GALVESTON BAY BENEFICIAL USE OF DREDGED MATERIAL

Galveston District
U.S. Army Corps
30 NOV 2018

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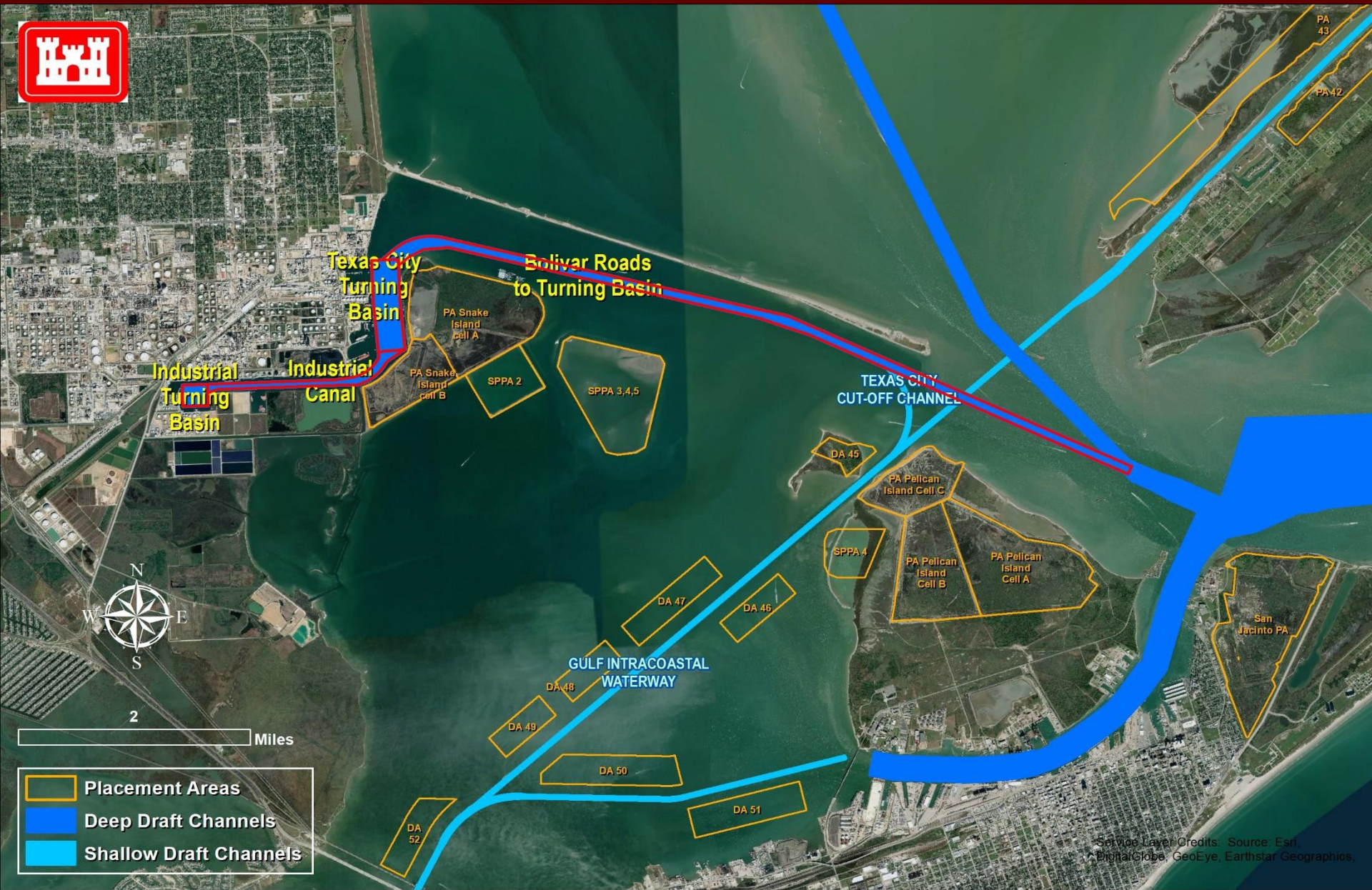
GALVESTON BAY NAVIGATION COMPLEX

TEXAS CITY SHIP CHANNEL



GALVESTON HARBOR - GALVESTON ENTRANCE CHANNEL TO GALVESTON BEACH

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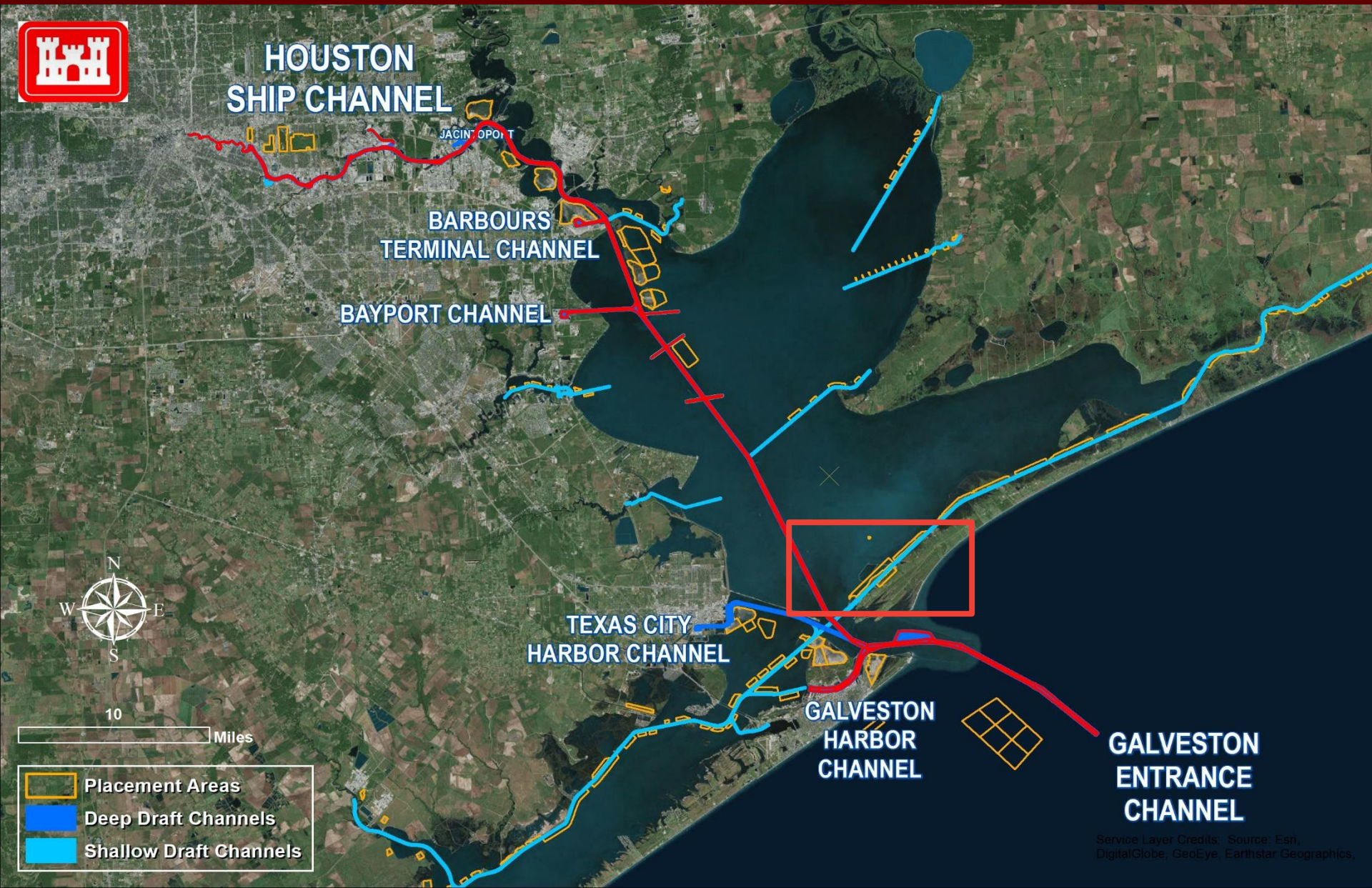
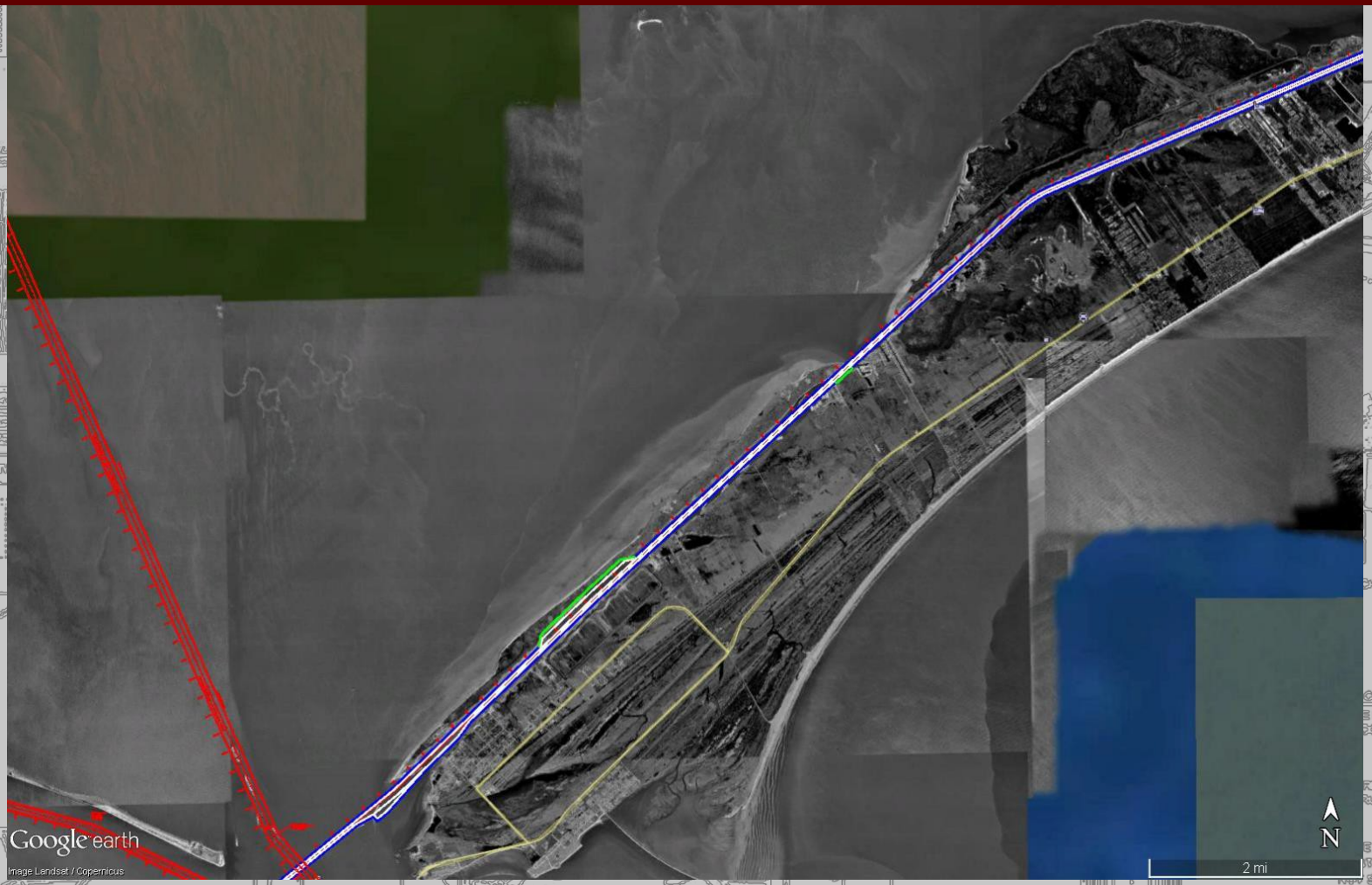
HOUSTON SHIP CHANNEL – GALVESTON HARBOR & CHANNEL



Bolivar Marsh 2002



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Bolivar Marsh 2004

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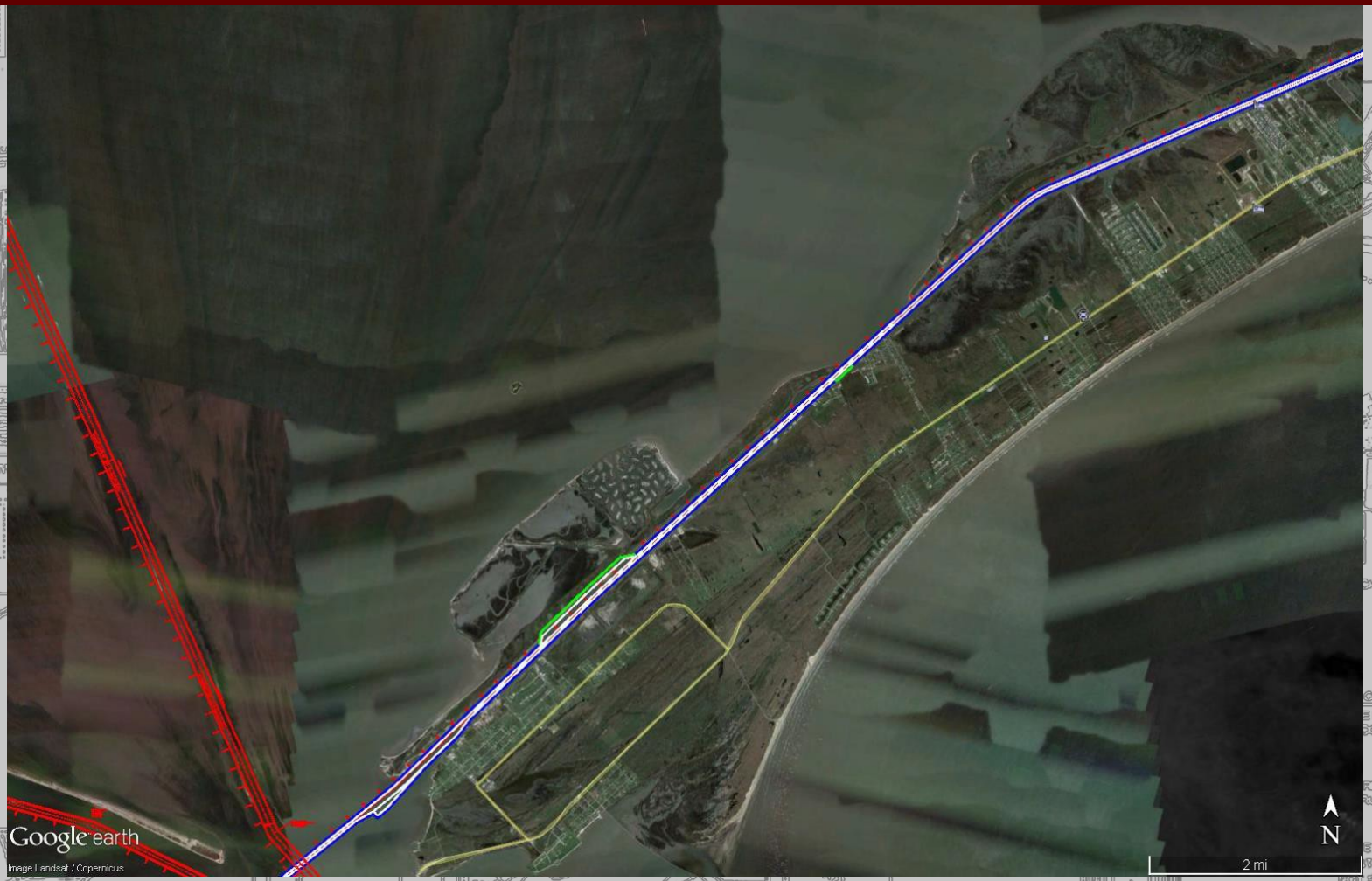
Bolivar Marsh 2017



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HOUSTON SHIP CHANNEL – GALVESTON HARBOR & CHANNEL

GULF INTRACOASTAL WATERWAY
BARRIER ISLAND WEST GALVESTON BAY

RSM Study December 2015

"*Alternatives to Reduce Shoaling in the Gulf Intracoastal Waterway and Prevent Erosion of Bay Islands along the North Shoreline of West Galveston Bay*"

Shoreline Analysis

Mapping Sea-grasses with Aerial Imagery

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Funding Sources

WRDA 2016 - Section 1122

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GULF INTRACOASTAL WATERWAY
BARRIER ISLAND WEST GALVESTON BAY

ERDC/CHL CHETN-XIV-44
December 2015

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Alternatives to Reduce Shoaling in the Gulf Intracoastal Waterway and Prevent Erosion of Bay Islands along the North Shoreline of West Galveston Bay

by Kimberly Townsend, Eric Wood, Derek Thornton, Jantzen Miller, Tricia Campbell, Sheridan Willey, Lihwa Lin, Coraggio Maglio, and Robert Thomas

PURPOSE: The purpose of this Coastal and Hydraulics Engineering Technical Note (CHETN) is to document development of a regional sediment budget and assessment of coastal sediment processes for a Regional Sediment Management (RSM) study along the Gulf Intracoastal Waterway (GIWW) of West Galveston Bay from just north of Greens Lake to Chocolate Bay, TX. The loss of bay barrier islands is reducing the available placement options and may be leading to increased channel shoaling rates. Several design alternatives were investigated to reduce dredging requirements and prevent erosion of the bay islands that act as a barrier protecting the GIWW.

INTRODUCTION: The area of study encompasses Sta. 40+000 to Sta. 120+000 (old stationing), with the primary focus on Placement Areas (PAs) 62 through 65 shown in Figure 1. PAs 62 and 63 serve as barriers along the GIWW and are experiencing the most significant erosion in this area at 8,000 cubic yards (yd^3)/ 5,000 linear feet per year (lin ft/yr). Sediment is being lost along the shallow embankments on both sides of the navigation channel and the adjacent bay shoreline due to a combination of currents, wind-generated waves, and ship wakes. PAs 62 and 63 are semiconfined, and as they erode and the frontage levees are breached, sand and silt pass through and are deposited in the channel. If the placement areas are allowed to further erode, they will eventually become unavailable for placement of future dredged sediment. To address this problem, the U.S. Army Corps of Engineers (USACE), District, Galveston (SWG), has identified several sediment management options to prevent erosion of these placement areas, to stabilize the inlets, and to reduce channel shoaling.

Figure 1. Placement Areas 62–65 along GIWW of West Galveston Bay, TX.

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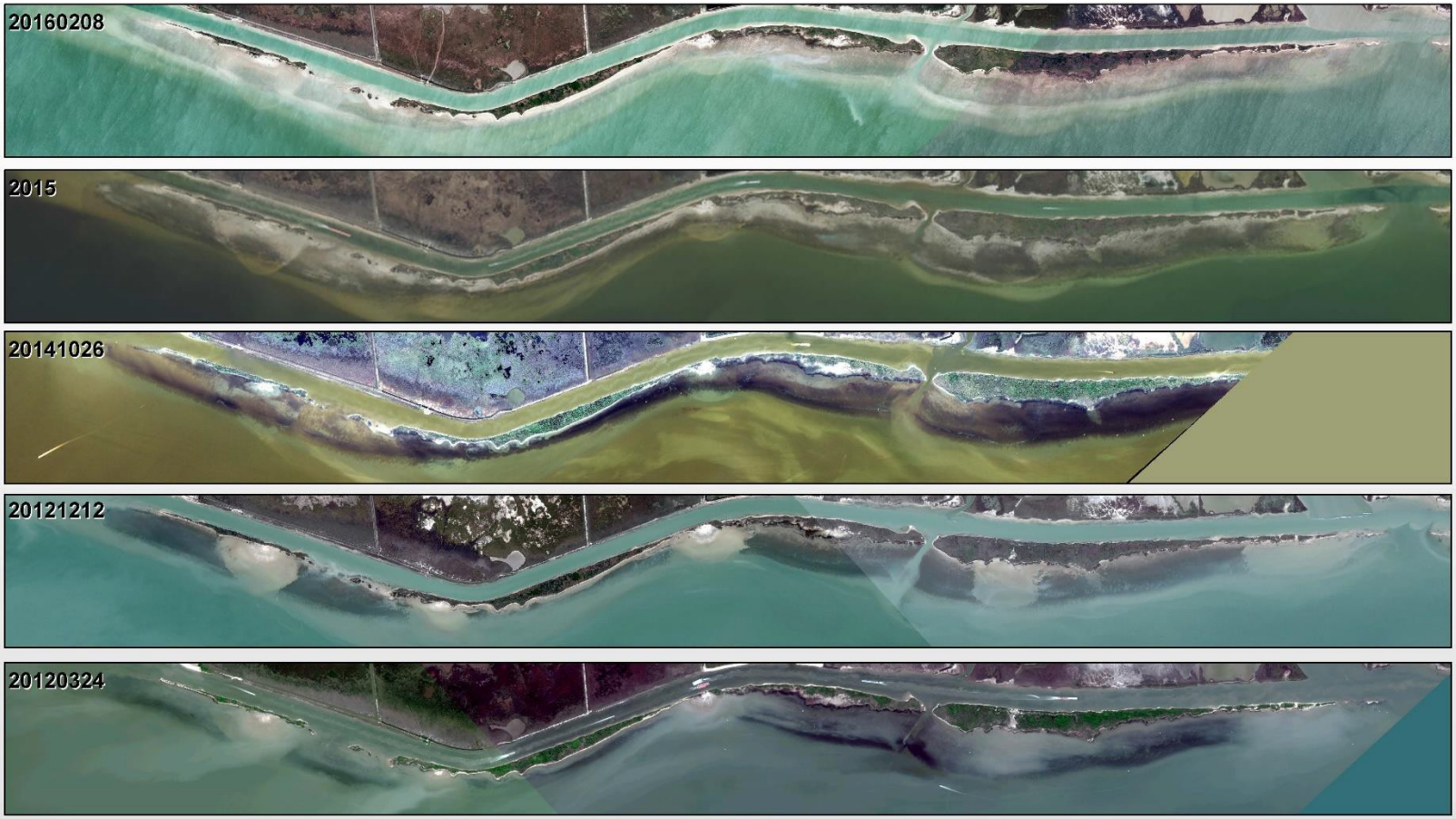

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INITIAL ALTERNATIVES: The primary metric for selecting one or more of the suggested alternatives below is quantifiable shoaling reduction. The alternative(s) must stabilize the inlets and reduce near-shore erosion. The alternative(s) must also be economically feasible and have the potential to be approved by resource agencies. Beneficial use of dredged sediment from the navigation channel is a preference. The following alternatives were posed for consideration:

- breakwaters: articulated concrete block (ACB), rip rap, reef balls, oyster castles
- sacrificial berms
- revetments: rip rap, reef balls.

COST ESTIMATE AND FINAL SELECTION OF ALTERNATIVES: A detailed design was completed for each of the aforementioned alternatives, and a cost comparison per linear foot was performed. Based on the cost comparison, a rip rap revetment was selected as the lowest cost alternative for structures adjacent to channels, costing $501/lin ft (Figure 6). Prefabricated breakwater concrete units, although cheaper at $402/lin ft, were not selected for these locations due to the potential for damage from barges, which would compromise their functionality and require significant repair to the revetment after each impact event.

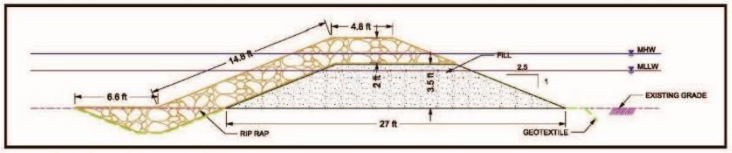

Figure 6. Typical cross section for rip rap revetment.

The lowest-cost alternative for bay-side structures is oyster castles, at $352/lin ft (Figure 7). This is also the most constructible alternative for these areas, as this material can be delivered to the construction location on small, shallow-draft boats and can be hand assembled, requiring no heavy equipment. However, because SWG has no previous experience implementing oyster castles, it may prove wiser to implement mostly rip rap revetment during Phase 1, initially placing oyster castles only where erosion is mild so that SWG can observe performance.

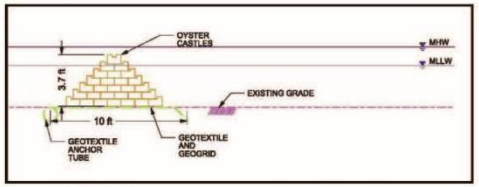

Figure 7. Typical cross section for oyster castle breakwater.

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In addition to these hard structures, *sacrificial berms* were chosen for the bay side of the bay barrier islands to serve as training dikes and allow for the continued placement of dredged sediment (Figure 8). The sacrificial berms also function as renourishment sediment to maintain the island features. The berms are economical as well, costing under $52/lin ft.

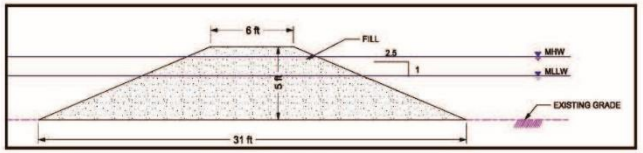

Figure 8. Typical cross section for sacrificial berm.

PROPOSED DESIGN LAYOUT: The final layout of protection was divided into two phases to ensure that structures in the most critical areas will be implemented first. Phase 1 encompasses PAs 62 through 64, with the regions to the north and south of these PAs designated as Phase 2. Within each phase, each structure was labeled with a certain priority based on the severity of erosion and on channel shoaling along that particular reach of shoreline. SWG chose to categorize the proposed designs this way to make very clear where the most critical areas are located in case resources are limited and only certain priority reaches can be addressed.

North of Greens Lake near PAs 60 and 61, a revetment is proposed along both sides of the GIWW. Along the bay side of these bay barrier islands, a sacrificial berm wraps all the way around to the channel side to provide continued storage of dredged sediment. A bayside offshore structure of either oyster castles or rip rap revetment serves as a means of erosion protection and as a physical barrier for the beneficial placement of dredged sediment bayside of existing identified resource areas (Figure 9).

Along PA 62, channel shoaling and shoreline erosion are major issues, particularly toward the north end. To alleviate the persistent shoaling in the GIWW, both sides of the channel along PA 62 should be protected by revetments. A sacrificial berm placed on the bayside of PA 62 could help expand the placement areas and prevent them from losing sediment to the bay. In addition, placement of a hard structure offshore beyond the sea grasses along the north end of the bay side of PA 62 will help protect the barrier island from further erosion. Erosion is not as severe farther south along PA 62, so the sacrificial berm in this area can be designated *beneficial*, and the offshore hard structure does not continue farther south.

The northern half of PA 63 is also experiencing significant erosion, and the GIWW shoals steadily in this area, as well. A revetment on both sides of the channel (Priorities 1 and 2) and a sacrificial berm along the bay side of the channel (Priority 1) (Figure 9) are proposed here to address the erosion issues. The revetment continues on both sides of the GIWW along the southern half of PA 63, as does the sacrificial berm on the bay side. Additionally, a hard structure is placed offshore beyond the seagrasses as a beneficial structure to prevent further erosion (Figure 10).

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