COASTAL **TEXAS** STUDY

A Case Study to Enhance Flood Protection and Resiliency: Overview of Coastal Texas Mega Project

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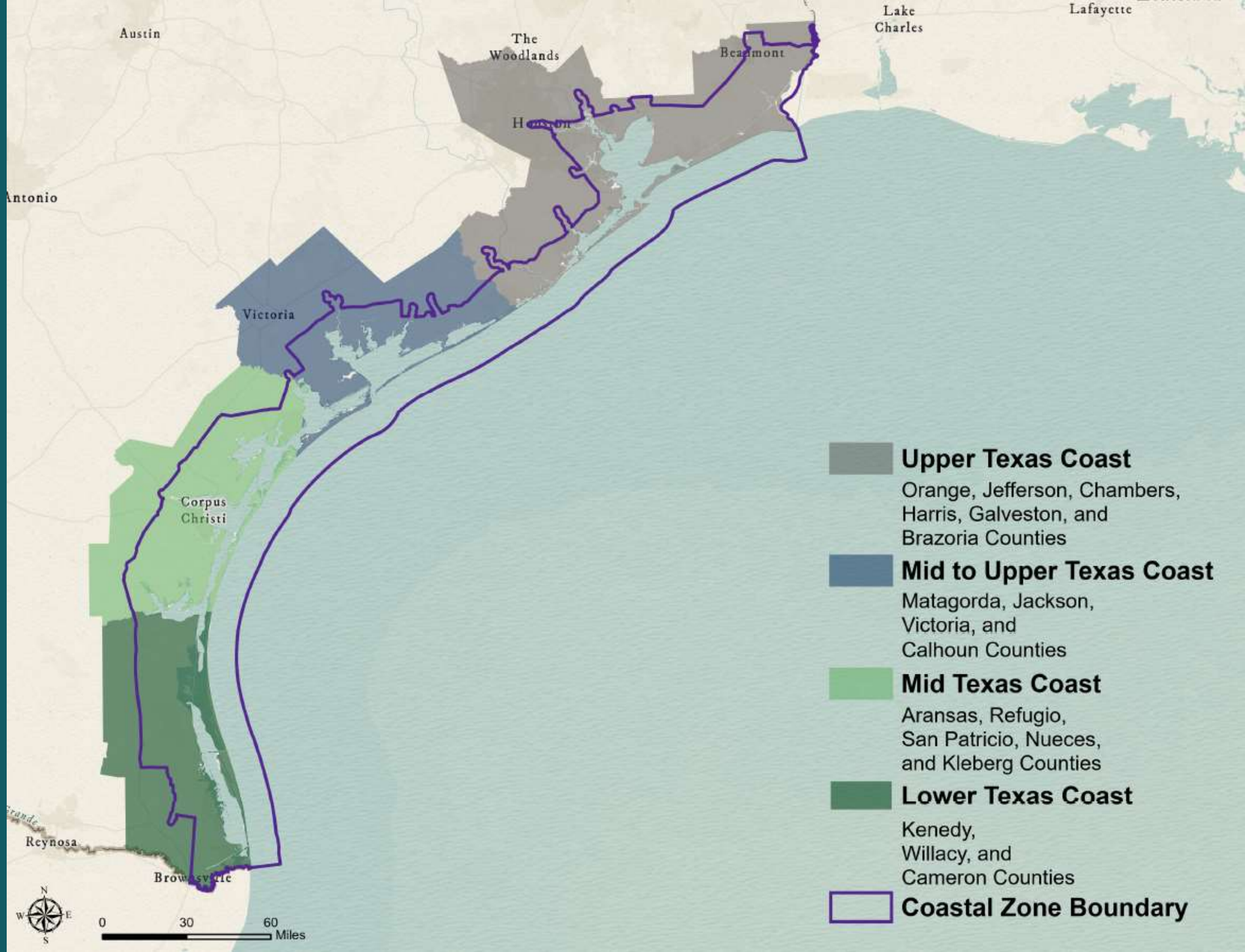
USACE Galveston

Study Area


Austin
The Woodlands
Beaumont
Lake Charles
Lafayette
Antonio
Victoria
Corpus Christi
Reynosa
Brownsville
N
W
E
S
0
30
60
Miles
Upper Texas Coast
Orange, Jefferson, Chambers, Harris, Galveston, and Brazoria Counties
Mid to Upper Texas Coast
Matagorda, Jackson, Victoria, and Calhoun Counties
Mid Texas Coast
Aransas, Refugio, San Patricio, Nueces, and Kleberg Counties
Lower Texas Coast
Kenedy, Willacy, and Cameron Counties
Coastal Zone Boundary

Regional Vulnerability

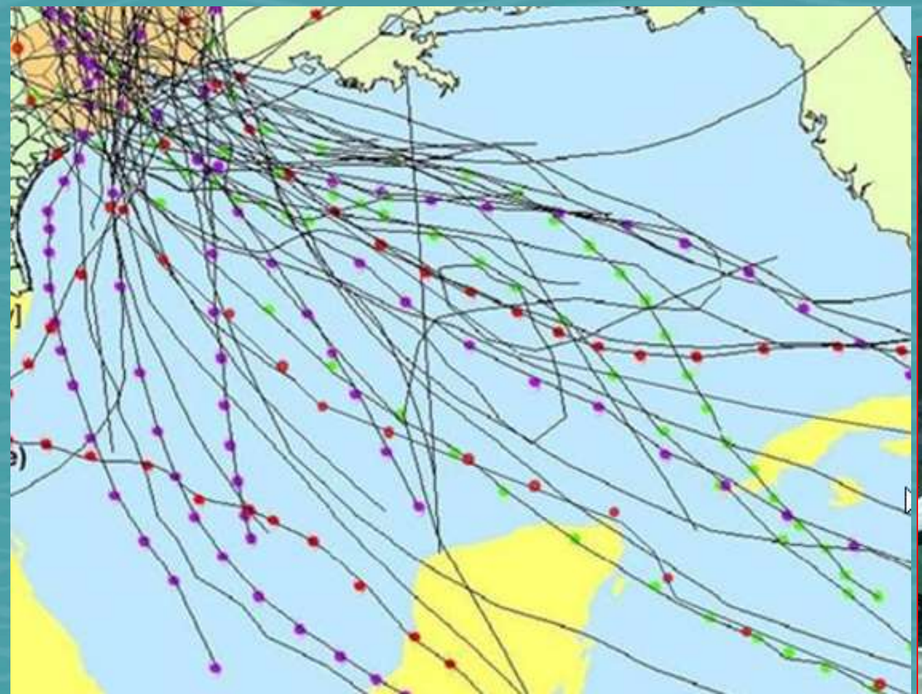
Extreme Impact on Community

13 major hurricanes (7 Cat 4) since 1851

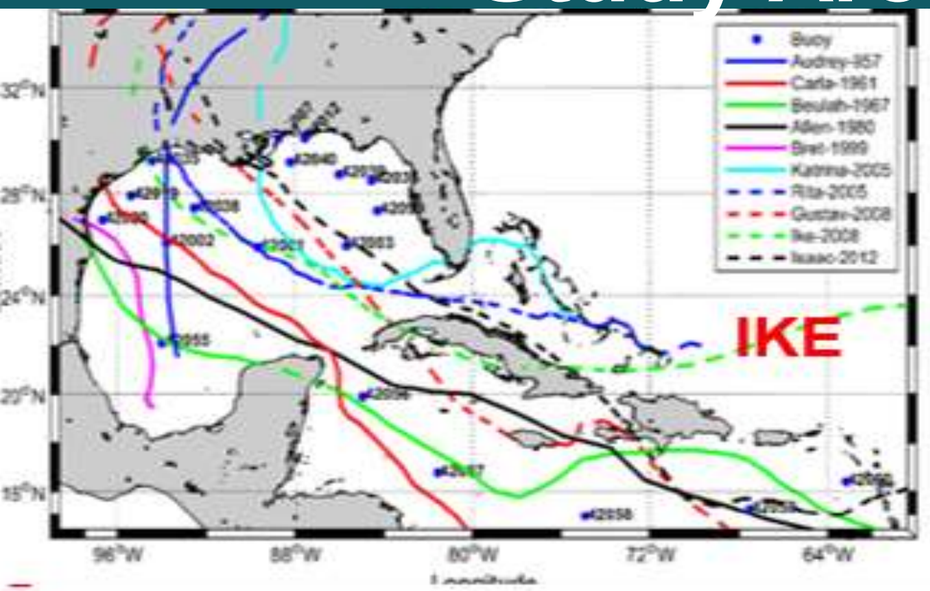
So…

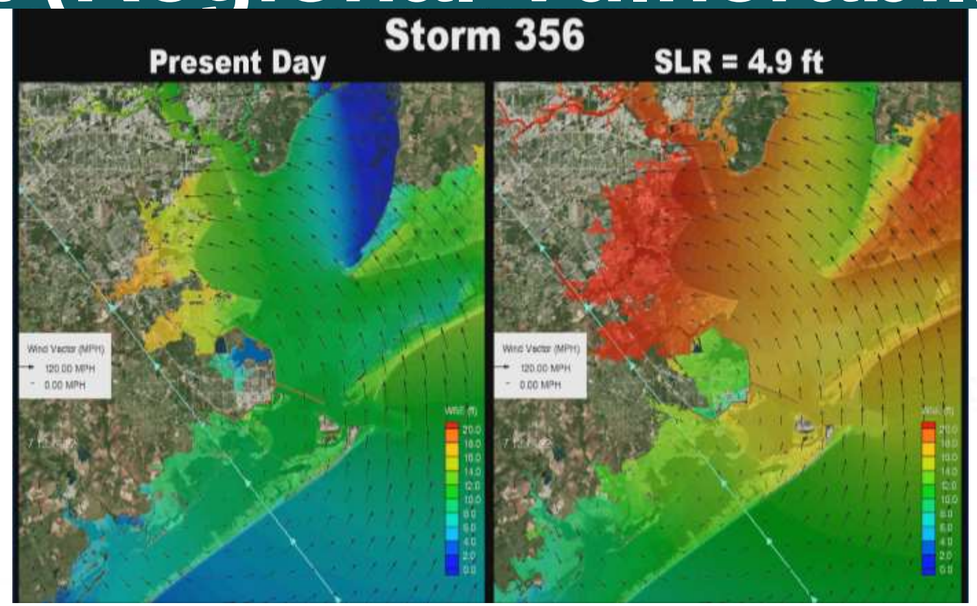
It is not a question about When a next storm will hit

It is a question about How we can prepare ourselves ahead of storm to minimize damage

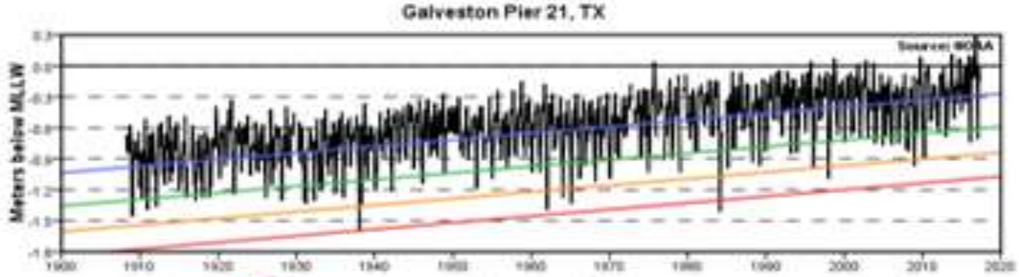


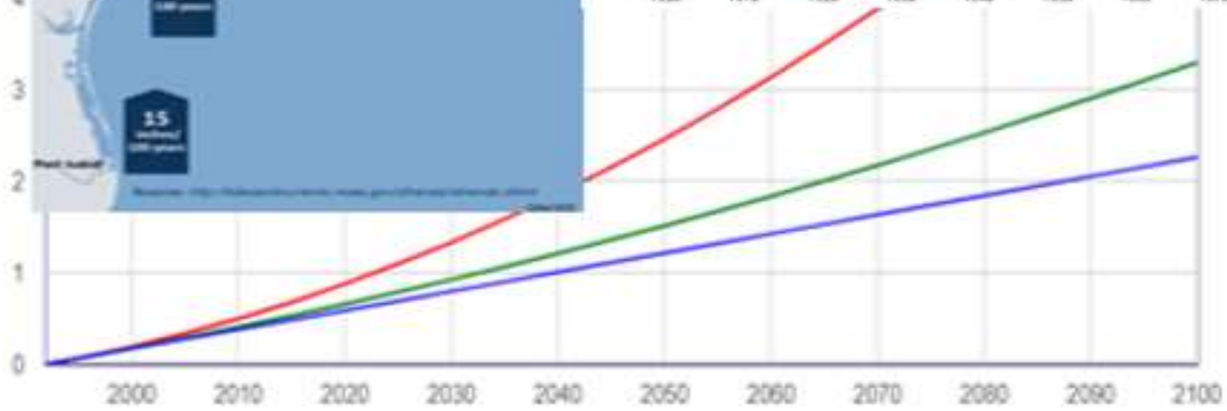
Study Area (Regional Vulnerability)





100 year Wave > 3m
Above 6.5m Storm surge
100 yr 24 hour rainfall = 18 inch

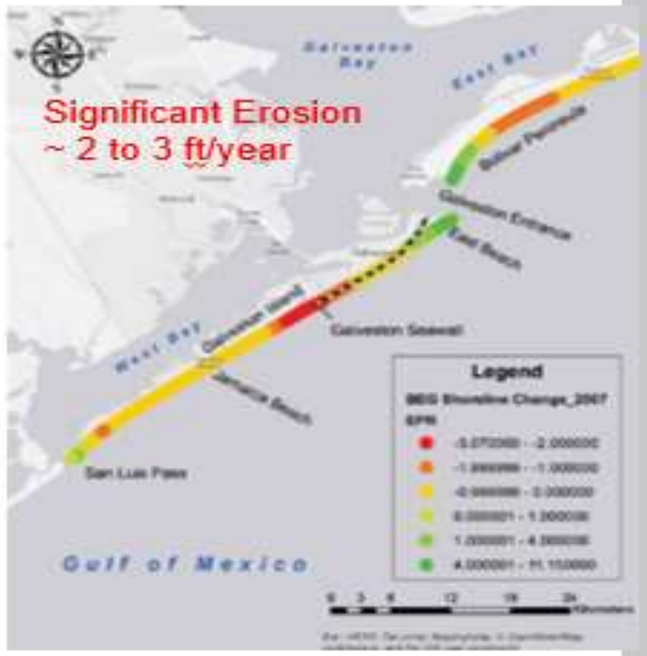




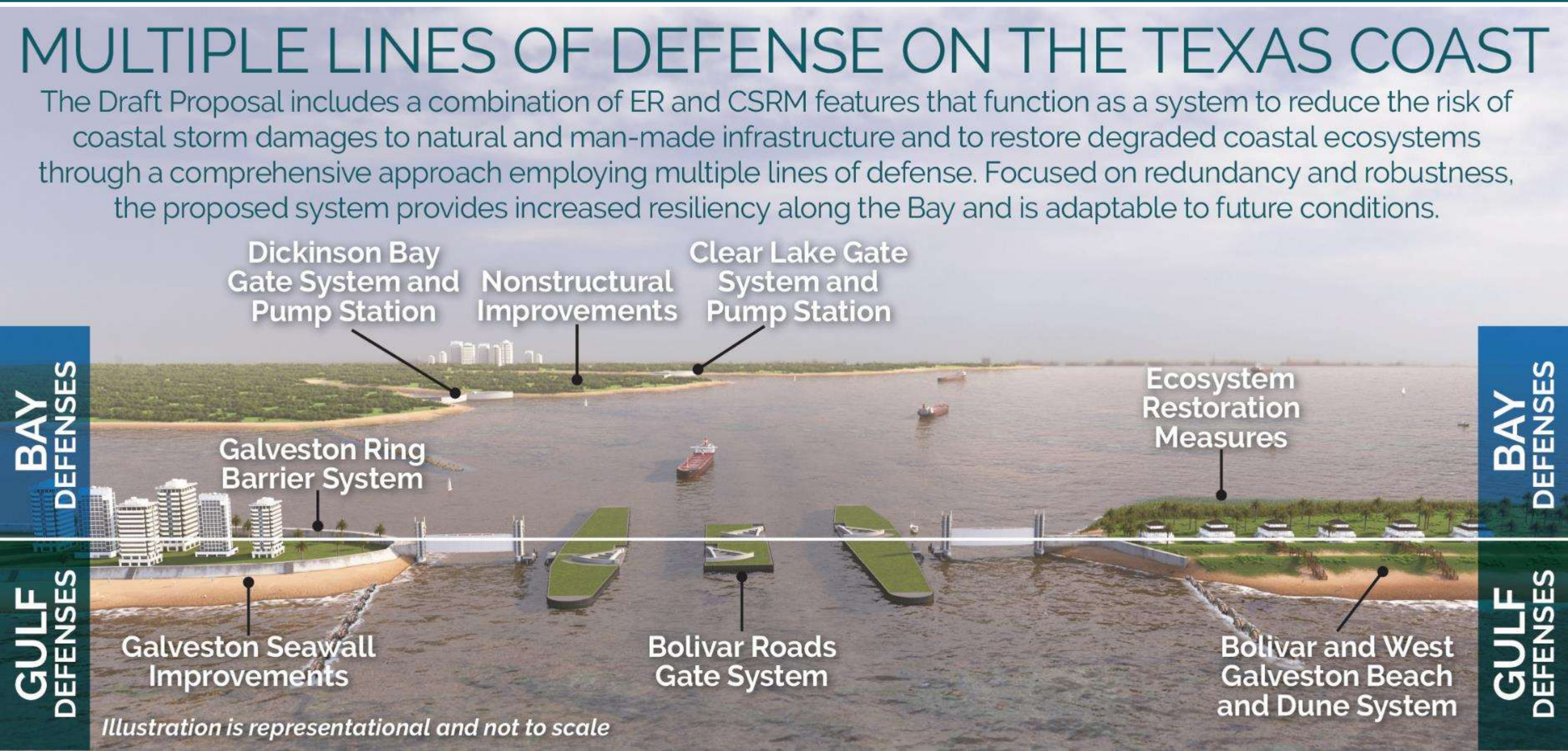
Tide Range <2 ft

RSLC

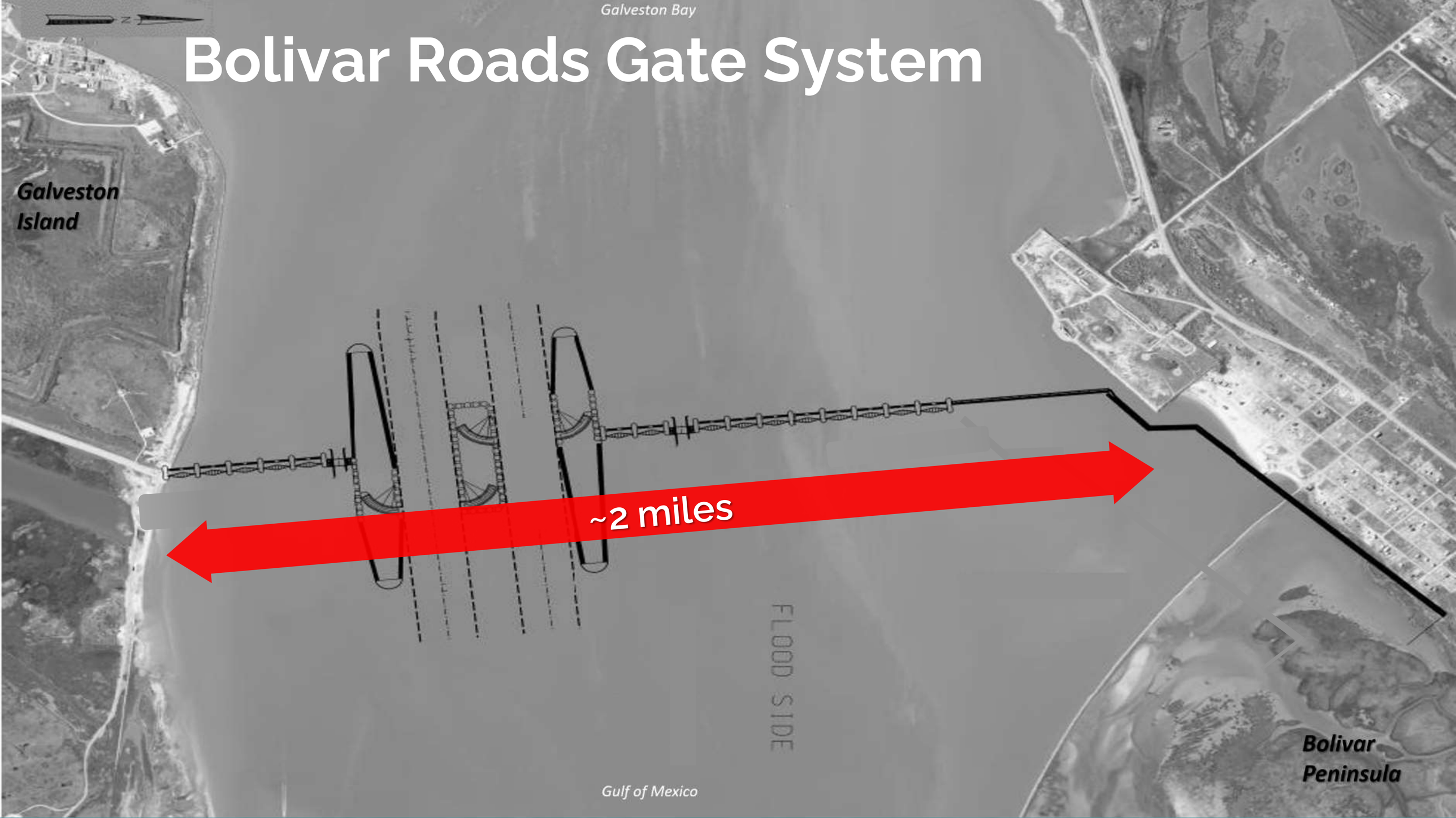
2 to 5 ft (Next 100 years)



Recommended Project



Bolivar Roads Gate System



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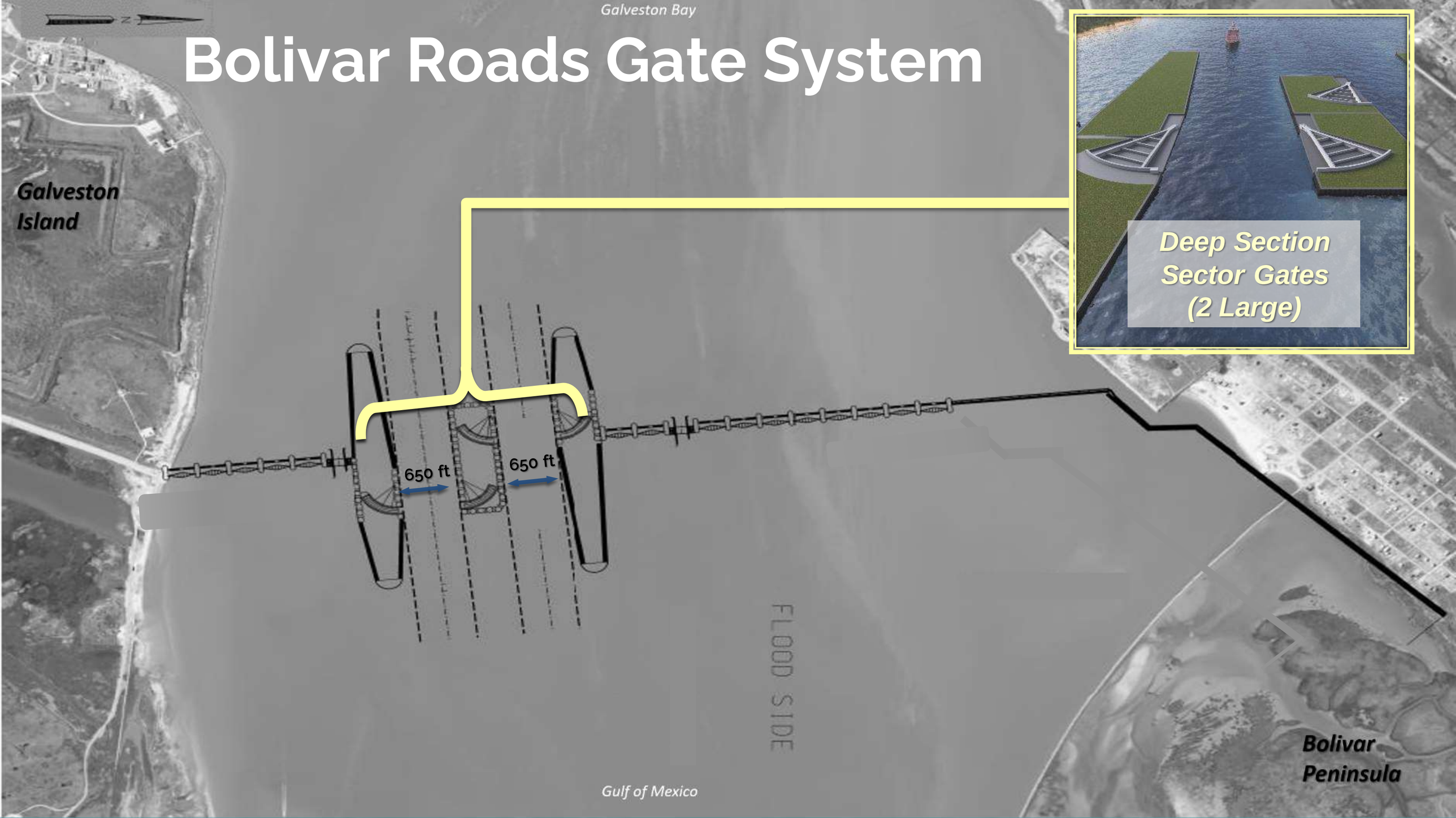
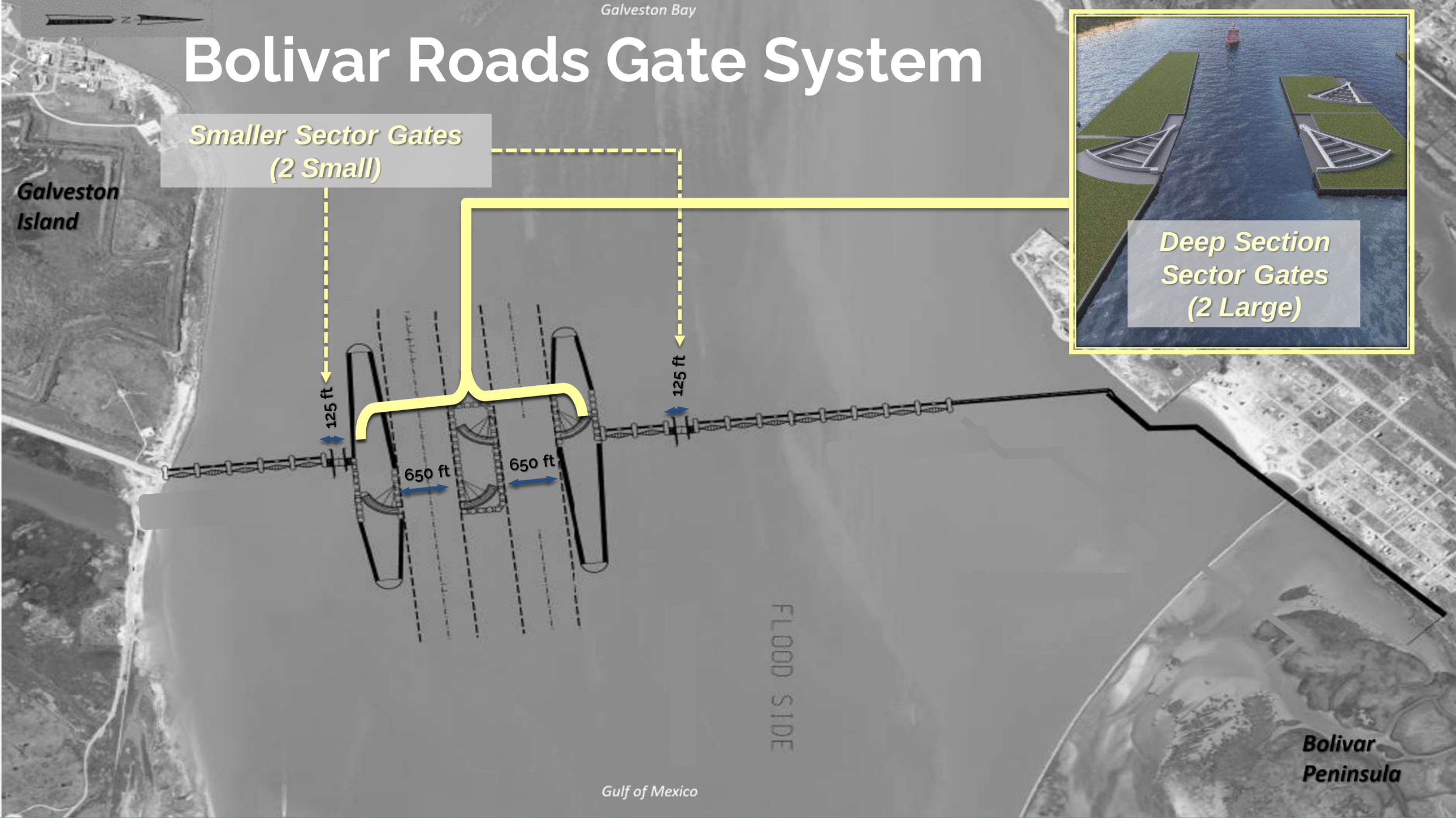


Bolivar Roads Gate System

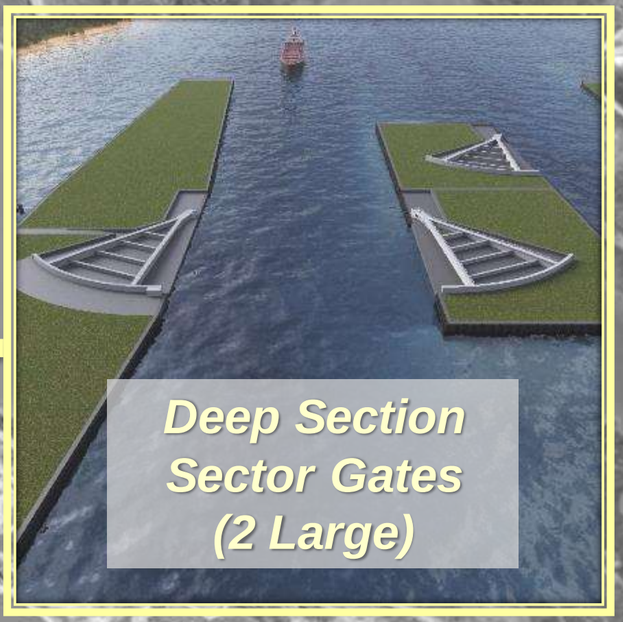


Bolivar Roads Gate System

Galveston Bay

Smaller Sector Gates
(2 Small)

Galveston
Island



Deep Section
Sector Gates
(2 Large)

125 ft

125 ft

1,500+ ft

650 ft

650 ft

600+ ft

2,400+ ft

FLOOD SIDE

Intermediate Sections
(15 Vertical Lift Gates)

Gulf of Mexico

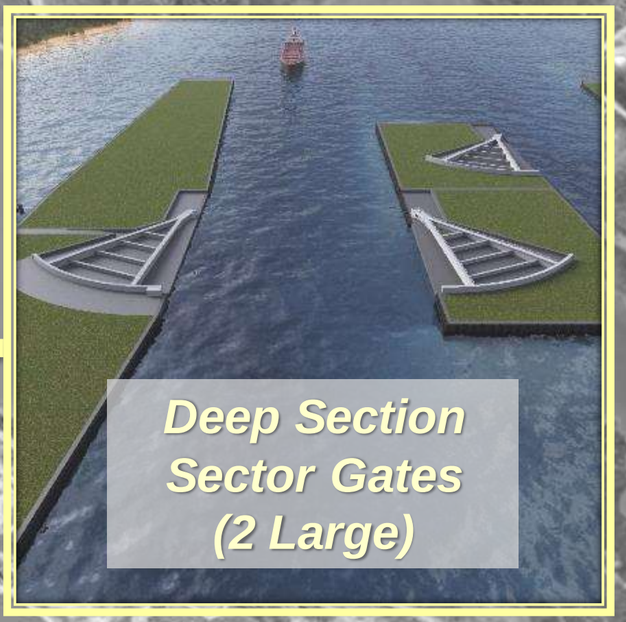
Bolivar
Peninsula

Bolivar Roads Gate System

Galveston Bay

Smaller Sector Gates
(2 Small)

Galveston
Island



Deep Section
Sector Gates
(2 Large)

1,500+ ft

125 ft

650 ft

650 ft

125 ft

600+ ft

2,400+ ft

1,536+ ft

FLOOD SIDE

Intermediate Sections
(15 Vertical Lift Gates)

Shallow Section
(16 Environmental

Gulf of Mexico

Bolivar
Peninsula


Conceptual rendering for illustrative purposes only
Galveston Island
Gulf of Mexico
Galveston Bay

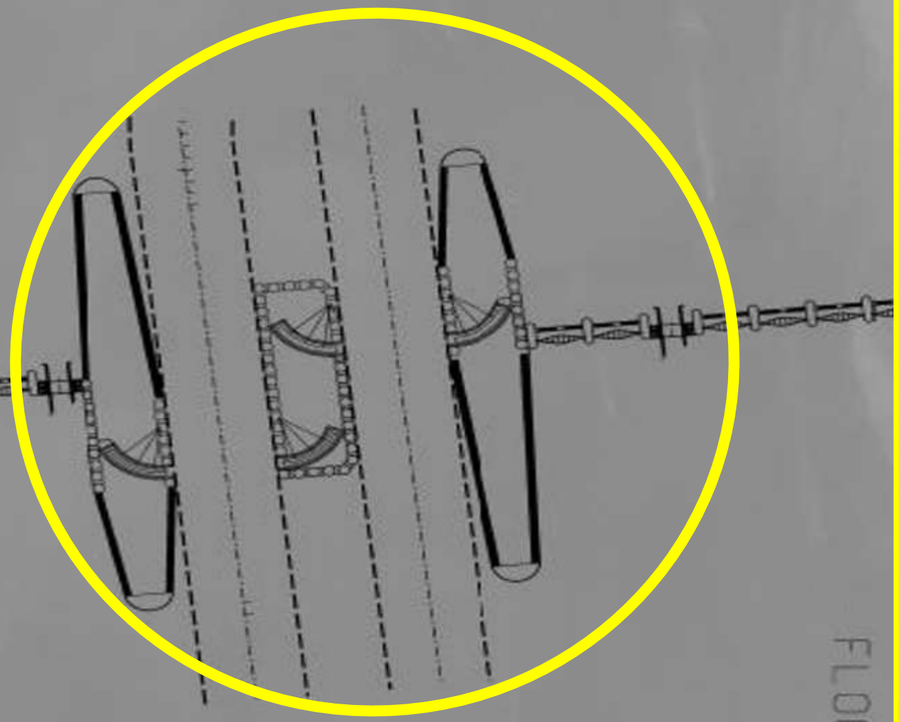
Open

Closed

Conceptual rendering for illustrative purposes only

Galveston Bay

Galveston Island



FLOOD SIDE

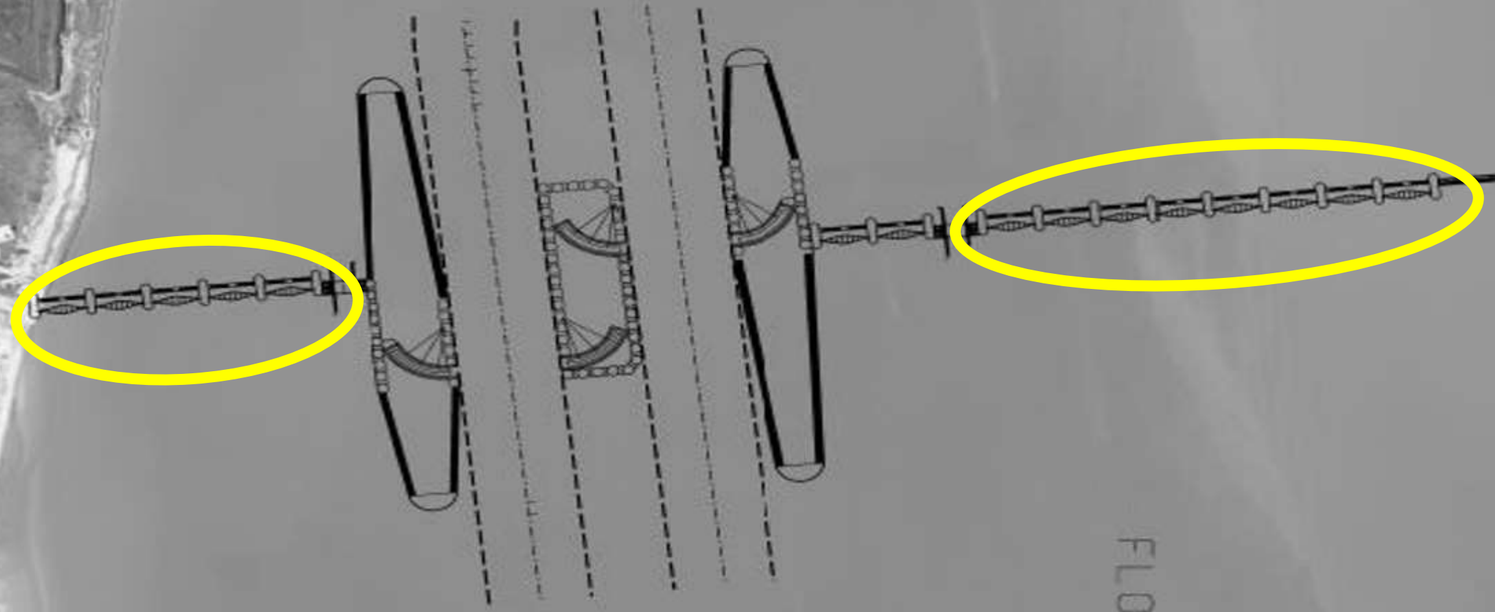
Gulf of Mexico

Bolivar Peninsula

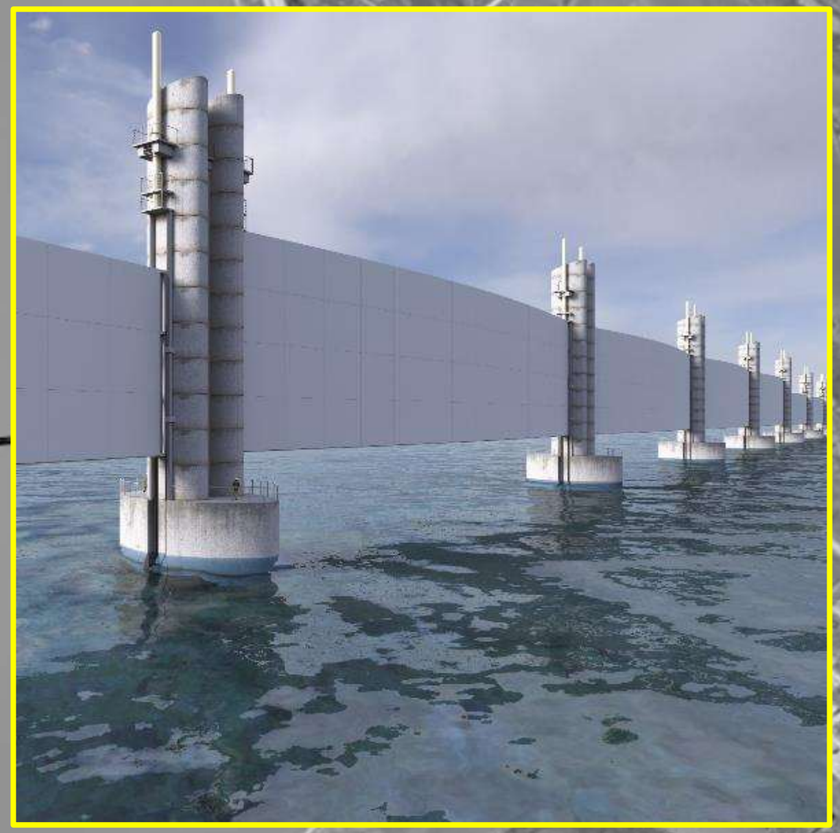
Conceptual renderings for illustrative purposes only

Galveston Bay

Galveston Island



FLOOD SIDE



Gulf of Mexico

Bolivar Peninsula

Conceptual renderings for illustrative purposes only

Galveston Bay

FLOOD SIDE

Gulf of Mexico

Bolivar Peninsula

Conceptual renderings for illustrative purposes only

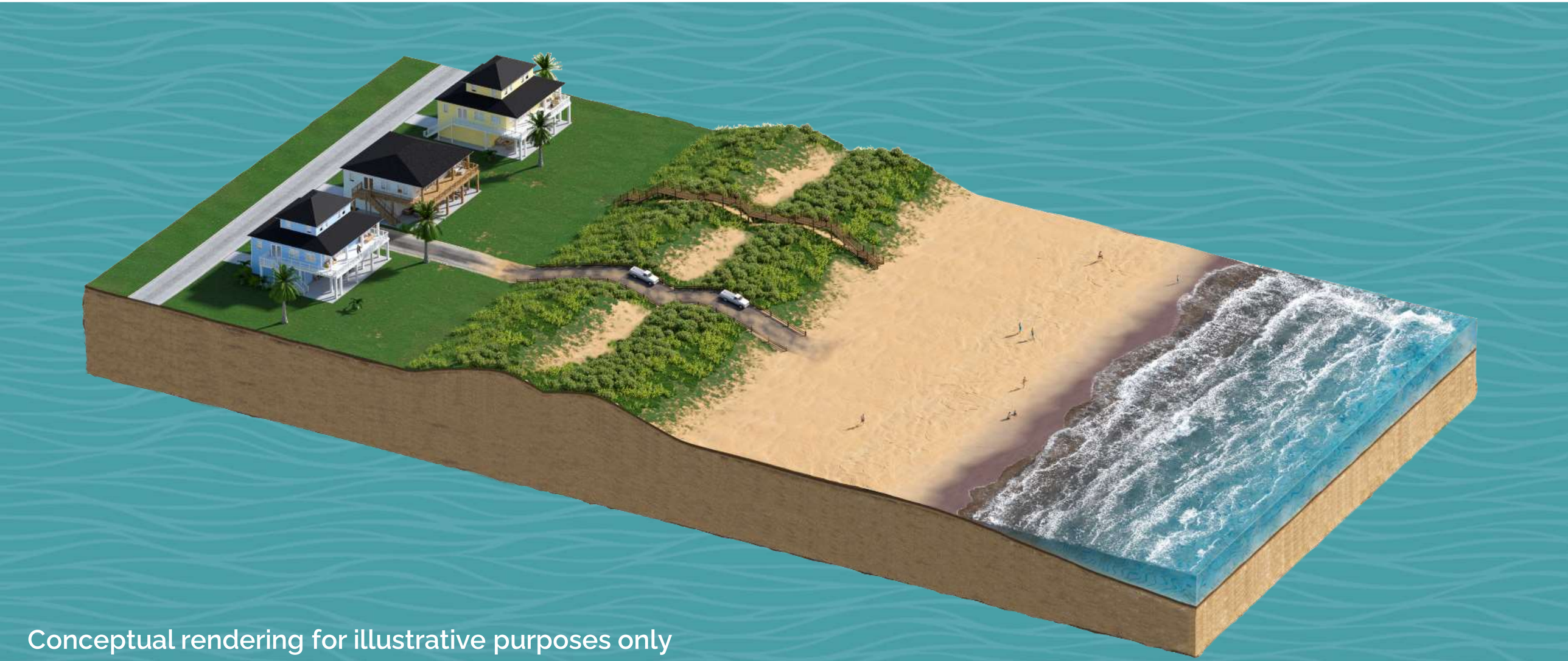
West Galveston & Bolivar Peninsula Beach & Dune System

West Galveston

Bolivar Peninsula

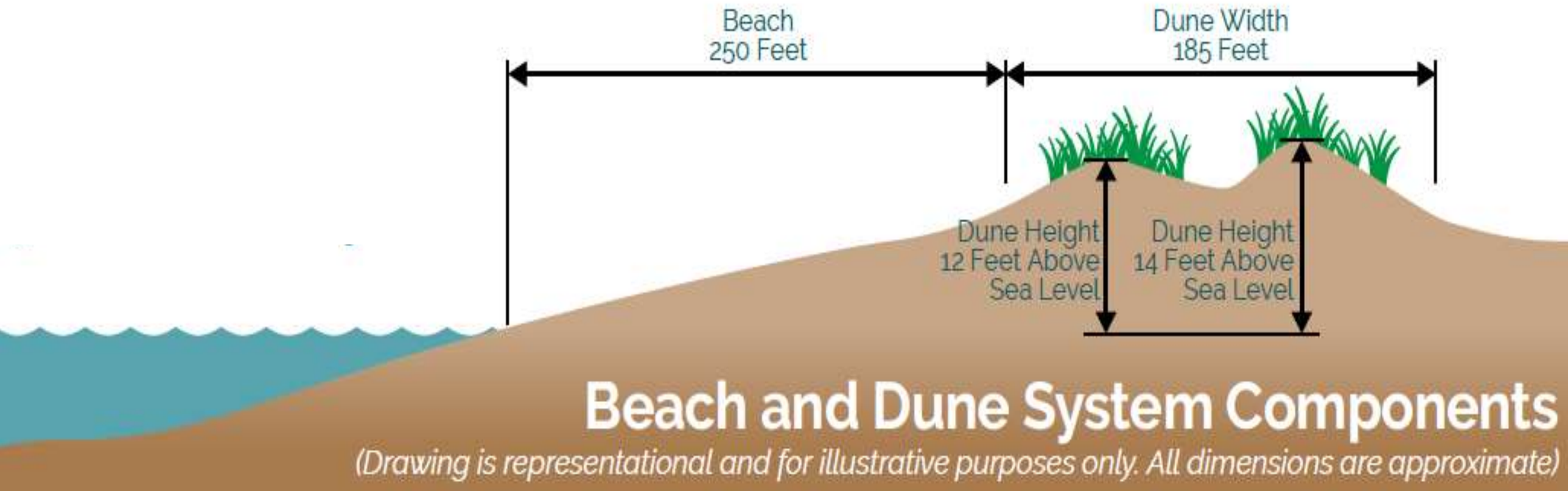

Conceptual rendering for illustrative purposes only
Levee
Beach and Dune System

West Galveston & Bolivar Peninsula Beach & Dune System



Conceptual rendering for illustrative purposes only

West Galveston & Bolivar Peninsula Beach & Dune System



Beach and Dune System Components

(Drawing is representational and for illustrative purposes only. All dimensions are approximate)

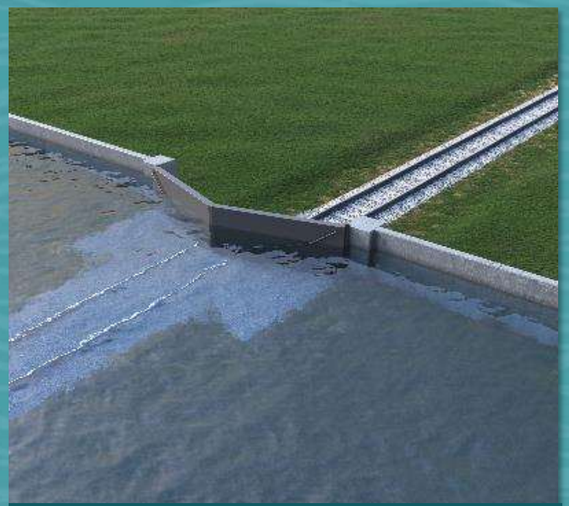
Galveston Seawall Improvements

Galveston Ring Barrier System

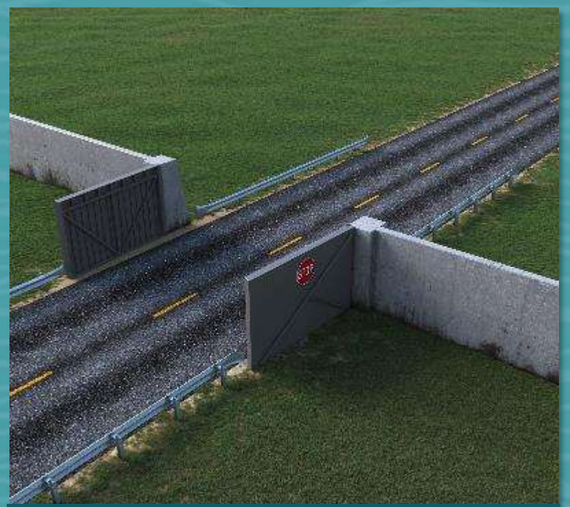
Open vertical lift gate

Closed vertical lift gate

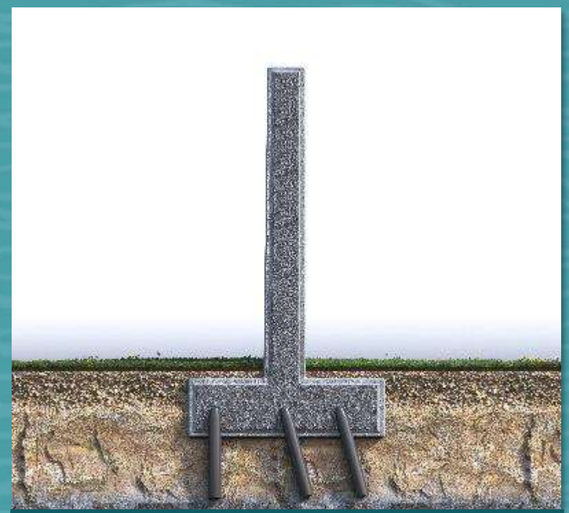
Flood wall



Example road/rail closure (closed)



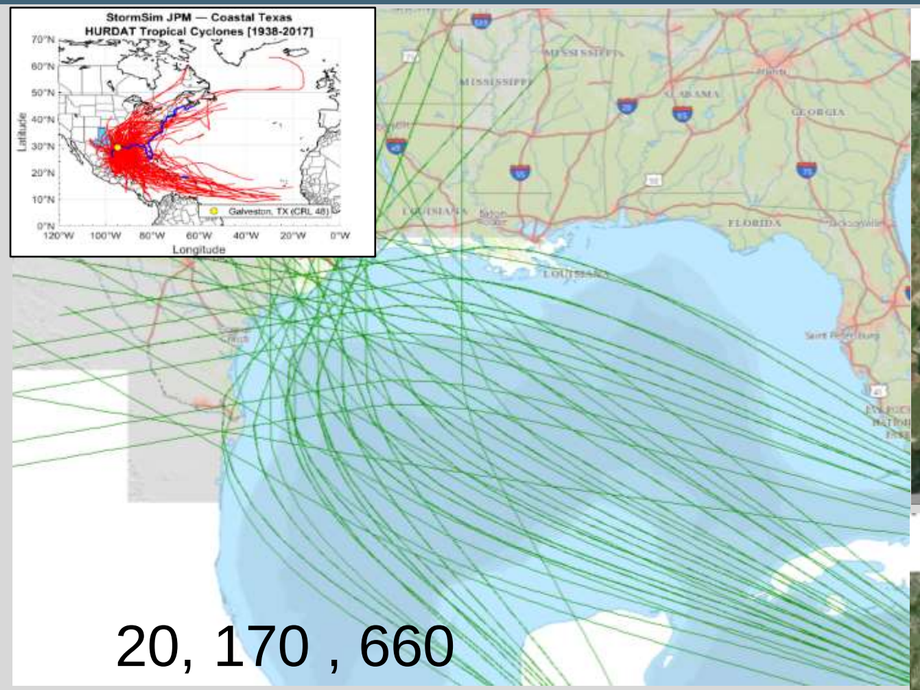
Example road/rail closure (open)



Flood wall cross section

Conceptual renderings for illustrative purposes only

MODELS APPLIED : CSTORM



20, 170 , 660

WOP, 5 other configurations

Optimum Simulations Needs

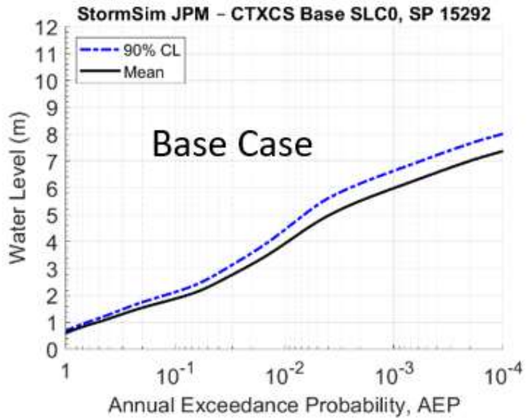
(300*3*6) ~5400

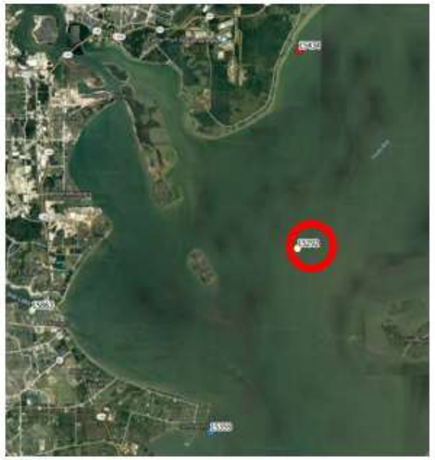
Used Reduced sample & expert judgment

~1900

CSTORM: SYSTEM PERFORMANCE (ARI)

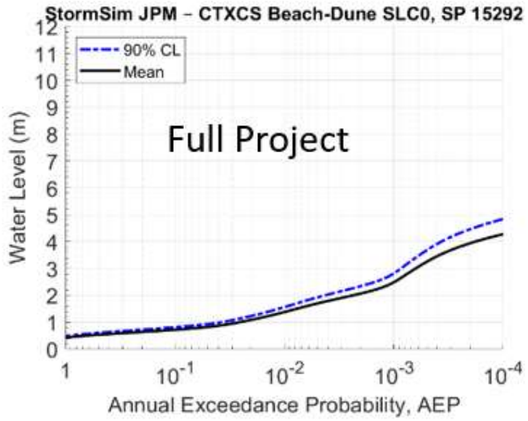
Mid Bay: SP 15292

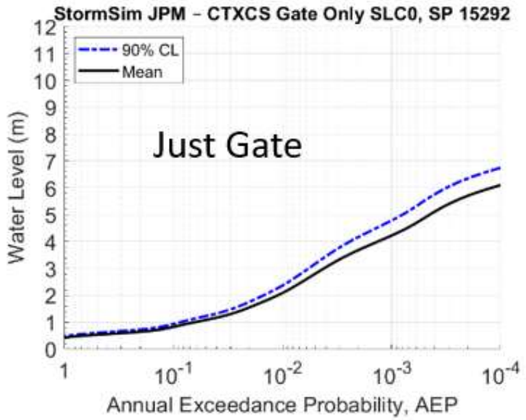


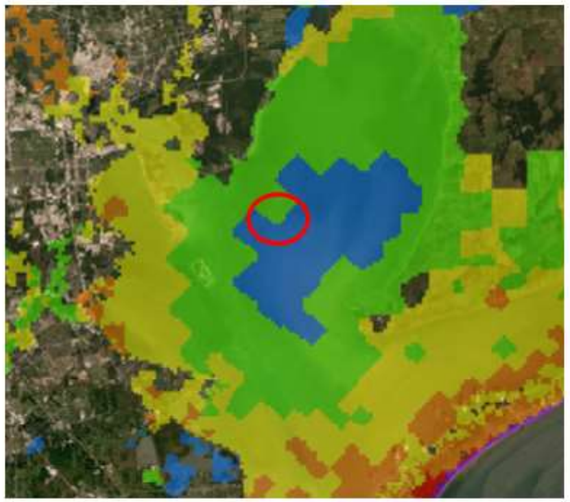


Without Project
Water level (100 year)

15 to 18 ft (~5.5 m)





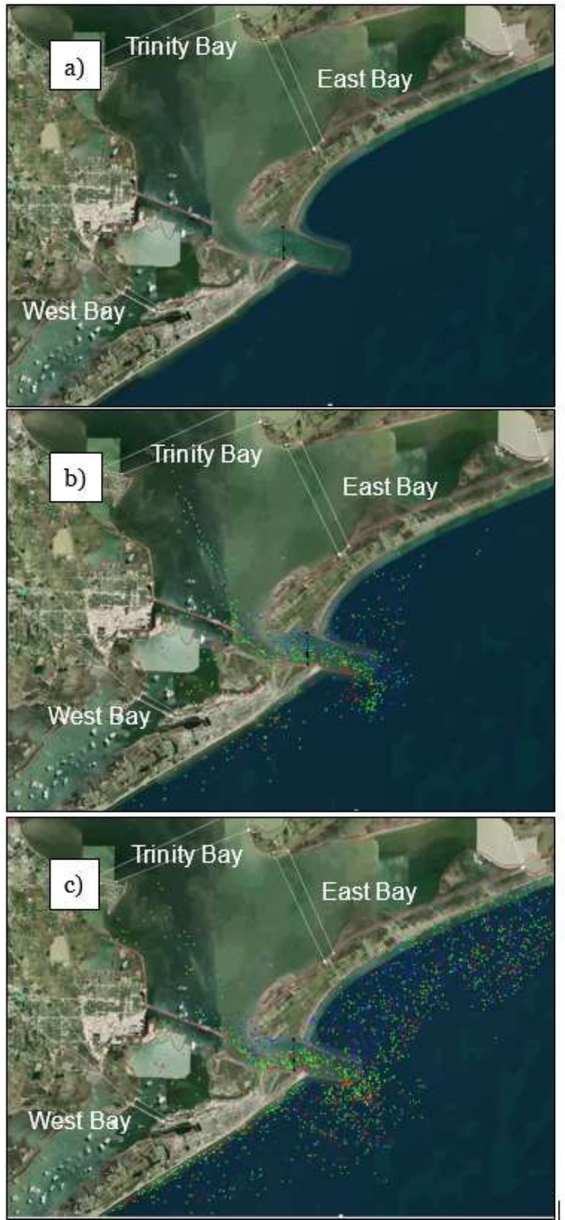


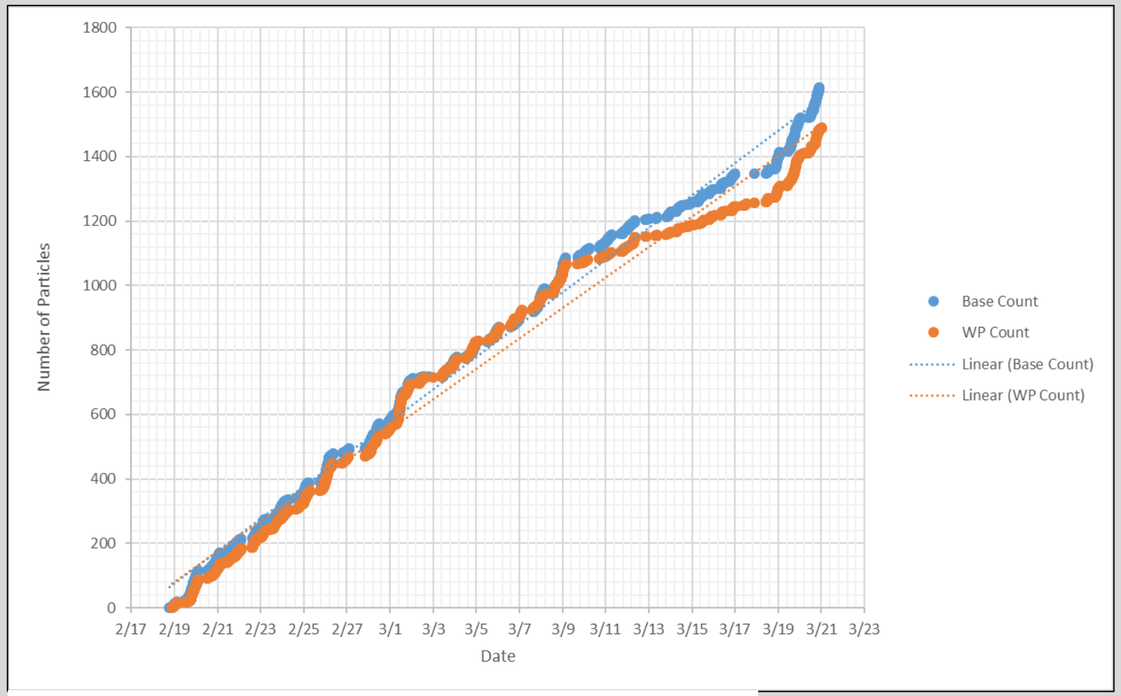
With Project Water
level (100 year)

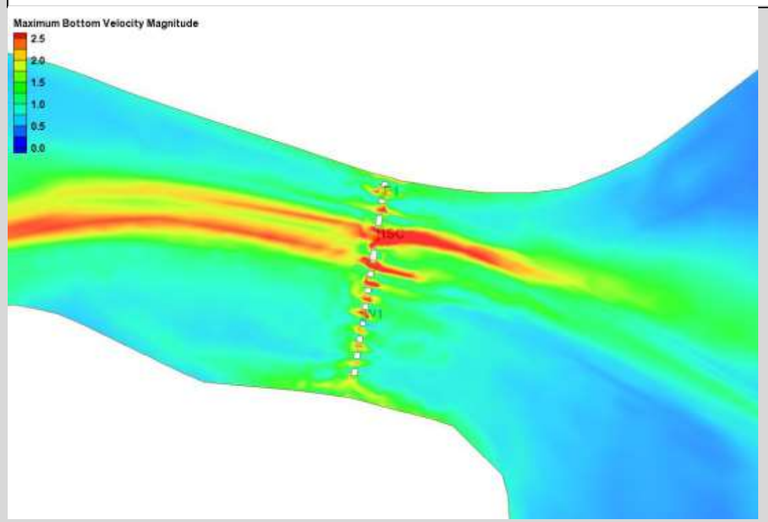
4 to 6 ft (~2 m)

Mid Bay : 100 ARI: Just Gate, surge reduction by 60% (5 meter to 2 meter) , another 0.5 meter reduction by dune field

DIRECT/INDIRECT IMPACT



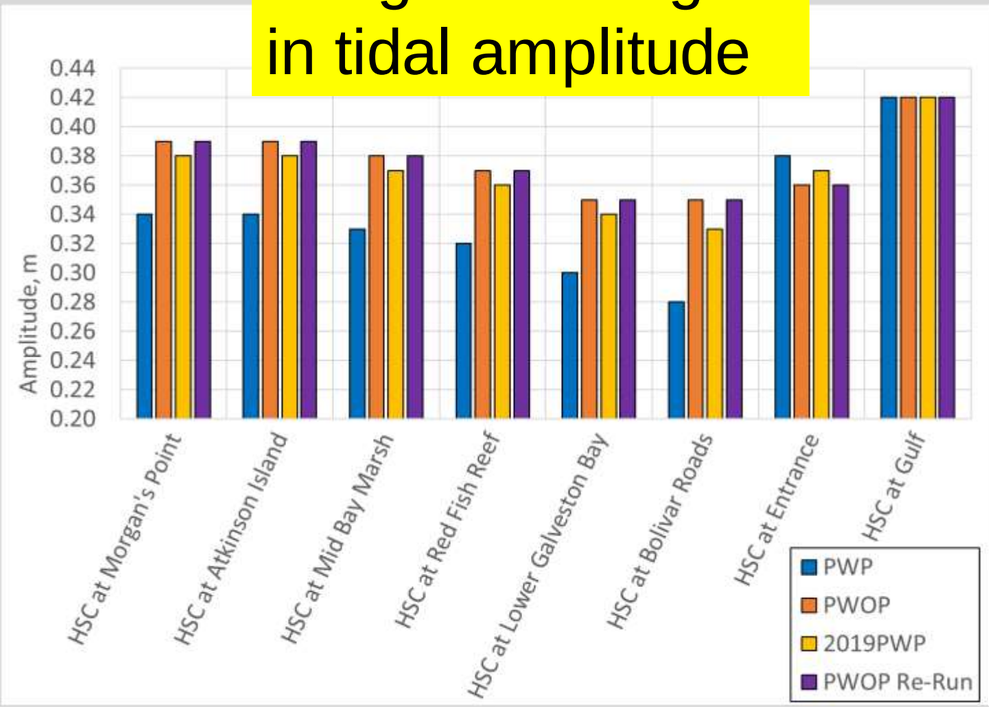


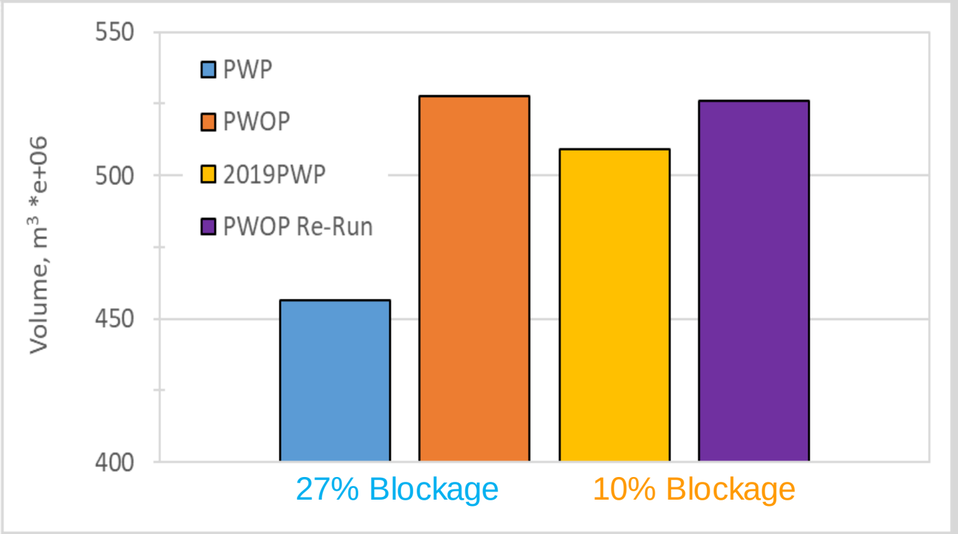


DIRECT/INDIRECT IMPACT

US Army Corps of Engineers

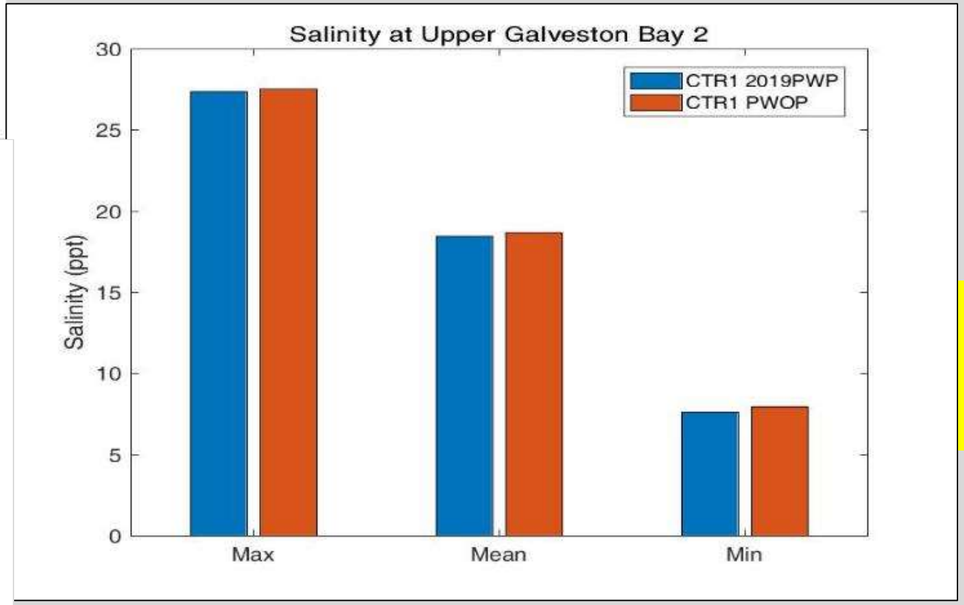
Marginal change in tidal amplitude





Tidal Prism Change: The percentage change from without project went from -13.5% to -3.2%.

Fresh water tends to stay slightly longer in the bay with project



Marginal change in salinity

Clear Lake Gate System

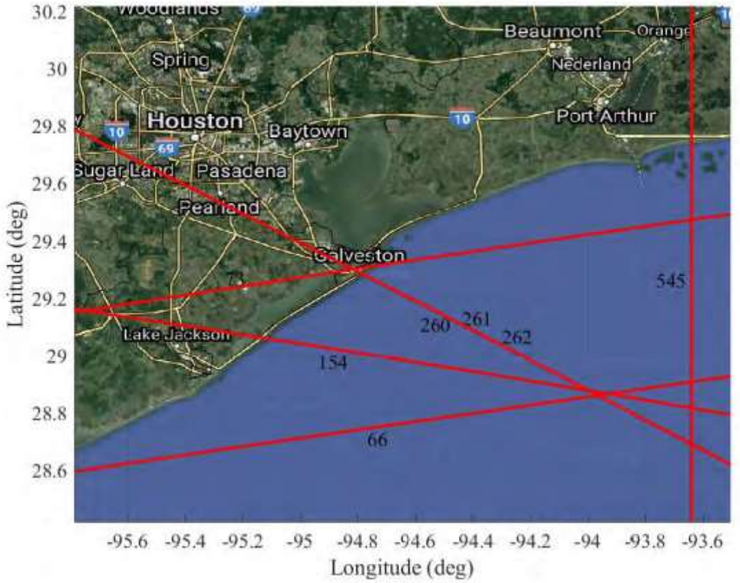
- Bulkhead
- Floodwall
- Shoreline Stabilization
- Circulation Gates
- Navigation Gate
- Pump Station
- Scour Protection
- Dredge Area
- Permanent Footprint
- Temporary Work Footprint

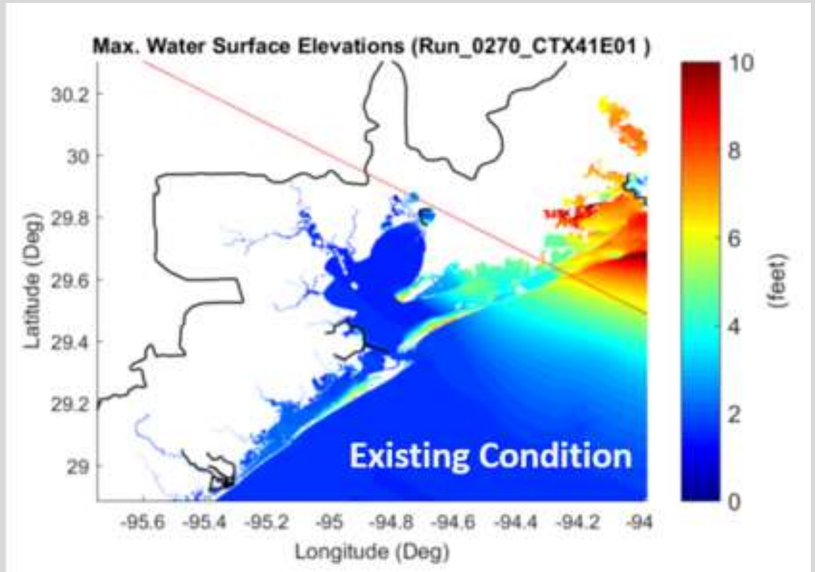
SURGE BARRIER SYSTEM CHALLENGES (OPERATION)

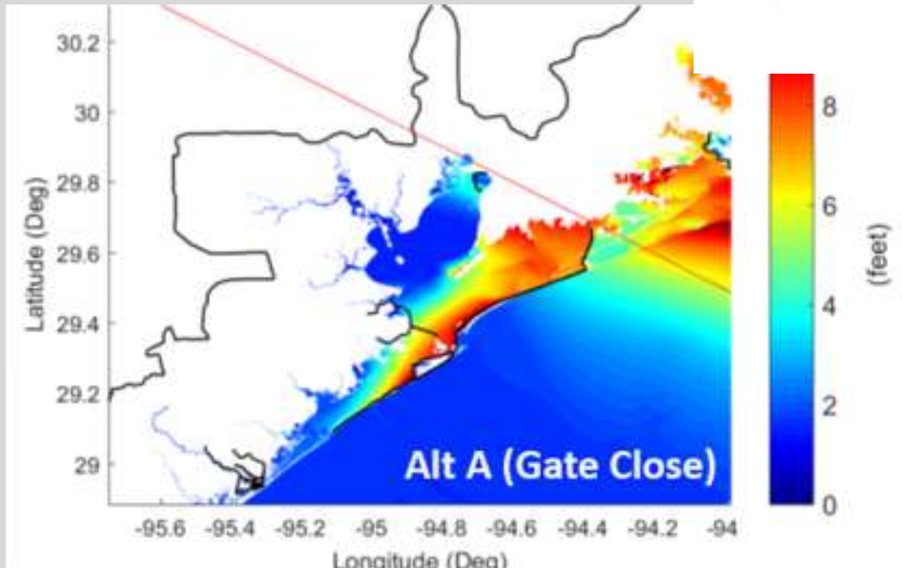
"Installing a barrier system is like buying an insurance"
(Marc Walraven, RWS)

Staged system : Sector gate, SWEG

Optimum Time to close : 3 to 8 hours.





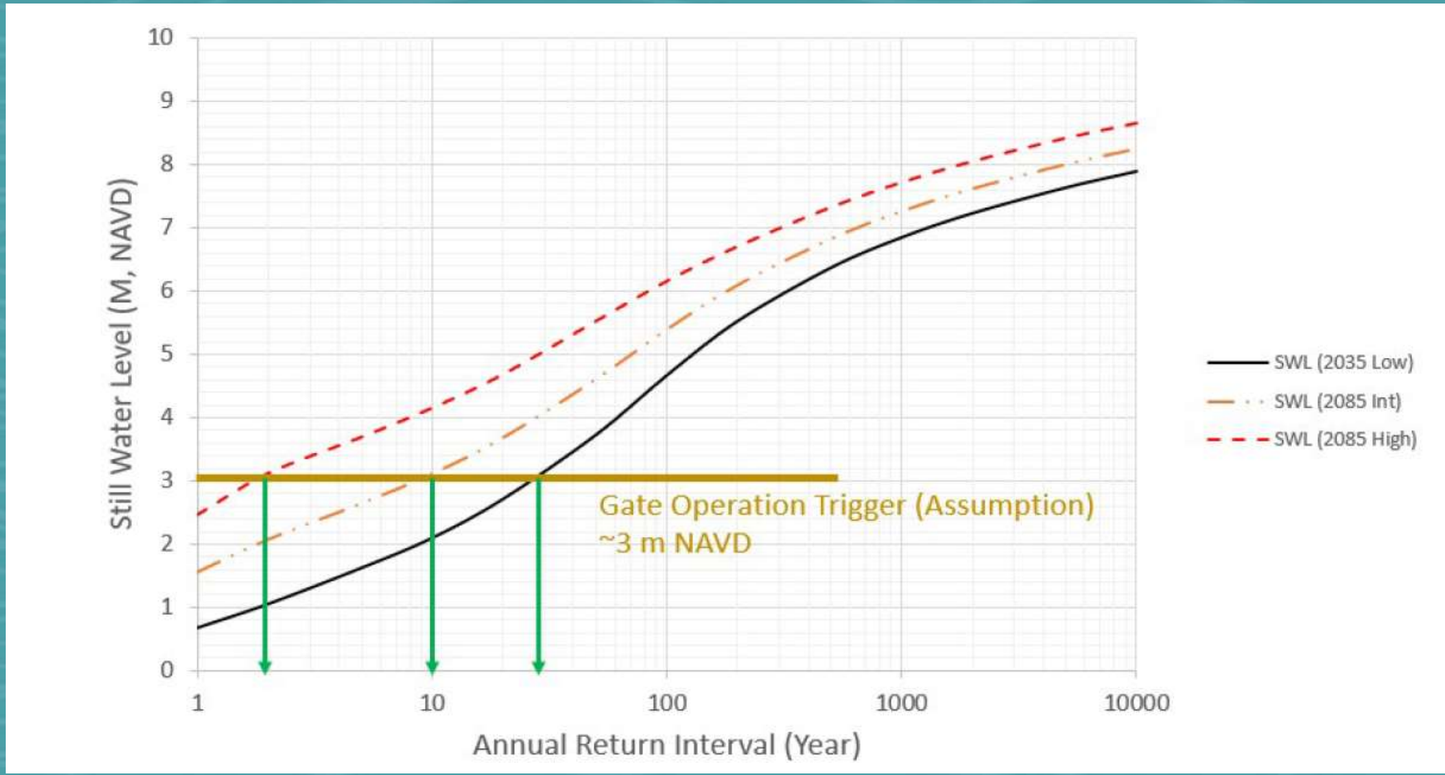


Forecasting System
With advanced modeling
And sensor deployment

Surge Gate Operation (Prel. Work)

- Trigger ??
- Frequency of Gate Operation may change over time

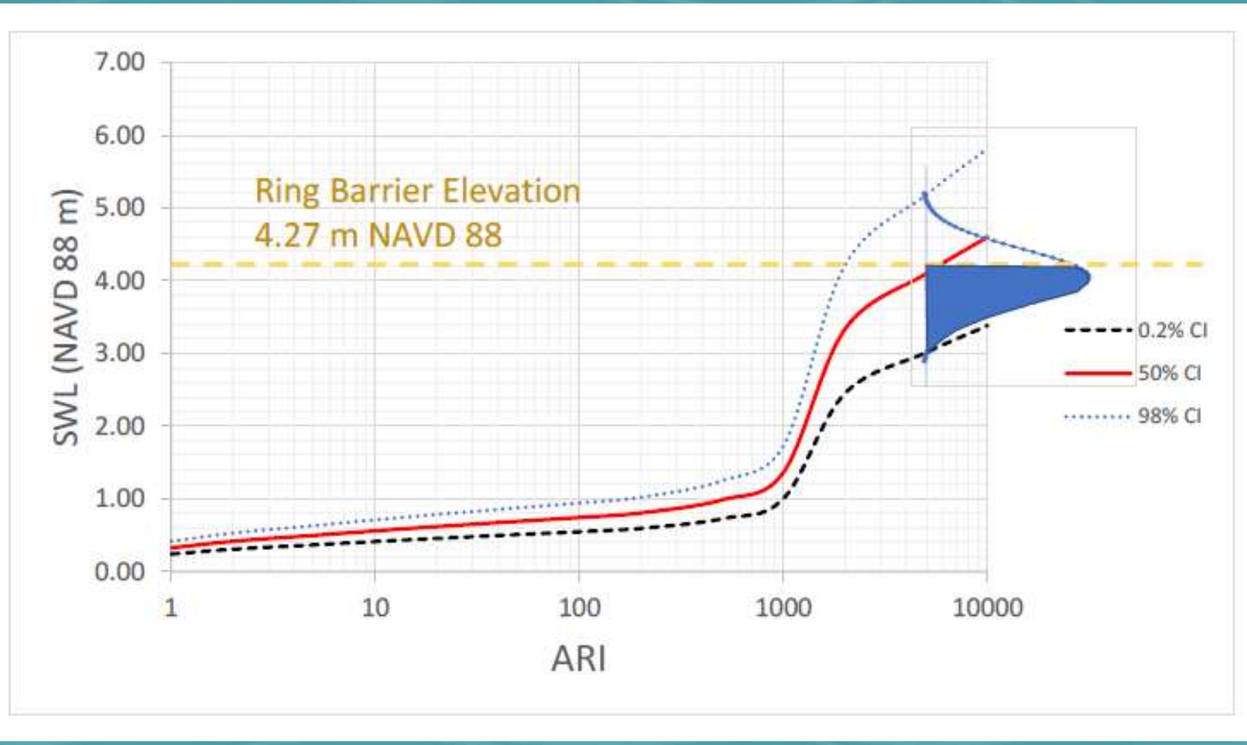
- However, the gate closure will be driven by more than storm frequency or trigger elevation. As we are planning 1 to 2 closures each year for maintenance or inspections, that alone dominates the number of closures apart from storms.



System Assurance ??

Better understanding is needed to quantify assurance on individual features & then the comprehensive system!!

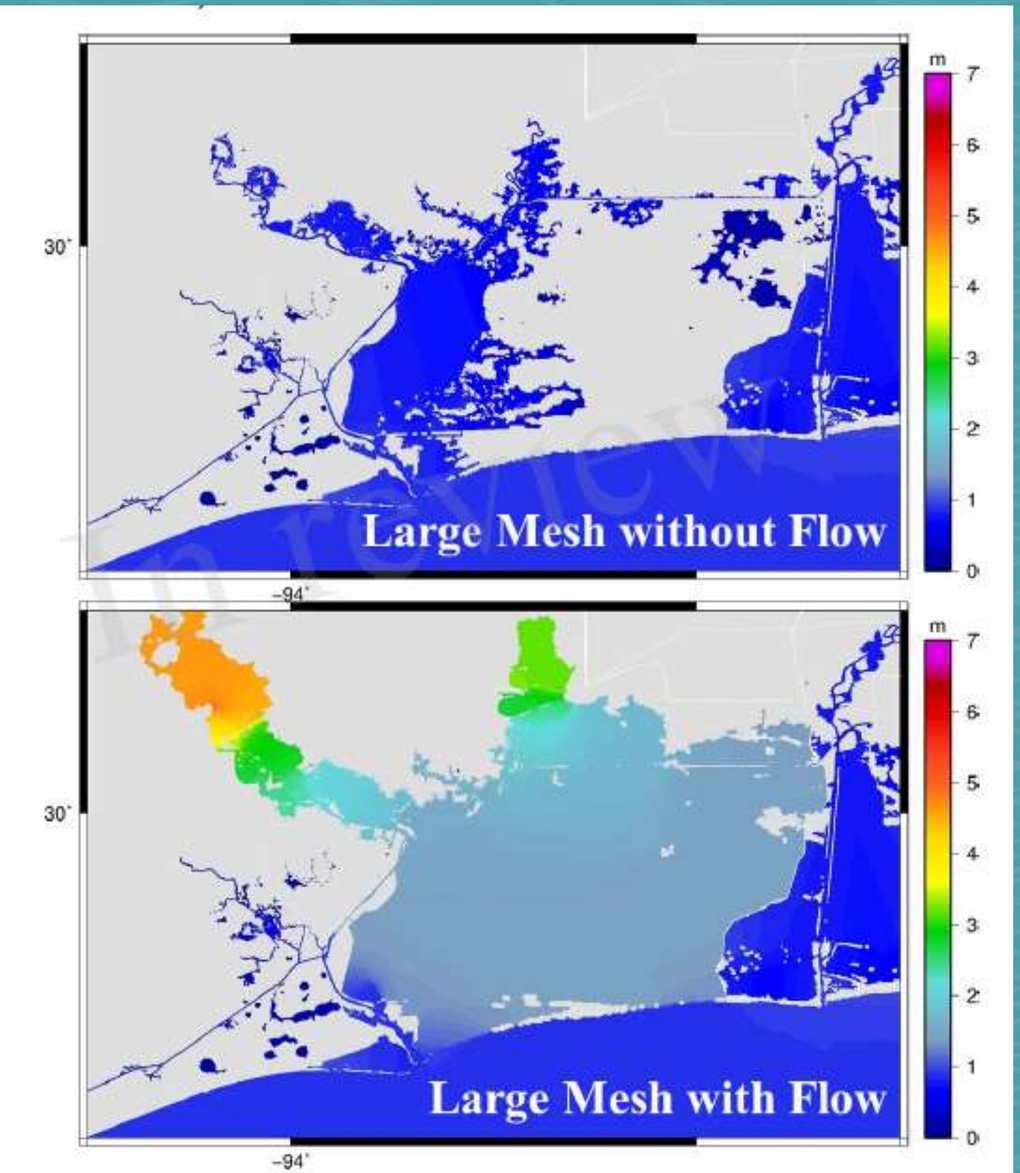
Representative Points	Alternative	Target Elevation (m NAVD)	Conditional Non Exceedance Probability				
			AEP = 0.1	AEP = 0.02	AEP = 0.01	AEP = 0.002	AEP = 0.0002
SP 12308 (Offats, Galveston)	Without Project	4.27	1.000	0.961	0.638	0.172	0.013
SP 12308 (Offats, Galveston)	With Project	4.27	1.000	1.000	1.000	1.000	0.561



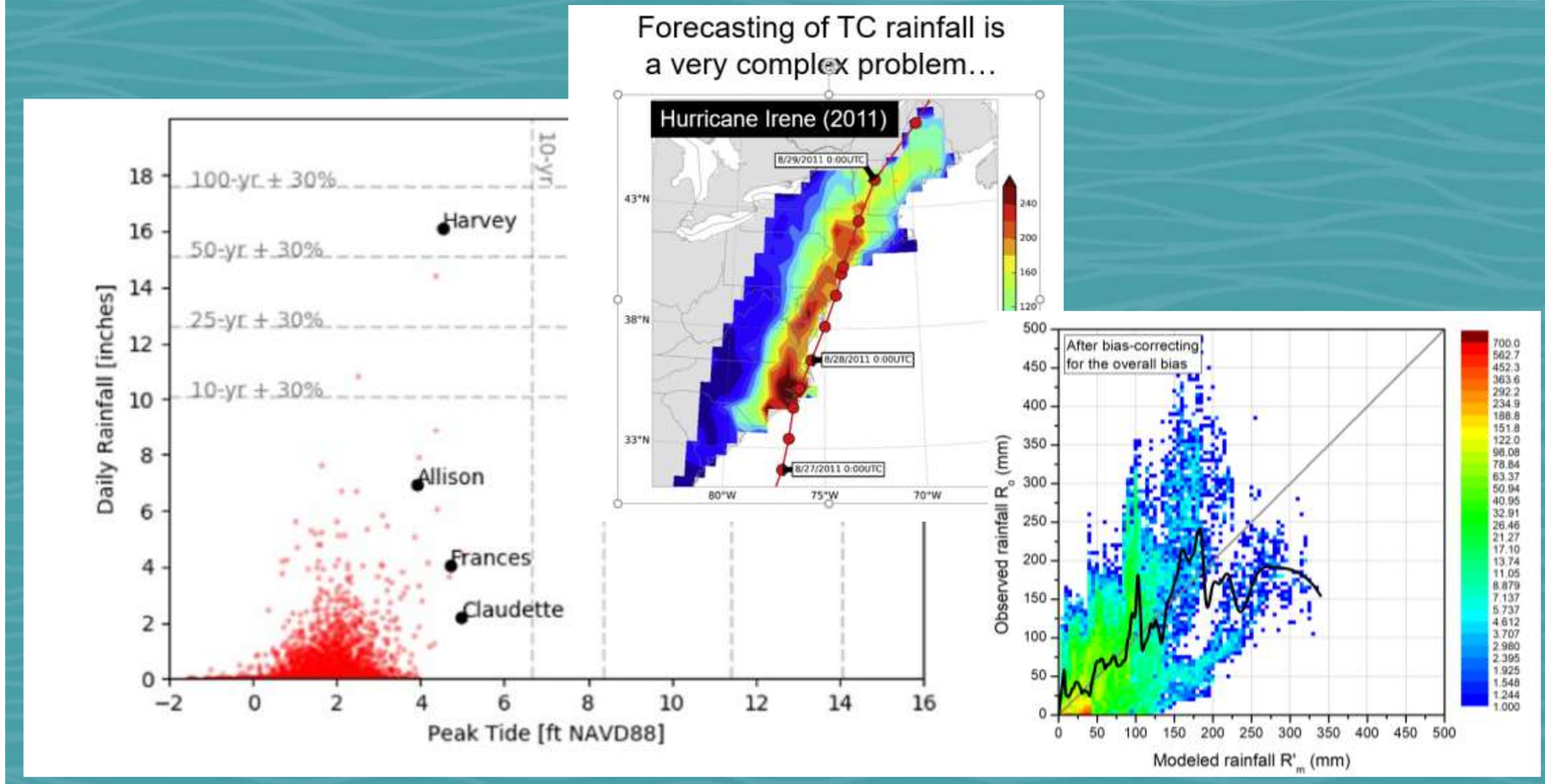
Drainage (Compound Effect)

Hurricane Harvey (2018) dumped over 50 inch rainfall

Uncertainty (Compound Effect)



Trigger & Operation of Pumps !!



THANK YOU!

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