

# CHALLENGES FROM COASTAL SHORELINE RETREAT—PLANNING FOR NOW AND THE FUTURE

## Dauphin Island Causeway Shoreline Restoration

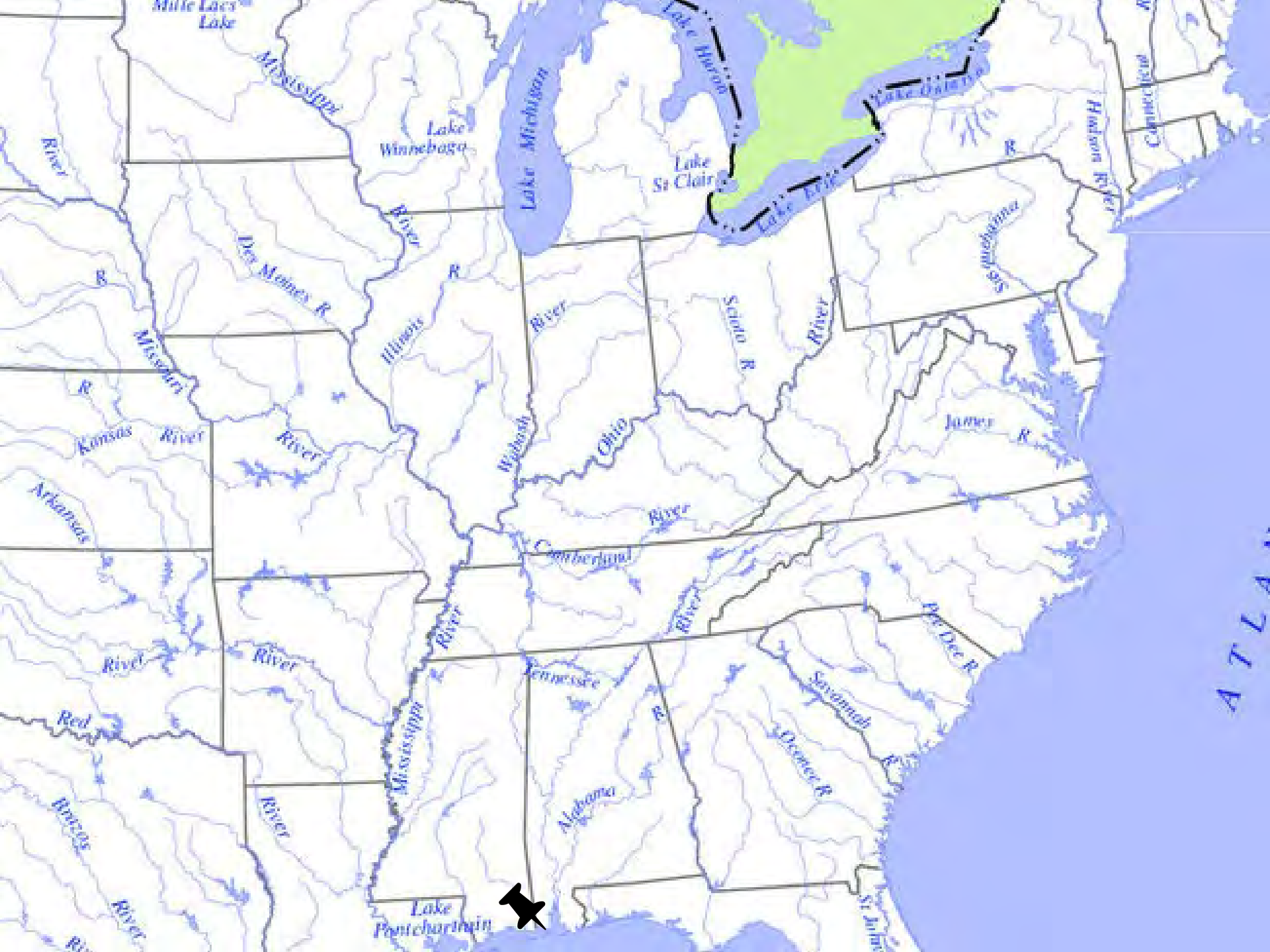


NEWEA 2020 Webinar Series

August 5, 2020



These projects were supported wholly or in part by Mobile Bay National Estuary Program as part of a grant from the National Fish and Wildlife Foundation



ATLAS





The Mobile Bay watershed is the sixth largest in the nation by area and at 62,000 cubic feet per second on average it has the fourth largest freshwater inflow on the North American continent.



<u>Rank</u>	<u>State</u>	<u># Species</u>
1	Alabama	332*
2	Tennessee	320
3	Georgia	265
4	Kentucky	248
5	Mississippi	209

Rank	State	# Species
1	Alabama	332*
2	Tennessee	320
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Alabama the Beautiful

**10%**  
of the freshwater  
resources in the  
continental United  
States flow through  
or originate in  
Alabama.

14  
river basins form  
the waterways of  
Alabama.

There are more than  
**132,000**  
miles of rivers and streams in  
Alabama. That's enough to  
circle the earth 5 times!

### Top 5 States

#### Freshwater Fish Biodiversity

Rank	State	# Species
1	Alabama	332*
2	Tennessee	320
3	Georgia	265
4	Kentucky	248
5	Mississippi	209

22%  
of North American  
crayfish species

27%  
of North American  
fish species

28%  
of North American  
freshwater snails

57%  
of North American  
freshwater turtles

61%  
of North American  
freshwater mussels

*Native to Alabama*

Alabama Ranks Number 1 in the U.S. for the number of freshwater crayfish, fish, snail, turtle and mussel species!

## 19% at Risk

19% of the freshwater fish species in Alabama are at risk due to pollution and destruction of habitat.



Alabama Water Watch is a program in the Auburn University Water Resources Center, which receives support from the Alabama Agricultural Experiment Station and the Alabama Cooperative Extension System.

## Get Involved!

Get certified as a water monitor and volunteer.  
Learn more at <http://alabamawaterwatch.org>

### References:



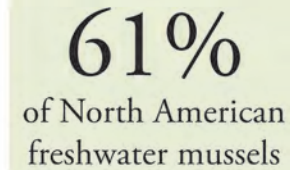
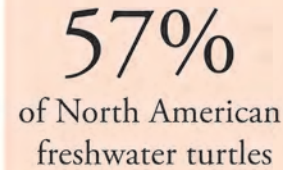
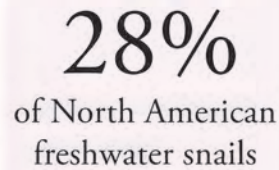
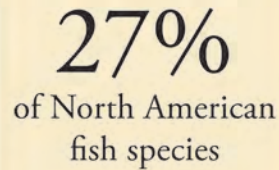
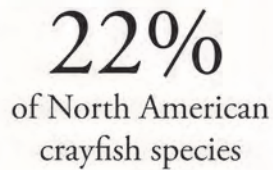
### Suggested Reading:

*Fishes of Alabama*  
by Herbert C. Boesche and  
Richard L. Mayden

*Southern Wonder:  
Alabama's Surprising Renaissance*  
By H. Scott Dixon

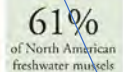
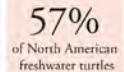
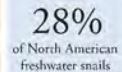
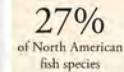
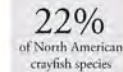
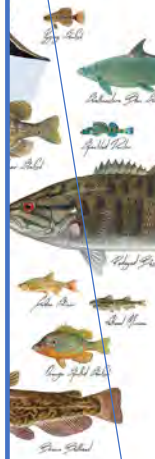






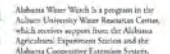
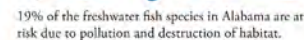
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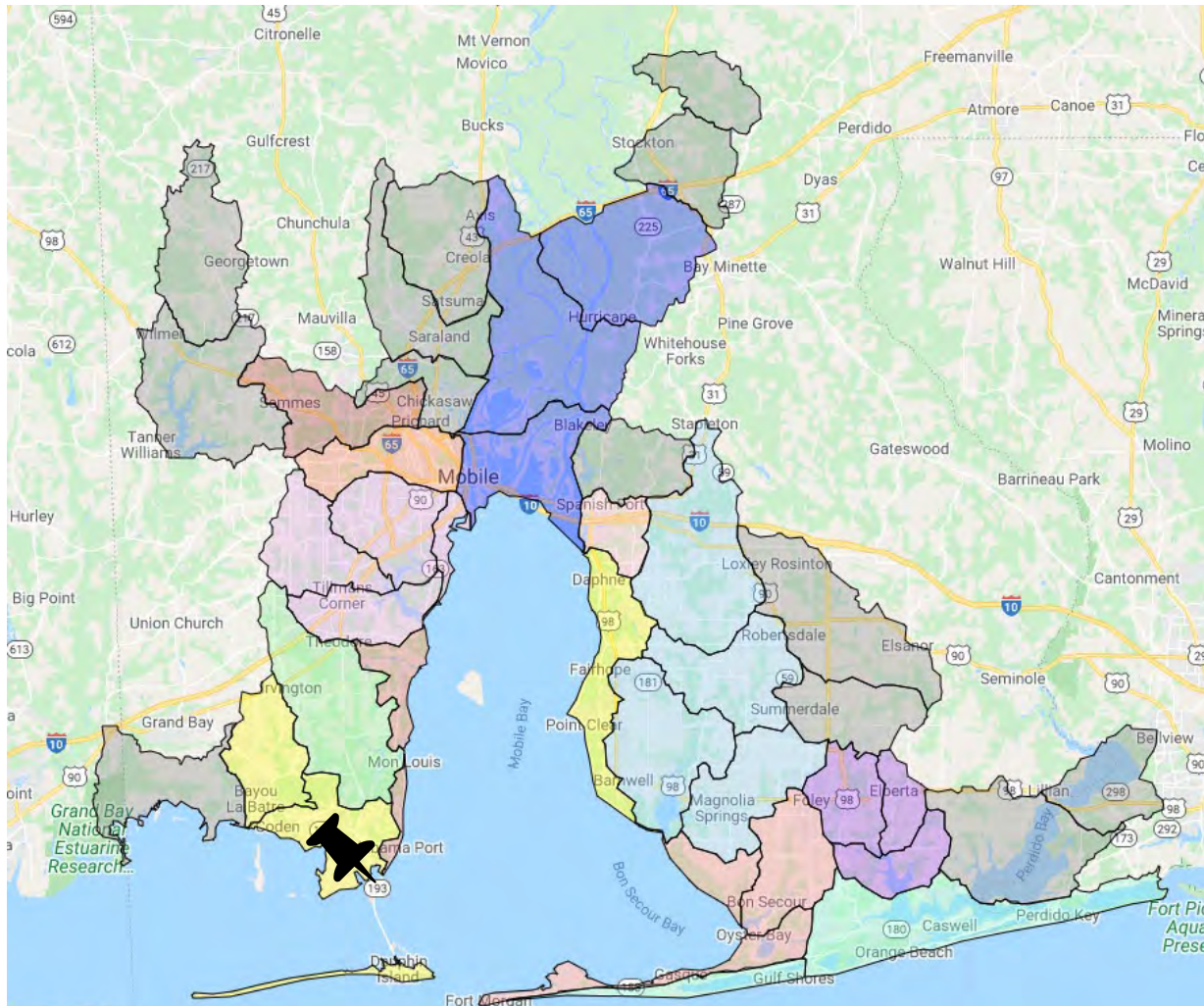
*Southern Winder:  
Albatross Surprising Readers  
The H. Scott Duncan*

1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 26

Geosyntec Consultants | Dauphin



# Comprehensive Watershed Planning (HUC 12 Level)





# Issue Identified





An aerial photograph showing a coastal road and marsh. The road runs diagonally from the bottom left towards the top right. To the left of the road is a body of water, and to the right is a dense forest of green trees. The marsh area between the road and the water is a mix of green and brown vegetation. Four blue boxes with white text are on the left side, each with a line pointing to a specific feature in the image. The first box points to a bridge in the distance. The second box points to the shoreline where it meets the road. The third box points to the marsh area approaching the road. The fourth box points to a large area of brown, dead marsh vegetation.

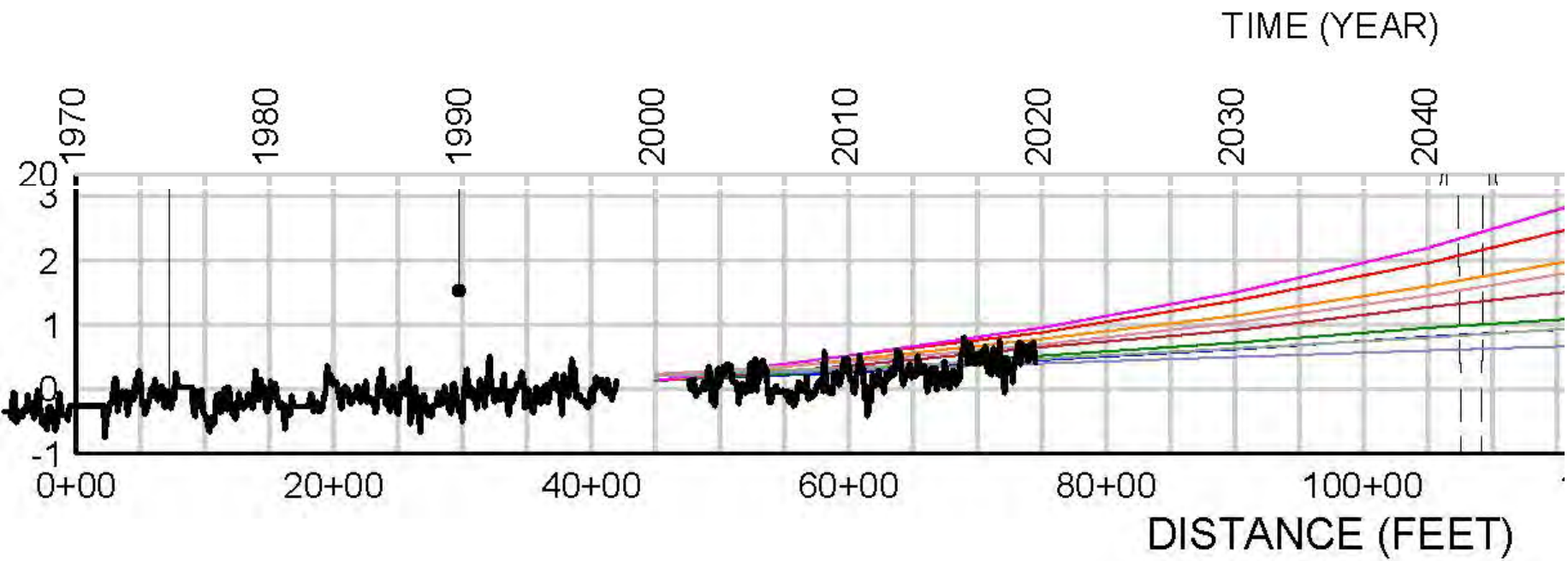
Bridge

Shoreline loss to  
roadway

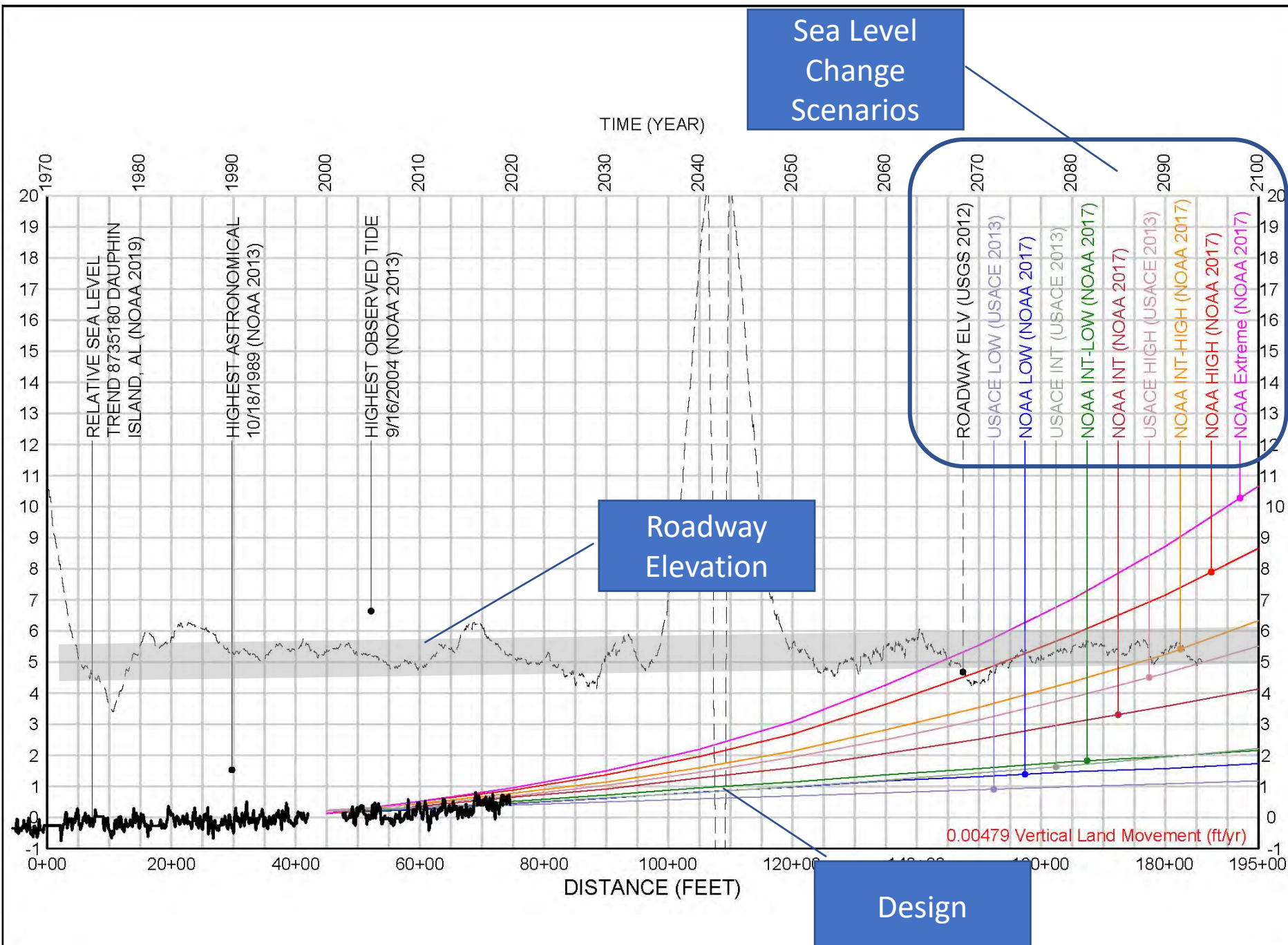
Shoreline  
approaching roadway  
(about 2' per year)

Loss of coastal marsh  
habitat







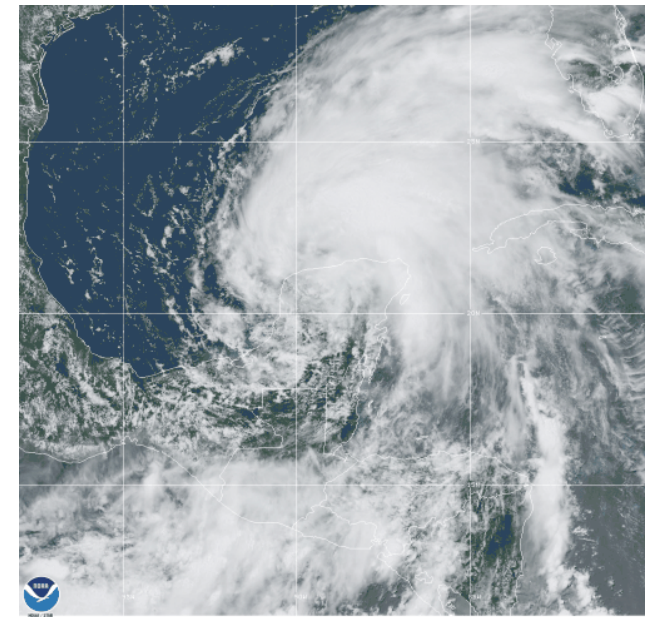
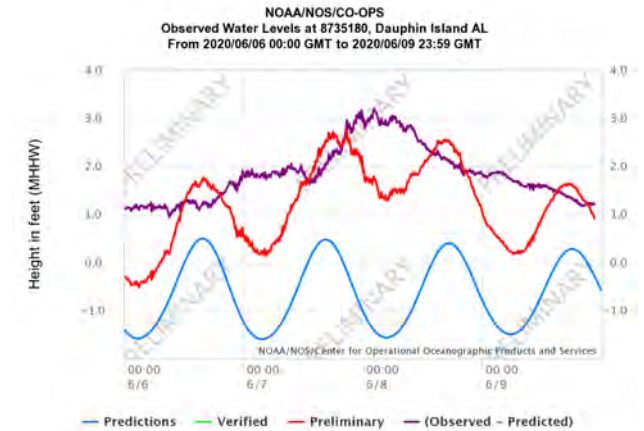




[http://www.mobilebaynep.com/the\\_watersheds/dauphin\\_island\\_watershed/the\\_flight\\_of\\_the\\_frigate\\_bird/](http://www.mobilebaynep.com/the_watersheds/dauphin_island_watershed/the_flight_of_the_frigate_bird/)



# Tropical Storm Cristobal



05 Jun 2020 17:50Z NOAA/NESDIS/STAR GOES-East GEOCOLOR



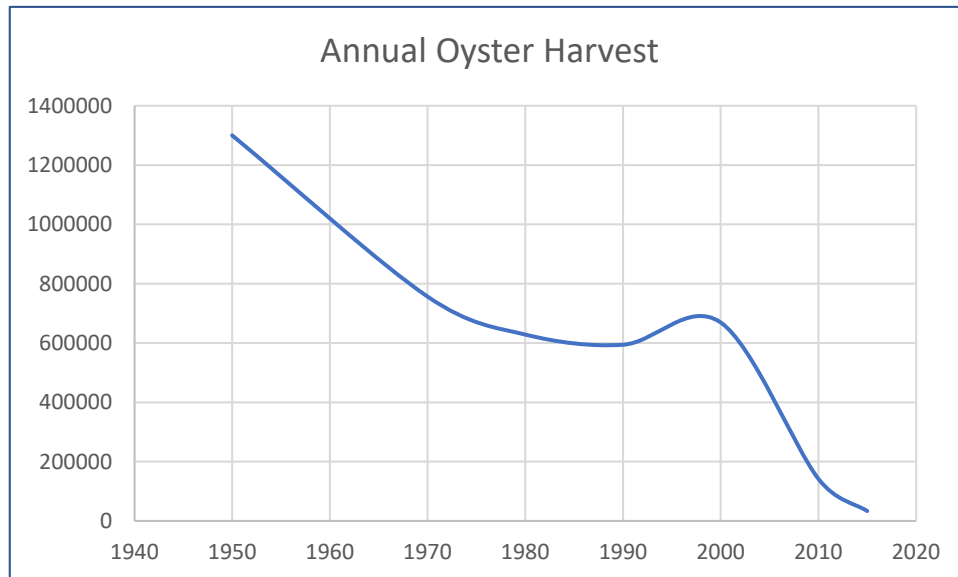
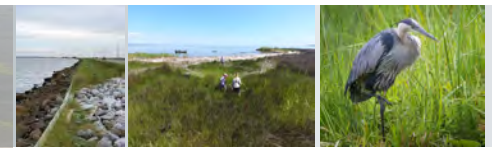




Notice high wave energy

Notice low wave energy

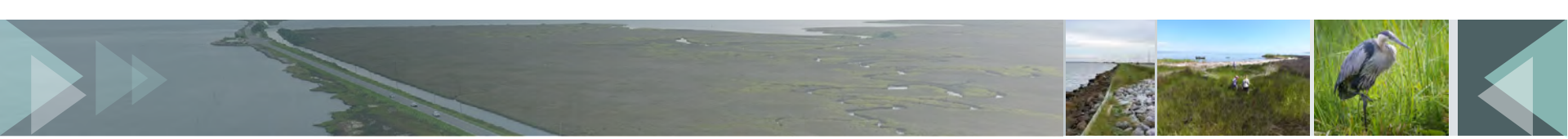
# Oyster Resources



<https://www.al.com/news/mobile/2020/01/alabama-oyster-harvesters-back-at-work-after-lost-year.html>

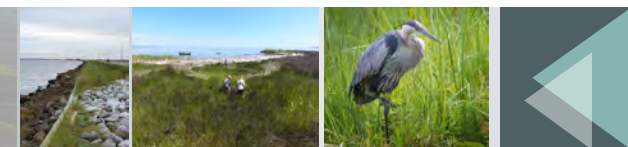
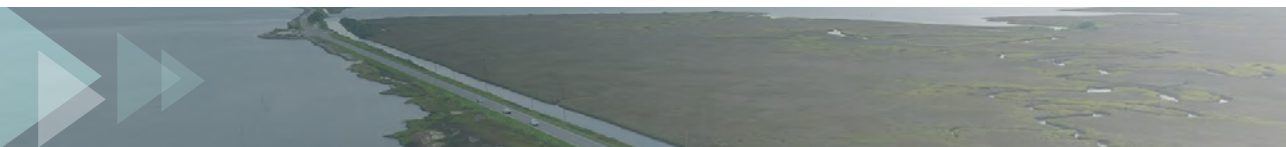






# Stakeholders

- Mobile County – park impacts / tax base
- Mobile Bay National Estuary Program – water quality
- Department of Transportation - roadway
- City of Dauphin Island – access / recreation taxes
- Residents of Dauphin Island - evacuation
- Oyster fishermen – way of life
- Marine Resources Division – oysters / finfish
- Alabama Department of Environmental Management – water quality



"I could see nothing but flames way past the crown," chief engineer Steve Bertone recalled of the dramatic moments before he ordered crew members to abandon the rig. Of the 115 survivors, 16 were seriously injured and medevaced to hospitals. Ninety-nine others, including Bertone, were transported to the mainland by the rescue vessel Bankston. Roughly 36 hours after the first explosion, *Deepwater Horizon* sank to the bottom. It was April 22—Earth Day.

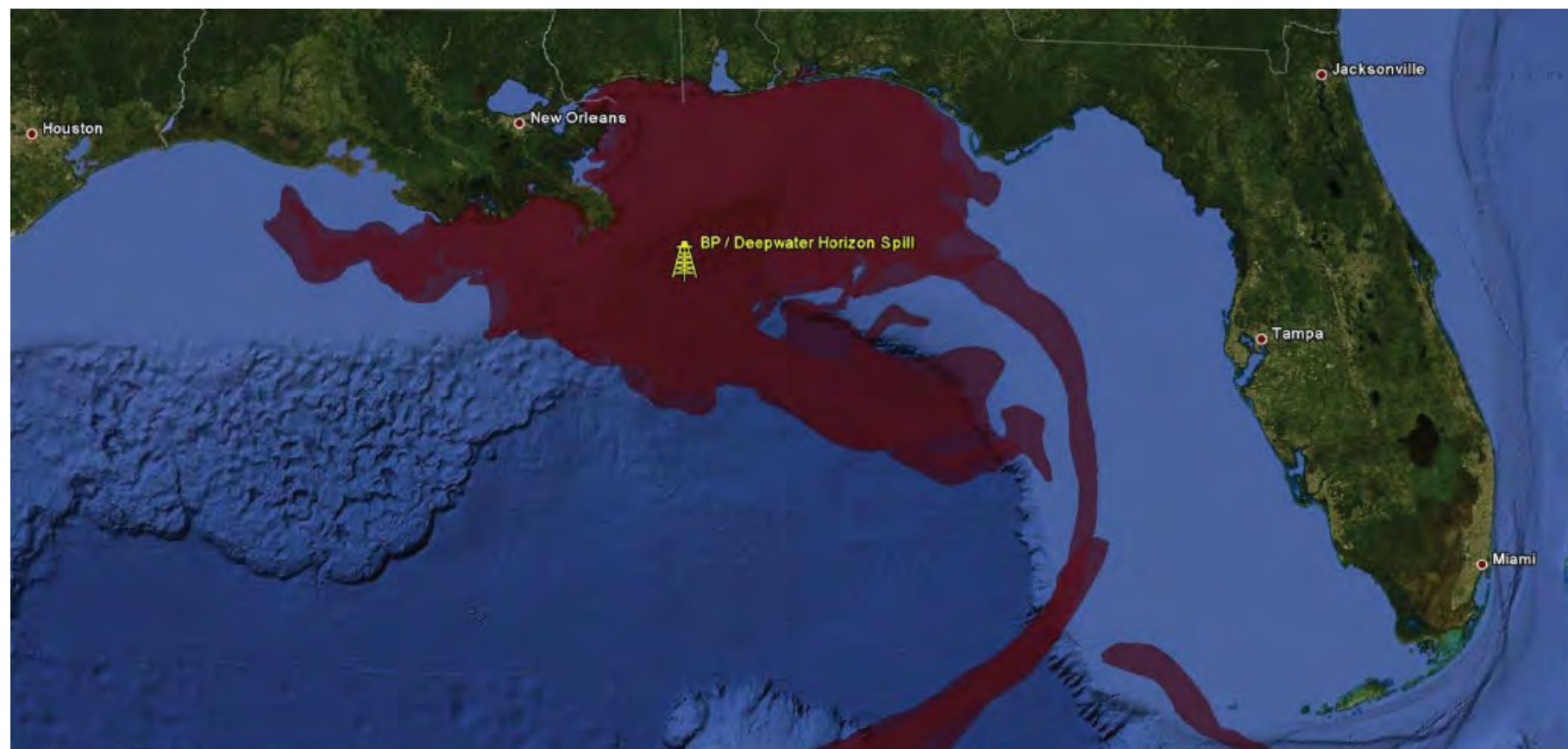
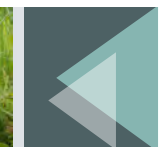
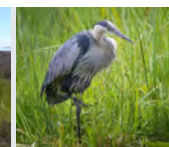
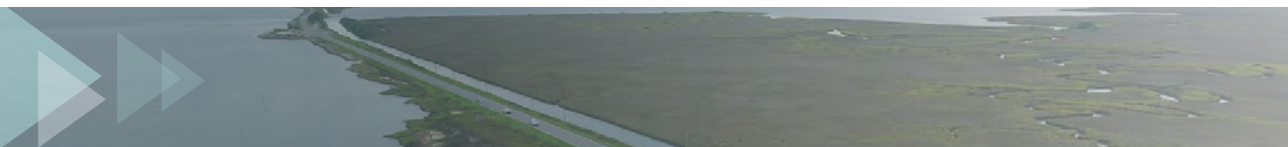
Gerald Herbert/Associated Press



U.S. Coast Guard photo

2011 National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling; Deep Water, The Gulf Oil Disaster and the Future of Offshore Drilling, Report to the President. <https://www.govinfo.gov/content/pkg/GPO-OILCOMMISSION/pdf/GPO-OILCOMMISSION.pdf>. Accessed 04 AUG 2020





The *Deepwater Horizon* oil spill is the largest and most complex spill in the nation.

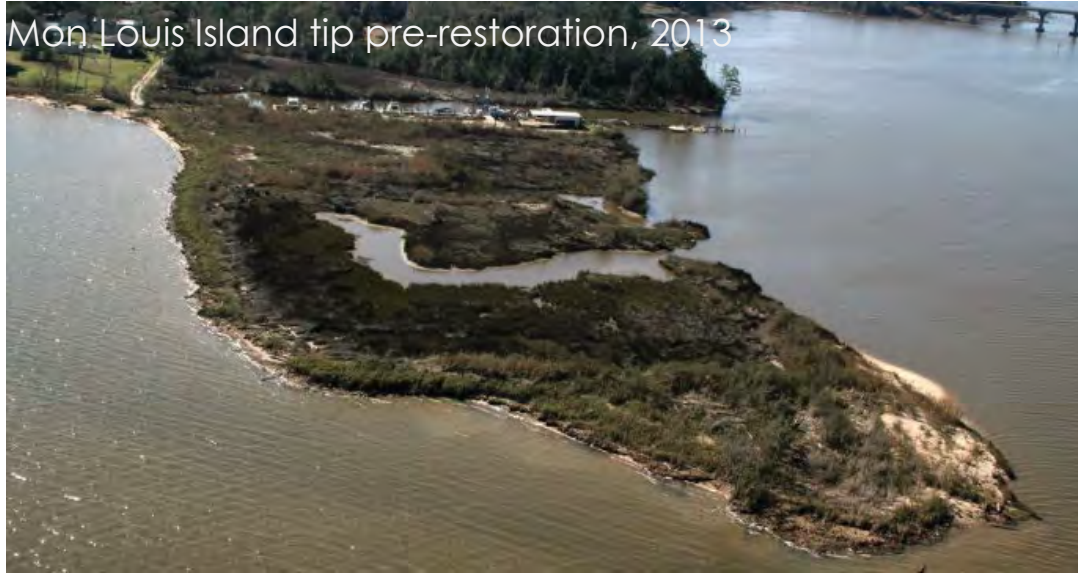
# Resulting Projects





# Resulting Projects

Mon Louis Island tip pre-restoration, 2013

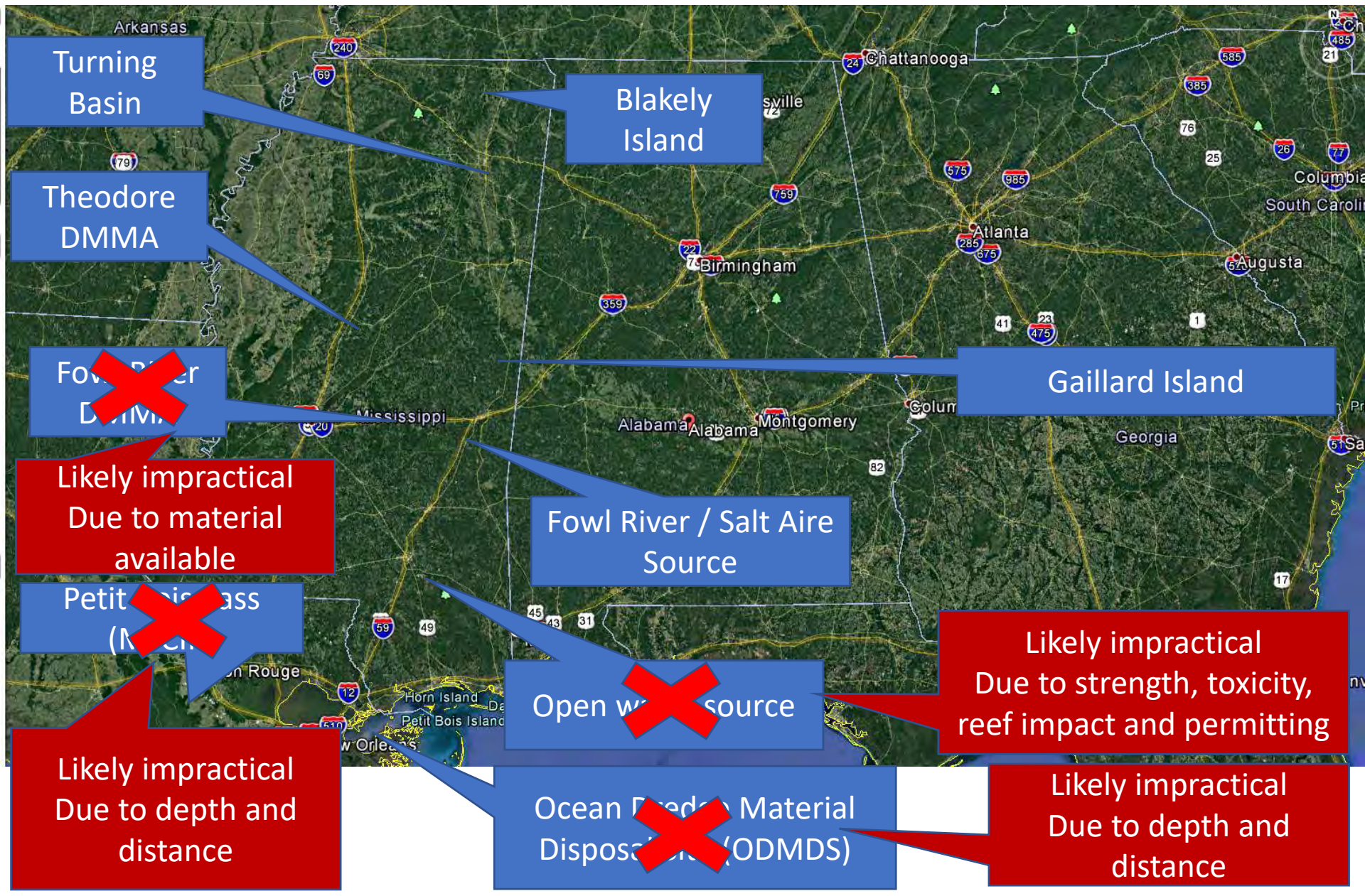


Mon Louis Island tip post-restoration, 2019



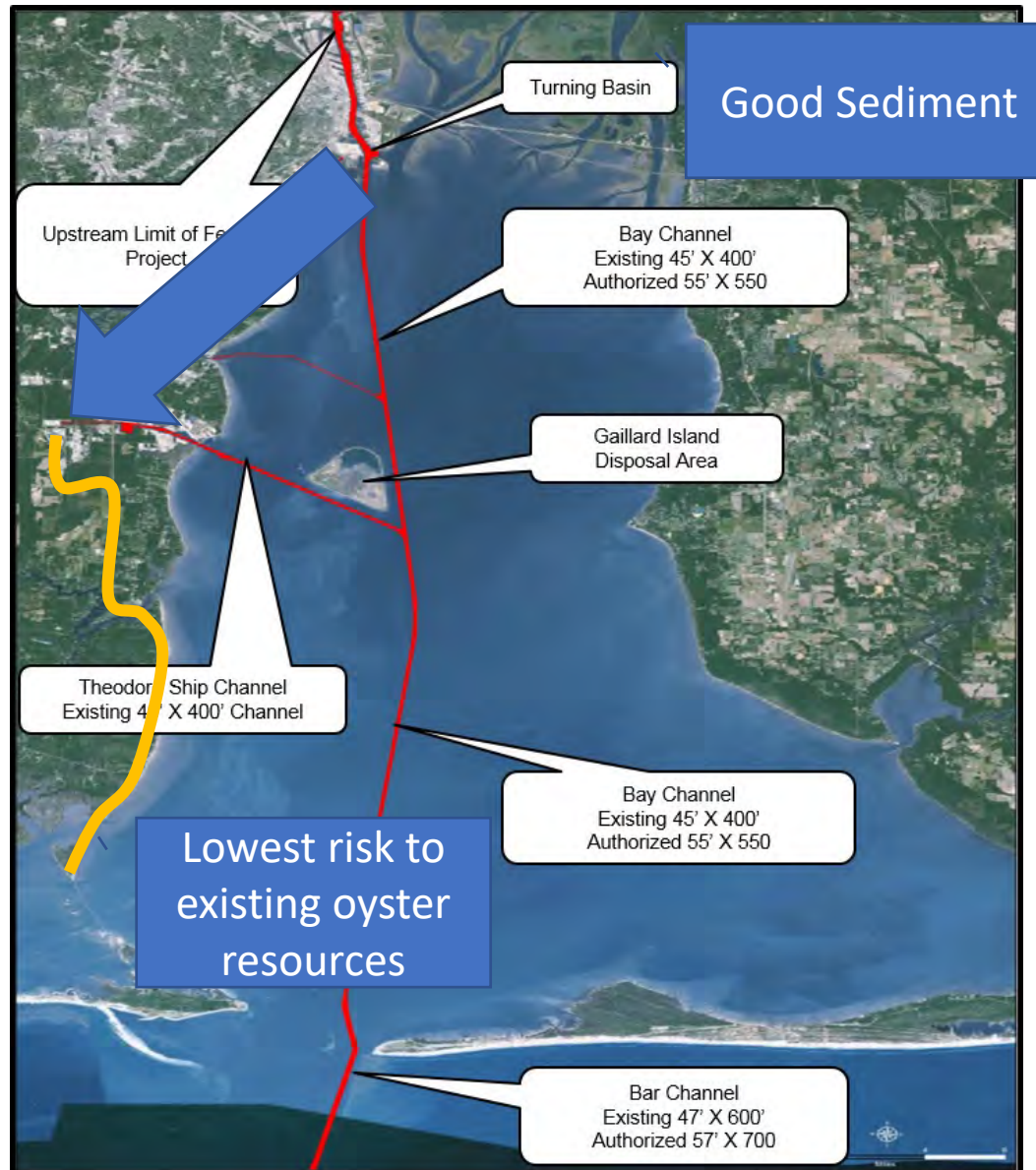


# Sediment sources:

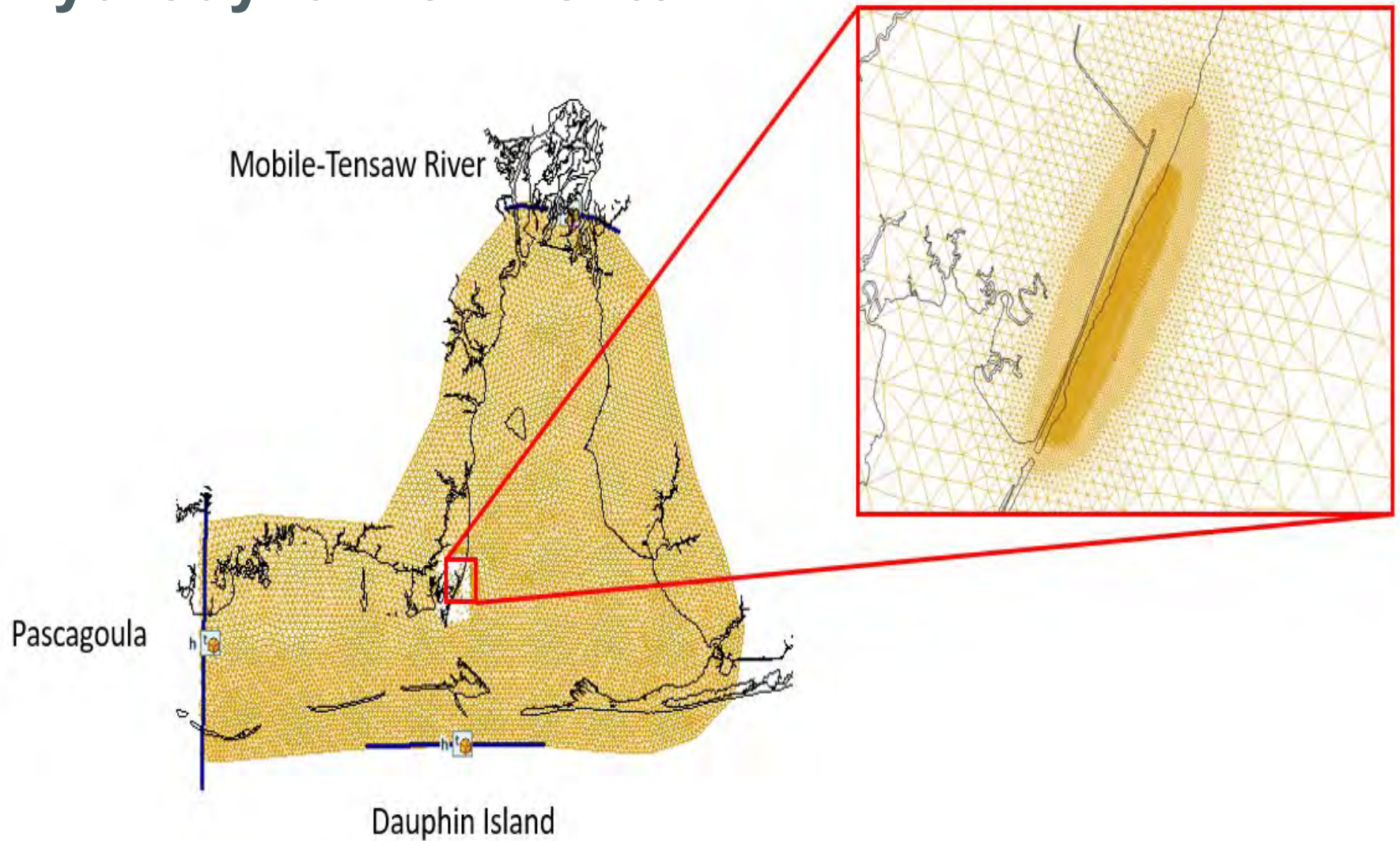




# Deepening and Widening



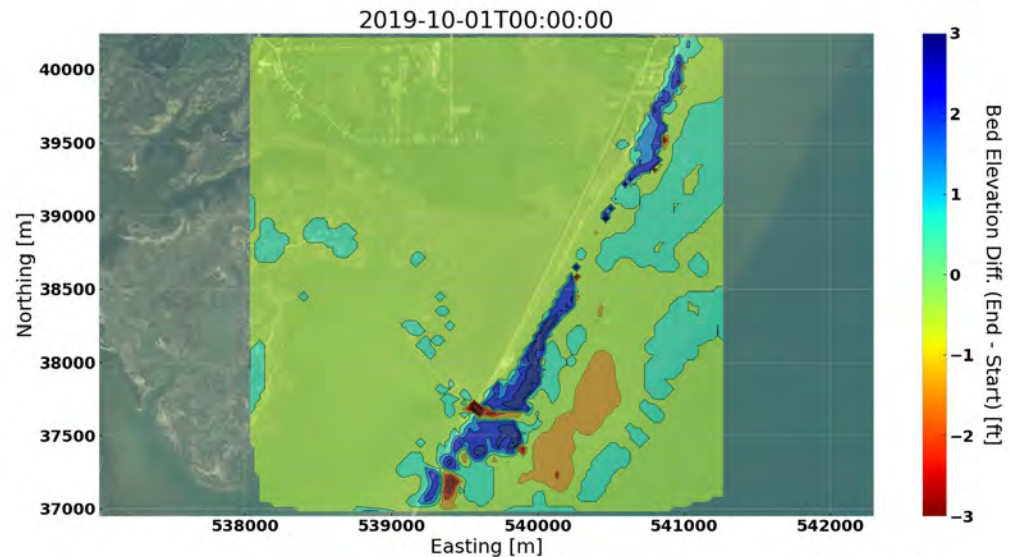
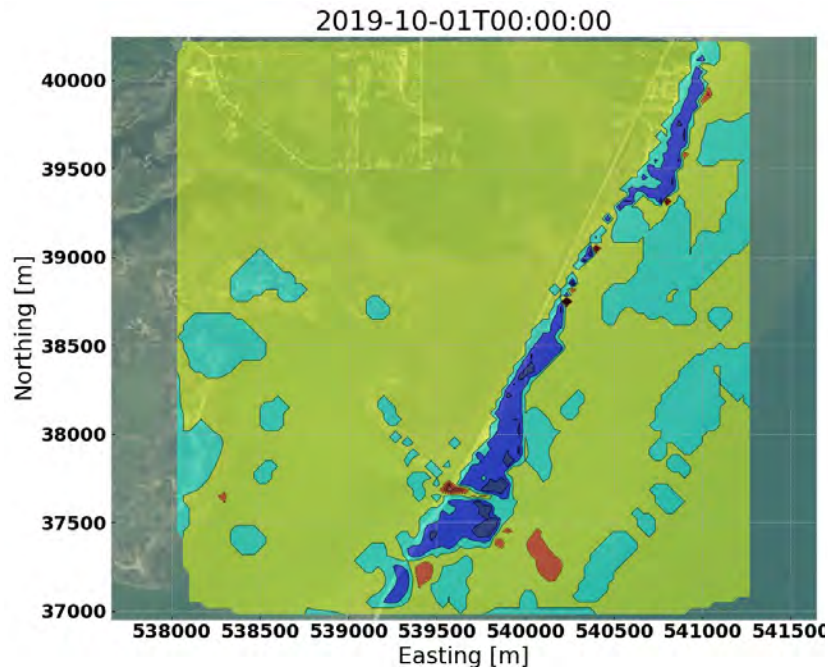
## Hydrodynamic: Delft3D





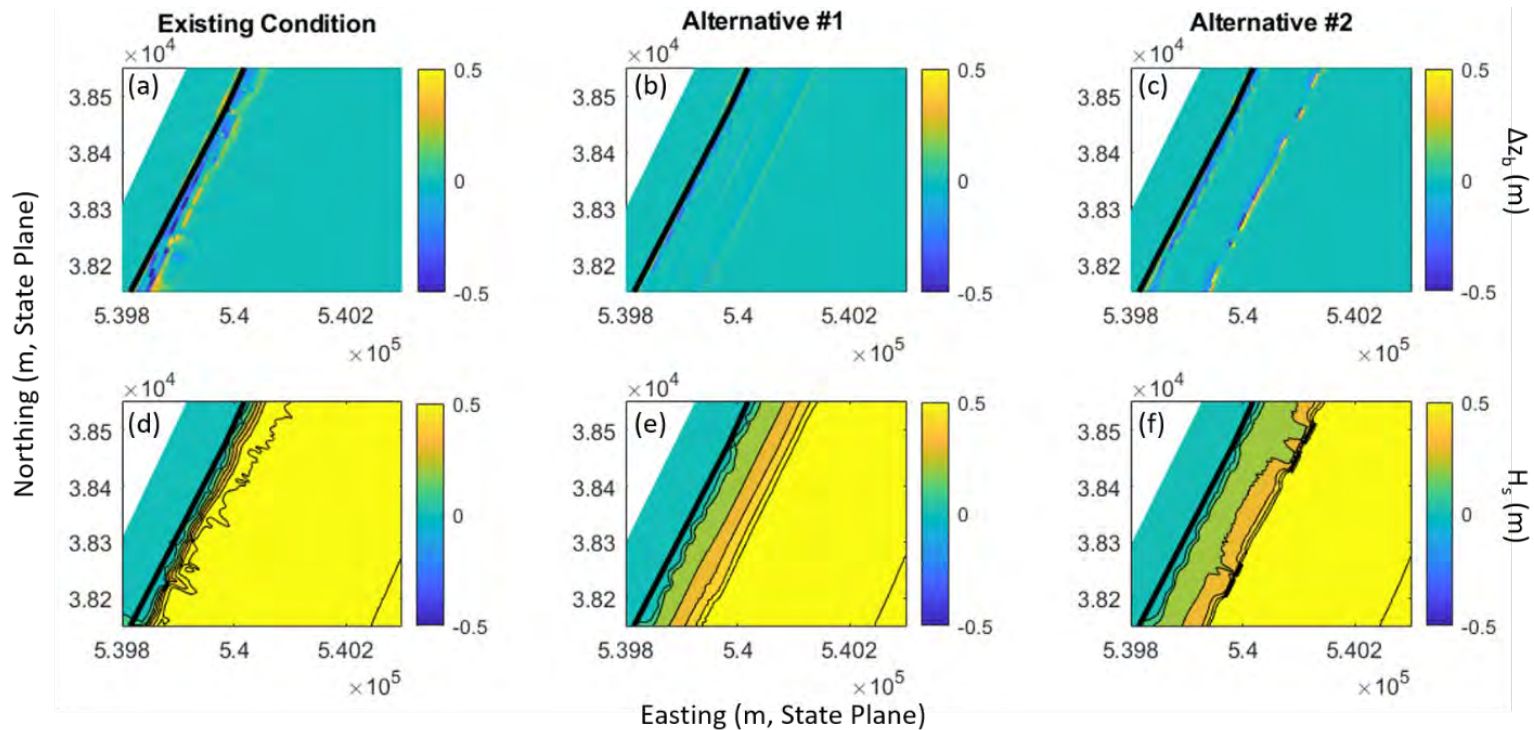
# Modeling

## Sediment and Morphodynamic modeling



# Modeling

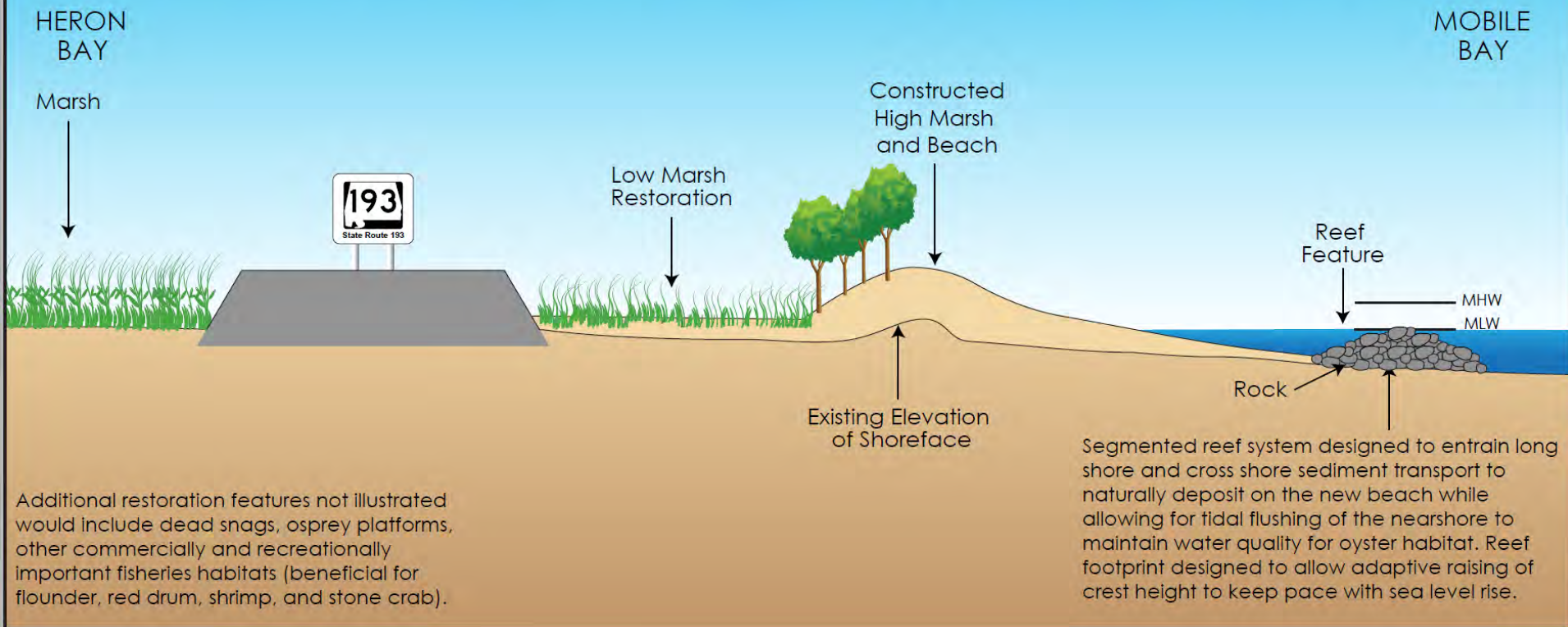
## Morphological Changes: XBeach





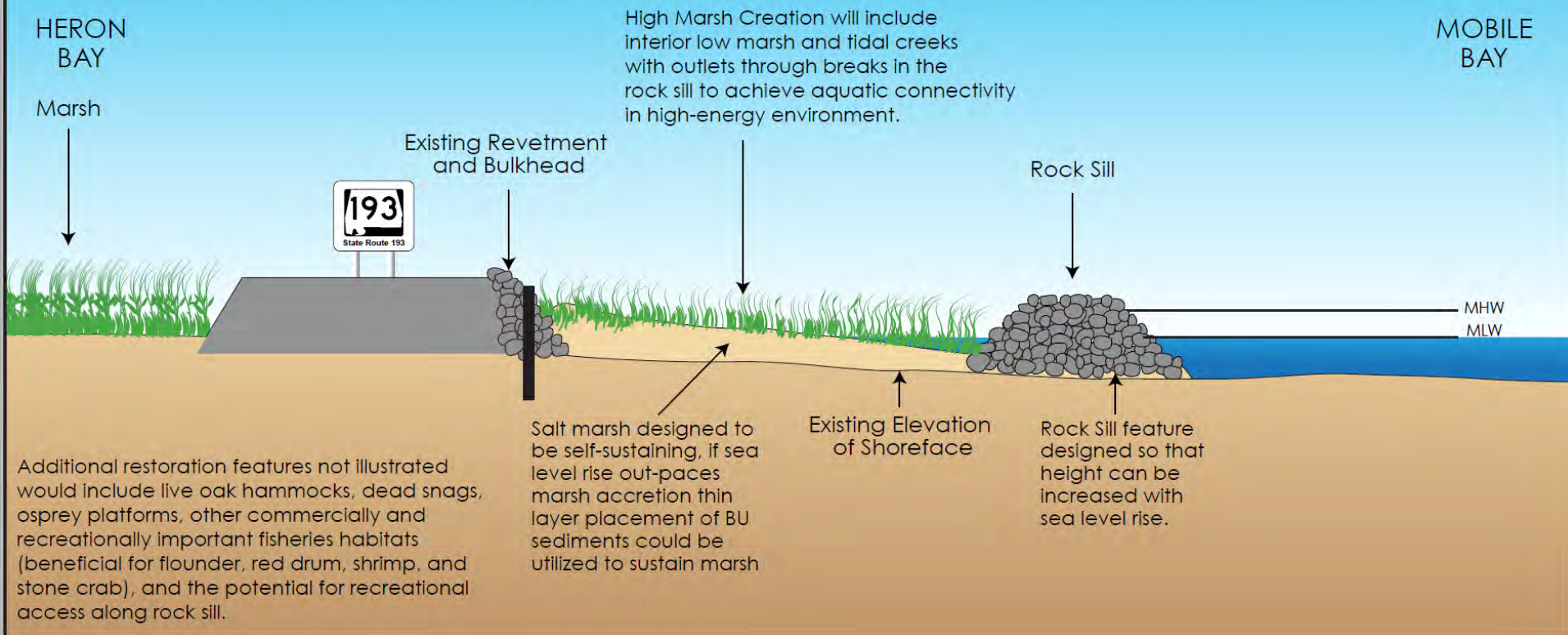


## Dauphin Island Causeway Moderate-Energy Shoreline Restoration Concept Cross Section





## Dauphin Island Causeway High-Energy Shoreline Restoration Concept Cross Section







# Sustainability



Resilience
▶ Adaptation Framework
▶ Case Studies
▶ Ongoing & Current Research
▶ Pilots
▶ Policy & Guidance
▶ Publications
▶ Tools
▶ Webinars
▶ Workshops & Peer Exchanges
▶ Related Links
Sustainable Highways Initiative
Energy and Emissions
Newsletter
Contacts

FHWA → Environment → Sustainability → Resilience → Ongoing And Current Research

## Nature-based Resilience for Coastal Highways

Transportation agencies must protect expensive public infrastructure from coastal flooding, especially as rising sea levels, higher storm surges, urbanization, and ecosystem stresses add complexity to already dynamic coastal systems and communities. An integrated approach to risk reduction includes natural and nature-based features in addition to structural and non-structural measures.

Nature-based features mimic characteristics of natural features and processes but are created by human design and engineering. Examples include dunes, wetlands, maritime forests, beaches, and reefs. These features can protect coastal highways from the brunt of storm surges and waves. Some can adapt to sea level rise by accreting sediment or migrating inland. They can also provide benefits such as recreation opportunities, habitat needed for commercial fisheries, and a healthier environment.


FHWA produced research and technical assistance that will enable transportation agencies to use natural and nature-based features, also called natural infrastructure or green infrastructure, to improve the resilience of transportation systems. FHWA sponsored five pilot projects, developed a white paper, regional peer exchanges, and an implementation guide.



Photo from Federal Highway Administration (FHWA)

## FHWA Resources

- **Implementation Guide: Nature-based Solutions for Coastal Highway Resilience**, September 2019 (PDF 5.5 MB). The Implementation Guide is designed to help transportation practitioners understand how and where nature-based solutions can be used to improve the resilience of coastal roads and bridges. Upfront, it summarizes the potential flood-reduction benefits and co-benefits of these strategies. From there, the guide follows the steps in the project delivery process, providing guidance on how to consider nature-based solutions in the planning process, how to conduct a site assessment to determine whether nature-based solutions are appropriate, key engineering and ecological design considerations, permitting approaches, construction considerations, and monitoring and maintenance strategies.
- **Project Flyer: Using Natural Infrastructure to Protect Coastal Roads and Bridges** (PDF 1 MB)
- **White Paper: Nature-based Solutions for Coastal Highway Resilience**, March 2018. Briefly describes the current state of practice regarding the use of natural and nature-based features to protect coastal roads from flooding. Provides an overview of available tools for design, implementation challenges, and knowledge gaps. (PDF 754 KB)
- **Peer Exchange Report: Nature-based Solutions for Coastal Highways**, August 2018 (PDF 3.6 MB)  
In Spring 2018, FHWA hosted four regional peer exchanges to inform the development of an implementation guide and to facilitate information exchange between transportation practitioners and coastal engineers and ecologists on nature-based

 **Sign up for Sustainable Transportation and Resiliency updates.**

**Contacts**

For more information, please contact:

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- Rebecca Lupes
- Heather Holsinger
- Tina Hodges
- Elizabeth Habic





U.S. Department of Transportation  
**Federal Highway Administration**

**NATURE-BASED  
SOLUTIONS FOR  
COASTAL HIGHWAY  
RESILIENCE:**  
AN IMPLEMENTATION GUIDE





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Adam Questad  
[AQuestad@Geosyntec.com](mailto:AQuestad@Geosyntec.com)



#### Links:

Flight of The Frigate Bird - An Omen of Rising Seas (1:00 Trailer) - <https://youtu.be/0HSIz1TC90Y>

The Flight of the Frigate Bird - [https://youtu.be/rFo\\_3Sdq9ro](https://youtu.be/rFo_3Sdq9ro)

[http://www.mobilebaynep.com/the\\_watersheds/dauphin\\_island\\_watershed/the\\_flight\\_of\\_the\\_frigate\\_bird/](http://www.mobilebaynep.com/the_watersheds/dauphin_island_watershed/the_flight_of_the_frigate_bird/)

Nature-based Resilience for Coastal Highways

[https://www.fhwa.dot.gov/environment/sustainability/resilience/ongoing\\_and\\_current\\_research/green\\_infrastructure/](https://www.fhwa.dot.gov/environment/sustainability/resilience/ongoing_and_current_research/green_infrastructure/)

Connect with us: Wade Burcham, [wburcham@Geosyntec.com](mailto:wburcham@Geosyntec.com) Adam Questad, [AQuestad@Geosyntec.com](mailto:AQuestad@Geosyntec.com)