOU DECADE RIDGE RESTORATION (03A.RC.01)

- Restoration of approximately 42,600 feet of historic ridge along Bayou DeCade to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation
- Implementation Year - 5

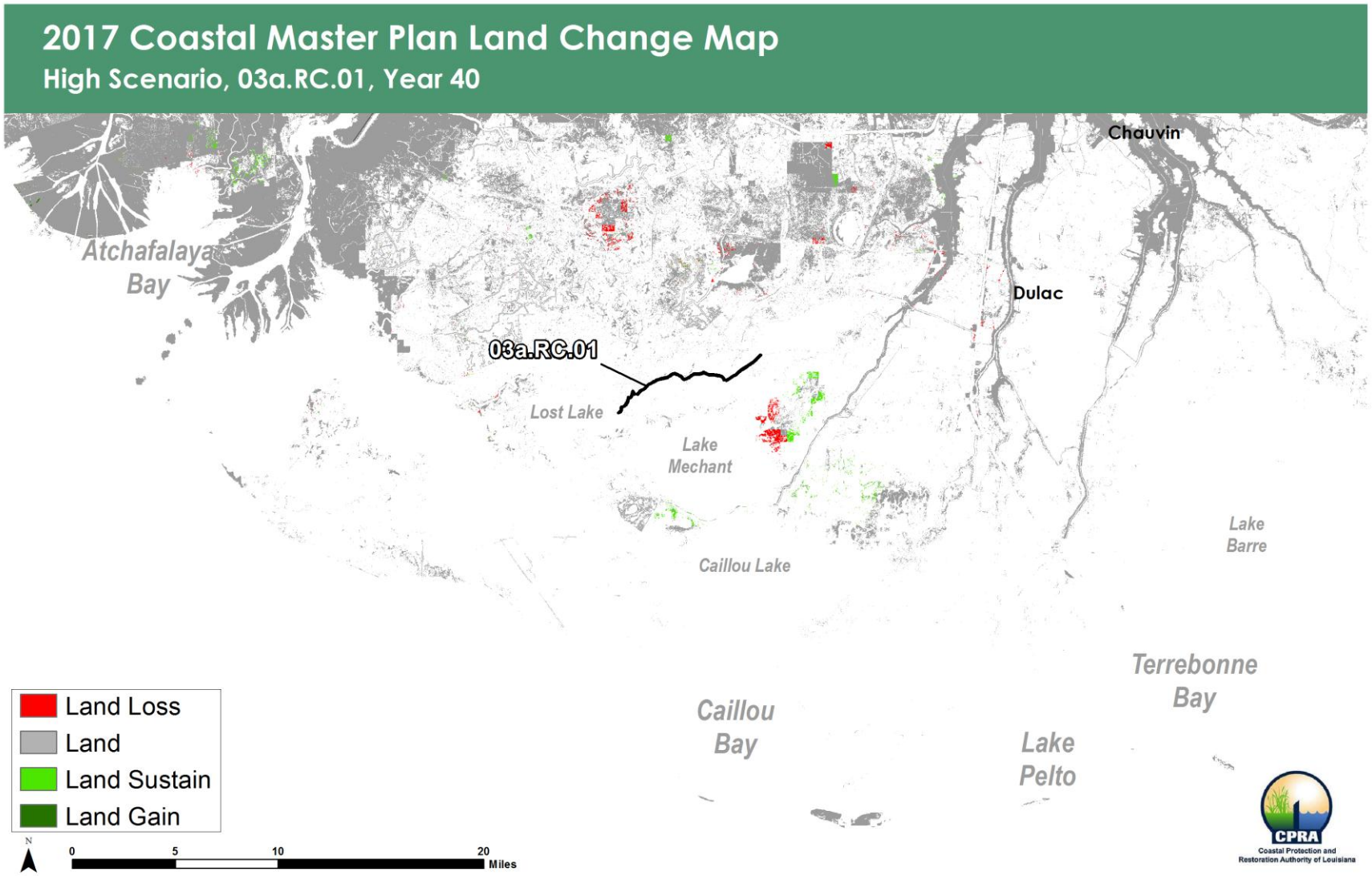
BAYOU DECADE RIDGE RESTORATION (03A.RC.01)



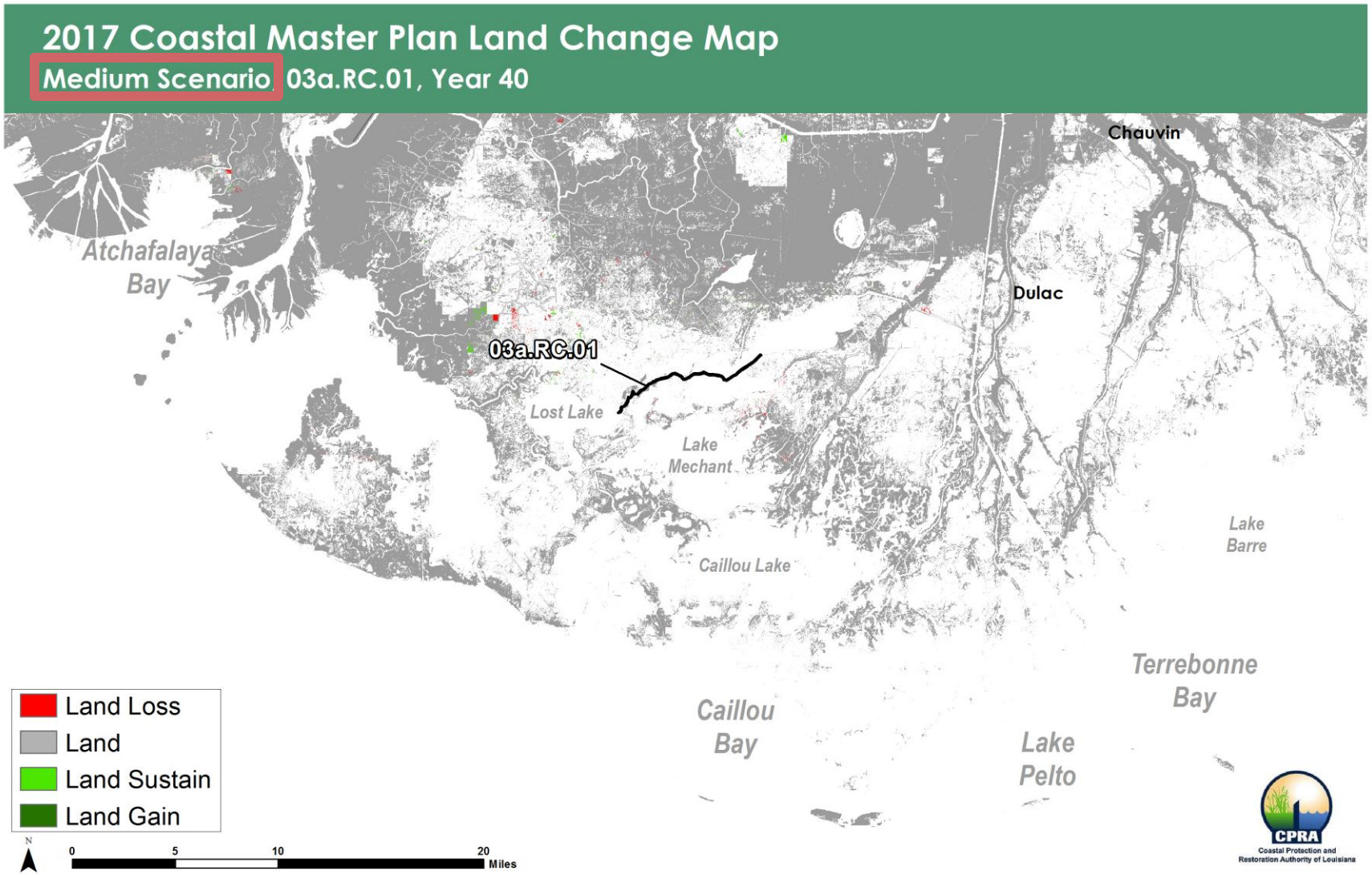
BAYOU DECADE RIDGE RESTORATION (03A.RC.01)



BAYOU DECADE RIDGE RESTORATION (03A.RC.01)



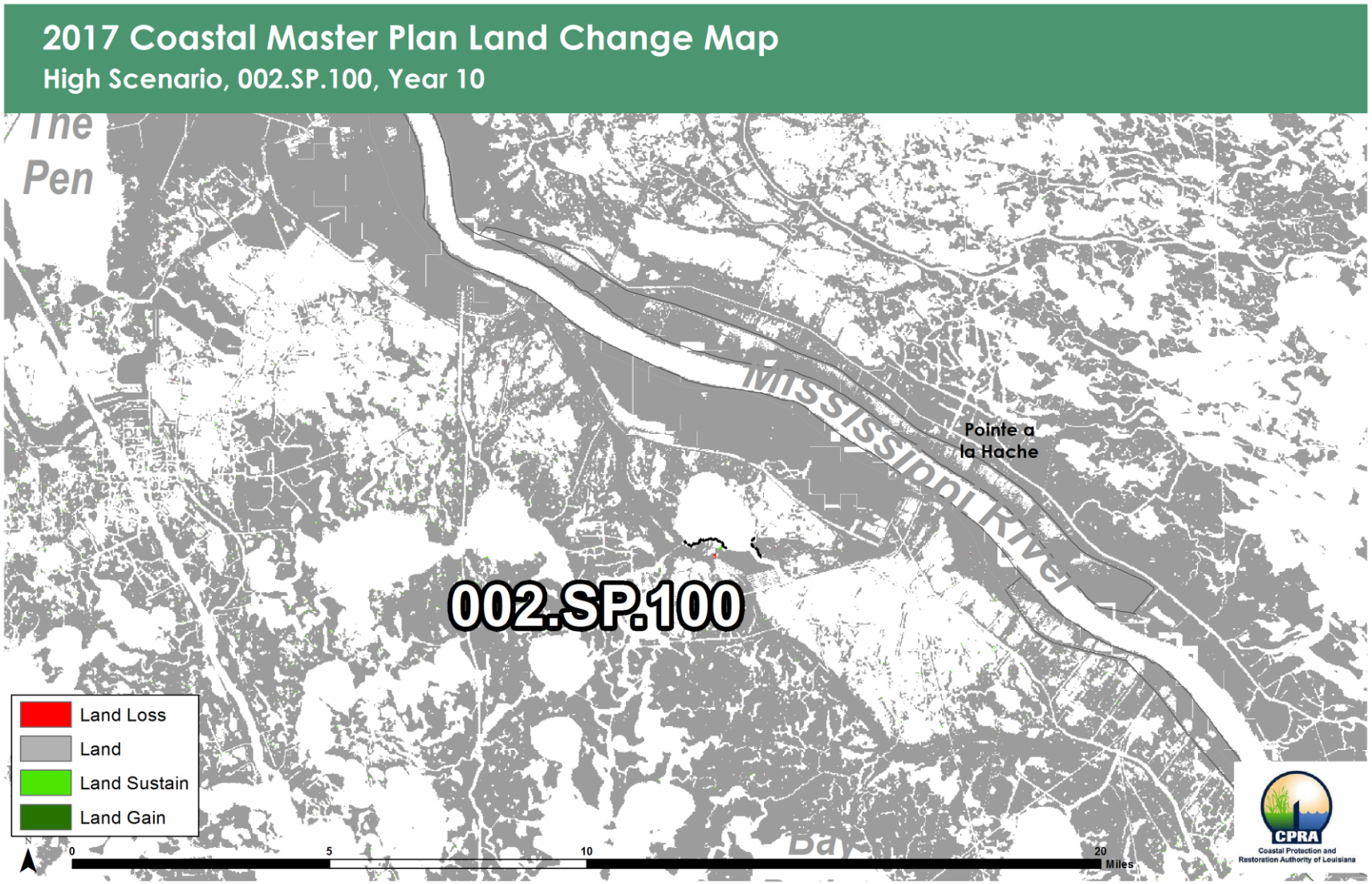
BAYOU DECADE RIDGE RESTORATION (03A.RC.01)



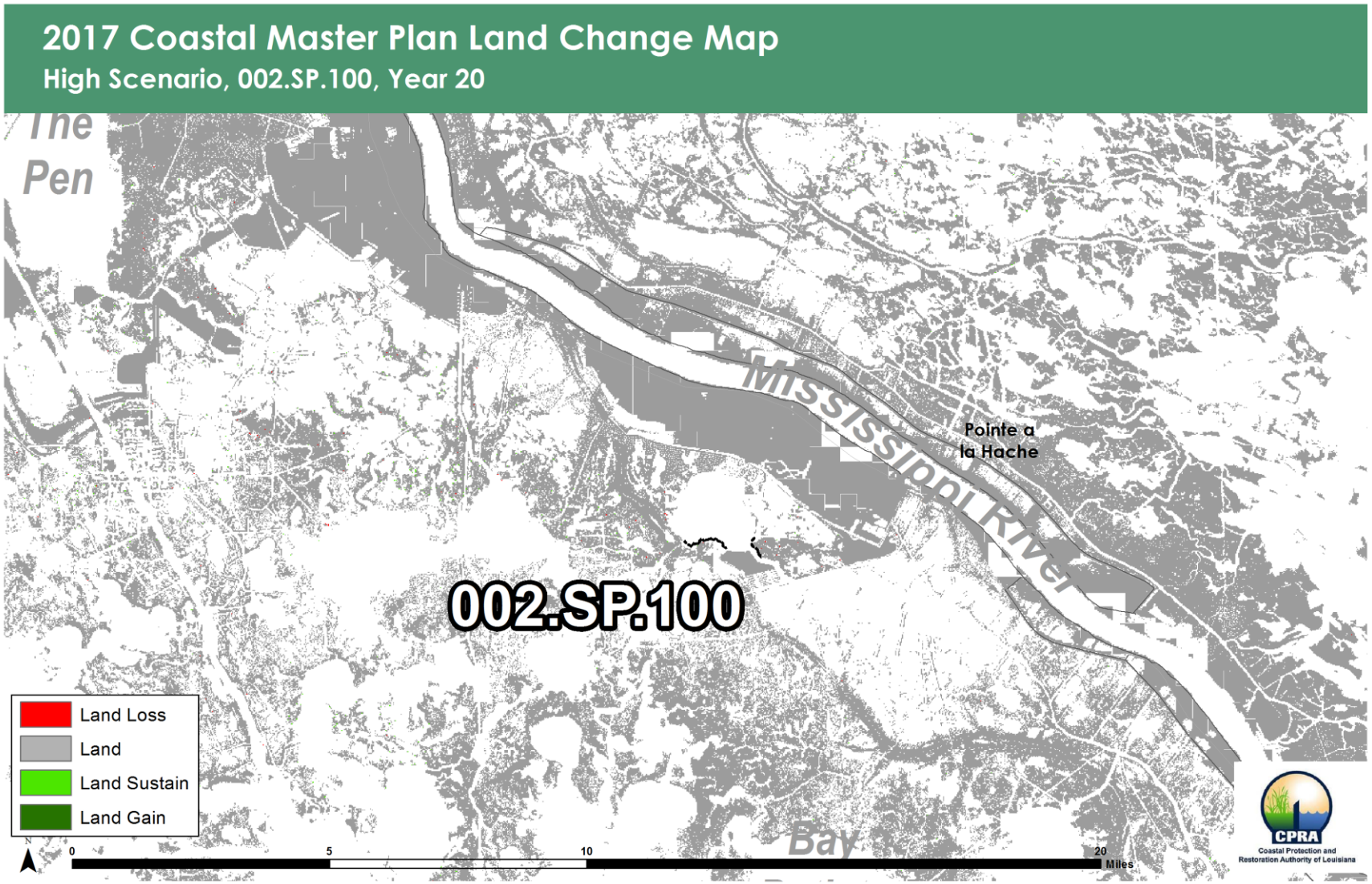
LAKE HERMITAGE SHORELINE PROTECTION (002.SP.100)

- Shoreline protection through rock breakwaters of approximately 7,700 feet around southern shore of Lake Hermitage to preserve shoreline integrity and reduce wetland degradation from wave erosion
- Implementation Year - 5

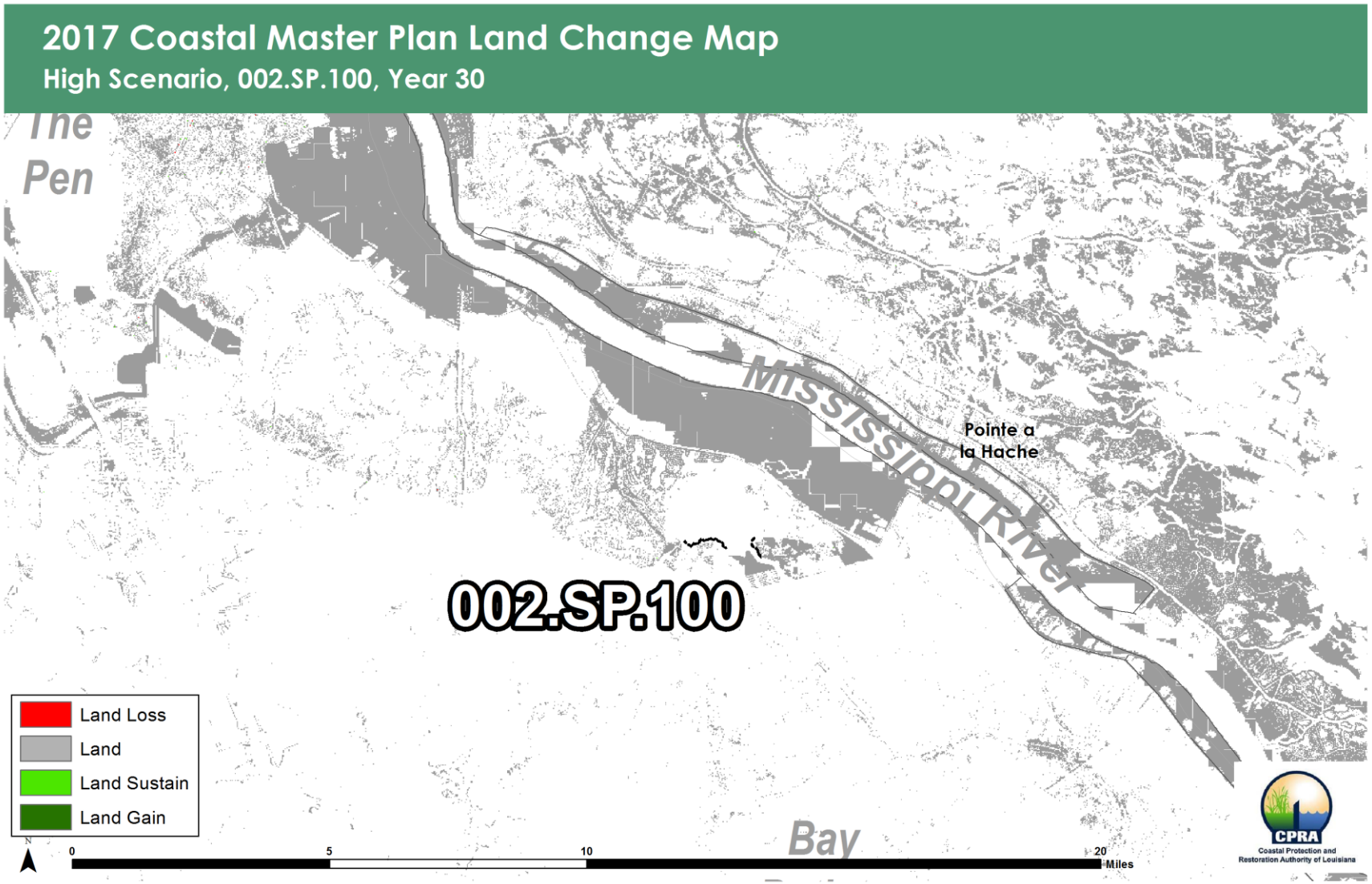
LAKE HERMITAGE SHORELINE PROTECTION (002.SP.100)



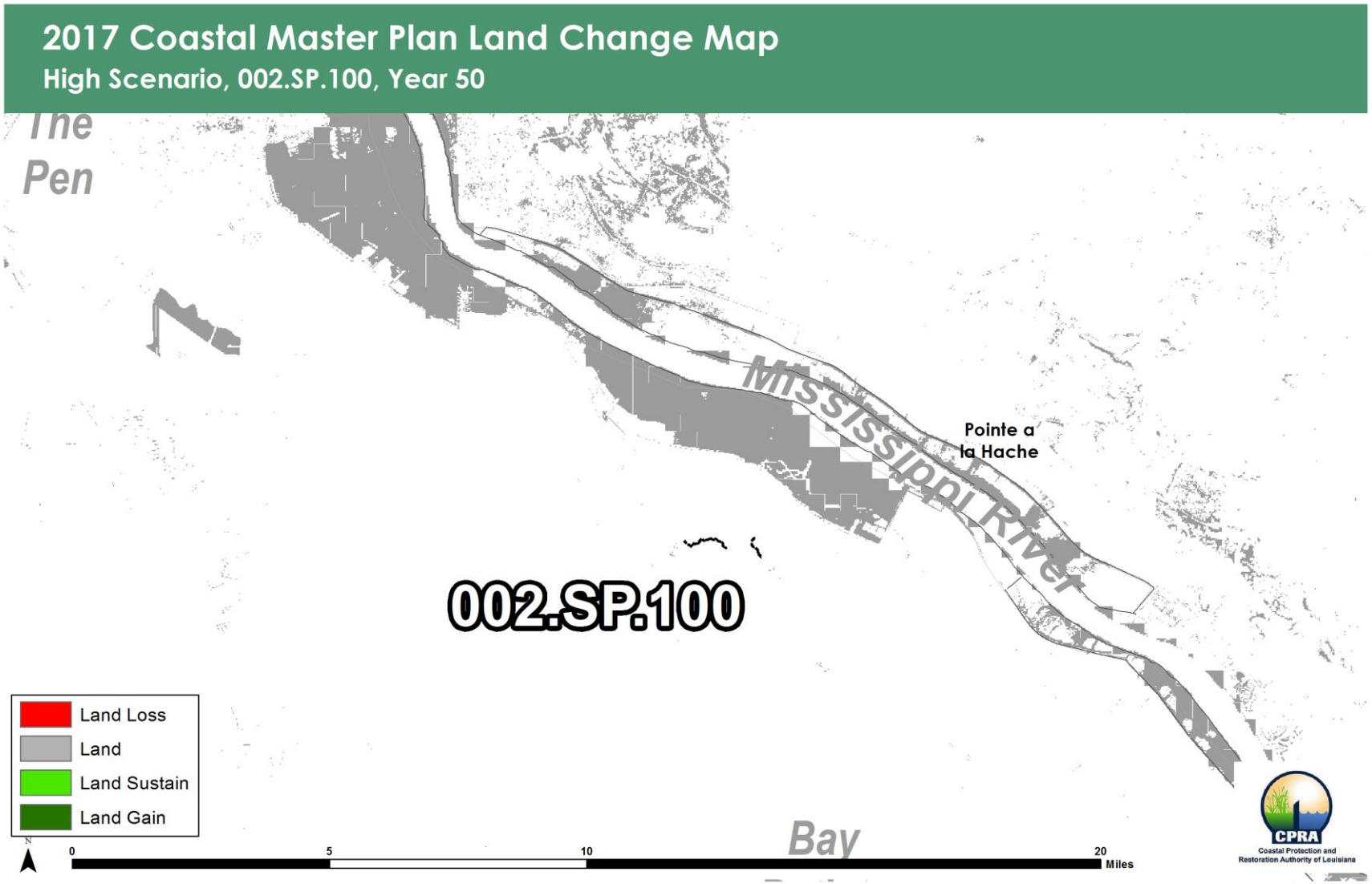
LAKE HERMITAGE SHORELINE PROTECTION (002.SP.100)



LAKE HERMITAGE SHORELINE PROTECTION (002.SP.100)



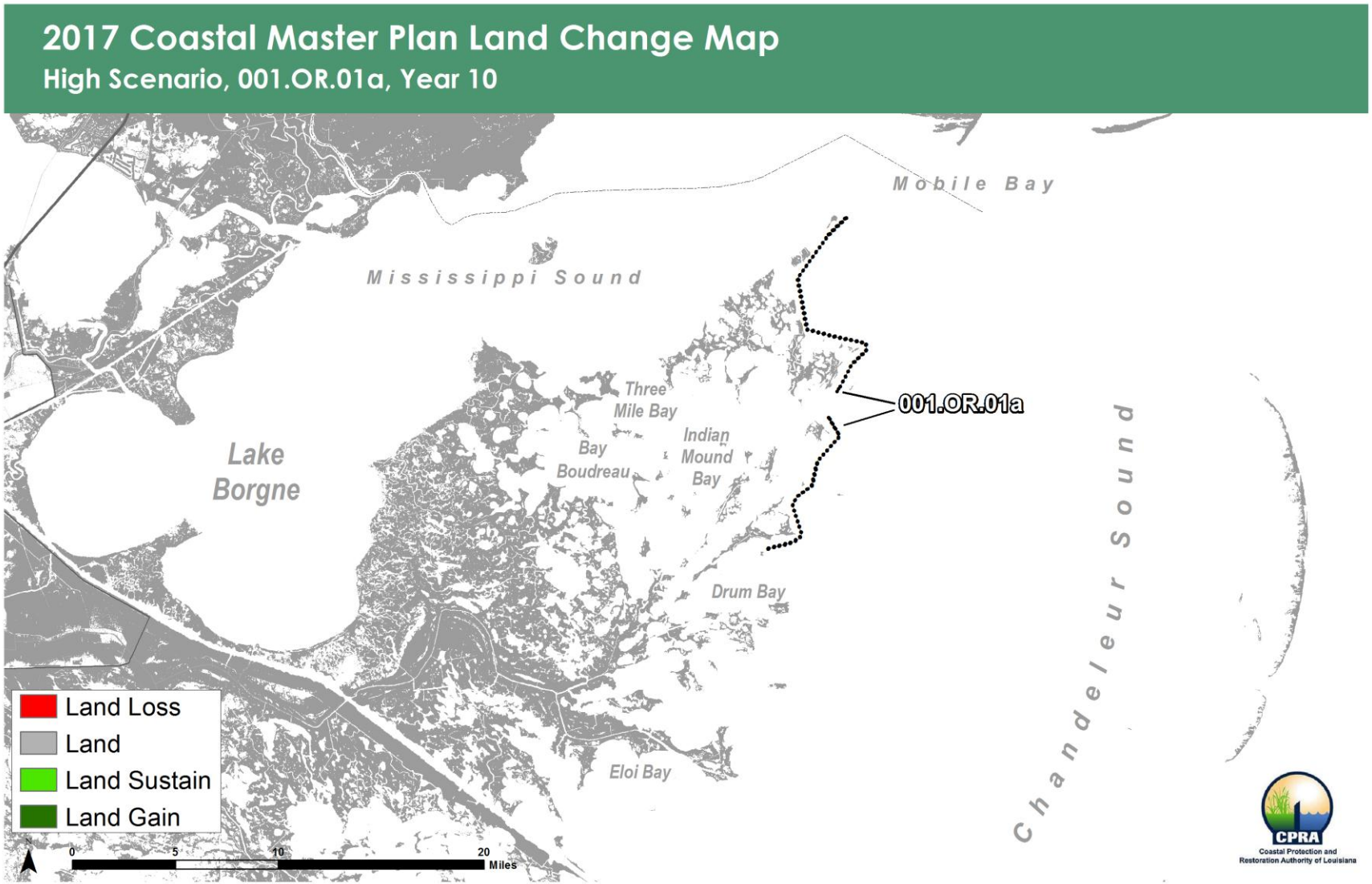
LAKE HERMITAGE SHORELINE PROTECTION (002.SP.100)



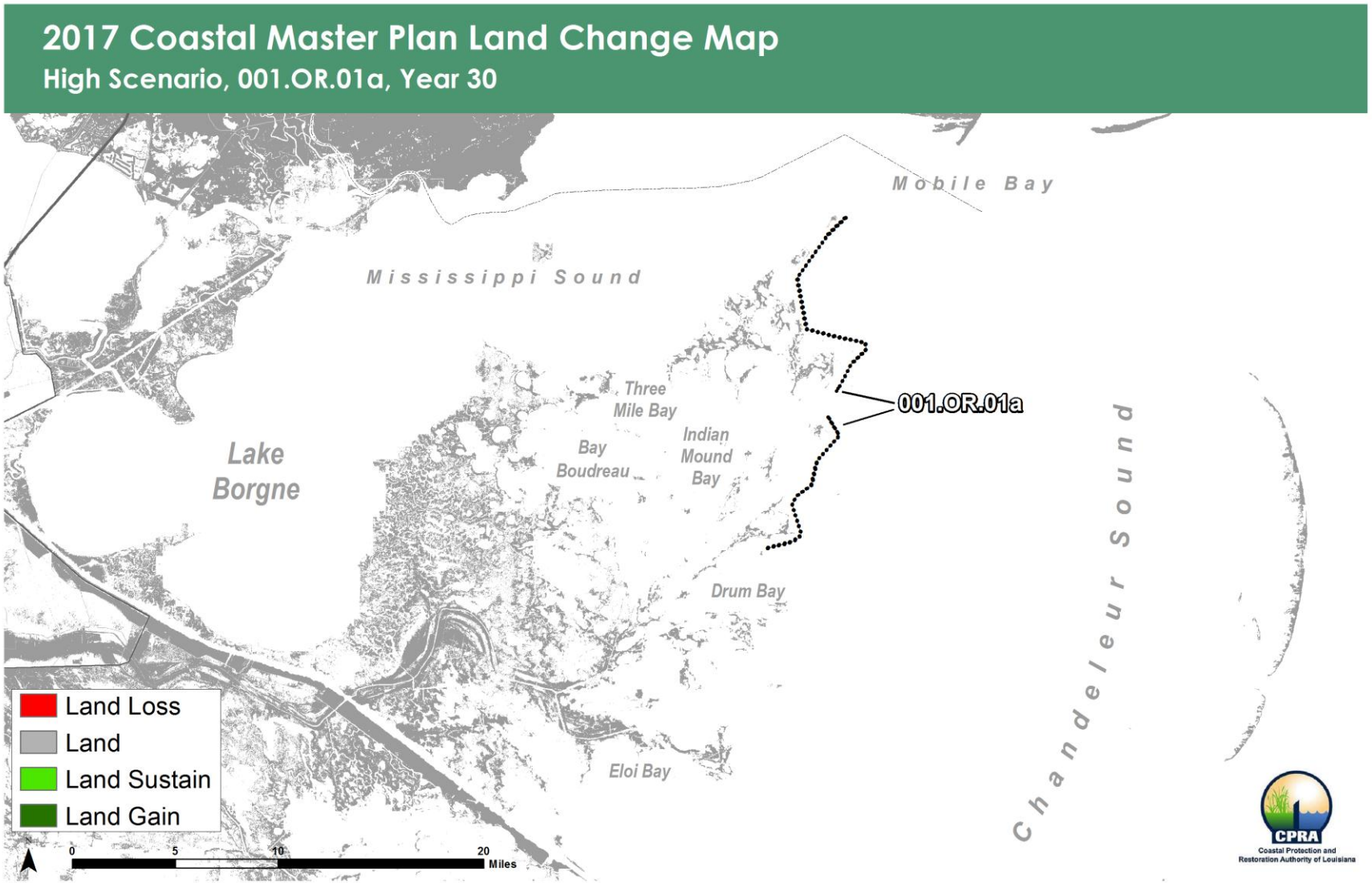
BILOXI MARSH OYSTER REEF (001.OR.01A)

- Creation of approximately 112,307 feet of oyster barrier reef along the eastern shore of Biloxi Marsh to provide oyster habitat, reduce wave erosion, and prevent further marsh degradation
- Implementation Year - 7

BILOXI MARSH OYSTER REEF (001.OR.01A)



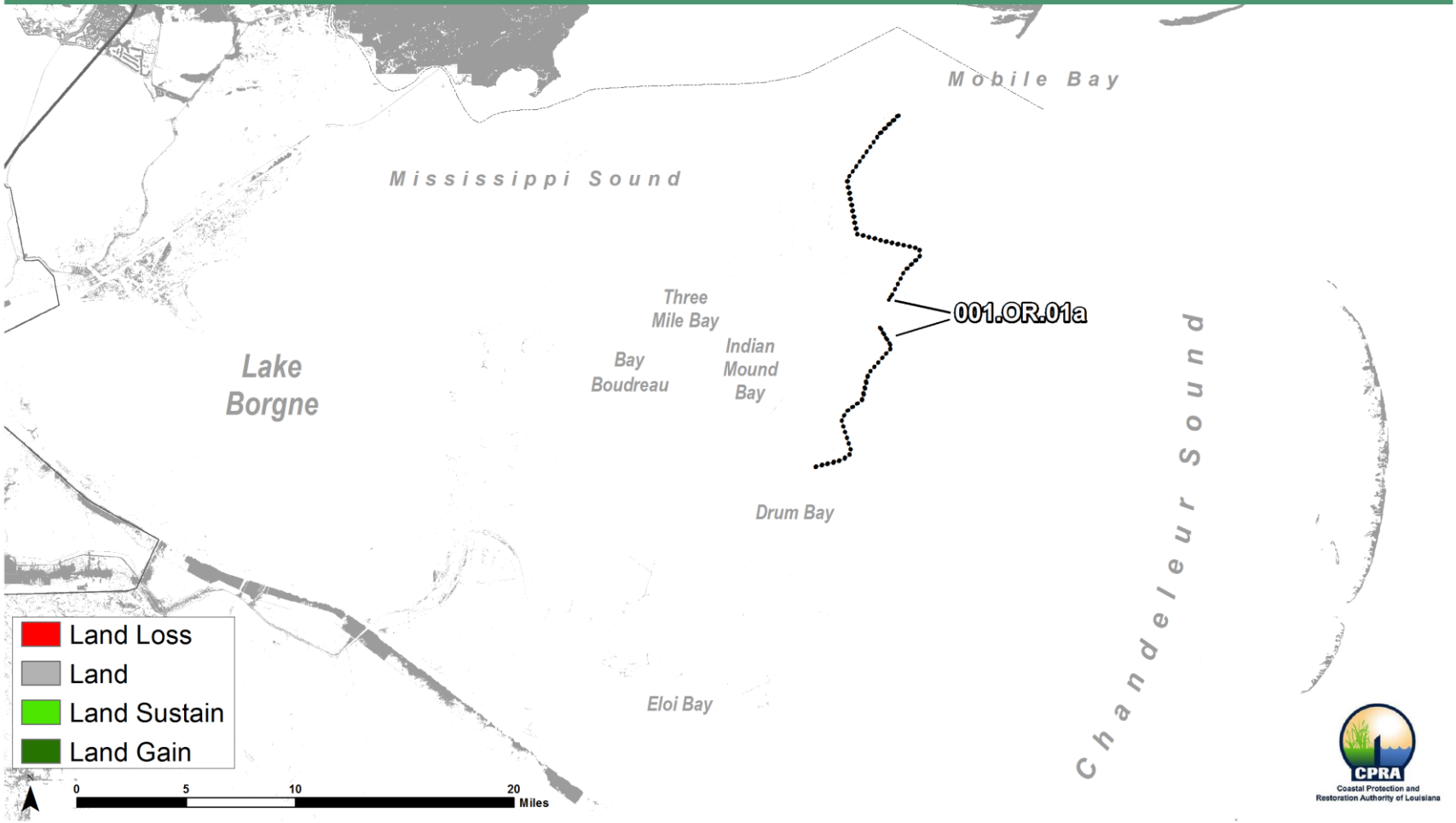
BILOXI MARSH OYSTER REEF (001.OR.01A)



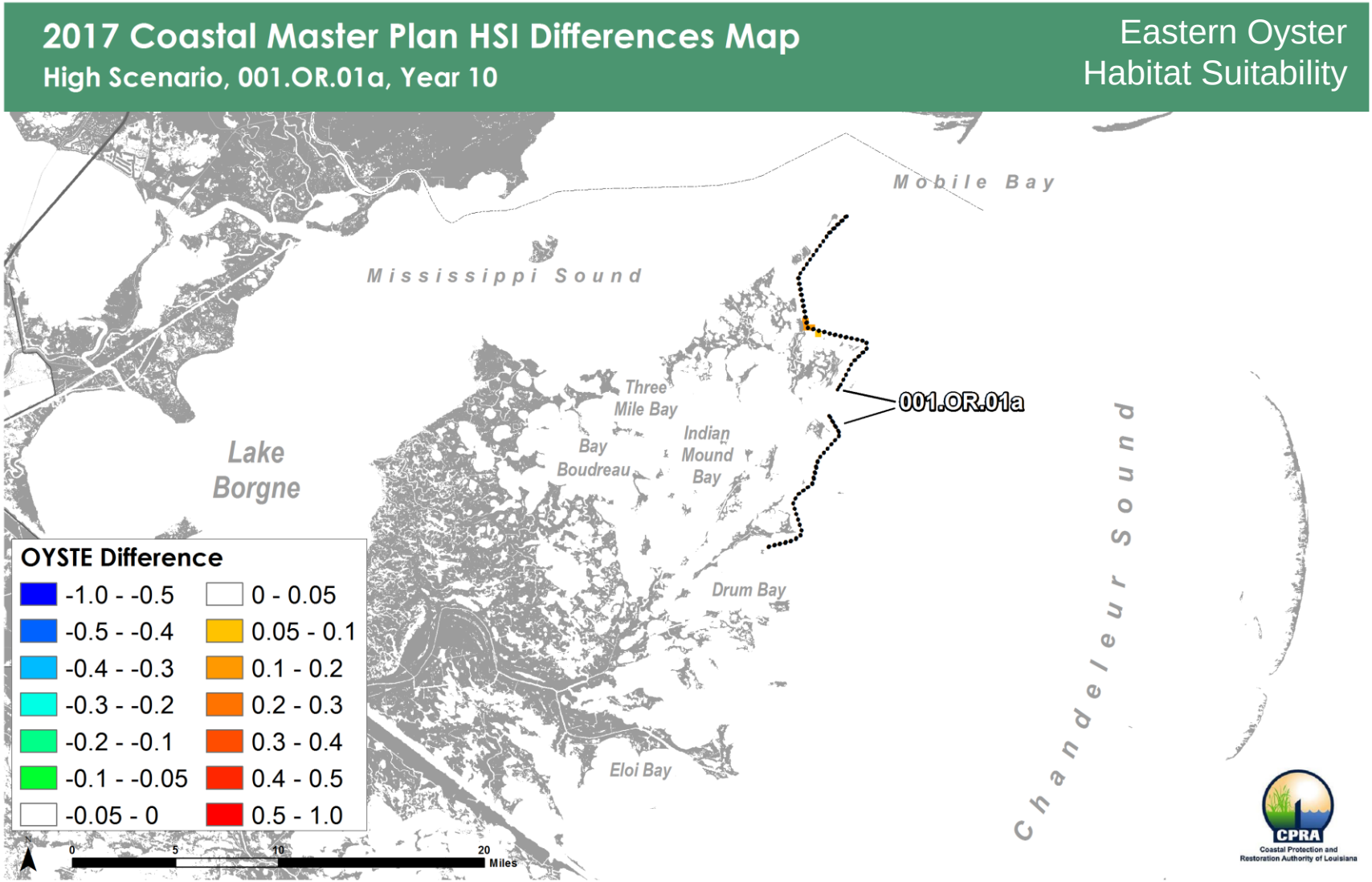
BILOXI MARSH OYSTER REEF (001.OR.01A)

2017 Coastal Master Plan Land Change Map

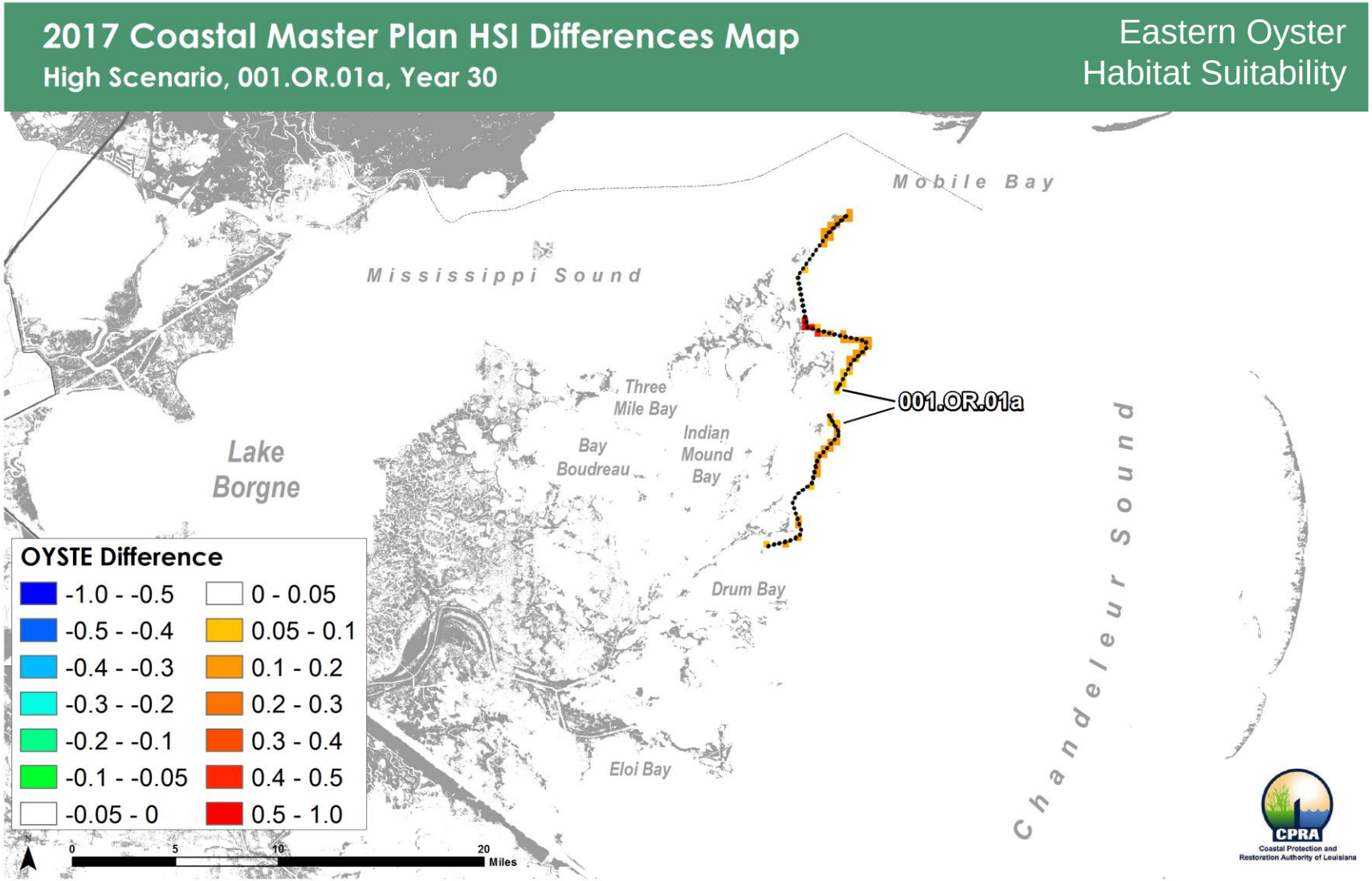
High Scenario, 001.OR.01a, Year 50



BILOXI MARSH OYSTER REEF (001.OR.01A)



BILOXI MARSH OYSTER REEF (001.OR.01A)

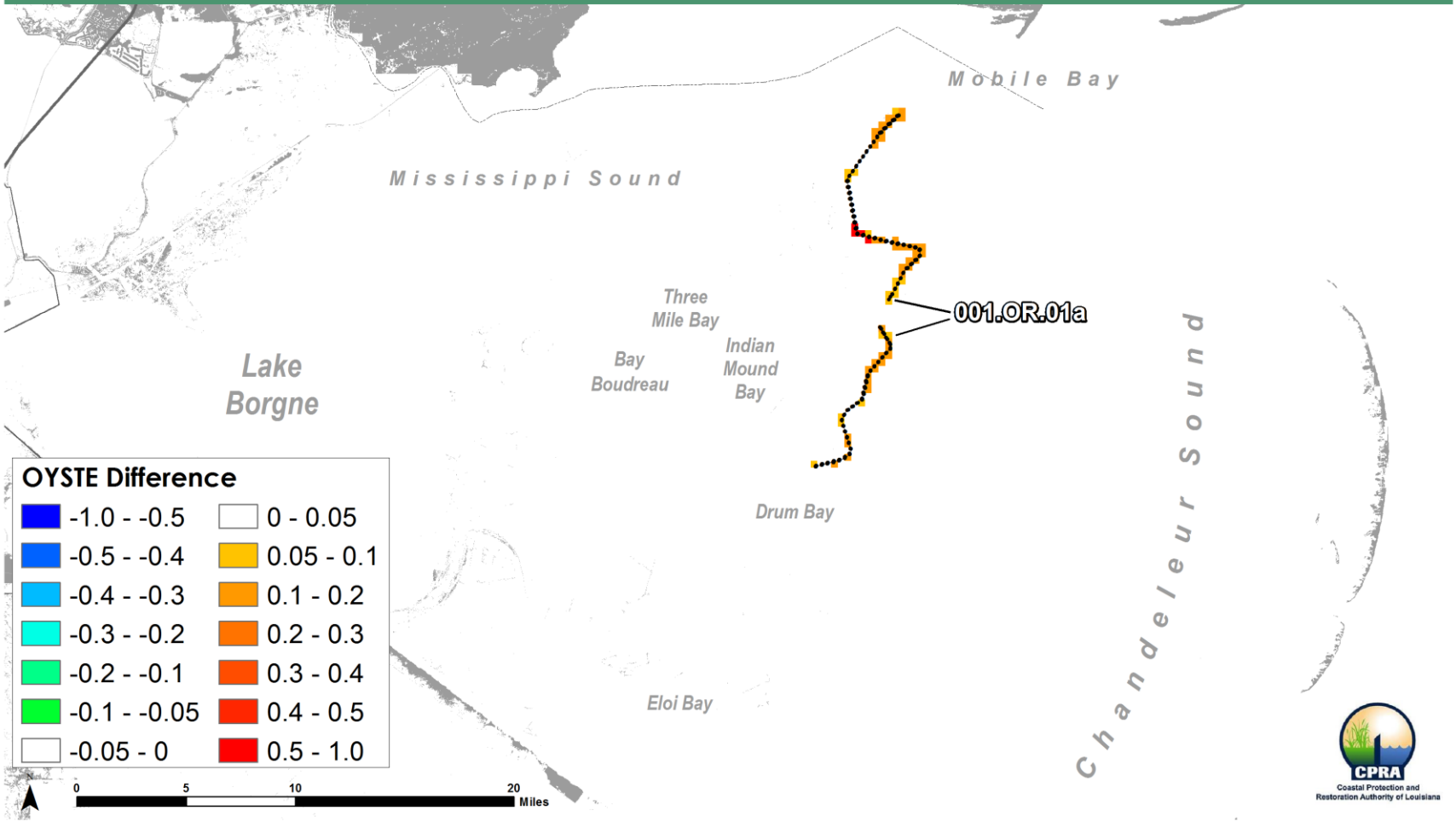


BILOXI MARSH OYSTER REEF (001.OR.01A)

2017 Coastal Master Plan HSI Differences Map

High Scenario, 001.OR.01a, Year 50

Eastern Oyster
Habitat Suitability



PROJECT INTERACTIONS

PROJECT INTERACTION RUN OBJECTIVES

- Initial plan formulation in Planning Tool conducted on output from individual project runs

- When multiple projects are combined in one run (e.g. Alternatives/Draft Plan/Final Plan)
  - Are any projects synergistic (i.e., greater than the sum of their parts)?
  - Are any projects redundant (i.e., build or sustain the same land)?

- Structural protection projects were not run in the landscape model during individual project runs
  - Are there discernible landscape impacts in the ICM from structural protection projects?
  - Will any impacts from structural protection projects be synergistic/redundant with restoration projects?

PROJECT INTERACTION RUNS

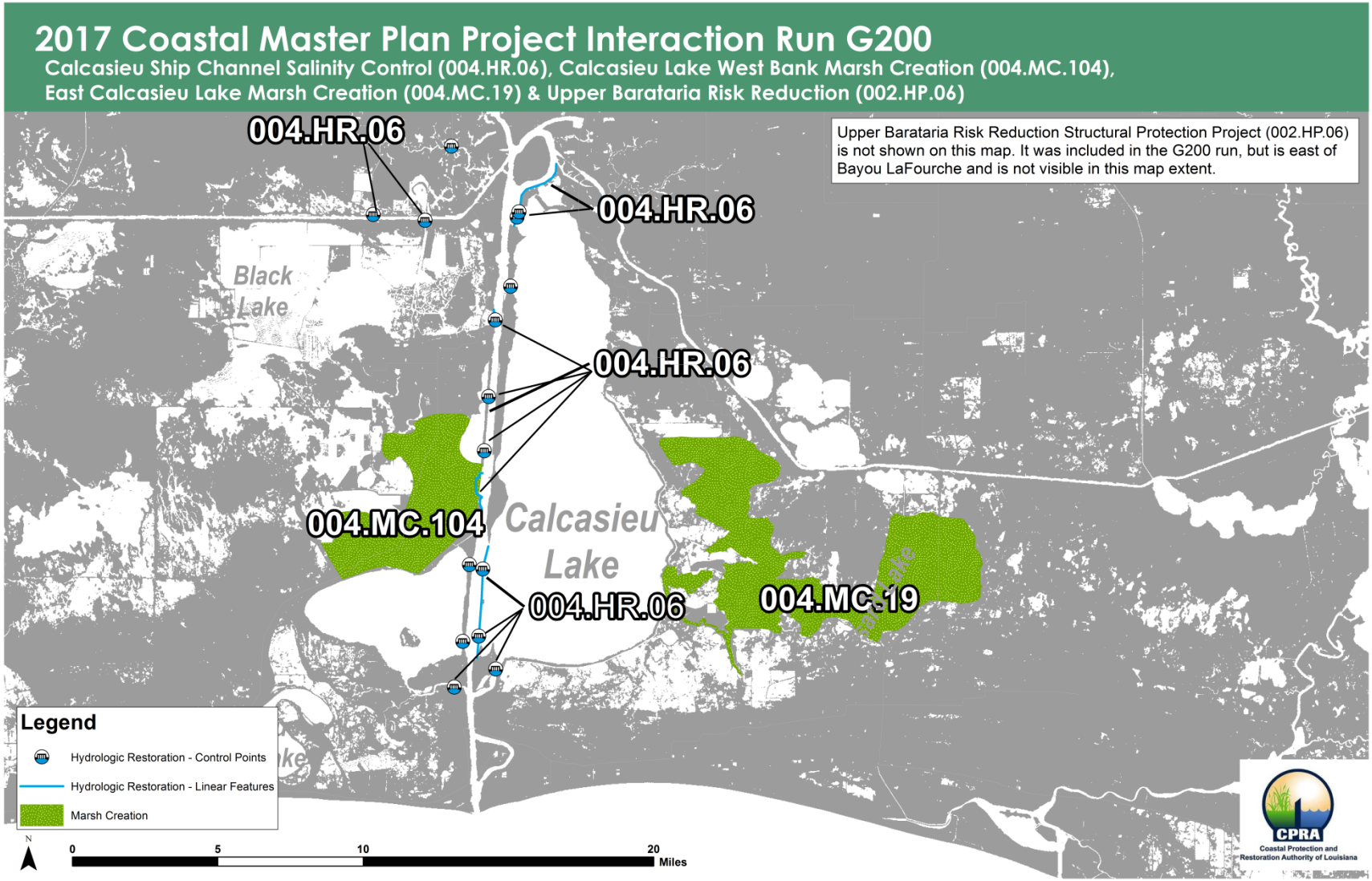
24 configurations modeled to test interaction between:

- Marsh creation & diversions
- Marsh creation & hydrologic restoration
- Ridge restoration & diversions
- Diversions & structural protection
- Marsh creation & diversion & structural protection
- Diversions & barrier island restoration
- Multiple diversions
- Diversion operations

Medium and High scenario was run for project interaction test runs

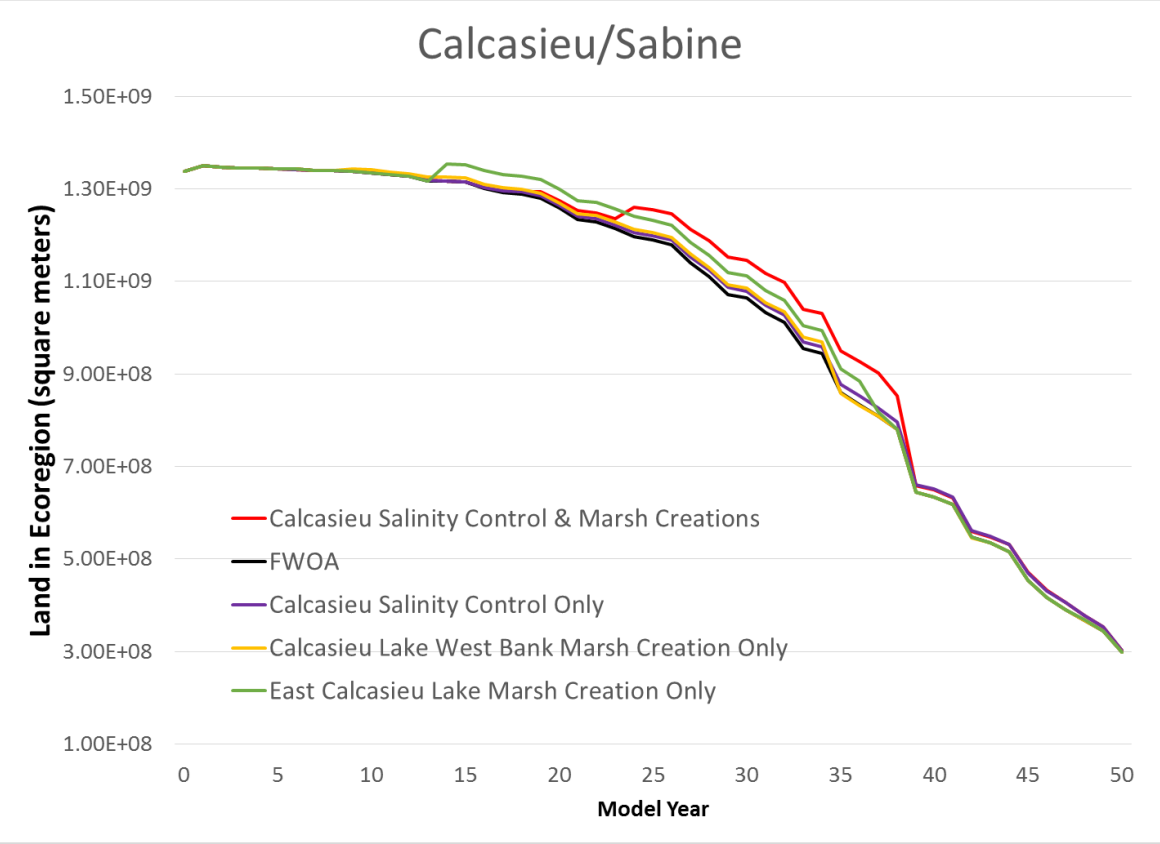
- Except for diversion operations runs which only used High

CALCASIEU SHIP CHANNEL SALINITY CONTROL & ADJACENT MARSH CREATION PROJECTS



CALCASIEU SHIP CHANNEL SALINITY CONTROL & ADJACENT MARSH CREATION PROJECTS

- Year 4: Calcasieu Ship Channel Salinity Control (004.HR.06)
- Year 19: Calcasieu Lake West Bank Marsh Creation (004.MC.104)
- Year 24: East Calcasieu Lake Marsh Creation (004.MC.19)



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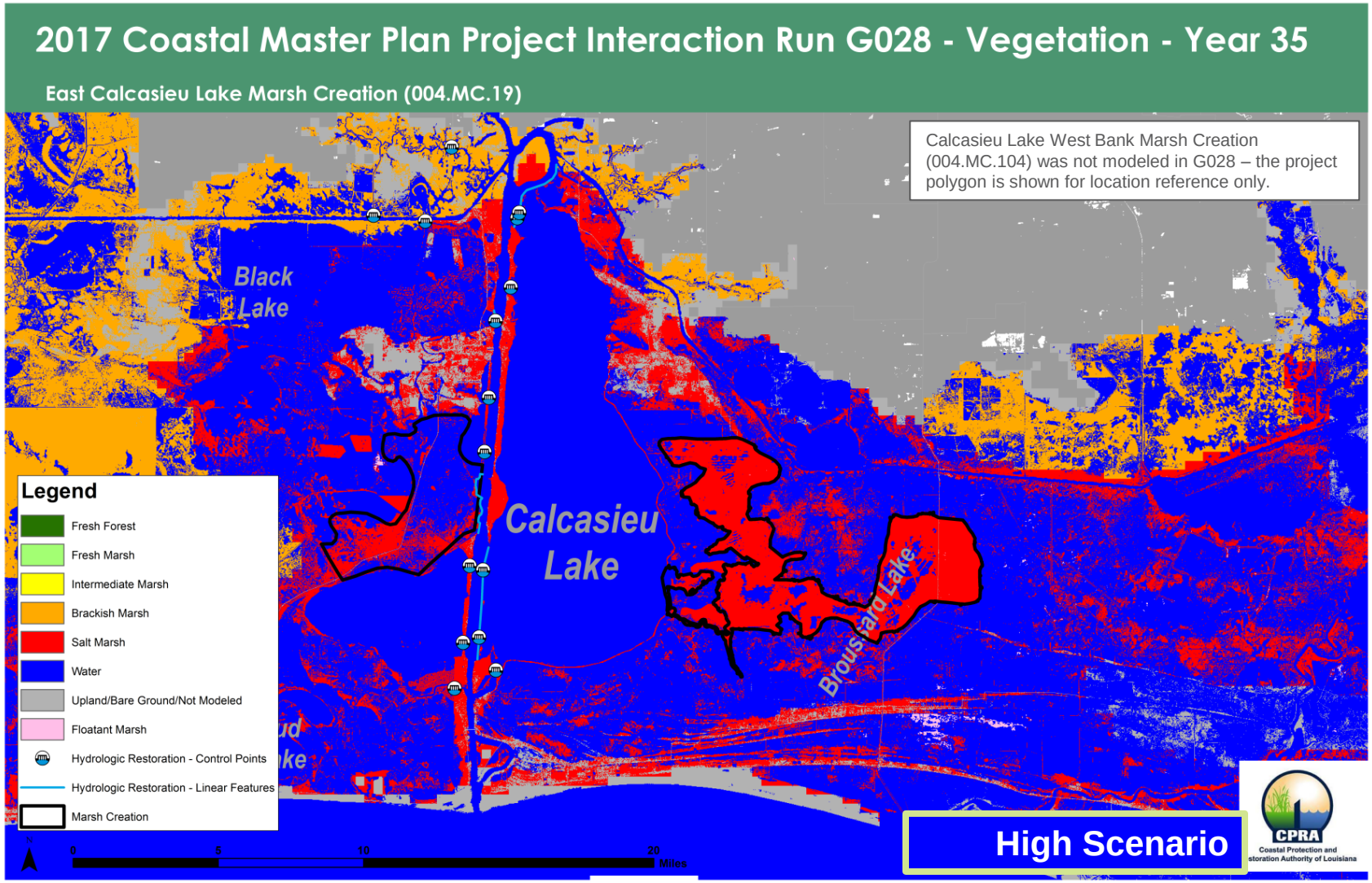
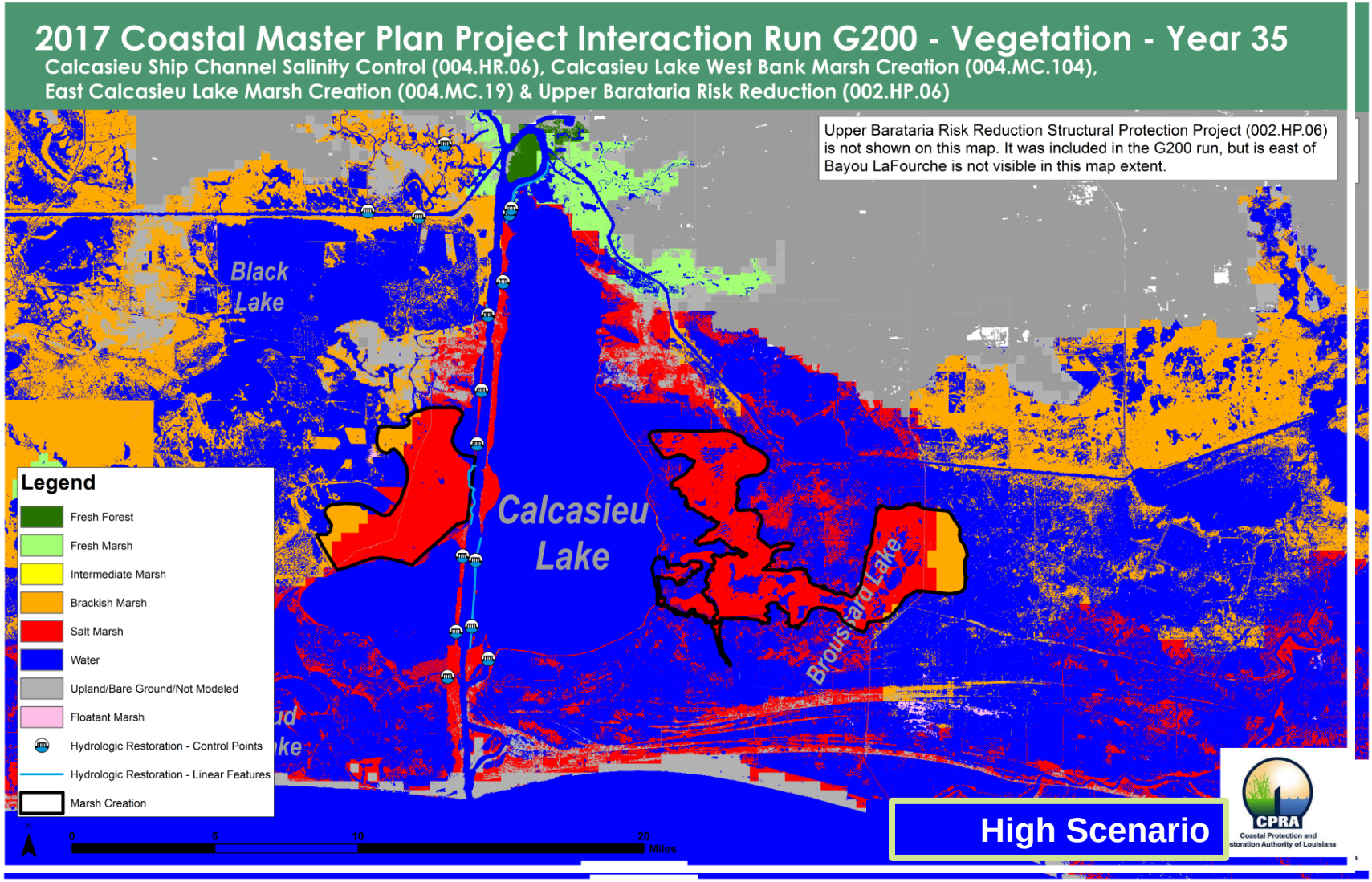


CALCASIEU SHIP CHANNEL SALINITY CONTROL & ADJACENT MARSH CREATION PROJECTS



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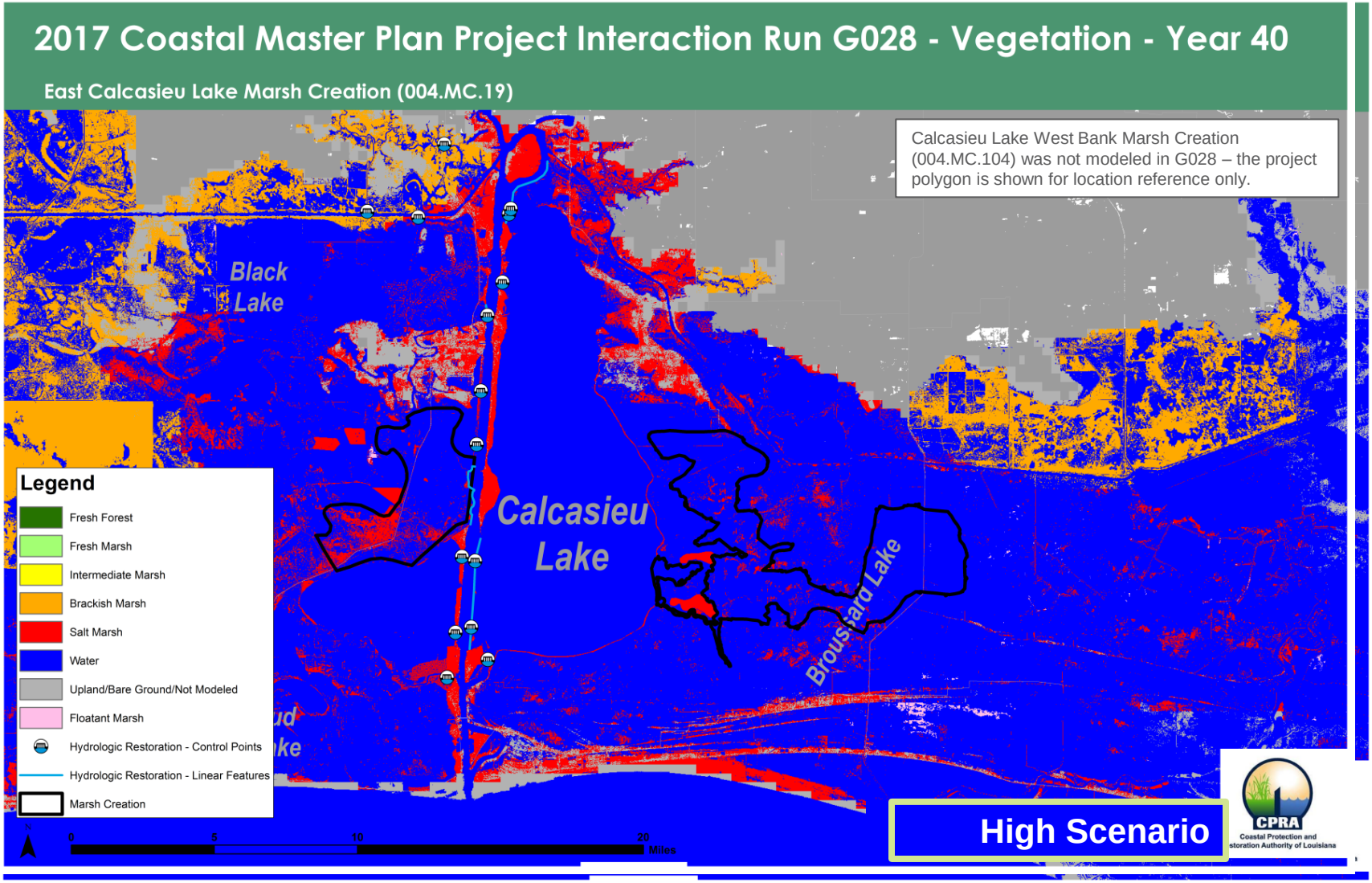

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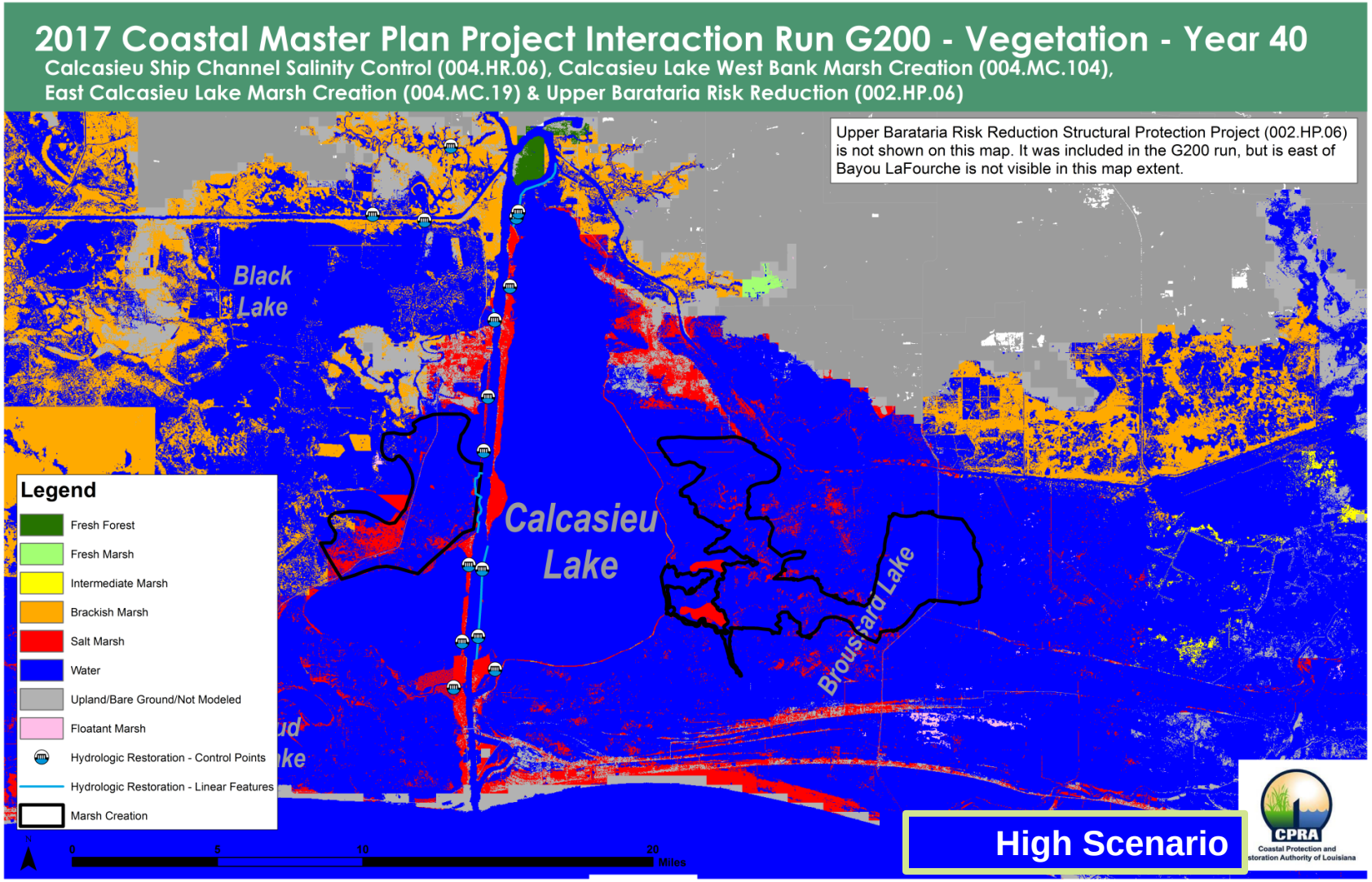

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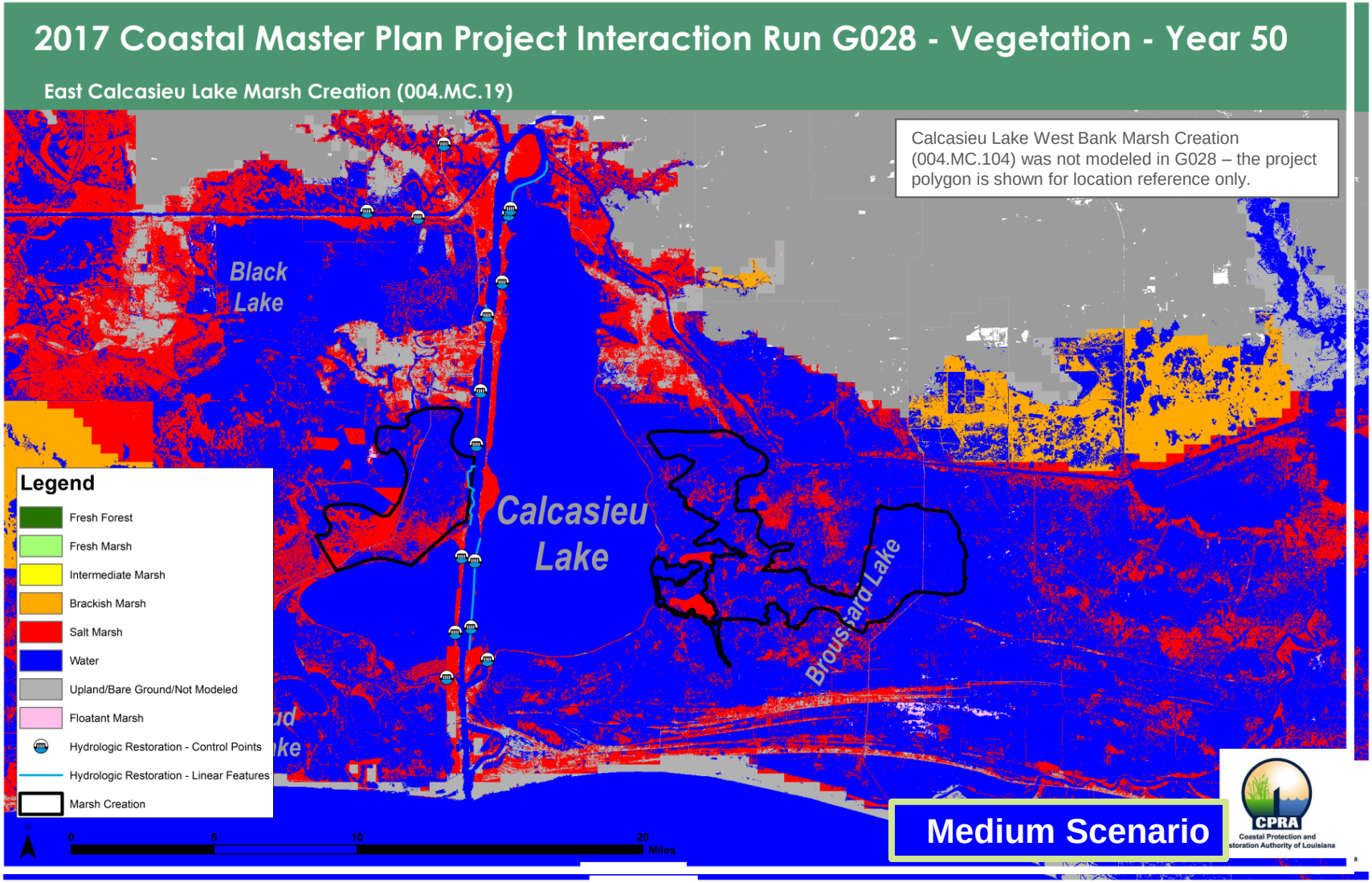

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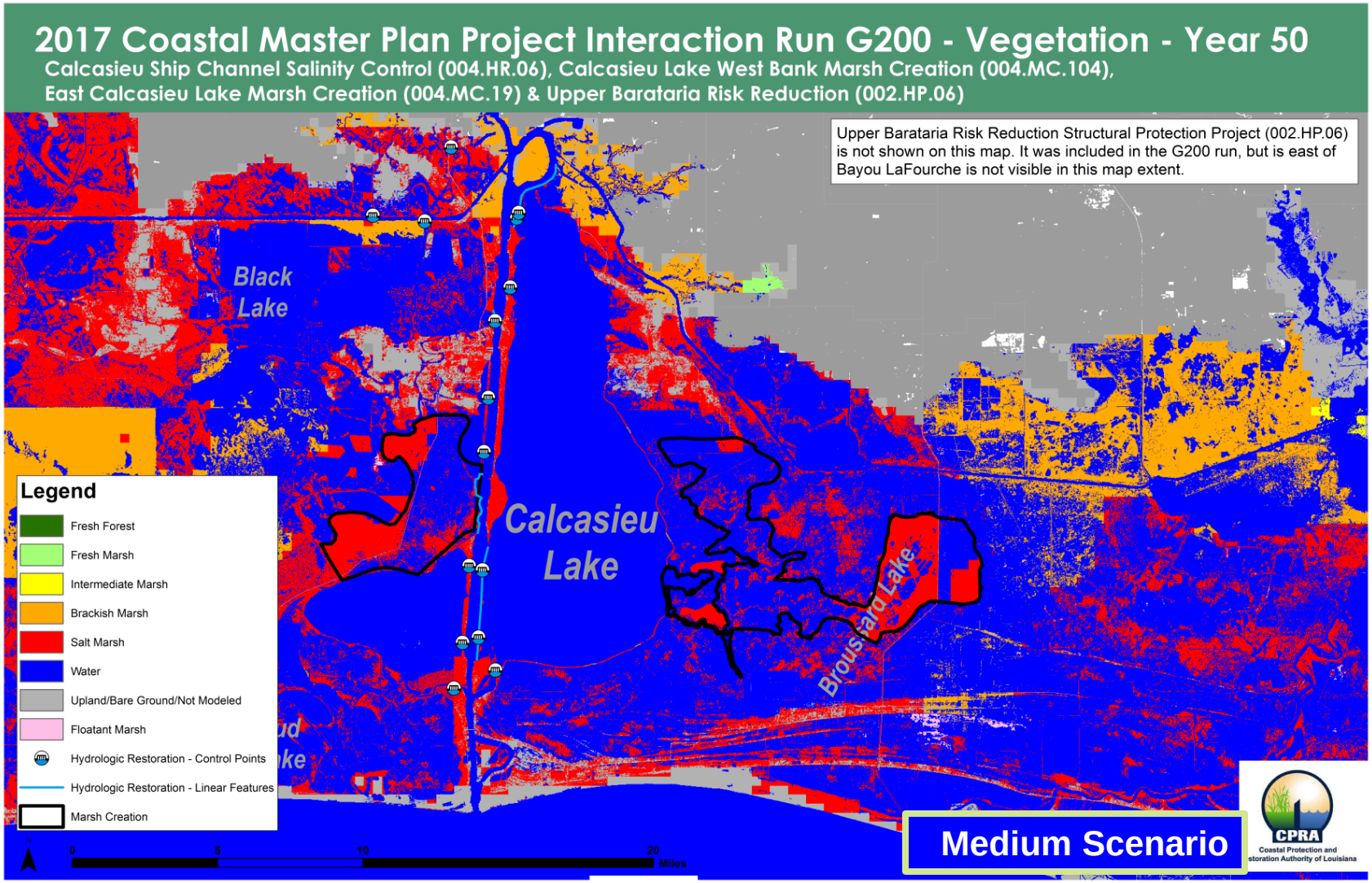
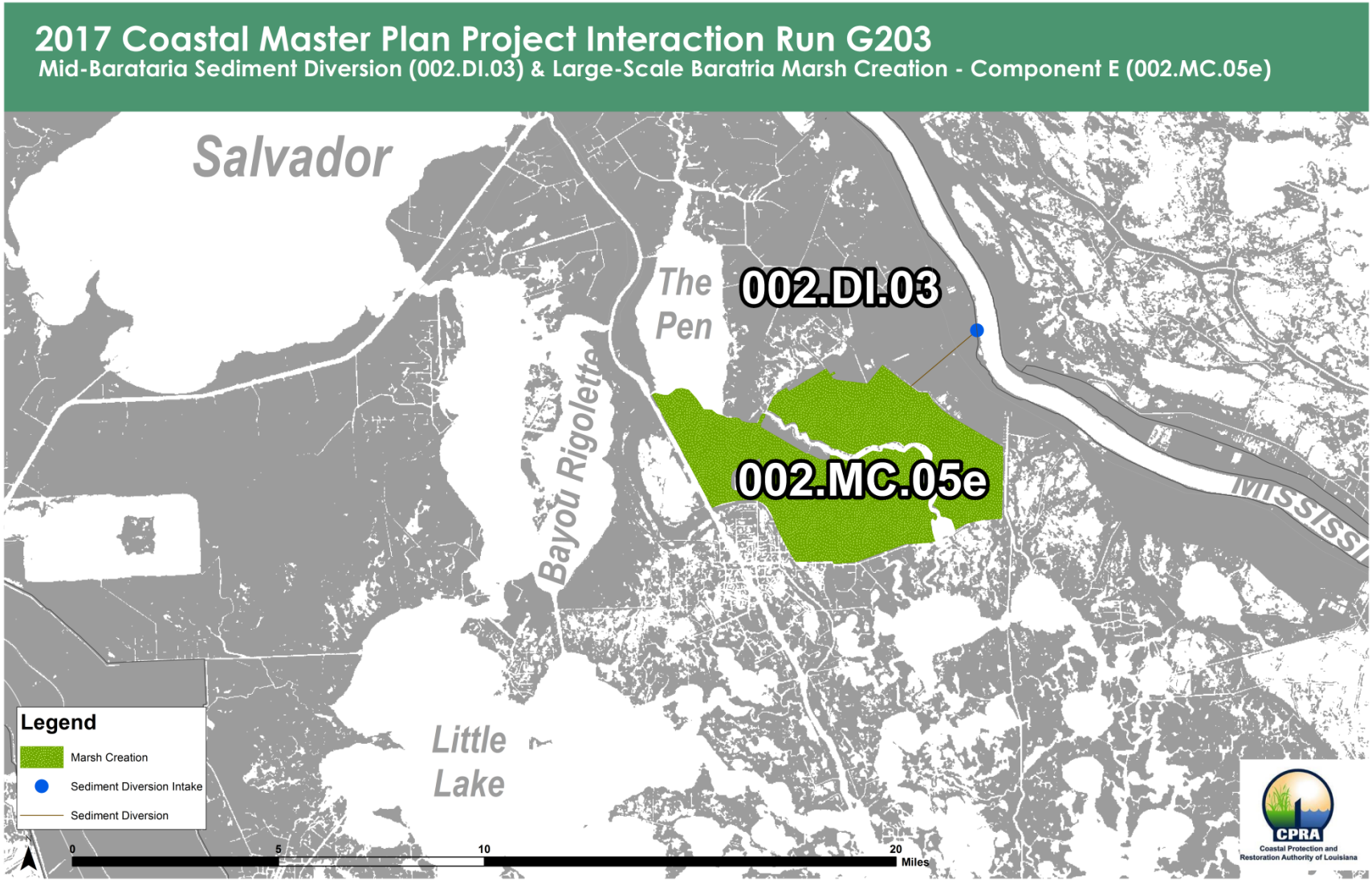
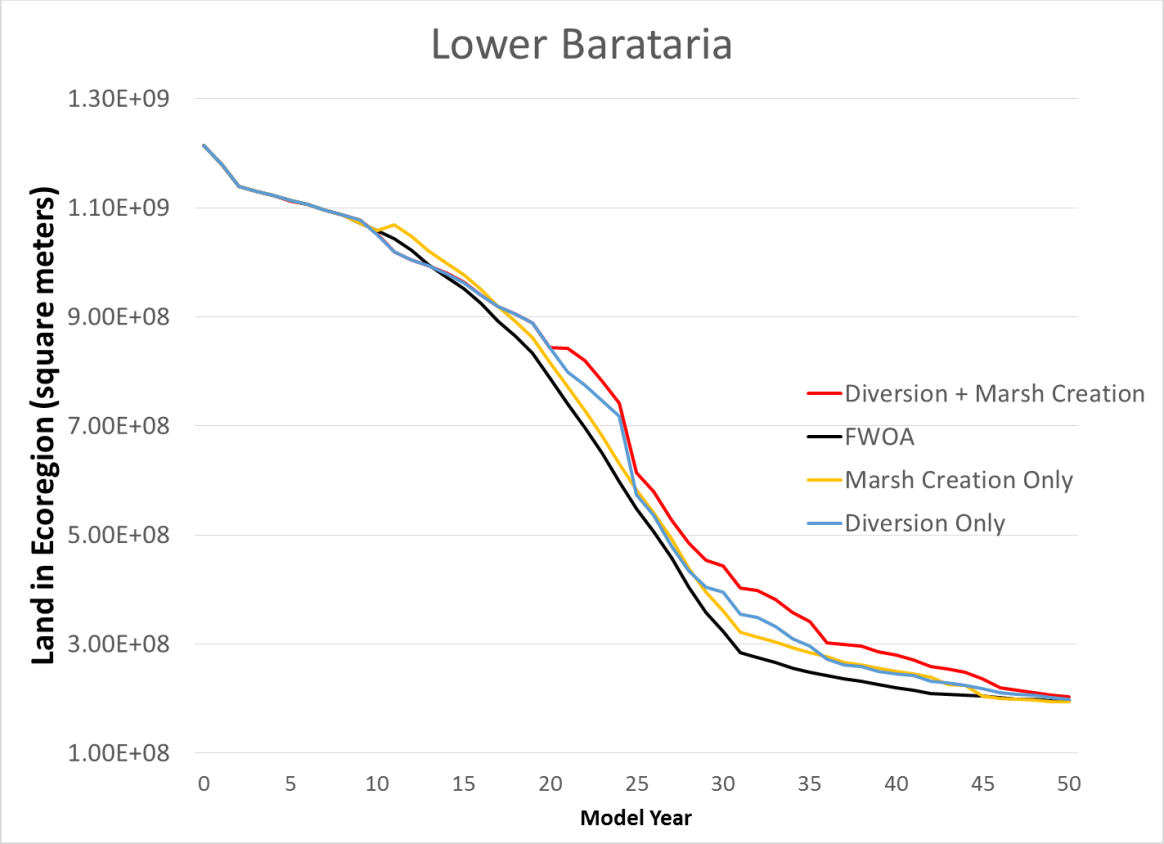


MID-BARATARIA SEDIMENT DIVERSION & ADJACENT MARSH CREATION PROJECT

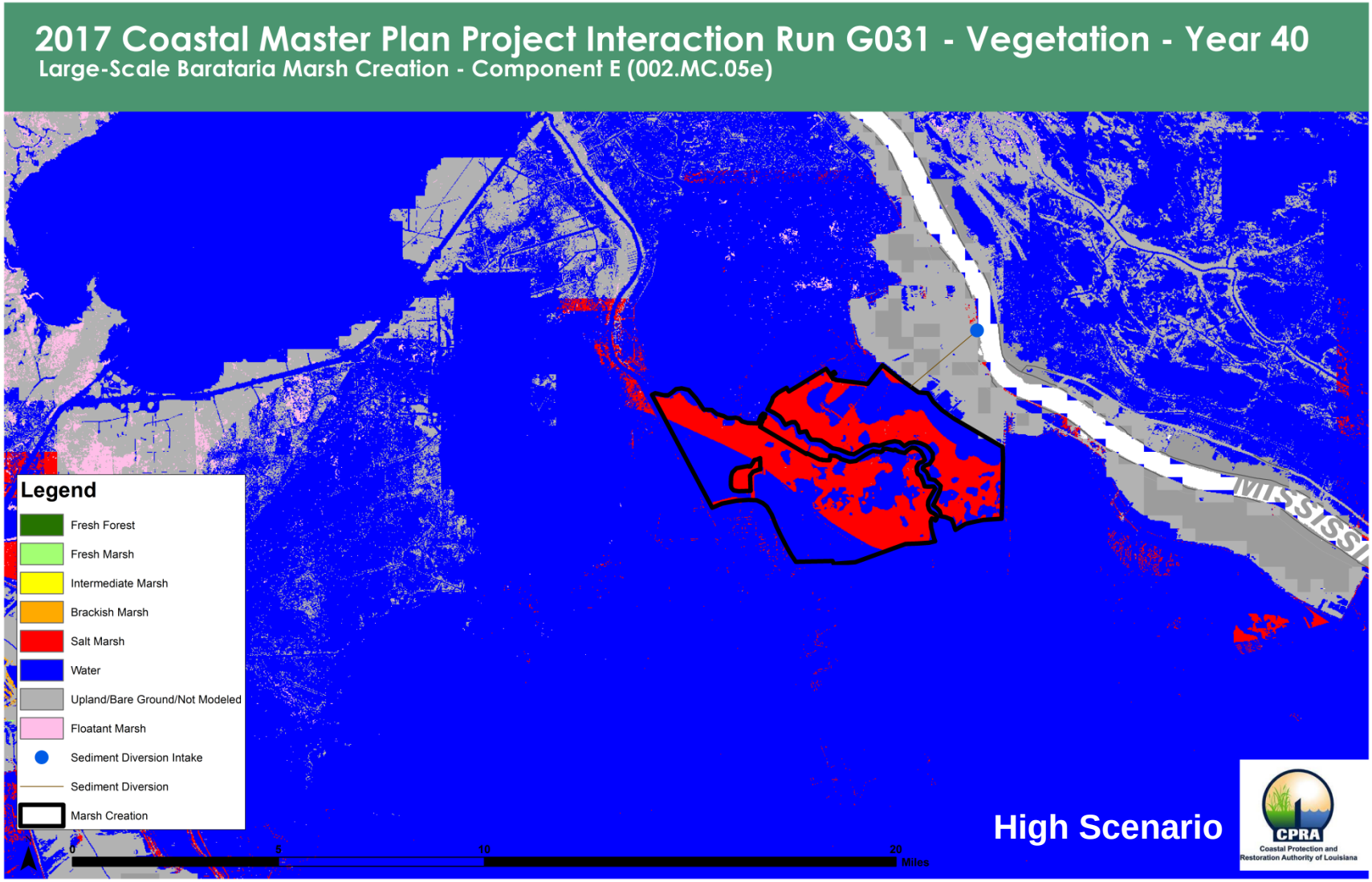


MID-BARATARIA SEDIMENT DIVERSION & ADJACENT MARSH CREATION PROJECT

- Year 9: Mid-Barataria Sediment Diversion (002.DI.03)
- Year 20: Large-Scale Barataria Marsh Creation Component E (002.MC.05e)



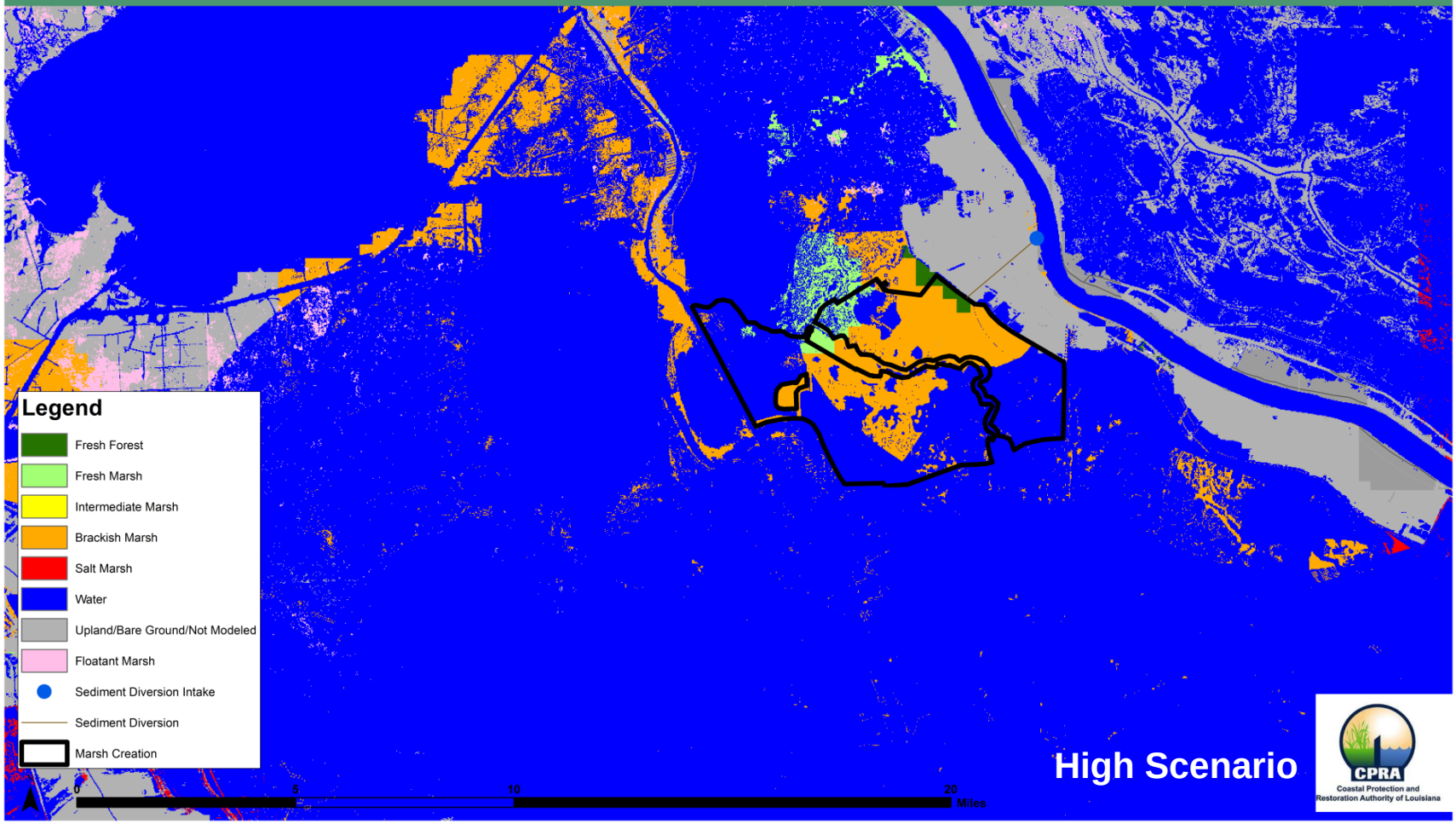
MID-BARATARIA SEDIMENT DIVERSION & ADJACENT MARSH CREATION PROJECT



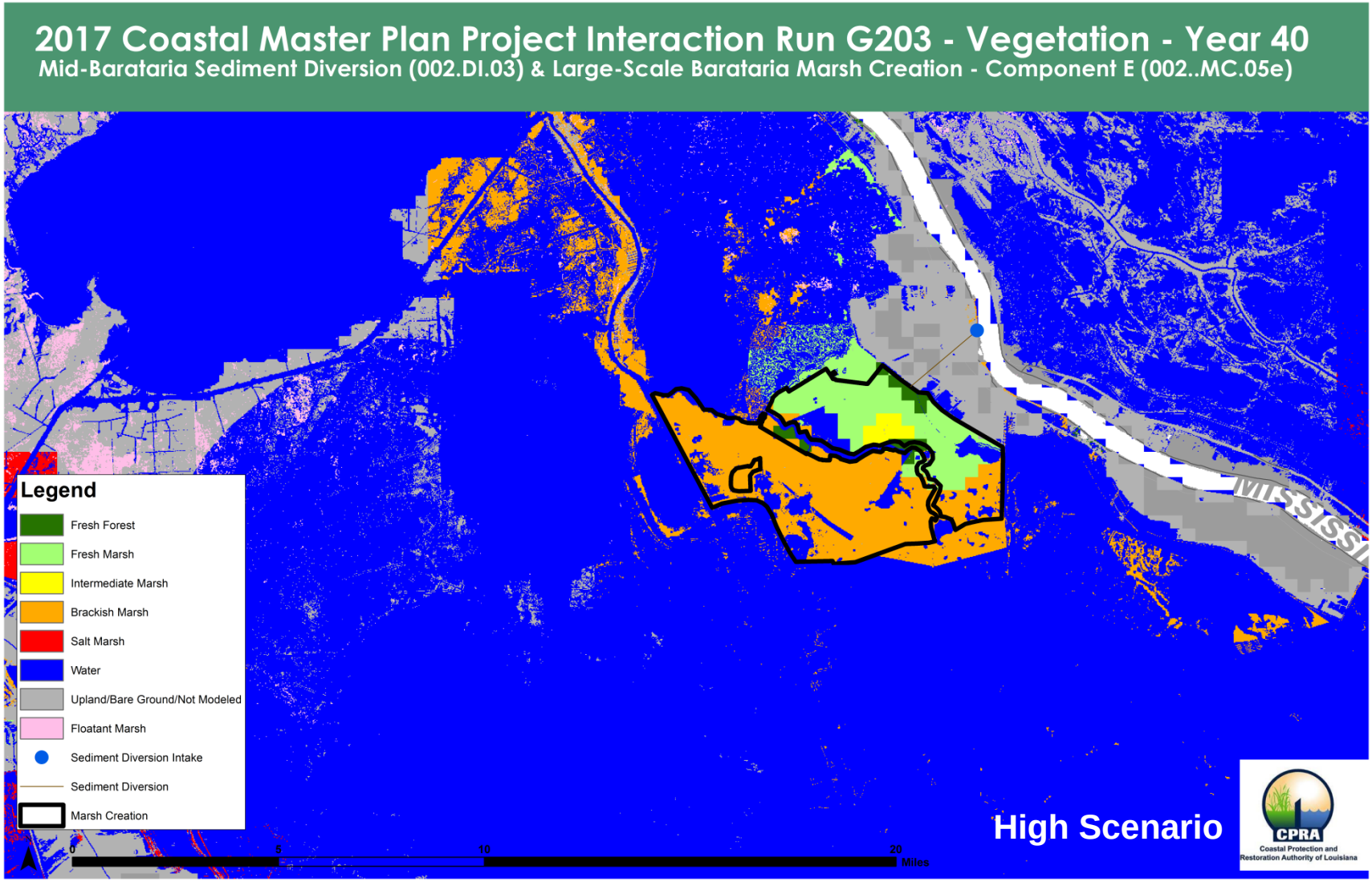
MID-BARATARIA SEDIMENT DIVERSION & ADJACENT MARSH CREATION PROJECT

2017 Coastal Master Plan Project Interaction Run G052 - Vegetation - Year 40

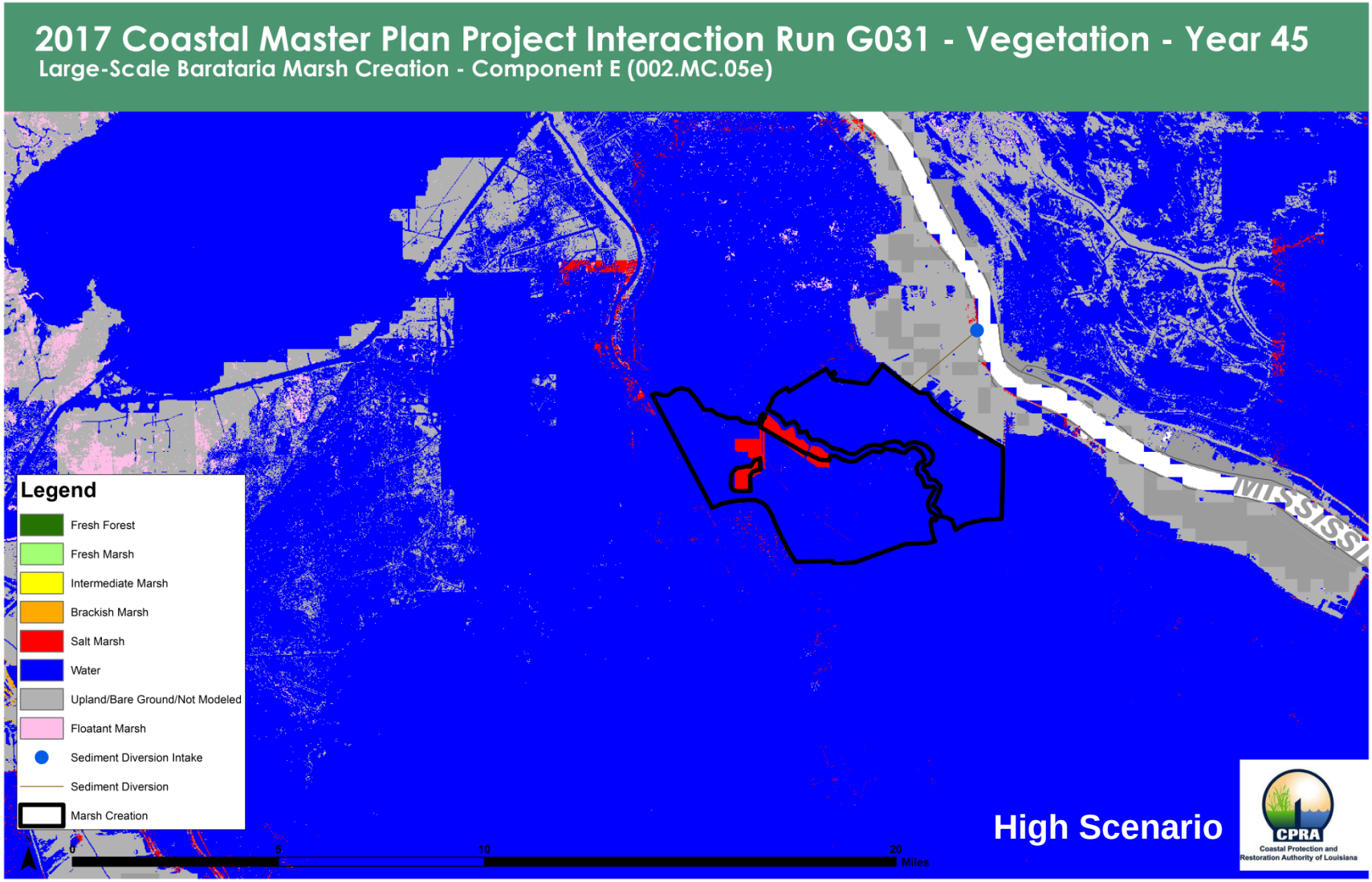
Mid-Barataria Sediment Diversion (002.DI.03)



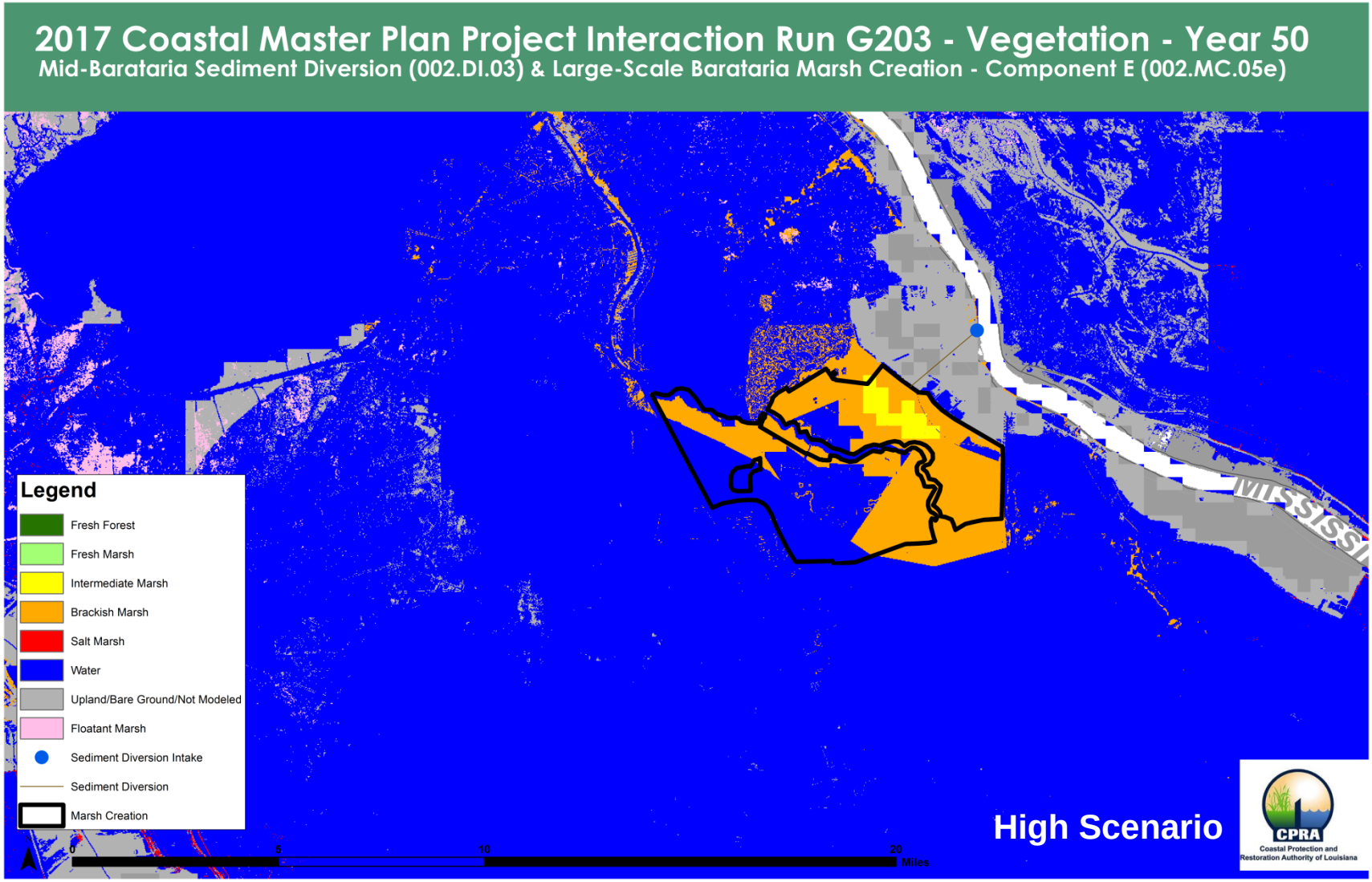
MID-BARATARIA SEDIMENT DIVERSION & ADJACENT MARSH CREATION PROJECT



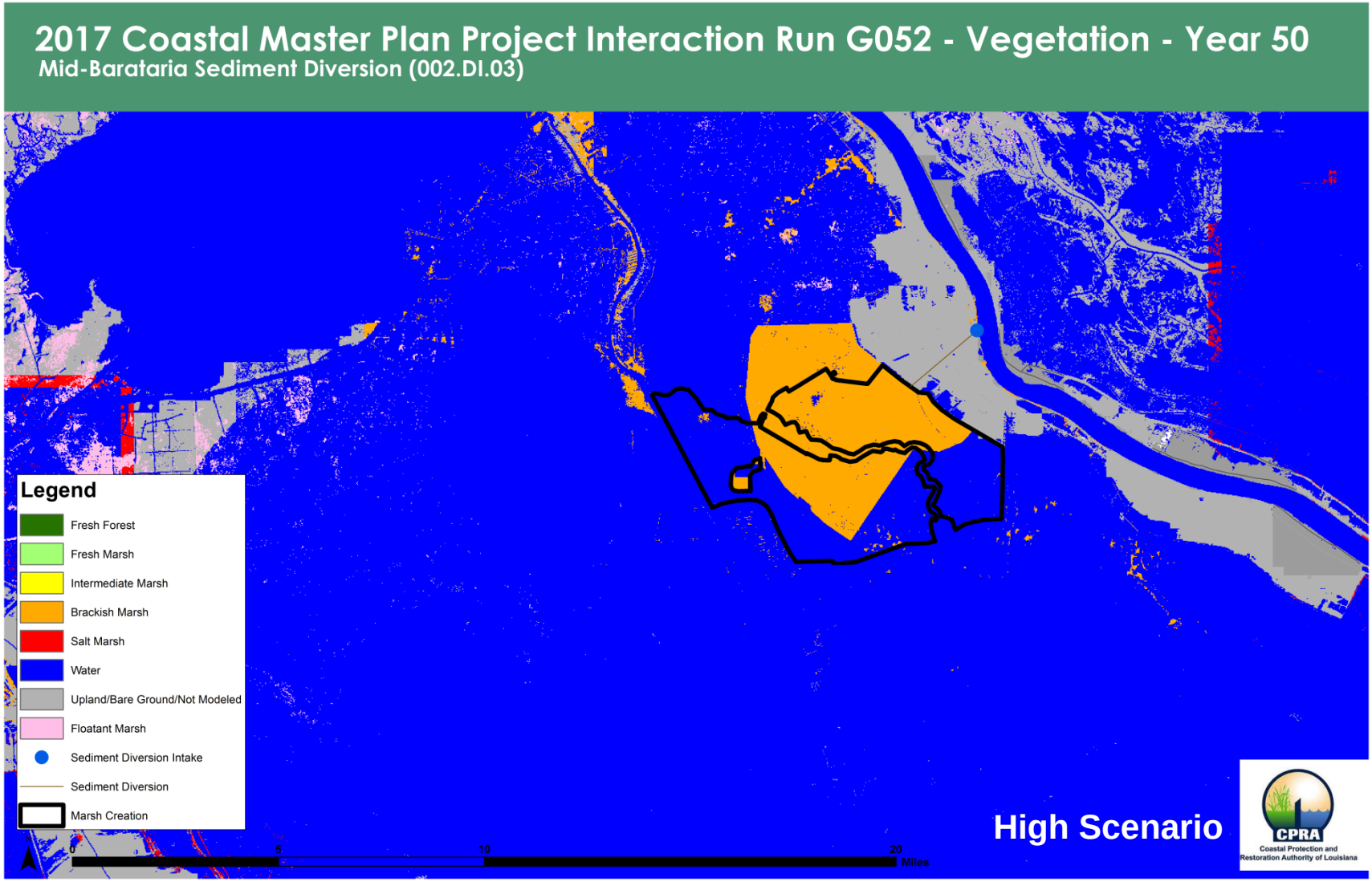
MID-BARATARIA SEDIMENT DIVERSION & ADJACENT MARSH CREATION PROJECT



MID-BARATARIA SEDIMENT DIVERSION & ADJACENT MARSH CREATION PROJECT



MID-BARATARIA SEDIMENT DIVERSION & ADJACENT MARSH CREATION PROJECT



MASTER PLAN TIMELINE

Summer 2016	Evaluate Project Interactions and Alternatives
October 2016	Community Meetings
Fall/Winter 2016	Develop Draft Plan/Draft Project List
January 2017	Draft Plan Released for Public Review
January 2017	Master Plan Public Meetings
April 2017	Submit Final Plan to Legislature

NEXT STEPS

- For additional information on the 2017 Coastal Master Plan including modeling technical reports: http://coastal.la.gov/a-common-vision/master-plan/

- A recording of today's webinar will be posted to the master plan's Videos page: http://coastal.la.gov/resources/videos/

- Please send any additional questions to masterplan@la.gov

QUESTIONS?

coastal.la.gov

THANK YOU