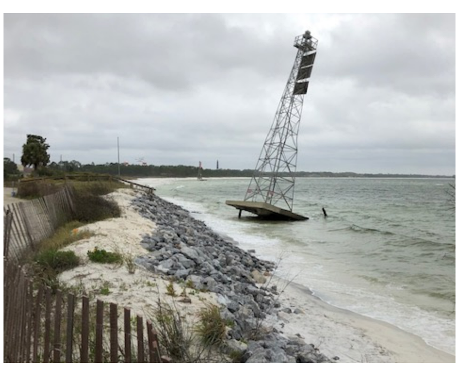
Pensacola Bay Living Shoreline Project

Basis of Design Report

March 2020



DEO FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

GULF COAST ECOSYSTEM RESTORE RESTORATION COUNCIL

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

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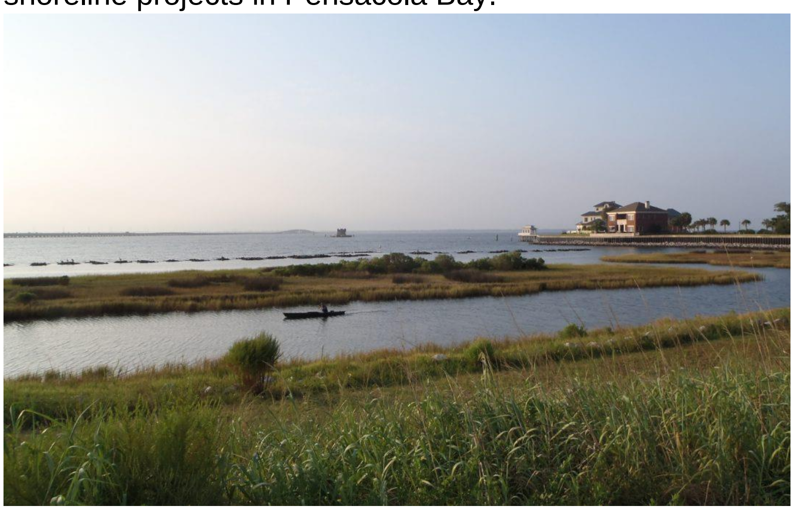
1.0 INTRODUCTION

Located in Escambia County, Florida, the Pensacola Bay Living Shoreline Project is a multi-phase, multi-stakeholder project to restore and protect approximately three miles of shoreline in Pensacola, Florida. The planning, engineering design, environmental compliance, and regulatory permitting for this living shoreline project are being managed by Escambia County with funds from two grants. One grant is linked to the RESTORE Act of 2012 and the other is a State of Florida Department of Economic Opportunity Defense Infrastructure Grant Agreement.

Project partners include the Florida Department of Environmental Protection (FDEP), Escambia County, and the Pensacola Naval Air Station. Volkert, Inc. was selected as the project engineer in 2018.

Escambia County has a robust environmental program and has worked closely with numerous Federal, State, and local interests and the public to design and implement living shoreline projects in Pensacola Bay. Escambia County, in partnership with the FDEP and the City of Pensacola, built the very successful Project Greenshores in Pensacola Bay in 2001, the first living shoreline project in Florida. The proposed action is a continuation of efforts to develop living shoreline projects in Pensacola Bay.



Project Greenshores in Pensacola, FL (Rick O'Connor)

HISTORY AND SIGNIFICANCE, PENSACOLA BAY

The Pensacola area has a rich and colorful history dating nearly 450 years, and has the distinction of being the first European settlement in the continental United States (1559). Known as the City of Five Flags, Pensacola has been under the possession of the Spanish, French, British, United States and Confederate States, and has remained a part of the United States since the end of the American Civil War.

In the past, the city gained prominence for its renowned fishery, timber industry, military presence, and port. Today, tourism and the military are major components of the economy; health care, high-technology industries, and manufacturing (fibers, chemicals, paper products, and building materials) are also important.

Pensacola's deepwater port has access to the Intracoastal Waterway and to the Gulf via a channel west of Santa Rosa Island.

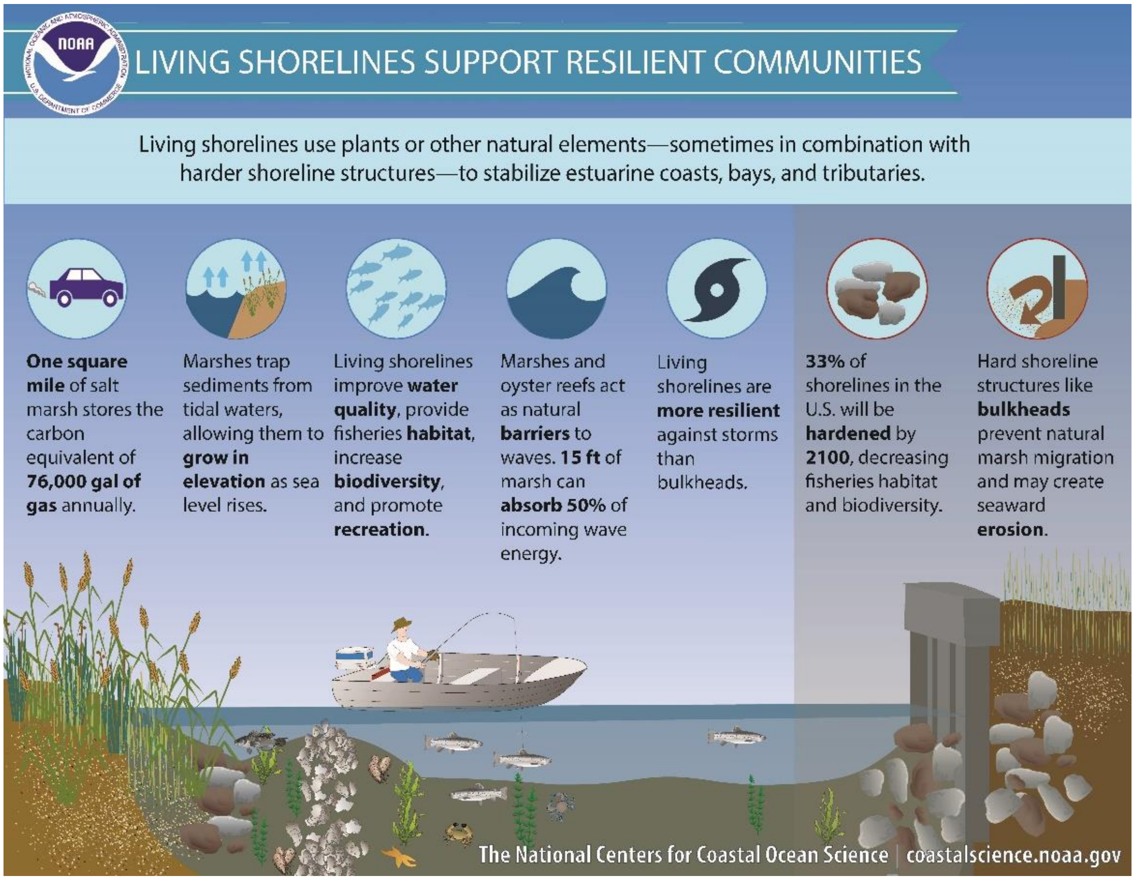


Figure 1. Living shorelines and their benefits

A living shoreline is a protected and stabilized shoreline made of natural materials such as plants, sand, or rock (Figure 1). Living shorelines can provide multiple benefits, including:

- Minimize coastal erosion
- Provide habitat for plants, wildlife, and people
- Improve water quality
- Increase biodiversity
- Provide recreational opportunities
- Make coastlines more resilient to storms

Three sites are currently being considered for the Pensacola Bay Living Shoreline Project including an area at White Island and along the eastern and southern shores of Naval Air Station (NAS) Pensacola (Figure 2).

The Basis of Design Report is a comprehensive evaluation leading to the development of conceptual designs specific to each of the three living shoreline sites. The Basis of Design Report addresses the following:

- Grant requirements
- Comprehensive site evaluations
- Compilation/review of existing project related data and evaluation of data gaps
- Coastal conditions analysis to define key design parameters such as tide, storm surge elevations, wave characteristics, and other site specific characteristics
- Project constraints
- Construction materials/survivability/constructability
- Permitting
- Public involvement
- Risks and strategies to mitigate
- Discussion of next steps

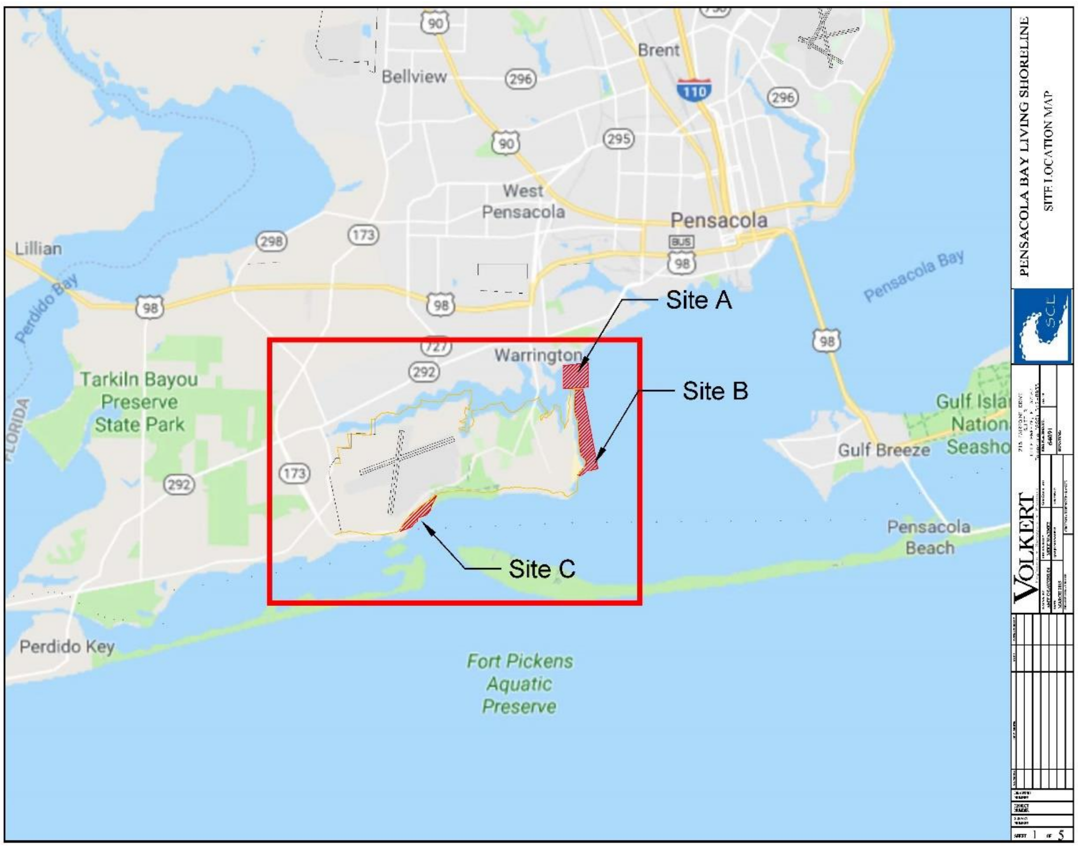


Figure 2. Project Location

Escambia County is working closely with key players in the development of the Pensacola Bay Living Shoreline Project. The project must be compatible with NAS Pensacola air use zones, land ownership, and force protection/exclusion zone needs. The FDEP has major involvement in the project through their responsibilities for State sovereign submerged lands, water quality certification, coastal zone consistency, and other permitting requirements as well as their role in the grant funding agreement with the Gulf Coast Ecosystem Restoration Council (RESTORE Council). A joint Section 10/404 permit will be required from the U.S. Army Corps of Engineers and the project will require a section 408 determination for avoidance of potential impacts to Federal navigation channels. The Pensacola Bay Living Shoreline Project is also serving as a pilot project to identify regulatory efficiencies for projects funded under the Council Restoration Component of the RESTORE Council. These efficiencies will be identified and facilitated via the Gulf Coast Interagency Environmental Restoration Work Group. Public involvement is also an important factor in success of the project. Escambia County has conducted early public meetings and will continue to keep the public involved in the planning process. Coordination is an important topic in the Basis of Design Report.

Table 1: Summary of Roles and Responsibilities for Pensacola Bay Living Shoreline Project

Entity	Role(s)
Gulf Coast Ecosystem Restoration Council	Grantor
State of Florida Department of Economic Activity	Grantor
Florida Department of Environmental Protection	Grant Recipient, Regulatory (Permitting) Agency
Escambia County	Grant Subrecipient, Project Manager
Pensacola NAS	Property Owner, Project Partner
Volkert, Inc. Team	Project Design, Engineer of Record

2.0 Pensacola Bay System Area Description

The Pensacola Bay System (PBS) covers over 6,800 square miles of northwest Florida and southern Alabama. The Pensacola Bay Watershed headwaters are in southern Alabama, and the bay itself lies in northwestern Florida, in Escambia and Santa Rosa counties, adjacent to Alabama and the Florida city of Pensacola. Pensacola Bay is approximately 13 miles long and 2.5 miles wide and lies behind the barrier beach of Santa Rosa Island. The Pensacola Bay estuary encompasses approximately 187 square miles and comprises five interconnected arms or large embayments: Pensacola Bay, Escambia Bay, Blackwater Bay, East Bay, and Santa Rosa Sound. The bay leads into Escambia Bay to the north and East Bay to the east, and is connected to the Gulf of Mexico by Pensacola Pass. It is partially enclosed by the Gulf Islands National Seashore. Within Florida the Escambia River, Blackwater River, Shoal River, and Yellow River drainage basins are the major sources of water to the Pensacola Bay estuary. Several bayous discharge directly to the bay, the largest being Bayou Grande, Bayou Texar, and Bayou Chico. Ecologically diverse, this watershed includes alluvial and blackwater rivers, floodplain swamps, tidal marshes, seagrasses, and oyster beds, among other types of natural communities (SWIM 2017). Additional information about the Bay system, natural resources and water quality can be found in Appendix B.

Numerous major navigation channels are located in Pensacola Bay as illustrated on NOAA Chart 11383. The shallow draft Gulf Intracoastal Waterway (12'x125') runs east/west through the lower section of Pensacola Bay. The deep draft Pensacola Harbor Channel is a north/south channel including: an entrance channel (35'x500') from the Gulf of Mexico to Pensacola Bay, a bay channel (33'x300') to the inner harbor approach channels (33'x300'), and the inner harbor channel at the Port of Pensacola (33'x500'). A Navy Department channel that overlaps the entrance channel with dimensions of 37'x800' leads to the Naval Air Station (NAS) Pensacola anchorage and turning basin (35').

The cities of Pensacola, Gulf Breeze, and Milton are located adjacent to the system. Pensacola is the largest of the three, bordering both northern Pensacola Bay and western Escambia Bay. Milton is located near the mouth of the Blackwater River, and Gulf Breeze is on the southern shore of Pensacola Bay. According to the 2010 US Census, the population of the City of Pensacola was 51,923. The city encompasses approximately 25 square miles and consists of a mixture of urban and residential areas. The US census estimates the populations in the cities of Milton and Gulf Breeze at 8,826 and 5,763 respectively.

3.0 Naval Air Station (NAS) Pensacola

NAS Pensacola is located on a peninsula within the Pensacola Bay system between Pensacola Bay and Bayou Grande, approximately 5 miles from downtown Pensacola, Florida (Figure 3). The Navy's presence was first established at the site of NAS Pensacola in 1825 when President John Quincy Adams and Secretary of the Navy, Samuel Southard, arranged to build a Navy Yard on the southern tip of Escambia County. Construction of the Pensacola Navy Yard began in 1826 and grew to be one of the best equipped naval stations in the country. Today, NAS Pensacola provides support to 94 Department of Defense (DoD) and 31 non-DoD tenant commands, most of which are primarily dedicated to the training of Navy, Marine Corps, and Coast Guard personnel in naval aviation.

Figure 3: NAS Pensacola Boundary and Project Sites

NAS Pensacola supports many activities, including the headquarters and staff of the Naval Education and Training Command; Training Air Wing Six and subordinate squadrons; USAF 479th Flying Training Group and subordinate squadrons; Naval Aviation Schools Command; Center for Naval Aviation Technical Training; Naval Air Technical Training Center; Marine Aviation Training Support Group-21; Center for Information Dominance; Navy Medicine Operations Training Center; Naval Recruiting Orientation Unit; Naval Education and Training Professional Development and Technology Center, Saufley Field; and the world-renowned Blue Angels Flight Demonstration Squadron. NAS Pensacola is one of the largest training operations in the Navy with nearly 60,000 students graduating from training programs annually. NAS Pensacola trains students from every branch of the military, the US Coast Guard, other agencies and foreign allies. It is one of only four installations in the continental United States with an active runway and a deep water port (NAS Pensacola 2019).

NAS Pensacola also supports non-defense related tenants including the National Park Service, Barrancas National Cemetery (administered by Veterans Affairs), the Federal Aviation Administration (FAA), and the National Museum of Naval Aviation. Support services located on NAS Pensacola include bachelor officers' quarters, morale, welfare, and recreation (MWR), a family services center, security, a commissary, and exchanges. (NAS Pensacola 2019). Additional information regarding the operational area at NAS Pensacola and the Air Installations Compatible Use Zones (AICUZ) Program is found in Appendix C.

4.0 Project Funding Sources

4.1 Gulf Coast Ecosystem Restoration Council (RESTORE Council)

The RESTORE Act, signed into law in July 2012, established a Gulf Coast Restoration Trust Fund (Trust Fund) which will receive 80 percent of the civil and administrative Clean Water Act penalties resulting from the *Deepwater Horizon* oil spill. The Trust Fund supports five restoration components aimed at restoring the long-term health of the valuable natural ecosystems and economy of the Gulf Coast region.

Thirty percent of the money directed to the Trust Fund is managed by the Gulf Coast Ecosystem Restoration Council (RESTORE Council) to implement ecosystem restoration under a Comprehensive Plan, developed by the Council with input from the public, to restore the ecosystem and the economy of the Gulf Coast Region. This 30 percent is referred to as the Council-Selected Restoration Component (commonly referred to as "Bucket 2"). The Council approves Bucket 2 projects and programs for funding in what is called a Funded Priorities List (FPL).

In 2015, the RESTORE Council approved their initial Funded Priorities List, known as FPL 1. The FPL included the Pensacola Bay Living Shoreline Project (Phase I) in two funding categories. Category 1 activities provided funding for planning, engineering, design, environmental compliance, and permitting for the three sites. The funding available for these activities is $217,499.38. Category 2 activities, if funded in the future, would provide a portion of the construction funds needed for the White Island section of the project, in the amount of $1,564,636.00 (RESTORE 2015).

4.2 Defense Infrastructure Grant Agreement, State of Florida Department of Economic Opportunity

Section 288.980(5), Florida Statutes (F.S.), establishes the Florida Defense Infrastructure Grant Program, the purpose of which is to support local infrastructure projects deemed to have a positive impact on the military value of installations within the state. Funds are to be used for projects that benefit both the local community and the military installation. Sections 288.980(3)(a) and 288.980(3)(b), F.S., authorize the Department of Economic Opportunity to award grants related to the Florida Defense Infrastructure Grant Program for such activities as studies, presentations, analyses, plans, modeling, construction, land purchases, and easements. Infrastructure projects to be funded under this program include, but are not limited to, those related to encroachment, transportation and access, utilities, communications, housing, environment, and security.

The grant was awarded in 2019 to Escambia County and totals $375,532.21. The purpose of the grant is to augment existing planning, engineering design, and regulatory permitting funds for the Pensacola Bay Living Shoreline Project (LSP) at Naval Air Station (NAS) Pensacola, which is linked to The RESTORE Act of 2012. The LSP will include the installation of an engineered breakwater located offshore of NAS Pensacola. The breakwater is expected to greatly enhance force protection and delineation of the Military Exclusion Zone around the perimeter of the base. Secondary benefits will include stabilization of NAS Pensacola shoreline, water quality improvements, and estuarine habitat enhancements.

Table 2: Project Goals, RESTORE Council Grant and State of Florida Defense Infrastructure Grant Agreement

Use natural shoreline stabilization approaches to reduce shoreline erosion along the west shore of Pensacola Bay
Restore habitat with specific value for invertebrates and coastal birds, finfish and shellfish species
Promote the growth of Submerged Aquatic Vegetation
Enhance force protection and delineation of the Military Exclusion Zone around the perimeter of NAS Pensacola

5.0 Public Input and Stakeholder Coordination

The shores of Pensacola Bay provide important habitat for myriad wildlife species, but they are also recreationally important to residents and visitors. Escambia County has sought input on the project prior to initiating design activities as well as prior to the completion of this basis of design report. The project team anticipates continued opportunities for public input as the project progress from the design phase into construction.

The conceptual designs contained in this report reflect the input received from members of the public as well as representatives of NAS Pensacola. For ease of reference, that input is also summarized in this section.

5.1 Summary of Public Input Received to Date

5.1.1 Pre-Project Public Input

Prior to initiation of the design study, Escambia County sought public input by conducting a stakeholder meeting on February 25, 2019, at the request of the Davenport Bayou/Star Lake neighborhoods.

Additionally, a public survey was made available on www.myescambia.com from 7/11/2018 until 3/16/2019. A total of 167 responses were received, which are summarized in Figure 4. The input is summarized below and meeting materials and responses are contained in Appendix E.

Summary of Public Input:

- Recreational use was rated extremely important for White Island.
- Fish and Wildlife Habitat, water quality and storm/shoreline protection were rated as extremely or very important for all 3 sites.
- Protection of NAS mission was identified as critical for Sites B and C.

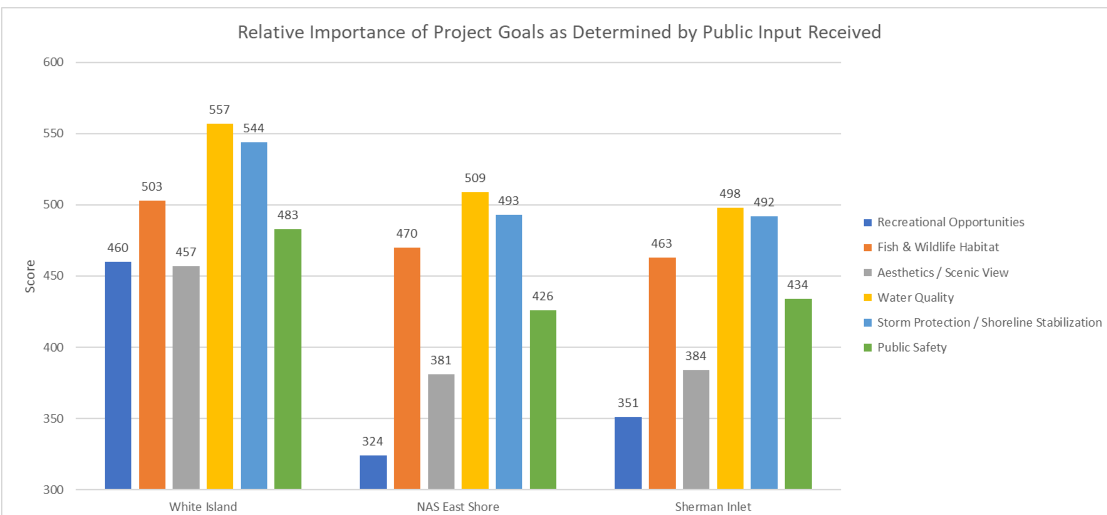


Figure 4: Summary of Online Survey

5.1.2 Conceptual Design Public Meeting—February 24, 2020

Escambia County and the Volkert Team held a public meeting on February 24, 2020 to discuss the conceptual designs discussed in this document and receive written public input. Attendees listened to a presentation discussing site conditions and other considerations that support the development of conceptual designs. Two alternative concepts were discussed for both Site A: White Island, and Site B: NAS Eastern Shore and a single concept was discussed for Site C: Sherman Inlet. After the presentation, an open house was held for participants to ask project team members specific questions related to the site. Sixty people attended the meeting, and a total of 36 written comments were received that evening. A summary is included in Appendix F. Overall, comments were positive and indicated an overwhelming preference for one concept at White Island (A2), which is carried forward and discussed below. Meeting attendees also expressed a strong desire for the recovery and use of sediments around White Island.

5.2 Site Evaluation/Kickoff Meeting—April 4, 2019

A comprehensive site evaluation and kickoff meeting was conducted on April 4, 2019. Participants included key members of the Volkert team, Escambia County, and NAS Pensacola. Project discussions included introductions, roles and responsibilities, project goals, grant requirements, NAS mission, project constraints, findings from the site evaluation, and public comments from the early coordination efforts. Based on the site visit, kickoff meeting and subsequent coordination, the general characteristics and opportunities for each site were identified. These will be further discussed in the site-specific conditions and considerations sections below.

5.3 Working Group Site Evaluation/Meeting—May 23, 2019

Image: Members of RESTORE Council Gulf Coast Interagency Environmental Restoration Work Group

The Pensacola Bay Living Shoreline project serves as a pilot project for identifying regulatory efficiencies for projects funded under the Council-Selected Restoration Component of the Gulf Coast Ecosystem Restoration Council (RESTORE Council). These efficiencies will be identified and facilitated via the Gulf Coast Interagency Environmental Restoration Work Group.

Members of the Volkert team, Escambia County, NAS, Florida Department of Environmental Protection (FDEP) and members of the RESTORE Council staff and Gulf Coast Interagency Environmental Working Group met at the Mahogany Mill Boat Ramp in Pensacola, FL on the morning of May 23, 2019 to visit the three project sites. Throughout the field visit, working group members were provided information about the coastal dynamics of the area, site-specific information regarding potential project concepts, locations of potential sediment sources and information about site characteristics.

Participants discussed each site in detail, including possible design concepts, opportunities, constraints, public input and regulatory compliance questions. Discussions centered around opportunities to provide information to support the completion of permits in an efficient manner (e.g., reviewing Jacksonville District Biological Opinion) and the timing and nature of opportunities for collaboration. Minutes of the meeting are provided in Appendix G along with a summary of action items and next steps forward. Land ownership, submerged lands issues and permitting information requirements emerged as key items for future consideration.

6.0 PRELIMINARY ENGINEERING

6.1 Compilation of Existing Data/Documents

The Volkert team compiled and reviewed available project related data obtained from 1) coordination with Escambia County, NAS, and other governmental agencies and key stakeholders, 2) the Volkert team's work with other living shoreline projects and 3) review of similar projects in the Pensacola area. The data/documents search included the following:

- Grant requirements
- Pre-design public comments
- NAS data/documents
- Submerged land leases/ownership
- Historic and current nautical information
- Historic meteorological data
- Tide and current data
- Sea level rise and subsidence data
- Bathymetric and topographic surveys
- Water quality data
- Historic and active State and Federal Permits
- Historic/Archeological data
- Dredging records
- Scientific studies
- Fisheries data
- Threatened and endangered species
- Habitat surveys
- Aerial photography
- Seagrass survey of living shoreline sites (SAV survey of potential borrow sites may need to be completed

This data/document list is a resource for the design process, and helps identify data gaps for additional study as the design progresses. The analysis identified the following data gaps:

- Florida Sovereign Submerged Land requirements. Coordination ongoing with FDEP.
- Property ownership consideration in the White Island area.
- Additional public coordination as the design progresses
- Site specific topographic/bathymetric surveys and geotechnical work at the living shoreline sites and borrow areas.
- Additional concept modeling
- Dolphin Density Survey (survey is expected to be complete in Fall 2020)
- Permitting/coordination

The Data/Document list including the data gap analysis is contained in Appendix H. Project design will be refined accordingly based on the additional data, information and coordination.

6.2 Coastal Conditions Analysis

The Volkert team completed a coastal conditions analysis to define key design parameters and completed empirical modeling to support preliminary engineering design of the breakwater structures and living shoreline features. The team's analysis also included the consideration of potential sources of sandy material for the shoreline restoration. Efforts concentrated on the grant requirements, minimizing potential environmental impacts, avoiding impacts to Federal navigation channels, engineering feasibility, and agency/public input. Cost effectiveness was not a primary consideration. The Coastal Conditions Analysis is contained in Appendix D and a short summary follows below for ease of reference.

Table 3: Summary of Coastal Conditions Analysis

Condition	Summary	Design Consideration(s)
Tides	Pensacola Bay experiences an average diurnal tide range of approximately 1.2 feet.	Tides do not significantly influence design considerations.
Local Wave Characteristics	All project sites are impacted by local waves generated by winds blowing across Pensacola Bay, East Bay, and Santa Rosa Sound. The shoreline along Site C is also impacted by waves propagating through Pensacola Pass from the Gulf of Mexico.	Because of the shallow water depths adjacent to each project site and/or the relatively light local winds that occur along fetches that impact these sites, the local wave characteristics are mild at Sites A and B.
Wind Characteristics	Local wind characteristics play a dominant role in wave generation and the subsequent sediment transport that impact bay shorelines in estuarine systems like Pensacola Bay.	At the subject study sites, northerly winds will not produce waves that impact their shorelines: winds from the east and south are most relevant to project design.
Geomorphological Features	The dominant geomorphological feature of each site today is a sandy bay shoreline consisting of a beach berm, storm berm, and vegetated dune and/or upland.	The presence, or lack thereof, of tidal marsh at these sites is consistent with the wave climate analysis: higher wave energy exposure tends to prohibit or discourage long-term tidal marsh viability.
Relative Sea Level Rise	As measured by the Pensacola NOAA tide station, the most recent linear trend in relative sea level rise is +2.4 mm/yr or approximately 0.8 feet per century	With an estimated project start date of 2020, the end of the design life would be 2050. By 2050 an appropriate range of engineering design values is 0.85 ft to 1.31 ft above the mean sea level position of 2000.

Condition	Summary	Design Consideration(s)
Critical Fetch Lengths	As a general comment, the critical fetch orientations for each site are those that align with large wind speeds that occur frequently. That combination of conditions exists for winds blowing from the northeast, southeast, and south.	Only those wind directions corresponding to fetch orientations within a 180-degree sector aligning with the average shoreline orientation are considered in this analysis. In other words, offshore-directed winds do not contribute to local wind, wave, and sand transport processes in our analysis. This is standard practice.
Longshore Sand Transport	Sites A and C exhibit clear net transport tendencies. Over the measurement period considered in this study, net transport at those sites has been to the left for an observer standing on the shoreline and looking toward the bay. In other words, net transport has been to the north at Site A, and to the north and northeast at Site C. Site B exhibits some traits of a bimodal transport system where, over the +10-yr period of analysis, similar volumes of sand have moved to the north and south annually.	A functional design that does not prohibit cross-shore sand transport is vital to long-term project success. In terms of functional design, this means avoiding excessively long, linear structures without gaps placed within the active surfzone.

7.0 Living Shoreline Concepts Sites A, B and C

The project team has developed a preliminary conceptual design and rough order of magnitude quantity estimates for each living shoreline site. These conceptual designs represent revisions to a set of concepts provided to Escambia County in July, 2019. These revised concepts prioritize the achievement of grant habitat metrics. These conceptual designs reflect our understanding of the physical coastal processes of each site, their suitability to support different types of habitat, their ability to facilitate different uses, and that also reflect the design constraints associated with each specific project location. The following paragraphs briefly describe each conceptual design and provide a limited discussion of potential design alternatives that we excluded from consideration. It should be stressed that these preliminary conceptual designs have been developed without up-to-date topographic and bathymetric data, and without any geotechnical data. These conceptual designs and their rough order of magnitude quantity estimates are subject to change as new data become available, and also through discussions with the client and stakeholders. An overview map of project locations is shown in Figure 3, above.

7.1 Site A (White Island)

Summary

- Proposed construction of: 45+ acres tidal marsh habitat; 15+ acres sandy/upland habitat; and 4100+ feet of submerged and emergent reef breakwaters
- Preliminary estimate for volume of sand required: approximately 330,000 cubic yards
- Preliminary estimate for weight of rock needed to build proposed structures: approximately 12,300 tons
- Two complementary concepts (A1 and A2) address goals of habitat creation and managed access for recreation and incorporate resilience to sea level rise.

Site Focus and Goals:

- Maximize habitat benefits (marsh, submerged aquatic vegetation, beach/dune/upland, and finfish)
- Provide continued managed recreational access
- Reestablish the island's historic size and elevation through the direct placement of sand
- Design features to maximize the long-term viability of the project by keeping sand in place as much as is feasible while still accounting for ecosystem dynamics

Key Considerations:

- Maximize habitat enhancement benefits to submerged aquatic vegetation, emergent marsh, shellfish and finfish
- Creation of new intertidal marsh habitat that works in conjunction with the enhancement of White Island while providing new recreational opportunities.
- Continued managed recreational access while maximizing habitat benefits.
- White Island has been disconnected from its historical sediment supply (Site B). The long-term performance and viability of White Island will be dictated by the volume of sand added and the ability to prevent it from continuing to move to the north and west as it has in the past.
- Reestablishment of a suitable island volume, as well as conditions for different vegetation types, will be achieved through the construction of large dune features on the island's interior. Pathways will separate these constructed dune features to accommodate recreational uses and access.

7.1.1 Summary of Site Conditions, Change Over Time and Anticipated Future Conditions

A review of historical shoreline positions was conducted as part of this preliminary design phase. The general timeframe associated with available shoreline positions is 1961 to present day. Those shoreline positions provide nearly 60 years of historical information regarding the retreat and reorientation of shorelines at each project location. Portions of White Island have changed substantially over this period of time, as shown by the historical shoreline positions visible in Figure 5. The northern-most tip of White Island, now referred to locally as Rock Island, has not experienced significant change over time. This is because of the presence of old ballast stone (from the previous railroad embankment) that armors the shoreline and keeps the sand and vegetation in place. This natural example provides evidence that some small amount of structure is sufficient for stabilizing sand and vegetation over time.

Empirical modeling of wind-generated waves and longshore sand transport were performed as part of this preliminary conceptual design phase at Site A. Results were used to inform and support the preliminary conceptual designs at the site by developing estimates of wave characteristics and potential net sediment transport tendencies.

The local wind-generated wave conditions at Site A are mostly mild with wave heights generally <2 ft and most wave heights <1 ft. These modest wave heights are the result of relatively short fetch lengths along prevailing wind directions. While Site A does have a very long fetch to the east, extending to the southeastern corner of East Bay, the frequency of occurrence of east winds is low and their associated magnitudes are weak. Therefore, the corresponding waves that align with this wind direction are infrequent and of lesser height. The most frequently occurring wave heights in the range 1 ft < H_{mo} < 2 ft occur along fetches directed toward the east-southeast, where H_{mo} is the spectrally significant wave height. For strong wind events from any direction, the maximum probable wave height at Site A will be depth-limited under all but the most extreme (i.e., 100-yr return period storm event) events. The broad and shallow shoals to the east of the project site naturally reduce wave height and wave energy.

The larger and more frequently occurring wave heights from the east-southeast would typically result in net longshore sand transport to the north. However, the jetty and navigation channel to the south of White Island prevent this movement of sand from Site B. While there may be some net transport to the north along the remnants of White Island, most transport appears to occur to the west, by way of storm overwash, during storm events. The estimated potential transport to the north is approximately 300 cy/yr while the maximum transport to the south is approximately 50 cy/yr. This imbalance leads to net transport to the north over the +10-yr period of analysis. See Appendix D for data supporting this summary.

Without a project at Site A, we expect the remaining amount of sand comprising White Island to overwash into surrounding areas and eventually become completely subtidal. The portion of emergent land and vegetation called Rock Island will shrink over time as sand is eroded form the unarmored portions of the island and as sea level continues to rise. Considering the historical trends in local relative sea level rise, as well as future projections, we anticipate that a range of reasonable mean sea level positions by 2050 will be between 0.85 feet and 1.31 feet above the mean sea level position of 2000. This estimated range will be factored into the restoration designs in subsequent tasks.

7.1.2. Discussion of Conceptual Designs

Sketches of the two preliminary conceptual designs for Site A are shown in Figures 6 and 7. The project goals at this site include the reestablishment of emergent sandy shoreline and upland habitat associated with White Island, and the creation of intertidal marsh habitat. Both concepts address these project goals. Concept A1 (Figure 6) envisions a future project where

White Island is shifted to the east and the intertidal marsh habitat is created where White Island exists now. Concept A2 (Figure 7) envisions a future project where White Island is enhanced in its present-day location and a new intertidal marsh habitat complex is created to the east of White Island. Both concepts create approximately the same amount of sandy shoreline and marsh habitats.

Concept A1 includes approximately 42 acres of intertidal marsh and 19 acres of sandy shoreline and upland habitat, stabilized using 2640 feet of reef/breakwater structures. The newly placed sand fill for White Island is stabilized along the south, east, and north-east facing shorelines using low-elevation headland and nearshore rock breakwaters. The headland structures will impede the movement of sand to the north and south and facilitate stable shoreline positions. Structures along the south-facing shoreline will also mitigate wake impacts from boats navigating the channel to/from Bayou Grande. The nearshore segmented breakwaters to the east will result in a shoreline that reaches a dynamic equilibrium over long periods of time, with seasonal adjustments throughout the year in response to local wind and wave conditions. Stabilization is not recommended on the west-facing (lee or protected) shoreline. The intertidal marsh complex would be constructed over the existing and previous locations of White Island. In this manner, the newly relocated and restored White Island serves as a buffer to protect the marsh from waves, and also serves as a source of sediment through natural overwashing of White Island during extreme events. Only one rock headland structure, along the existing navigation channel, is proposed in the marsh complex.

Concept A2 includes approximately 46 acres of intertidal marsh and 17 acres of sandy shoreline and upland habitat, stabilized using 4170 feet of reef/breakwater structures. In this concept White Island is enhanced/restored in its present-day location and the intertidal marsh complex is constructed to the east. The western-most extent of the restored White Island would be just slightly west of its present-day location but expanded eastward to approximately the location of the old railroad embankment. A small tidal channel would separate a restored White Island from an expanded Rock Island. White Island would consist mainly of beach, dune, and upland habitat with minimal marsh fringe. The expanded Rock Island would be primarily marsh habitat. No structures are proposed for stabilizing White Island or Rock Island in Concept A2. However, a mixture of low-elevation rock breakwaters, rock piles, and subtidal rock reefs would be constructed to serve as finfish habitat and wave attenuation for the new intertidal marsh complex.

In both concepts, the sand fill used to reestablish White Island will create a suitable island volume, conditions for different vegetation types, and dune features on the island’s interior. Pathways will separate these constructed dune features to accommodate recreational uses and access. Also in both concepts, small tidal creeks separate marsh cells, providing the necessary tidal drainage, increasing the length of marsh edge, and offering managed access opportunities for kayaks and stand-up paddleboards.

We have prepared a very rough order of magnitude estimate of sand volumes and rock weight needed to construct these preliminary conceptual design alternatives. These estimates are very preliminary and are subject to change. For Concept A1 the estimated volume of sand is

330,000 cubic yards and the estimated weight of rock needed to build the reef/breakwaters structures is approximately 7,700 tons. For Concept A2 the estimated volume of sand is approximately the same at 330,000 cubic yards, but the estimated weight of rock needed to build the reef/breakwaters structures is much greater at 12,300 tons.

7.1.3 Design Constraints

- **Depth:** Site A is characterized by a relatively broad and shallow shelf adjacent to its shoreline. The shallow nature of the site is potentially beneficial in terms of reduced fill volumes and structure quantities, as well as the natural wave attenuation that it provides to the shoreline. However, the shallow depths also pose a constraint on the selection of materials used to build breakwaters and/or reef structures at these sites.

- **Construction**: There is no feasible project design that allows land-based construction methods for the restoration of White Island. Water-based construction activities for the placement of offshore structures will be limited to navigable depths for light-loaded barges and scows unless construction access channels are dredged. Dredging of construction access channels could be combined with on-site recovery of sandy material that meets the restoration goals of the project.
- **Marsh Plants**: The creation of 40+ acres of intertidal marsh habitat will require an extremely large number of marsh plants. Planting densities and planting schemes will require careful consideration.
- **Structure Stability:** Rock reef and breakwater structures must be designed so that the rocks are stable under design conditions. Also, vertical settlement should be limited as much as possible through the use of appropriate underlayment (e.g., geotextiles, geogrids, marine mattresses, etc.).

7.1.4 Other Alternatives Considered

A number of alternatives were considered and excluded prior to arriving at these preliminary conceptual designs. Restoration concepts without structures were initially considered but dismissed based on potentially high maintenance requirements, exacerbated shoaling, and the inability to meet the stated restoration goals for reef creation. A restoration of White Island without the use of structures to stabilize the newly placed sand fill would result in the need for frequent island renourishment. The repeated loss of sand to the north and west would worsen shoaling in areas used by local residents for navigational access to their properties. A restoration of only White Island was considered and dismissed as it failed to meet the project's restoration goal of marsh habitat creation.

7.1.5 Risks and Considerations, Strategies to Mitigate

The primary risks associated with the conceptual restoration designs include erosion and future inundation due to sea level rise. While both are natural processes, both can be managed through appropriate design of project elements. For example, erosion of newly-placed sand fill can be mitigated through the use of nearshore and headland breakwaters. Erosion and sediment transport associated with overwashing during extreme events can be mitigated by planting appropriate vegetation in dune and upland areas of White Island. Erosion of the marsh edge can be mitigated through the use of breakwaters and subtidal reefs. Future inundation due to long-term sea level rise is unavoidable. The sand on White Island and the intertidal marsh complex will attempt to naturally adjust to future sea levels through lateral migration. Both concepts for Site A incorporate resilience elements that address this need. In Concept A1, sand from the relocated White Island will periodically overwash into the marsh complex during extreme events. This source of sediment will facilitate vertical accretion of the marsh over time. Alternatively, in Concept A2 the marsh habitat can laterally migrate to higher elevations on the restored White Island portion of the project as sea levels rise.

Secondary risks associated with the conceptual restoration designs include shoaling of channels and areas used for recreational boating and impacts to NAS Pensacola flight operations due to the presence of large birds utilizing the marsh habitat. The risk of shoaling can be reduced by addressing the erosion risks mentioned previously. The creation of a large intertidal marsh complex will likely attract large birds (e.g., pelicans, herons, egrets, etc.), thereby increasing the potential for bird strikes. Bird abatement techniques could be considered if NAS considers the risk to be unacceptable. However, NAS has stated that the presence of large birds at Site A is of less concern than at Site C.

7.1.6 Next Steps

These are highly conceptual designs that are subject to change based on data collection, modeling, environmental resource permitting, availability of materials/resources, and availability of construction funds. At a minimum, geotechnical investigations and bathymetric/topographic surveys of Site A will be required before these conceptual designs can be refined and advanced to 30 percent and 60 percent designs. Development of the 30 percent design will incorporate the survey and geotechnical data. Advancement to the 60 percent design phase will incorporate the results of hydrodynamic and sediment transport modeling.

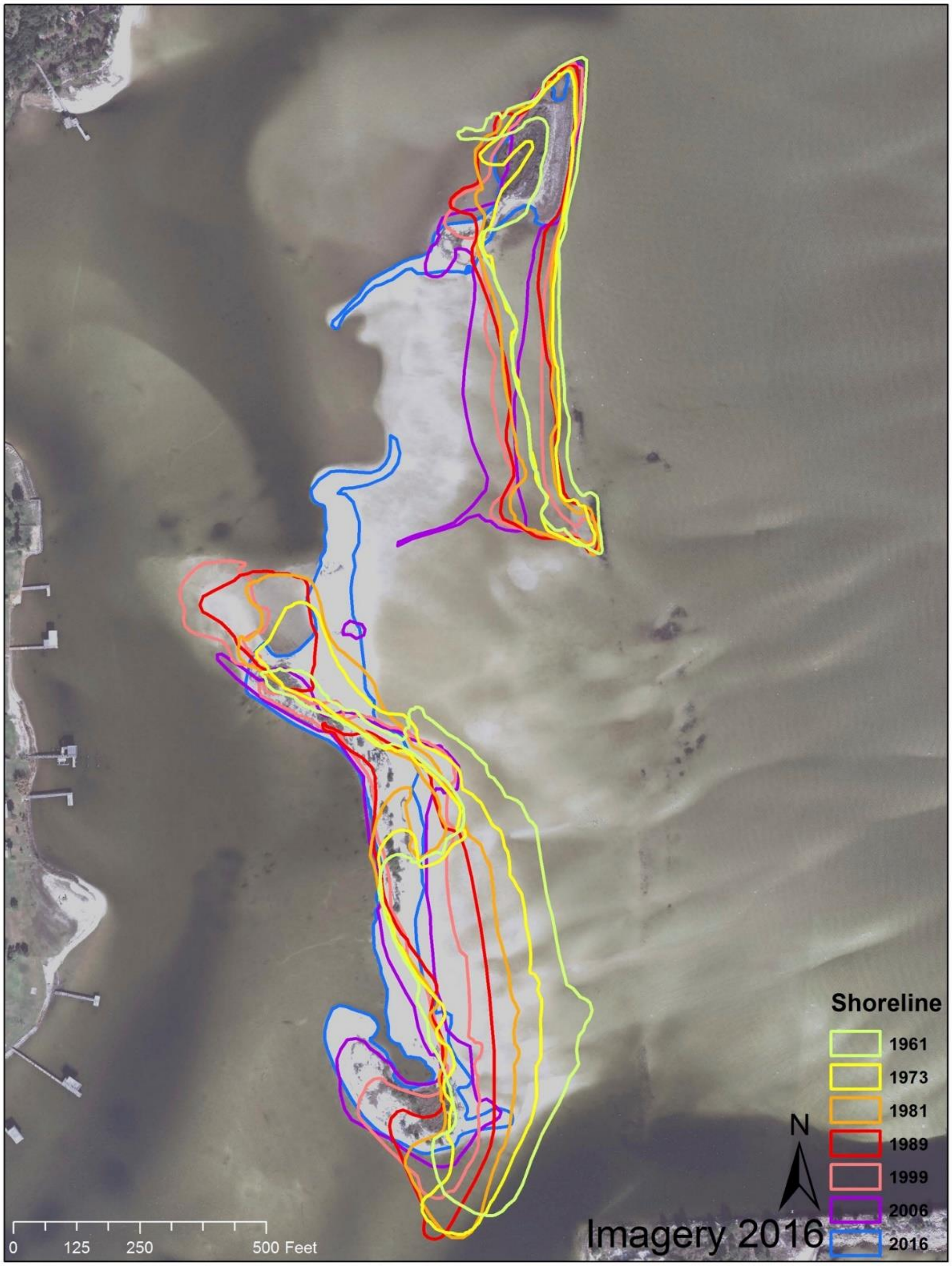


Figure 5. Historical shoreline positions of White Island for the time period 1961 to 2016.

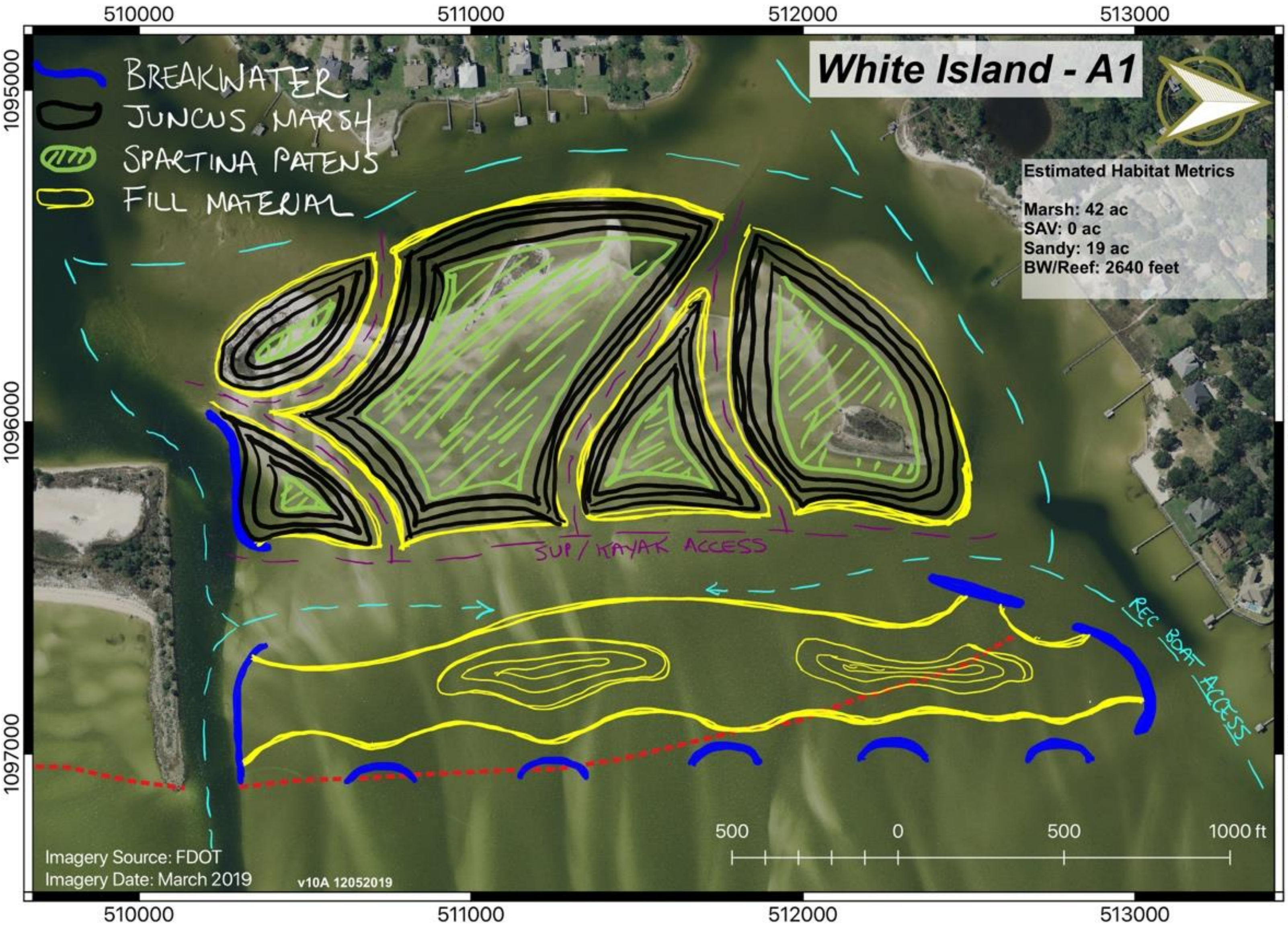


Figure 6: Preliminary conceptual design (A1) for White Island (Site A).

Figure 7: Preliminary conceptual design (A2) for White Island (Site A).

7.2 Site B (Eastern Shore)

Summary

- Proposed construction of: 34+ acres tidal marsh habitat; enhancement of 15+ acres of SAV habitat; and 5500+ feet of subtidal reef and emergent breakwaters
- Preliminary estimate for volume of sand required: approximately 140,000 cubic yards
- Preliminary estimate for weight of rock needed to build proposed structures: approximately 13,500 tons.
- Two complementary concepts (B1 and B2) address the goals of habitat creation and force protection enhancement for NAS Pensacola

Site Focus and Goals:

- Maximize habitat benefits (marsh, SAV, and finfish)
- Provide additional passive force protection through creation of structures along exclusion zone
- Stabilize the existing shoreline and minimize continued sediment inputs to the bay
- Design features to maximize the long-term viability of the project by protecting newly created marsh habitat and providing lateral space for migration in response to future sea level rise

Key Considerations:

- Shoreline change has been slow but continuous; impacts to some upland infrastructure would occur in the future if shoreline retreat continues.
- Little sediment input to this site with the exception of cross-shore sediment transport between the sandy shoreline and bay bottom.
- Creation of marshes to increase habitat while simultaneously stabilizing shoreline.
- Use of nearshore breakwaters and reefs as passive force protection for NAS Pensacola

7.2.1 Summary of Site Conditions, Change Over Time and Anticipated Future Conditions

A review of historical shoreline positions was conducted as part of this preliminary design phase. The general timeframe associated with available shoreline positions is 1961 to present day. Those shoreline positions provide nearly 60 years of historical information regarding the retreat and reorientation of shorelines at each project location. Portions of Site B have changed substantially over this period of time, as shown by the historical shoreline positions visible in Figure 8. The shoreline near the existing sediment disposal retreated substantially until the shoreline was armored with stone. Erosion of this natural shoreline headland likely served as a source of sediment for shorelines to the north, including White Island (Site A) prior to construction of the channel and jetty. The rate of shoreline retreat over the past 20+ years was lower than it was for the period 1961 to 1993.

Empirical modeling of wind-generated waves and longshore sand transport were performed as part of this preliminary conceptual design phase at Site B. Results were used to inform and support the preliminary conceptual designs at the site by developing estimates of wave characteristics and potential net sediment transport tendencies.

Locally generated wind-waves impact Site B from the north, northeast, east, and southeast. This site has a number of long fetches that align with prevailing seasonal wind directions (north to northeast and southeast to south). Because of the shallow water depths and relatively light winds, most wind-generated wave heights are <0.5 ft (see Appendix D). Wave heights ranging from 0.5 ft < H_{mo} < 1 ft occur from most quadrants but less frequently than the smaller waves. The largest wave heights are 2 ft or less, with the maximum possible wave heights limited by the shallow depths adjacent to Site B. Wave heights >1 ft more frequently occur during winds from the southeast than other directions.

The somewhat even distribution of larger wave heights from all possible fetches results in a mostly balanced longshore sand transport system (Appendix D). Waves approaching from the southeast can produce potential longshore sand transport rates on the order of 300 cy/yr to the north. Waves approaching from the northeast can produce potential longshore sand transport rates on the order of 250 cy/yr to the south. The imbalance leads to preferential transport to the north over the +10-yr analysis period. However, the bimodal transport behavior suggests that there is a strong seasonal component to longshore transport and that during the year transport could be to the north or the south.

Without a project at Site B, we expect the existing shoreline retreat to continue as a function of natural erosion, episodic erosion during storms, and in response to long-term sea level rise. Considering the historical trends in local relative sea level rise, as well as future projections, we anticipate that a range of reasonable mean sea level positions by 2050 will be between 0.85 feet and 1.31 feet above the mean sea level position of 2000. This estimated range will be factored into the restoration designs in subsequent tasks.

7.2.2 Discussion of Conceptual Designs

Sketches of the two preliminary conceptual designs for Site B are shown in Figure 9 and Figure 10. The project goals at this site include the creation of intertidal marsh habitat, facilitation of SAV habitat, creation of finfish habitat, and enhancement of force protection for NAS Pensacola. Both concepts address these project goals. Concept B1 (Figure 9) envisions a future project where a number of intertidal marsh cells are created in open water west of the existing shoreline. Concept A2 (Figure 10) envisions a future project where the new intertidal marsh extends continuously from the existing shoreline/upland out into Pensacola Bay. Both concepts create approximately the same amount of intertidal marsh habitat and use the same amounts and types of structures (e.g., rock piles, emergent breakwaters, subtidal reefs). The structures are placed slightly inside the 500-ft exclusion zone to assist with force protection. Shallow waters in between the structures and intertidal marsh will enhance SAV habitat in both concepts.

Concept B1 includes approximately 34 acres of intertidal marsh and 15 acres of potential SAV habitat, stabilized using 5590 feet of reef/breakwater structures. Approximately 11 intertidal marsh cells, or terraces, would be constructed with clean sand fill. Small tidal creeks and open, shallow water would separate these cells to facilitate proper drainage of and circulation within the marsh complex. The marsh cells would not directly connect to the existing shoreline or upland. Offshore segmented breakwaters, rock piles, and subtidal reefs would provide the wave attenuation needed to protect the marsh vegetation from wave action and facilitate deposition of suspended sediments within the marsh complex over time. The breakwaters and reefs will also provide structure that enhance fisheries habitat. Gaps between breakwaters, rock piles, and reefs will be of sufficient size (~50 to 300 feet) for fish passage and circulation.

Concept B2 includes approximately 36 acres of intertidal marsh and 25 acres of SAV habitat, stabilized using 5590 feet of reef/breakwater structures. In this concept the intertidal marsh extends continuously from the existing shoreline/upland out into Pensacola Bay. Clean sand fill would be added to establish a new intertidal slope for the marsh habitat. The maximum bayward extent of new marsh fill is approximately 450 feet from the existing shoreline. On average, the fill extends approximately 300 feet from the present shoreline. Existing SAV beds delineated in a 2019 survey would be avoided. The use of structures in this concept is identical to that of Concept B1. Open water areas between the structures and bayward extent of the intertidal marsh could support additional SAV habitat.

We have prepared a very rough order of magnitude estimate of sand volumes and rock weight needed to construct these preliminary conceptual design alternatives. These estimates are very preliminary and are subject to change. For Concept B1 the estimated volume of sand is 131,000 cubic yards and the estimated weight of rock needed to build the reef/breakwaters structures is approximately 13,500 tons. For Concept B2 the estimated volume of sand is 140,000 cubic yards and the estimated weight of rock is the same at 13,500 tons.

7.2.3 Design Constraints

- **Depth:** Site B is characterized by a relatively broad and shallow shelf adjacent to its shoreline. The shallow nature of the site is potentially beneficial in terms of reduced fill volumes and structure quantities, as well as the natural wave attenuation that it provides to the shoreline. However, the shallow depths also pose a constraint on the selection of materials used to build breakwaters and/or reef structures at these sites.
- **Construction**: Land-based construction activities are possible at Site B. However, construction of the breakwaters, rock piles, and reefs would most likely be performed by water. Water-based construction activities for the placement of offshore structures will be limited to navigable depths for light-loaded barges and scows unless construction access channels are dredged. Dredging of construction access channels could be combined with on-site recovery of sandy material that meets the restoration goals of the project.

- **Marsh Plants:** The creation of 30+ acres of intertidal marsh habitat will require an extremely large number of marsh plants. Planting densities and planting schemes will require careful consideration.
- **Structure Stability:** Rock reef and breakwater structures must be designed so that the rocks are stable under design conditions. Also, vertical settlement should be limited as much as possible through the use of appropriate underlayment (e.g., geotextiles, geogrids, marine mattresses, etc.).

7.2.4 Other Alternatives Considered

A number of alternatives were considered and excluded prior to arriving at these preliminary conceptual designs. Restoration concepts without structures were initially considered but dismissed based on potentially high maintenance requirements and the potential for marsh and shoreline erosion due to wave action. A much smaller restoration concept requiring much less fill and far fewer structures was rejected as it failed to meet habitat creation goals and did not enhance force protection for NAS Pensacola.

7.2.5 Risks and Considerations, Strategies to Mitigate

The primary risks associated with the conceptual restoration designs include erosion and future inundation due to sea level rise. While both are natural processes, both can be managed through appropriate design of project elements. For example, erosion of newly-placed sand fill can be mitigated through the use of breakwaters and subtidal reefs, and the use of appropriate vegetation. Erosion and sediment transport associated with overwashing during extreme events is not a risk at Site B. Erosion of the marsh edge can be mitigated through the use of breakwaters and subtidal reefs. Future inundation due to long-term sea level rise is unavoidable. Both concepts provide adequate space to the west for migration of the marsh vegetation both laterally and vertically on the profile.

Secondary risks associated with the conceptual restoration designs include the potential for navigational hazards and impacts to NAS Pensacola flight operations due to the presence of large birds utilizing the marsh habitat. The navigational hazard posed by emergent breakwaters and subtidal reefs is of lesser concern since they will be located inside the Navy's marked exclusion zone. However, the subtidal reefs may still require visible, above water signage for safety reasons. The creation of a large intertidal marsh complex will likely attract large birds (e.g., pelicans, herons, egrets, etc.), thereby increasing the potential for bird strikes. Bird abatement techniques could be considered if NAS considers the risk to be unacceptable. However, NAS has stated that the presence of large birds at Site B is of less concern than at Site C.

7.2.6 Next Steps

These are highly conceptual designs that are subject to change based on data collection, modeling, environmental resource permitting, availability of materials/resources, and availability of construction funds. At a minimum, geotechnical investigations and bathymetric/topographic surveys of Site A will be required before these conceptual designs can be refined and advanced to 30 percent and 60 percent designs. Development of the 30 percent design will incorporate the survey and geotechnical data. Advancement to the 60 percent design phase will incorporate the results of hydrodynamic and sediment transport modeling.

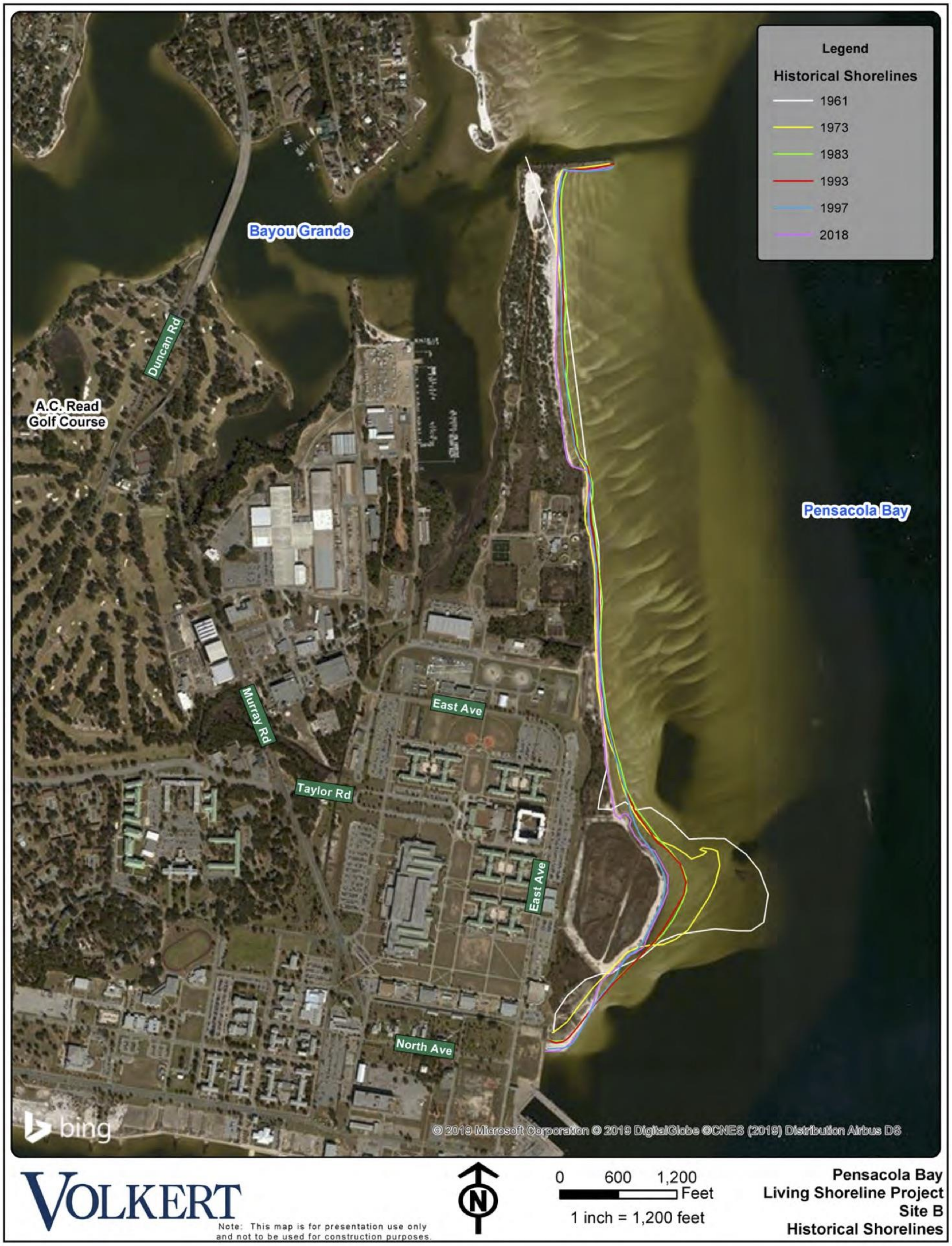


Figure 8: Historical shoreline positions of Site B (Eastern Shore) for the time period 1961 to 2018.

Figure 9: Preliminary conceptual design (B1) for the Eastern Shore (Site B).

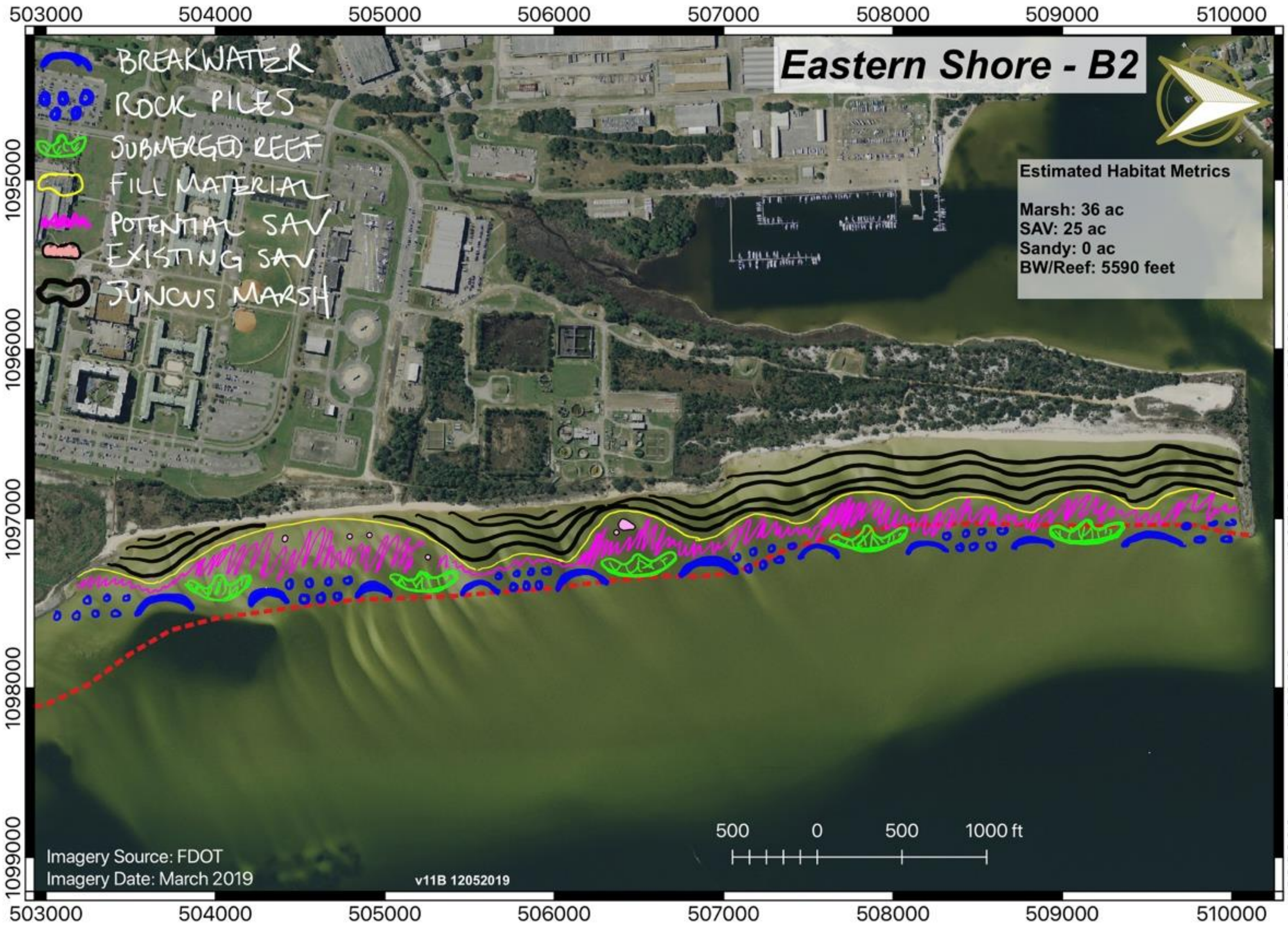


Figure 10: Preliminary conceptual design (B2) for the Eastern Shore (Site B).

7.3 Site C (Sherman Inlet)

Summary

- Proposed construction of: 9+ acres of sandy beach and dune habitat; enhancement of 22+ acres SAV habitat; and 5350+ feet of subtidal reefs and emergent headland breakwaters
- Preliminary estimate for volume of sand required: approximately 100,000 cubic yards
- Preliminary estimate for weight of rock needed to build proposed structures: approximately 11,200 tons.
- The proposed concept achieves goals of shoreline stabilization, expansion of SAV habitat, and enhancement of fisheries habitat without increasing the potential bird strike risk for NAS Pensacola.

Site Focus and Goals:

- Maximize SAV and fisheries habitats
- Provide additional passive force protection through creation of structures along exclusion zone
- Stabilize the existing shoreline and minimize continued sediment inputs to the bay
- Design features to maximize the long-term viability of the project by protecting newly created beach and dune habitats

Key Considerations:

- Shoreline change has been considerable, with transport to the north and east.
- Little new sediment input to this site with the exception of cross-shore sediment transport between the sandy shoreline and bay bottom.
- Stabilization of shoreline with headland breakwaters that avoid existing SAVs.
- Use of subtidal reefs as passive force protection for NAS Pensacola.

7.3.1 Summary of Site Conditions, Change Over Time and Anticipated Future Conditions

A review of historical shoreline positions was conducted as part of this preliminary design phase. The general timeframe associated with available shoreline positions is 1961 to present day. Those shoreline positions provide nearly 60 years of historical information regarding the retreat and reorientation of shorelines at each project location. Shoreline position within the project area at Site C has changed substantially over this period of time, as shown by the historical shoreline positions visible in Figure 11. The shoreline has retreated over 400 feet since 1961 in some portions of the study area. The rate of shoreline retreat over the past 20+ years was lower than it was for the period 1961 to 1993. The formation of multiple offshore sandbars, created through offshore-directed sediment transport during erosive events, has likely contributed to the slowing of shoreline retreat over time as large waves break over the bars.

Empirical modeling of wind-generated waves and longshore sand transport were performed as part of this preliminary conceptual design phase at Site C. Results were used to inform and support the preliminary conceptual designs at the site by developing estimates of wave characteristics and potential net sediment transport tendencies.

Local wind-wave generation at Site C is even milder than the other two sites (see Appendix D), with one substantial caveat mentioned below. A majority of locally generated wind-waves are <0.5 ft at Site C. The small wave heights are attributed to relatively short fetches that do not align with prevailing wind directions. Though there are long fetches to the east-southeast, the frequency and magnitude of winds from that direction are both small. Design wave heights at this location will need to be determined through numerical wave modeling, scheduled for subsequent project tasks, due to this site's exposure to wave energy from the Gulf of Mexico.

A major exception to the wave climate at Site C is the exposure to wave energy from the Gulf of Mexico between compass bearings of 120° and 155°. The empirical shallow water wave forecasting equations cannot accurately represent wave propagation from the open ocean. We have accounted for this shortcoming by substituting the average offshore wave characteristics within this 35-degree sector. The US Army Corps of Engineers maintains a statistical database of offshore winds and waves as part of their Wave Information Studies (WIS) program (http://wis.usace.army.mil). WIS data are analyzed using wave hindcasting models that account for historical wind speed and direction in open ocean basins. These data are organized into virtual "stations" that are spaced along the coastline. We selected WIS station 73167 located in 65 ft of water approximately 6.5 miles southeast of Pensacola Pass. This is the closest WIS station to Site C. The 35-yr statistical analysis of waves at this station, within this 35-degree sector, yields an average significant wave height of H_{mo}=1.97 ft, and a peak wave period of T_p=4.9 s. This offshore wave energy represents the dominant wave conditions for Site C in all but the strongest of wind events. This statement will be supported by numerical wave modeling results in subsequent phases of the project. However, the resulting change in shoreline position over the last +50 years is supported by this conclusion and the longshore sand transport analysis that follows.

The analysis of longshore sand transport at Site C reveals a substantial tendency for transport to the north and east as a result of offshore wave energy contributions (see Appendix D). The contribution from waves propagating from the Gulf of Mexico is so large that other potential transport components are not visible in the directional distribution. With inclusion of the average offshore wave conditions, the potential longshore sand transport rate reaches 6,000 cy/yr to the north and east. Transport to the south is, comparatively, insignificant. Annual values of net transport to the north exceed 12,000 cy in some years during the period 2007 to 2018. Over the past 50 years this transport rate could potentially contribute to 100 ft of shoreline retreat when averaged over the length of Site C. This rough order of magnitude calculation supports the retreat in shoreline position visible in Figure 11.

The longshore sand transport results for Site C change considerably if we ignore wave energy contributions from the Gulf of Mexico. Locally-generated waves result in a two-way transport system with relatively low average transport rates of 150 cy/yr to the north/east and just over 50 cy/yr to the south/west. While the imbalance still contributes to net transport to the north and east, the signature of seasonal reversals in transport and low transport rates do not necessarily support the shoreline response at Site C over recorded history. These findings suggest that local, synoptic wind conditions create a wave climate that supports net transport to the north with weak seasonal reversals, but that wave energy from the Gulf of Mexico dominates the longshore sand transport and shoreline response under average, synoptic meteorological and oceanographic conditions. Wave energy from the Gulf of Mexico is also likely driving cross-shore transport, particularly erosion during periods of strong storms.

Preliminary numerical modeling of wave transformation from the Gulf of Mexico (not shown in this report) and locally-generated wind waves support the statements above. However, for very strong wind events and considerable offshore wave energy, the locally-generated waves may control the design of project elements at Site C. Very high wave energy from the Gulf of Mexico is effectively damped due to breaking and refraction over shoals south of Pensacola Pass, through diffraction as waves propagate through the pass, and again through refraction as wave crests orient themselves parallel to depth contours adjacent to Site C.

Without a project at Site C, we expect the existing shoreline retreat to continue as a function of natural erosion, episodic erosion during storms, and in response to long-term sea level rise. Considering the historical trends in local relative sea level rise, as well as future projections, we anticipate that a range of reasonable mean sea level positions by 2050 will be between 0.85 feet and 1.31 feet above the mean sea level position of 2000. This estimated range will be factored into the restoration designs in subsequent tasks.

7.3.2 Discussion of Conceptual Designs

A sketch of the preliminary conceptual designs for Site C is shown in Figure 12. The project goals at this site include the creation and stabilization of new sandy beach and dune habitat, facilitation of SAV habitat, creation of finfish habitat, and enhancement of force protection for NAS Pensacola. The conceptual design addresses these project goals. Concept C1 (Figure 12) envisions a future project where a number of headland rock breakwaters are constructed in conjunction with newly placed clean sand fill to create a series of pocket beaches along the subject shoreline. These pocket beaches will adjust seasonally but maintain a stable and predictable shoreline position over the project life. The segmented headland breakwaters will allow some natural sediment transport in the alongshore and cross-shore directions. Placement of headland breakwaters will avoid existing SAV in the project area. Offshore subtidal reefs, constructed within the Navy’s 500-ft exclusion zone, will serve multiple purposes.

Concept C1 includes approximately 22 acres of sandy beach and dune habitat and the potential enhancement of 22 acres of SAV habitat, stabilized using 5350 feet of headland structures and subtidal reefs. The amount of sand fill for this concept is intentionally minimized to promote stability of the shoreline near its present day location. This concept does not attempt to create a substantially wider subaerial beach. Rather, clean sand fill will be added above and below the present mean water level in an effort to create a new equilibrium shoreline template. The purpose of the headland breakwaters is to intentionally create a series of segmented pocket beaches that promote shoreline stability. The resulting shoreline position is controlled through wave diffraction within the gaps between structures and is very predictable. Two of the headland breakwaters include landward "T" segments to prevent flanking in critical areas (e.g., where the shoreline orientation changes, and near Sherman Inlet). Placement of structures on either side of Sherman Inlet will be intentional so as to promote consistent tidal connectivity. The goals of the subtidal reefs are to dissipate wave energy, enhance fisheries habitat, and assist in force protection along the NAS exclusion zone. The dissipation of wave energy will enhance shoreline stabilization while potentially facilitating the expansion of existing SAV beds in calmer waters.

We have prepared a very rough order of magnitude estimate of sand volumes and rock weight needed to construct these preliminary conceptual design alternatives. These estimates are very preliminary and are subject to change. The estimated volume of sand is 100,000 cubic yards and the estimated weight of rock needed to build the headland breakwaters and subtidal reefs is approximately 11,200 tons.

7.3.3 Design Constraints

- **Depth:** Site C is characterized by a relatively broad and shallow shelf adjacent to its shoreline. The shallow nature of the site is potentially beneficial in terms of reduced fill volumes and structure quantities, as well as the natural wave attenuation that it provides to the shoreline. However, the shallow depths also pose a constraint on the selection of materials used to build breakwaters and/or reef structures at these sites.
- **Construction:** Land-based construction activities are possible at Site C. This includes direct placement of sand fill and the construction of headland breakwaters. However, construction of the subtidal reefs would be performed by water. Water-based construction activities for the placement of offshore structures will be limited to navigable depths for light-loaded barges and scows unless construction access channels are dredged. Dredging of construction access channels may not be necessary given the proximity of the subtidal reefs to slightly deeper depths (>4 feet).
- **Structure Stability:** Rock reef and breakwater structures must be designed so that the rocks are stable under design conditions. Also, vertical settlement should be limited as much as possible through the use of appropriate underlayment (e.g., geotextiles, geogrids, marine mattresses, etc.).
- **Bird Strike Hazard:** Site C is located near the end of an active runway and under a lower flight path. Accordingly, an increase in bird strike hazard is unacceptable at this location. The structures and habitat envisioned in the conceptual design for this site were intentionally chosen to minimize this concern as much as practicable.

7.3.4 Other Alternatives Considered

A number of alternatives were considered and excluded prior to arriving at this preliminary conceptual design. Restoration concepts without structures were initially considered but dismissed based on potentially high maintenance requirements associated with the substantial shoreline retreat. A much larger volume of sand fill and wider beach were originally envisioned, but existing SAVs in the project area will prohibit filling in many areas.

The use of offshore emergent breakwaters was rejected due to the potential increase in perching area for large birds. Creation of marshes was ruled out for this site because of the exposure to wave energy and the potential for attracting large birds. The presence of SAV in the project area greatly limits the habitat creation opportunities and use of structure at this site.

7.3.5 Risks and Considerations, Strategies to Mitigate

The primary risks associated with the conceptual restoration designs include erosion and future inundation due to sea level rise. While both are natural processes, both can be managed through appropriate design of project elements. For example, erosion of newly-placed sand fill can be mitigated through the use of breakwaters and subtidal reefs. Erosion and sediment transport associated with overwashing during extreme events is not a significant risk at Site C. Future inundation due to long-term sea level rise is unavoidable. The headland breakwaters will be designed to account for an appropriate amount of relative sea level rise over the life of the project. During that time, the pocket beaches will slightly expand as mean sea level slides up the beach profile.

Secondary risks associated with the conceptual restoration designs include the potential for navigational hazards and impacts to NAS Pensacola flight operations due to the presence of large birds utilizing the marsh habitat. The navigational hazard posed by emergent breakwaters and subtidal reefs is of lesser concern since they will be located inside the Navy's marked exclusion zone. However, the subtidal reefs may still require visible, above water signage for safety reasons, particularly given their proximity to the Intracoastal Waterway and Pensacola Pass. The creation of any new emergent structure has the potential to attract large birds. The use of headland rock breakwaters along the shoreline should minimize this concern. Being adjacent to one another and having similar elevations, the presence of rock structures should serve as no greater an attractive nuisance for large birds as the existing sandy beach. Markers/signage for the subtidal reefs may attract large birds. There are caps and other devices that can be added to pilings and signs in order to dissuade the use of large birds. Additional bird abatement techniques could be explored if NAS considers the risk to be unacceptable.

7.3.6 Next Steps

These are highly conceptual designs that are subject to change based on data collection, modeling, environmental resource permitting, availability of materials/resources, and availability of construction funds. At a minimum, geotechnical investigations and bathymetric/topographic surveys of Site A will be required before these conceptual designs can be refined and advanced to 30 percent and 60 percent designs. Development of the 30 percent design will incorporate the survey and geotechnical data. Advancement to the 60 percent design phase will incorporate the results of hydrodynamic and sediment transport modeling.

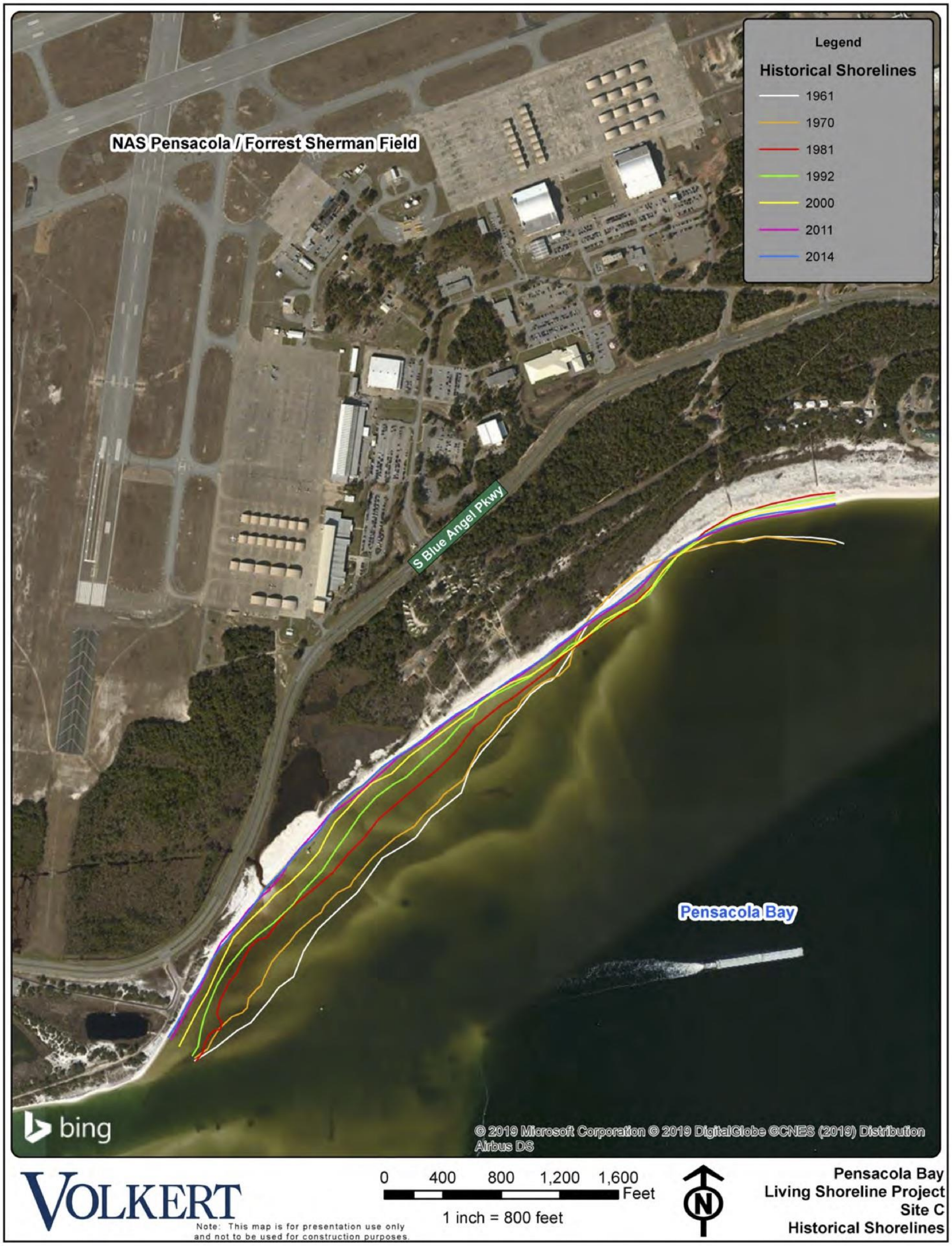


Figure 11: Historical shoreline positions of Site C (Sherman Inlet) for the time period 1961 to 2014. Aerial imagery shows the shoreline position as of 2019.

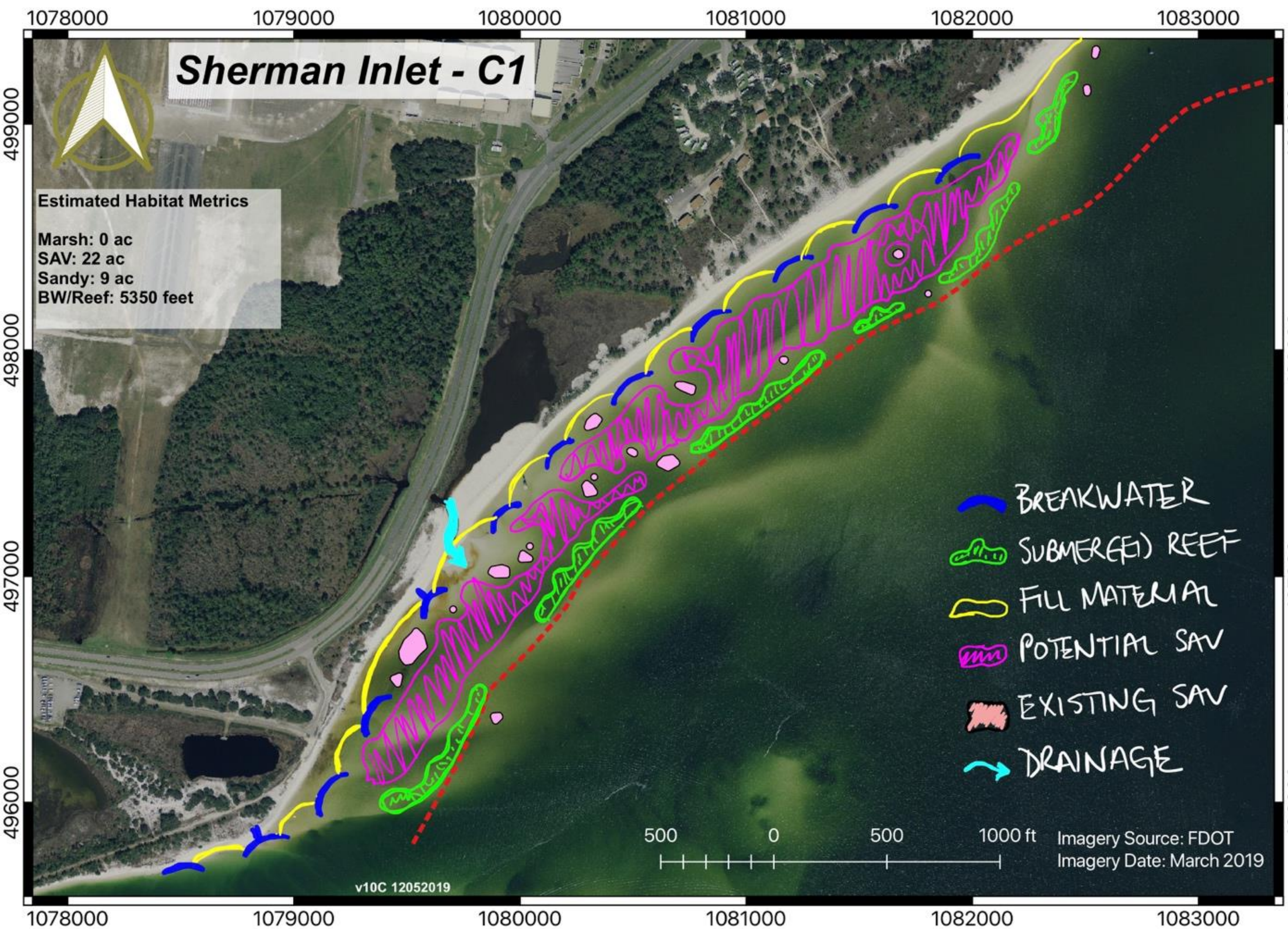


Figure 12: Preliminary conceptual design (C1) for Sherman Inlet (Site C).

8.0 Potential Borrow Sites

Construction of project features such as shoreline nourishment and marsh establishment will require substantial amounts of fill material which must be obtained from appropriate borrow sites. Required quantities of material may range from 500,000 to 1,000,000 cubic yards depending on the specific final design features. Potential sources of fill material near the Living Shoreline sites were considered including upland sites, Federal navigation channels, and other water bottom areas.

Upland areas west of the living shoreline sites are highly developed and it would be difficult to find areas of sufficient size with suitable material. Also, it would most likely entail trucking the material which would add traffic to the already busy road network and would be a costly option. One upland area appeared to have potential as a possible source of suitable sandy material. It is an approximately 20-acre site located near the living shoreline Site B (Figure 13). According to information provided by NAS Pensacola, the site has a history of dredged material disposal dating back to the 1950's through the mid 1990's. The area was used by the Navy for disposal of dredged material from the turning basin near the piers in preparation for the aircraft carriers. A 1995 analysis indicated the basin sediments exceeded the surface soil guidelines and as such can only be used as fill material if it is covered by at least two feet of clean soil and placed in areas not subject to erosion. Based on this information the upland disposal area is not considered to be a suitable source of material for the living shoreline project. Also, the area currently has visual and natural value. Immediately north of the site is a board walk and informational nature plaques.

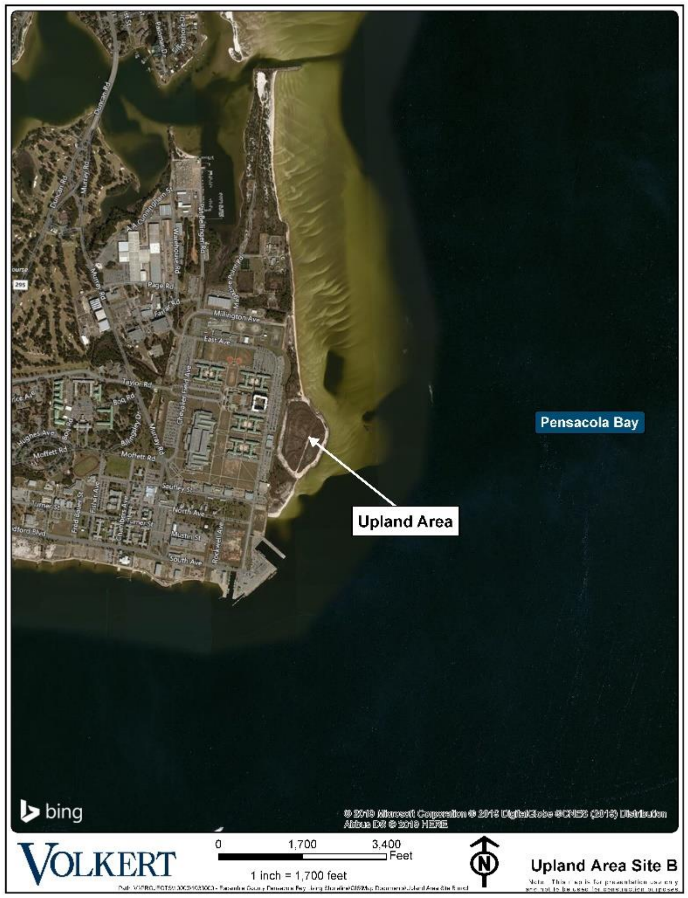


Figure 13: Potential Upland Borrow Area

Federal navigation channels in the Pensacola Bay area are maintained by the U.S. Army Corps of Engineers (USACE), Mobile District. This includes the Gulf Intracoastal Waterway (GIWW), Pensacola Entrance Channel, Pensacola Bay Channel, and assistance to the Navy with maintenance of their channels and Turning Basin. Accordingly, the USACE Mobile District Operations and Planning Divisions were contacted concerning dredging frequency, dredged quantities, dredged material disposal areas, sediment quality, and existing FDEP permits. Information provided by the USACE is shown in the Data/Document List Appendix

H. Review of the information indicates sandy material can be found in the Pensacola Entrance Channel, The GIWW near Site C, and Disposal Area 45 (DA 45, Robertson Island) as shown on Figure 14.

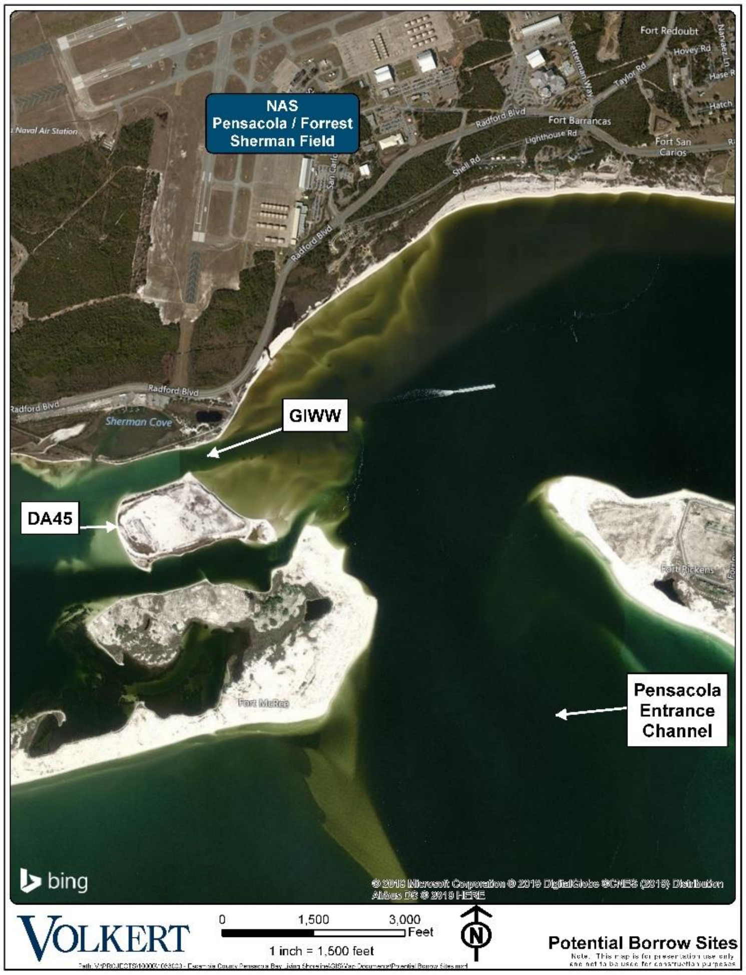


Figure 14: Potential Borrow Areas, GIWW and DA 45 (Robertson Island)

The GIWW near Site C is dredged every three to five years with an average of approximately 24,500 cubic yards of sandy material removed per dredging cycle. This appears to be suitable sand for the living shoreline project but additional sediment testing may be required to confirm. One dredging cycle would provide a small portion of the quantity of sand needed for the project. The USACE performs channel condition surveys to determine the need for dredging and the quantities of material to be removed. A hydraulic pipeline dredge could be used with direct discharge at the living shoreline area. Although other sources of sandy material would need to be utilized to meet the needs of the entire living shoreline project, this could be an economical source of material if leveraged with the USACE dredging program. The USACE would expect payment for any costs above their normal dredging and disposal costs. Early coordination with the USACE and FDEP indicate this may be a viable option. Additional coordination with the USACE and FDEP will be required for this option relative to permits.

The Pensacola Entrance Channel is dredged every two to six years with quantities ranging from approximately 143,000 cubic yards to 340,000 cubic yards per dredging cycle. USACE sediment testing indicates the dredged material is predominately sand. One dredging cycle could represent a substantial portion of the needs for the Living Shoreline. The USACE performs channel condition surveys to determine the need for dredging and the quantities of material to be removed. A hopper dredge with shoreline pump-out capabilities may be needed to get the material to the Living Shoreline areas. It may also be feasible to use a hydraulic pipeline dredge (approximately 30 inch dredge) with booster pumps as necessary to get the material to the living shoreline areas. If the living shoreline project could be timed with the USACE normal dredging cycle then a cost savings may be realized by interfacing with the Corps dredging effort and paying only the costs above their normal dredging and disposal costs. Consideration of this option would be subject to USACE and FDEP's review of the current policy to place the beach quality sand within the Gulf beach system. Additional coordination with the USACE and FDEP will be required for this option relative to permits with focus on availability of the material.

DA 45 is an island used for placement of sandy material dredged from the GIWW near Site C. Sand dikes surround an approximately 36-acre area and an outlet weir is located on the south side of the island. The U.S. Geological Survey 2018 topographic map indicates some areas of the dredged material on the island are as high as 25 feet above mean sea level. As such it appears this site could accommodate a substantial portion of the material needed for the Living Shoreline project. Removal of sand from the site could be accomplished by mechanical or hydraulic equipment or a combination of the two. Mechanical equipment may include excavators, conveyors, barges, and support vessels. Hydraulic equipment may include dredges, pumps, pipelines, and support vessels. The USACE has indicated an interest in use of the material for the Living Shoreline project as it would complement their beneficial use program and add needed capacity to DA 45. Early coordination with USACE and FDEP indicates additional topographic and geotechnical surveys would be required to determine the quality and quantity of the material at this site. These surveys will be vital in determining the adequacy of this site for the living shoreline project. Additional coordination with the USACE and FDEP will be required for this option relative to permits.

Obtaining dredged material from the navigation channels or the dredged material disposal area would need to comply with the existing FDEP permits for the projects. These permits include consideration of Outstanding Florida Waters (Gulf Island National Seashore and Ft. Pickens State Park Aquatic Preserve), Coastal Zone Consistency, Water Quality Certification, Florida sovereign submerged lands, migratory birds, seagrass protection, manatee protection, disposal area operation and maintenance plans, and the National Marine Fisheries Service Biological Opinion for Hopper Dredging (Pensacola deep draft Channel). Use of the material for the Living Shoreline project would also require filing a Joint Permit Application with the USACE Jacksonville District and the FDEP.

Other water bottoms of Pensacola Bay could also be considered for borrow sites. In particular, the public meetings for this project revealed a substantial interest in recovery of sediment near White Island (Site A). Potential recovery areas include the area between the mainland and White Island, and the shallow areas east of the Island. Use of these nearby sources of fill material could result in substantial cost efficiencies. The fill material would be used appropriately with clean sandy material used for island reestablishment and marsh area containment. Less sandy material may be suitable for use within the containment area for the marsh establishment. All fill material would be subjected to testing for physical and chemical characteristics to determine suitability as required by the USACE Jacksonville District and FDEP permitting process.

Additional data needs include updated topographic/bathymetric surveys and additional geotechnical work to determine the adequacy of the above described potential borrow sites. If the additional information indicates these sites cannot provide sufficient quantities of suitable material then the project site design may need to be adjusted or additional borrow sites must be identified.

9.0 CONCLUSIONS/RECOMMENDATIONS

9.1 Decision/Risk

Discussions in the preceding sections have outlined concepts to address the specific needs of each living shoreline site and the project goals. Development of project concepts includes consideration of biological resources, constraints, resiliency, constructability, permitting, recreation, and initial public input. As indicated throughout the discussions there are risks associated with variables such as identified data gaps, potential constraints, and the need for additional coordination with the agencies and the public. With this understanding, a qualitative decision/risk analysis has been developed to aid in the decision process and is included at the end of this document (Table 4). In the table, A, B, and C denote high, medium and low risk impact, respectively. High or medium risks being realized could result in design, construction, and/or scheduling delays. Cost risks could result in construction delays or the need to seek additional sources of funding. Identifying these risks early in the project process facilitates the implementation of mitigation measures to avoid risks being realized and/or compounded.

9.2 Recommendations

The Volkert team recommends the preliminary living shoreline concepts presented in this report be advanced to the next stage of design. As discussed throughout the report, additional data, information and coordination will be needed to fill in gaps to refine the project design. These requirements are summarized as follows:

- Florida Sovereign Submerged Land requirements. Coordination ongoing with FDEP.
- Property ownership White Island area.
- Additional public coordination as the design progresses
- Site specific topographic/bathymetric surveys and geotechnical work at the living shoreline sites and borrow areas.
- Additional concept modeling
- Dolphin density survey to be conducted by NAS Pensacola. Survey began in Fall 2019 and is scheduled for completion in Fall 2020.
- Possible seagrass survey of areas surrounding the borrow site areas.
- Need additional Coordination with USACE on Section 408 considerations (potential impacts to the Federal Channel), borrow sites, and permitting requirements (Mobile and Jacksonville Districts). Any activities for dredging and fill will require a Joint permit application with the Corps of Engineers and the FDEP. The USCE Jacksonville District has Section 404/10 permitting responsibilities for any dredging and fill activities in waters of the United States for the Florida area. The FDEP is authorized to issue

permits in State regulated waters including proprietary authorization for any activities located on sovereign submerged lands, coastal zone consistency, and water quality certification. Early coordination has been initiated with both the USACE and FDEP. Topics being discussed include the Living Shore concepts, implications of on-site recovery of sand, applicant(s), potential permit processing fees, possible waiver of dredged material severance fee, and land ownership questions. Discussions with USACE and FDEP will continue into the design and permitting phases.

- Need additional coordination with FDEP on permitting requirements
- Continued follow-up on Interagency Working Group Action Items

Table 4: Risk Response Matrix

Risk	Discussion	Risk Impact	Objective Risk Likelihood	Response	Strategy to Mitigate
Construction Constraints	Site A: Water-based construction is inevitable. Site B: Shallow depths pose a constraint on selection of breakwater/reef materials at site. Sites A& B: Water-based construction activities for the placement of offshore structures will be limited to navigable depths for light-loaded barges and scows unless construction access channels are dredged. Site C: Land-based construction activities are possible at Site C	B	Low	Design constraints were considered in the development of the conceptual designs	Sites A & B: Dredging of construction access channels could be combined with on-site recovery of sandy material that meets the restoration goals of the project. Site C: Land-based construction activities are possible at Site C. This includes direct placement of sand fill and the construction of headland breakwaters. However, construction of the subtidal reefs would be performed by water. Water-based construction activities for the placement of offshore structures will be limited to navigable depths for light-loaded barges and scows unless construction access channels are dredged. Dredging of construction access channels may not be necessary given the proximity of the subtidal reefs to slightly deeper depths (>4 feet).
Sediment Availability	Construction of project features such as shoreline nourishment and	A	Medium	Required quantities of material may range from	Preliminary investigation of potential borrow areas is

Risk	Discussion	Risk Impact	Objective Risk Likelihood	Response	Strategy to Mitigate
	marsh establishment will require substantial amounts of fill material which must be obtained from appropriate borrow sites.			500,000 to 1,000,000 cubic yards depending on the specific final design features.	discussed in the basis of design. Quantities and sources must be identified as early in the design process as possible.
Construction--Plantings	A large number of appropriate plants will be required to meet habitat targets	C	Medium	Planting densities and planting schemes will require careful consideration.	Begin identifying potential nursery suppliers at 30% design stage
Structure Stability	Rock reef and breakwater structures must be designed so that the rocks are stable under design conditions.	C	Low		Limit vertical settlement as much as possible through the use of appropriate underlayment (e.g., geotextiles, geogrids, marine mattresses, etc.).
Project Life	The primary risks associated with the conceptual restoration designs include erosion and future inundation due to sea level rise.	C	Medium Low	While both are natural processes, they can be managed through appropriate design of project elements.	Design concepts incorporate resilience elements that recognize that marsh features will attempt to adjust to future sea levels through lateral migration. Erosion of marsh edge is mitigated through the design of breakwater structures. Placement of sediment will facilitate vertical accretion over time. Site C: The headland breakwaters will be designed to account for an appropriate amount of relative sea level rise over the life of the project.

Risk	Discussion	Risk Impact	Objective Risk Likelihood	Response	Strategy to Mitigate
					During that time, the pocket beaches will slightly expand as mean sea level slides up the beach profile.
Bird Strike/Hazards at NAS Pensacola	Sites A and B: The creation of a large intertidal marsh complex will likely attract large birds (e.g., pelicans, herons, egrets, etc.), thereby increasing the potential for bird strikes. Site C: Site C is located near the end of an active runway and under a lower flight path. Accordingly, an increase in bird strike hazard is unacceptable at this location.	B	Medium Low	NAS has stated that the presence of large birds at Sites A and B is off less concern than at Site C. Site C: The structures and habitat envisioned in the conceptual design for this site were intentionally chosen to minimize this concern as much as practicable.	Bird abatement techniques could be considered if NAS considers the risk to be unacceptable.
Navigation Hazard	Breakwaters can pose a navigational hazard for recreational boaters.	B	Medium Low	Risk can be mitigated through inclusion of signage/appropriate markings at project site.	Site A: Appropriate signage will be included in project to mark breakwaters and reef structures. Sites B and C: Design locates emergent breakwaters and submerged reefs inside the Navy's marked exclusion zone. However, the subtidal reefs may still require visible, above water signage for safety reasons.
Cost	Revised conceptual designs did not consider cost as a primary consideration in design, per Escambia County.	A	High	Design prioritized the achievement of grant goals and objectives to of creating/enhancing/protectin	Develop a rough order of magnitude cost estimate and make adjustments to

Risk	Discussion	Risk Impact	Objective Risk Likelihood	Response	Strategy to Mitigate
				g habitat and enhancing force protection (At NAS sites).	tasks and schedules if needed.
Presence of cultural/archeological resources	Cultural and/or archeological resources may be present at planting sites and in the water (risk associated with potential construction access channels)	B	Medium	Surveys will be conduted as needed to identify contraints that could impact design.	Conduct necessary surveys to identify potential constraints
Regulatory Compliance	Section 408 determination for Site C	B	Medium Low	Section 408 determination could impact the design at Site C	Continued coordination with Army Corps of Engineers; rework design if necessary

APPENDIX A

ACRONYMS

Appendix A
Acronyms

AICUZ	Air Installations Compatible Use Zones
APZ	Accident Potential Zone
ATL	Applied Technology Council
CERC	Coastal Engineering Research Center
CNATRA	Chief of Naval Air Training
CNET	Chief of Naval Education and Training
DOD	Department of Defense
EMI	Electromagnetic Interference
FAA	Federal Aviation Administration
FDEP	Florida Department of Environmental Protection
FEMA	Federal Emergency Management Agency
FIS	Flood Insurance Study
FPL	Funded Priorities List
GIWW	Gulf Intracoastal Waterway
LiDAR	Light Detection and Ranging
LSP	Living Shoreline Project
MHW	Mean High Water
MHHW	Mean Higher High Water
MLW	Mean Low Water
MLLW	Mean Lower Low Water
MSL	Mean Sea Level
MWR	Morale, Welfare, and Recreation
NAS	Naval Air Station Pensacola
NATC	Naval Air Training Command
NAVD	North American Vertical Datum
NFO	Naval Flight Officer
NOAA	National Oceanic and Atmospheric Administration

Acronyms (cont.)

PBS	Pensacola Bay System
PPT	Parts Per Thousand
RESTORE	Council Gulf Coast Ecosystem Restoration Council
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
TMDL	Total Maximum Daily Load
TRAWING	Training Air Wing

APPENDIX B

PENSACOLA BAY SYSTEM AREA INFORMATION

Appendix B
Pensacola Bay System Area Information

The PBS is designated for recreational and commercial uses by the State of Florida Department of Environmental Protection. Commercial uses include a shrimp fishery, an active port, and military flight training. Both Escambia and East Bays are utilized for shrimp and oyster fisheries. Fuel and raw materials are delivered to industries along the Escambia River via barges. The bay system also supports an active recreational fishery and a variety of water sports (USEPA 2005). The PBS is classified as a drowned river valley. As a coastal plain estuary, this system is partly enclosed by a barrier island, Santa Rosa Island, and an interior peninsula. Tidal exchange with the Gulf of Mexico occurs through Pensacola pass a narrow pass at the southwestern point of the system. Salinities within the system range from 0 to 35ppt. A salt wedge is present when river flow is high but becomes partially mixed during low flow. As with all estuaries, surface flow tends to be seaward and bottom flow riverward. The upper reaches of the PBS is mesohaline, with salinity ranging between 5-18ppt, whereas Pensacola Bay is polyhaline (18-30ppt.) The PBS is a low-energy system dominated by river flow. The average tidal range is 1.6 feet classifying the system as microtidal. Based on average river flow and tidal range, PBS should flush on the order of 34 days but may take as long as 200 days (USEPA 2005).

Natural Resources

The watershed's diverse habitats support more than 200 species of fish and shellfish, including 70 identified rare, imperiled, or threatened animal species, including the Gulf sturgeon; and 68 rare, imperiled, or threatened plant species. Outside the City of Pensacola much of the watershed consists of conservation and recreational lands representing a diverse assemblage of ecological types and protecting many of the watershed's water resources and ecosystems. These lands include Blackwater River State Forest; Blackwater, Yellow, and Escambia Rivers Water Management Areas; Garcon Point Water Management Area; and Gulf Islands National Seashore. Large tracts of Eglin Air Force Base are also managed for conservation and endangered species protection. Waterbodies within the Pensacola watershed have been given additional protection through designation as Outstanding Florida Waters, including the Blackwater River; Shoal River; all waters in the Yellow River Marsh Aquatic Preserve, Fort Pickens Aquatic Preserve, Gulf Island National Seashore, and Blackwater River State Park; Escambia Bay Bluffs; and Milton to Whiting Field (FDEP 2014).

Pensacola Bay was once known for its thriving oyster industry, but by 1971 over 90 percent of Escambia Bay's commercially harvestable oysters were found dead from the fungus *Perkinsus marina*. Because of the lack of suitable substrate and disease, the oysters have been slow to recover (USEPA 2005). The availability of hard substrate for colonization is a determining factor for the establishment of oyster reefs. Although hard substrate is not particularly common in the Pensacola Bay system, East Bay has historically supported healthy oyster populations. Oyster reefs have been widely demonstrated to improve water quality, protect shorelines by abating wave energy, stabilize bottom sediments, and provide habitat for fish, crab, and other invertebrates. The most current assessments report approximately 235 to 245 acres of oyster reef habitat within the

Pensacola Bay system, including reefs that are closed for harvesting. Of this total area, it is estimated that approximately 75 percent of oyster reefs occur in East Bay. Habitat restoration projects such as Project Greenshores are attempting to restore oyster reef habitat. These restoration attempts may provide vital information for re-establishing oyster populations within the system (SWIM 2017).

Five species of submerged aquatic vegetation have been found in Pensacola Bay and include: widgeon grass (*Ruppia maritime*), shoal grass (*Halodule wrightii*), manatee grass (*Syringodium filiforme*), star grass (*Halophila engelmannii*), and turtle grass (*Thalassia testudinum*) (Schwenning *et al*. 2002). During the 1960s, approximately 9,500 acres of seagrass were observed in the Pensacola Bay system, but by 1992 that number had decreased to 4,500 acres. By 2003 seagrasses in Pensacola Bay, East Bay, and Escambia Bay covered 511 acres, a 43 percent decline from 1992 (FDEP 2014).

Salt marshes in the Florida Panhandle are usually characterized by large, fairly homogeneous expanses of dense black needlerush (*Juncus roemerianus*). Often, they are accompanied on the water-ward side by smooth cordgrass (*Spartina alterniflora*). The *Juncus* and *Spartina* zones are distinctive and can be separated easily by elevation Salt marshes form where the coastal zone is protected from large waves, either by the topography of the shoreline, a barrier island, or by location along a bay or estuary. Salt marshes support a number of rare animals and plants and provide nesting habitat for migratory and endemic bird species. Many of Florida's extensive salt marshes are protected in aquatic preserves, but the loss of marshes and adjacent seagrass beds due to human impacts such as shoreline development, ditching, and pollution and natural stressors, such as sea level rise, have vastly reduced their numbers. Salt marshes are instrumental in attenuating wave energy and protecting shorelines from erosion and are found in the coastal/ estuarine portion of the watershed (SWIM 2017).

Water Quality

Historically, the PBS has had problems with anthropogenic inputs, both point and non-point source, discharging into its waters. Problems in the PBS have been associated with point and non-point source discharges into Escambia Bay and the Lower Escambia River (USEPA1975). Weak circulation and flushing of the system allows particles and dissolved materials in the water to remain in the upper portion of the system for longer periods. Prior to regulatory intervention, massive fish kills, and algal blooms were frequently reported in this area. USEPA (1975) required relocating point source discharges to deeper waters, no new permitted discharges, and continued development and implementation of a system wide management plan. After the implementation of these recommendations in the early 1970s, there were noticeable improvements in water quality and a reduction in the number and extent of fish kills (SWIM 1997).

The FDEP has identified 23 segments within the Pensacola Bay watershed as impaired based on Florida's Impaired Surface Waters Rule, Chapter 62-303, Florida Administrative Code (F.A.C). Waterbody segments verified as impaired based on sufficient data and identified causative pollutants, form the list of waters for which Total Maximum Daily Loads

(TMDLs) will be developed. Nearly all segments are impaired for bacteria (five for fecal coliforms, six for beach advisories, seven for shellfish harvesting classification, two for enterococci, one for Escherichia coli, and one for bacteria in shellfish), two segments for nutrients, and two segments for metals (FDEP 2017). Most estuarine waters have been listed as impaired for bacteria and Escambia Bay has been listed for nutrients. Additional bacteria impairments are concentrated in the Yellow River and Blackwater River basins. County health departments monitor recreational beaches for bacterial contamination and issue health advisories closing beaches when bacterial counts are too high. Beaches with more than 21 closures in a year are identified as impaired by FDEP. (SWIM 2017)

The PBS is classified as a drowned river valley. As a coastal plain estuary, this system is partly enclosed by a barrier island, Santa Rosa Island, and an interior peninsula. Tidal exchange with the Gulf of Mexico occurs through Pensacola pass a narrow pass at the southwestern point of the system. Salinities within the system range from 0 to 35ppt. A salt wedge is present when river flow is high but becomes partially mixed during low flow. As with all estuaries, surface flow tends to be seaward and bottom flow riverward. The upper reaches of the PBS is mesohaline, with salinity ranging between 5-18 ppt, whereas Pensacola Bay is polyhaline (18-30ppt). The PBS is a low-energy system dominated by river flow. The average tidal range is 1.6 feet classifying the system as microtidal. Based on average river flow and tidal range, PBS should flush on the order of 34 days, but may take as long as 200 days (USEPA 2005).

History

The Pensacola area has had a rich and colorful history dating nearly 450 years, being the first European settlement in the continental United States (1559) and controlled by five countries. Pensacola has been under the possession of the Spanish, French, British, United States and Confederate States, and has remained a part of the United States since the end of the American Civil War.

European exploration of the area began in the 16th century. In 1516, Diego Miruelo may have been the first European to sail into Pensacola Bay. Members of the expeditions of Pánfilo de Narváez in 1528 and Hernando de Soto in 1539 visited the bay, during the latter of which Francisco Maldonado recorded its name as the Bay of Ochuse, related to the Indian province. A community was officially established in 1559. The city's founder was a Spanish soldier named Tristán de Luna y Arellano, who brought more than 1,400 people with him, aboard 11 ships. Sadly, the first permanent settlement in Pensacola history was abruptly destroyed in a 1559 hurricane. Five ships sank beneath the Bay of Ochuse and hundreds of lives were lost. The 1,000 survivors abandoned the town altogether in 1561 and headed north to Santa Elena, in present day South Carolina, only to face another devastating hurricane. The remaining survivors returned to Mexico and northwest Florida was considered unsafe for permanent settlement for over a century.

The Spanish once again attempted to settle nearby when they established a fortified town close to Fort Barrancas in 1698. Three fortified bases called 'presidios' were built during this time in local history, to defend the community against the French, who wanted the region to be part of

Louisiana. The French burned Pensacola during its brief occupation of the region between 1719 and 1722.

Pensacola was again Spanish territory between 1722 and 1763, the year the British won control of the region following the French and Indian War (1754 to 1763). The British named their new colony West Florida and made Pensacola its capital. The Spanish reclaimed the city and the rest of West Florida during the 1781 Battle of Pensacola but sold its Florida territories to the United States in 1819.

The Pensacola area is home to three historic U.S. forts, Fort Pickens, and Fort McRee, and Fort Barrancas. **Fort McRee** was constructed from 1834 to 1839. The facility was a three-tiered fort and a detached water battery close to sea level. It was located on the eastern tip of Perdido Key on a stretch of beach known as Foster's Bank. It had a highly unusual shape because of its position on a small, narrow barrier island. **Fort Pickens** is a pentagonal historic United States military fort on Santa Rosa Island. It is named after American Revolutionary War hero Andrew Pickens. The fort was completed in 1834 and was one of the few forts in the South that remained in Union hands throughout the American Civil War. It remained in use until 1947. Fort Pickens is included within the Gulf Islands National Seashore, and as such, is administered by the National Park Service. **Fort Barrancas** (1839) or **Fort San Carlos de Barrancas** (from 1787) is a United States military fort and National Historic Landmark located physically within Naval Air Station Pensacola, which was developed later around it (Wikipedia 2019).

After Pensacola rejoined the United States in 1868, the city gained prominence for its renowned fishery, timber industry, military presence, and its port. Today, tourism and the military are major components of the economy; health care, high-technology industries, and manufacturing (fibres, chemicals, paper products, and building materials) are also important. Pensacola's deep-water port has access to the Intracoastal Waterway and to the gulf via a channel west of Santa Rosa Island. Pensacola Junior College (now Pensacola State College) opened there in 1948, and the University of West Florida opened in 1967.

Notable attractions in the city include the National Museum of Naval Aviation, Historic Pensacola Village (a complex of 19th-century buildings and museums), and Fort Barrancas. Mardi Gras events are held annually prior to Lent, and the Fiesta of Five Flags, reflecting the city's colorful history, is an annual event in June. The U.S. Navy's Blue Angels precision flying squadron is stationed in Pensacola. Gulf Islands National Seashore, Fort Pickens State Park Aquatic Preserve, and Big Lagoon State Recreation Area are all along the gulf south of the city (Brittanica 2019).

APPENDIX C

NAS PENSACOLA OPERATIONAL AREA AND AIR INSTALLATION COMPATIBLE USE ZONES PROGRAM

Appendix C
NAS Pensacola Operational Area and
Air Installations Compatible Use Zones Program

Operational Area

The landing area at NAS Pensacola, also commonly called Sherman Field, consists of three runways, Runway 01/19, Runway 07L/25R, and Runway 07R/25L. As of July 2007, the field elevation at NAS Pensacola averaged 28 feet above Mean Sea Level (MSL). Runways are numbered according to their magnetic heading for aircraft on approach or departure. For example, on Runway 01/19, the numbers 01 and 19 signify that this runway is most closely aligned with a compass heading of 10 and 190 degrees, respectively (FAA 2019). NAS Pensacola primarily is utilized for pilot and navigation training for Navy and sister service pilots and navigators. Currently, NAS Pensacola conducts significant naval aviation training and serves as the home field for all Training Air Wing (TRAWING) 6 operations. Fixed-wing and rotary-wing operations are also generated by the Blue Angels Flight Demonstration Team training, 479th Flying Training Group, fleet detachments, and transient aircraft. Touch-and-go, emergency landing practice and instrument approach practice account for the bulk of NAS Pensacola operations (NAS Pensacola 2019).

Air Installations Compatible Use Zones (AICUZ) Program

The United States Department of Defense (DoD) initiated the AICUZ Program to help governmental entities and communities anticipate, identify, and promote compatible land use and development near military installations. The Naval Facilities Engineering Command Southeast has prepared an AICUZ study for NAS Pensacola (AICUZS 2010). The goal of this program is to protect the health, safety, and welfare of those living or working near military air installations, as well as protect the military operational capabilities of the air station. This is achieved by promoting compatible land use patterns and activities in the vicinity of a military installation. The AICUZ Program recommends that noise levels, Accident Potential Zones (APZs), and flight clearance requirements associated with military airfield operations be incorporated into local community planning programs in order to maintain the airfield's operational requirements while minimizing the impact to residents in the surrounding community. Mutual cooperation between military airfield planners and community-based counterparts serves to increase public awareness of the importance of air installations and the need to address mission requirements and associated noise and risk factors.

In addition to the Navy AICUZ instruction, the Federal Aviation Administration (FAA) and DoD also have developed specific instructions and guidance to encourage local communities to restrict development or land uses that could endanger aircraft in the vicinity of the airfield, including lighting (direct or reflected) that would impair pilot vision; towers, tall structures, and vegetation that penetrate navigable airspace or are constructed near the airfield; uses that generate smoke, steam, or dust; uses that attract birds, especially waterfowl; and electromagnetic interference (EMI) sources that may adversely affect aircraft communication, navigation, or other electrical system.

History

The Navy's presence was first established at the site of NAS Pensacola in 1825 when President John Quincy Adams and Secretary of the Navy, Samuel Southard, arranged to build a Navy Yard on the southern tip of Escambia County. Construction of the Pensacola Navy Yard began in 1826 and grew to be one of the best equipped naval stations in the country. The Navy Yard was decommissioned in 1911. However, in 1914, the first U.S. NAS was established on the abandoned Navy Yard site and has become the primary installation providing aviation training to the Navy. In 1971, NAS Pensacola was selected as the headquarters site for Chief of Naval Education and Training (CNET), a new command that combined the direction and control of all Navy education and training. The Naval Air Basic Training Command was absorbed by the Naval Air Training Command (NATC) (which moved to Corpus Christi, Texas) and is known as Chief of Naval Air Training (CNATRA); NAS Pensacola provides support for the operation of the Chief of Naval Air Training. Known as the "Cradle of Naval Aviation," the air station serves as the launching point for the flight training of every Naval Aviator, Naval Flight Officer (NFO), and enlisted air crewman. In addition, it is the Navy's premier location for enlisted aviation technical training. (NAS Pensacola 2019).

APPENDIX D

COASTAL CONDITIONS ANALYSIS

Appendix D
Coastal Conditions Analysis

Coastal Conditions Analysis

The coastal conditions analysis included defining the key design parameters and empirical modeling to perform preliminary engineering design of the breakwater structures and living shoreline features. Analysis also included the consideration of potential sources of sandy material for the shoreline restoration. Efforts concentrated on the grant requirements, minimizing potential environmental impacts, avoiding impacts to Federal navigation channels, engineering feasibility, agency/public input, and cost effectiveness.

Key Design Parameters

Key design parameters for the living shoreline concepts at each site include:

- tide range and tidal datums,
- local wind characteristics,
- critical fetch lengths,
- local wave characteristics,
- longshore sand transport trends,
- historical shoreline positions,
- return period storm water levels,
- relative sea level rise,
- existing topographic and bathymetric elevations,
- existing geomorphological characteristics and features,
- habitat suitability, and
- design constraints.

Offshore wave characteristics are also important but only for Site C. The geotechnical characteristics and characteristic elevations of each site are also of interest but have not yet been determined.

Tide Range and Tidal Datums

Pensacola Bay experiences an average diurnal tide range of approximately 1.2 feet. Tides experience a predictable tropic (i.e., spring) and equatorial (i.e., neap) cycle: the maximum and minimum tide ranges are separated by distinct 14-day periods (see for example Figure6). Tidal and survey datum relationships are listed in Table D1. The datum values are expressed in feet above the MLLW tidal datum. In other words, the NAVD88 survey datum is 0.32 feet above MLLW or 0.30 feet below MSL. This means that the MSL tidal datum is 0.30 feet above the NAVD88 survey datum.

Table D1. Tidal and survey datum relationships, in feet relative to MLLW, for Pensacola, Florida (NOAA Station 8729840).

Datum	Value (ft)	Description
MHHW	1.26	Mean Higher-High Water
MHW	1.22	Mean High Water
MSL	0.62	Mean Sea Level
MLW	0.03	Mean Low Water
MLLW	0.0	Mean Lower-Low Water
NAVD88	0.32	North American Vertical Datum of 1988

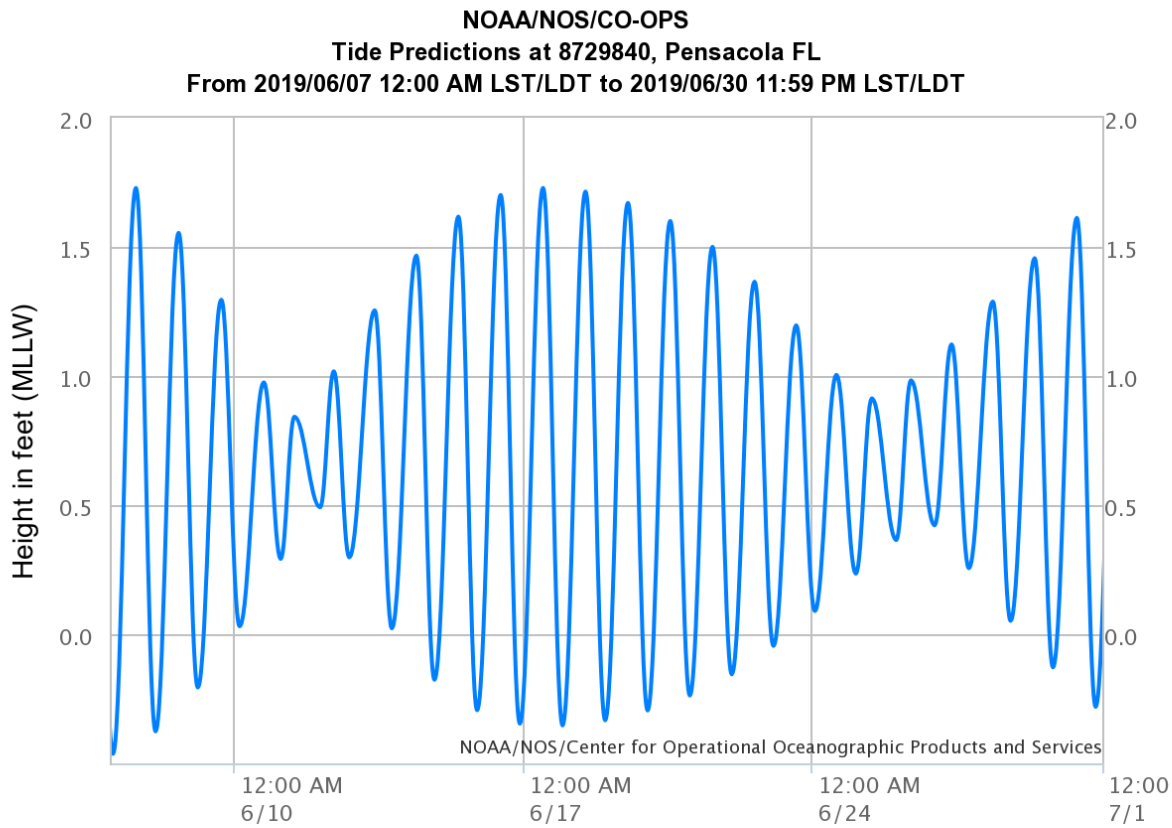


Figure D1. Example of the tropic-equatorial tidal signal in Pensacola Bay, FL.

Local Wind Characteristics

Local wind characteristics play a dominant role in wave generation and the subsequent sediment transport that impact bay shorelines in estuarine systems like Pensacola Bay. We obtained hourly wind speed and direction data for the period 2007 to 2018 (inclusive) from the NOAA/CO-OPS tide station 8729840 located near Palafox Pier on Pensacola Bay. An 11-year data set was chosen because one year in the record (2010) contained only five months' worth of measurements. This record provides ten full years of local wind characteristics by which to assess the wind conditions that lead to wave generation in the estuary. In our experience working on similar projects, a ten-year record of hourly observations is sufficient for characterizing local winds.

Using the period previously described, we found the average wind speed to be 4.8 kts (5.5 mph) and the average direction to be 174° (south-southeast). Wind measurements were segregated into 22.5-degree bins for the purpose of frequency-magnitude-direction analysis. The resulting data were plotted as a “wind rose” and are provided in Figure D2. In that figure, frequency of occurrence is represented by the “size” of each rose petal and/or the overall size/length of the slice. The numbers, increasing in value as a function of increasing radial distance from the center of the plot, represent the number of times that wind speed (colored legend) and direction (compass sector) occurred. For reference, the total number of measurements was n=79929. Therefore, the longest “slices” that exceed 8000 occurrences happen more than ten percent of the time. To that end, the most frequent wind directions are from the north and the south, which roughly correspond to our seasonal winter and summer wind directions, respectively. The strongest winds (>16 kts) correspond to southerly wind directions. At the subject study sites, northerly winds will not produce waves that impact their shorelines: winds from the east and south are most relevant to project design.

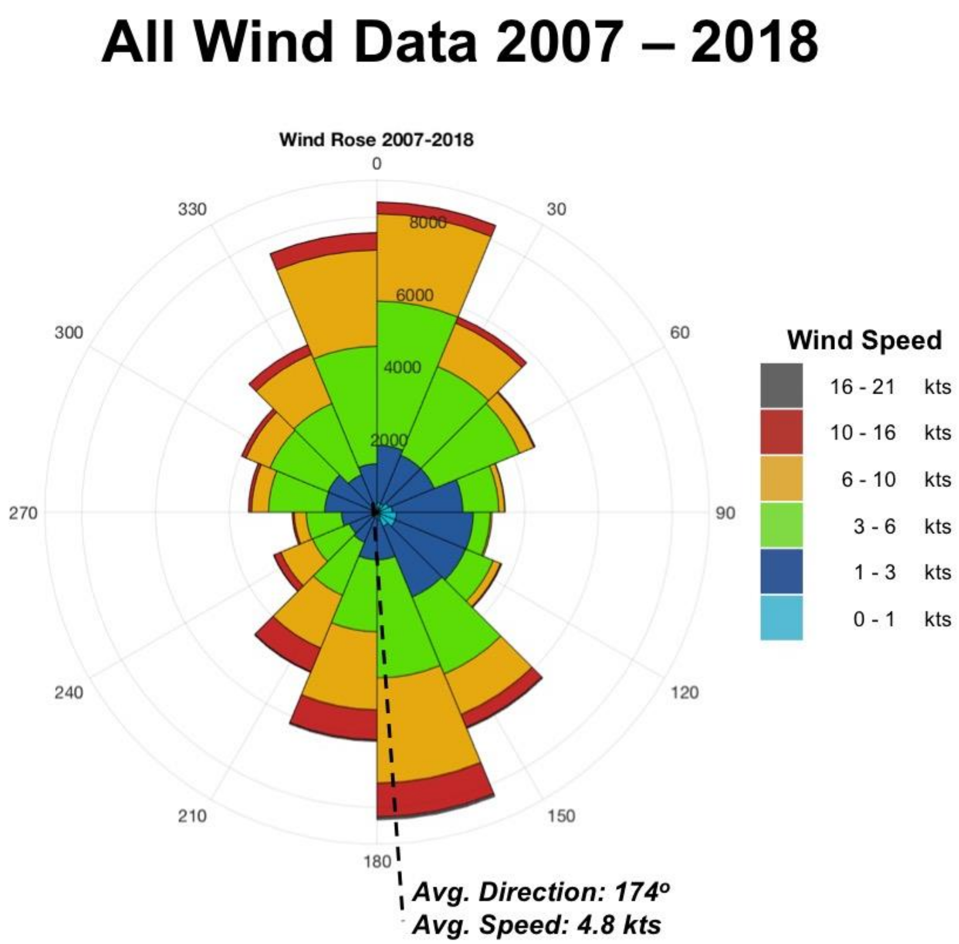


Figure D2. Wind rose for Pensacola Bay, FL for all hourly wind measurements 2007 to 2018.

In addition to the synoptic winds that govern the generation of waves and their sediment transport, storms produce higher wind speeds that can lead to larger wave heights at the project sites. The Applied Technology Council (ATC) provides return period wind speeds for user-selected locations around the US. For these project sites, the ATC database (https://hazards.atcouncil.org) yields the following information:

- 10-yr Return Period Wind Speed: 74 kts (85 mph)
- 25-yr Return Period Wind Speed: 88 kts (101 mph)
- 50-yr Return Period Wind Speed: 98 kts (113 mph)
- 100-yr Return Period Wind Speed: 109 kts (125 mph)

Critical Fetch Lengths

With the exception of Site C, wave conditions at the project sites are the result of local winds blowing across the adjacent estuarine waterbodies of East Bay, Pensacola Bay, and a portion of Santa Rosa Sound. Site C is impacted by both local wind-generated waves and also remote wave forcing from the Gulf of Mexico. The primary variables controlling wave generation by wind are wind speed, water depth, and fetch length. In all cases, wave height and wave period increase as any/all of those parameters increase. Critical fetch lengths are those that align with frequent local wind directions having magnitudes substantial enough to generate local waves.

For each site we delineated fetches using 15-degree bins emanating from a central location. The 15-degree bins correspond to compass headings of 0, 15, 30, etc. degrees relative to true north. The length and average depth along each of fetch were measured using GIS software and associated data, and then tabulated for further analysis. Overview and detailed location maps showing these fetches and their orientations relative to project sites are provided in Figure D3 and Figure D4, respectively. Fetch depths were adjusted to the MHHW tidal datum by adding 1.26 feet to each value.

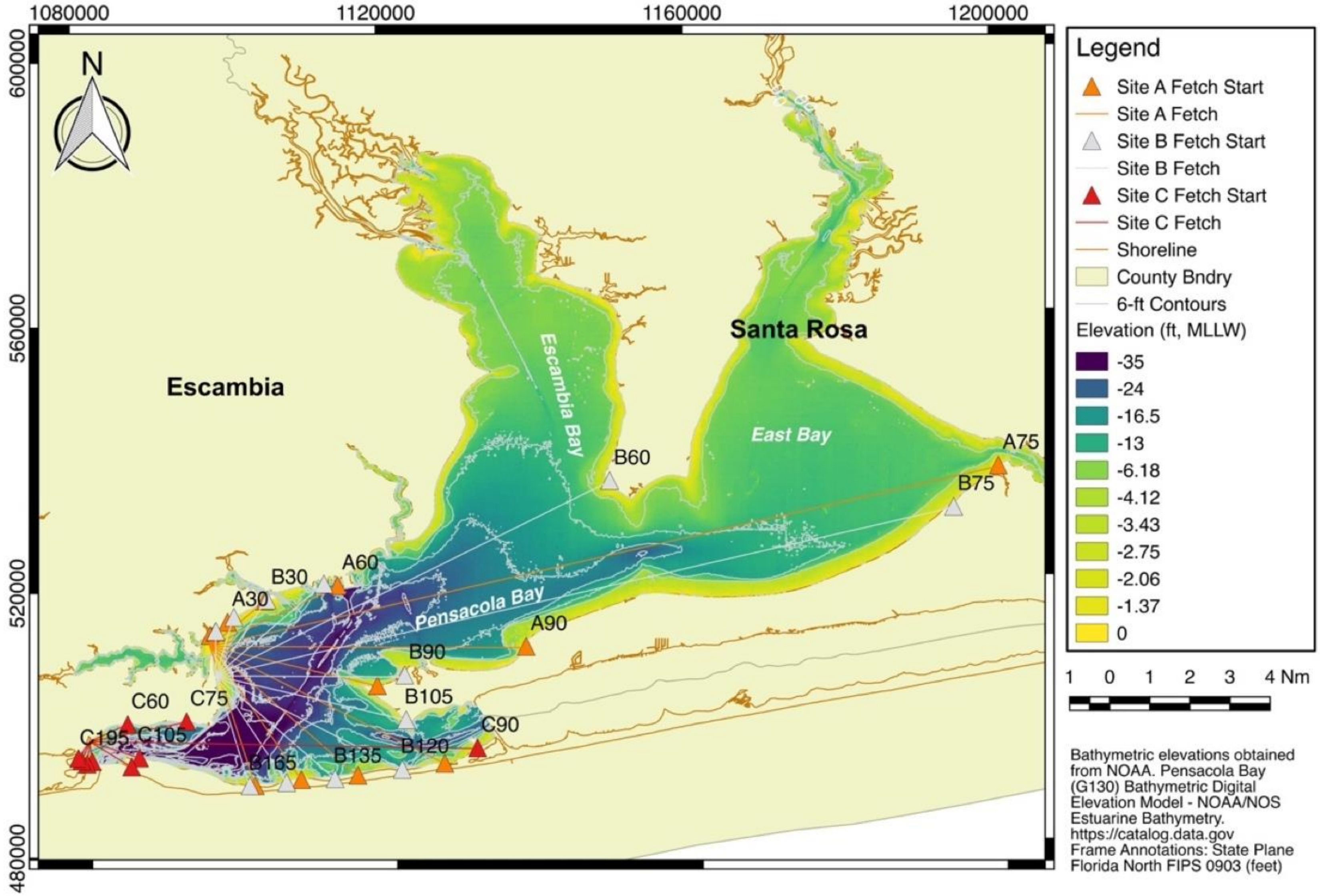


Figure D3. Location overview map showing fetch delineation for each project site.

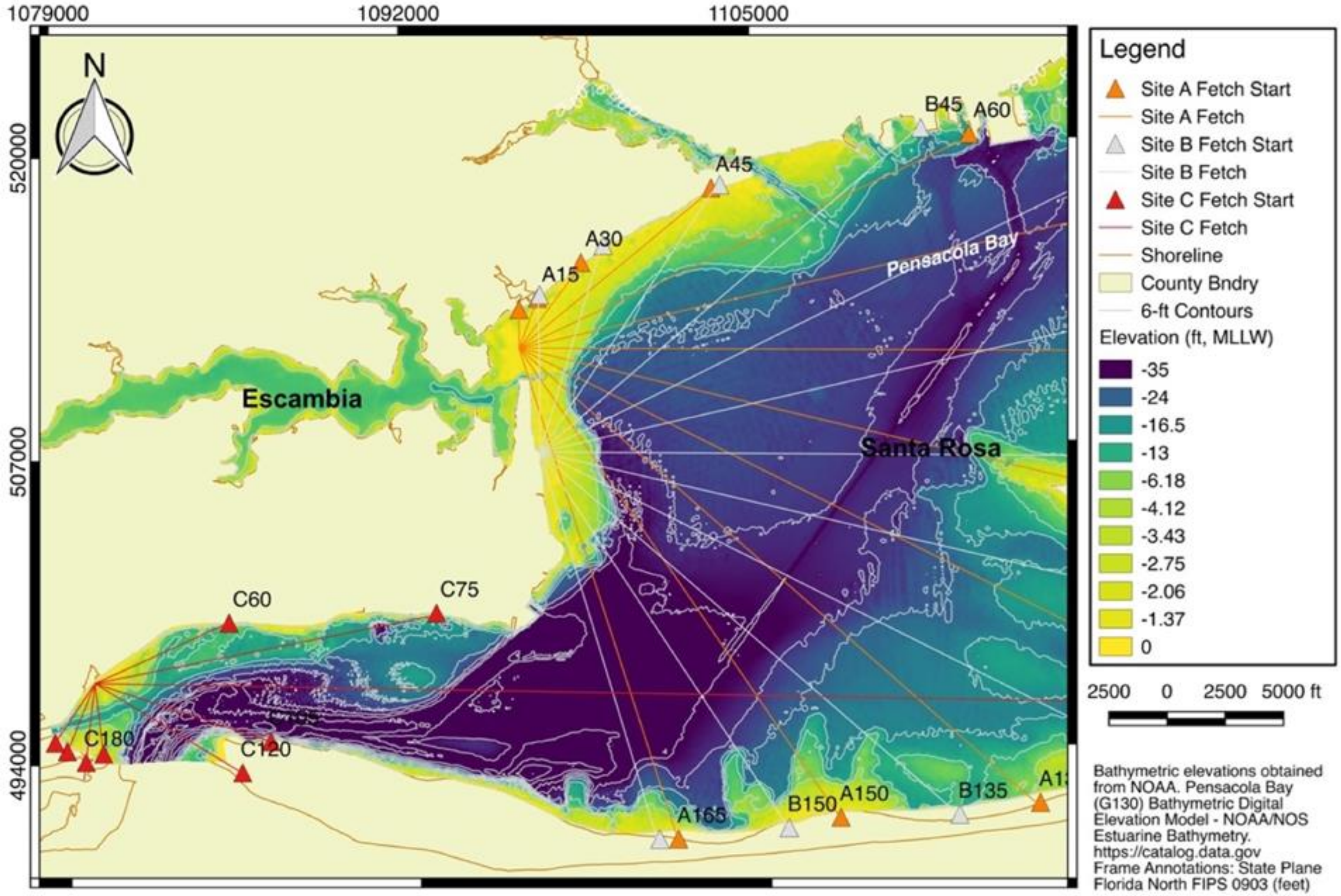


Figure D4. Location overview map showing delineated fetches in more detail for each project site.

As a general comment, the critical fetch orientations for each site are those that align with large wind speeds that occur frequently. That combination of conditions exists for winds blowing from the northeast, southeast, and south. East winds are typically light and infrequent. Note that some wind directions do not generate waves that impact the subject shorelines. Therefore, only those wind directions corresponding to fetch orientations within a 180-degree sector aligning with the average shoreline orientation are considered in this analysis. In other words, offshore-directed winds do not contribute to local wind, wave, and sand transport processes in our analysis. This is standard practice.

Local Wave Characteristics

As mentioned previously, all of the project sites are impacted by local waves generated by winds blowing across Pensacola Bay, East Bay, and Santa Rosa Sound. The shoreline along Site C is also impacted by remove waves propagating through Pensacola Pass from the Gulf of Mexico. Those remote waves and their impacts on Site C are further described in the conceptual design section of the main document. However, for all sites local wind-generated waves have played, and will continue to play, an important role in sediment transport and the subsequent shoreline retreat and erosion. These locally generated waves, and water levels, are a key consideration in the design of living shoreline projects. Living shorelines are resilient for frequently occurring conditions of low to moderate intensity. While project elements, such as the size of stone used in a breakwater, are designed to “survive” an extreme storm event, a project’s functional design and performance are related more to frequently occurring events than they are infrequent, extreme events.

Local wave characteristics were determined using the empirical wind-wave generation equations and techniques described in the US Army Corps of Engineers’ Shore Protection Manual Volume 1 (1984). We applied the equations for spectrally significant wave height (H_{mo}) and peak wave period (T_p) which are functions of fetch length, wind speed, and average depth along the fetch. Wind measurements were corrected to the standard meteorological reference elevation of 10 meters prior to use in these forecasting equations.

When applied, the empirical shallow water wave forecasting equations assume that wave direction aligns with wind direction. Because it is impractical to delineate fetches for every single wind direction in the record, the appropriate 15-degree fetch is assigned when it falls within plus or minus 7.5° of the hourly wind direction measurement. For example, a wind direction of 20° is assigned to the fetch with a compass bearing of 15°, while a wind direction of 23° is assigned to the fetch with a compass bearing of 30°. Again, this is standard practice. Because of the shallow water depths adjacent to each project site and/or the relatively light local winds that occur along fetches that impact these sites, the local wave characteristics are mild. The most frequently occurring wave height is <0.5 ft for all sites. Some locally generated wave heights exceed 2 ft at each site but occur infrequently. Under storm conditions when winds are stronger and water depths are greater, these locally generated wave heights can grow to the point where their maximum height is limited by the water depth (i.e., depth-limited wave breaking).

Longshore Sand Transport

Shoreline retreat and erosion are functions of both cross-shore and longshore sand transport. These sediment transport mechanisms, occurring perpendicular and parallel to the shore, respectively, are key considerations in project design for two reasons. First, their characteristic values and trends provide evidence to support visual interpretations of shoreline change over time. In other words, they provide the numerical evidence that supports what we see and observe when reviewing historical shoreline position data and/or aerial imagery. Second, understanding their values, specifically longshore sand transport tendencies, are essential to the functional design of a project and will in some cases dictate its long-term performance.

Understanding the net and gross longshore sand transport characteristics at a site is an important consideration in the design of most projects. Appropriately managing longshore sand transport rates along a shoreline reach, with for example offshore segmented breakwaters, is one form of managed shoreline stabilization. Also, the longshore sand transport characteristics of your site may tell you how much sand is, on average, moving into, thru, and out of your project site. This is often an important consideration for ensuring no adverse impacts to adjacent shorelines when sediment trapping, or blockage is a concern. We estimated longshore sand transport rates and directions using the US Army Corps of Engineers' Coastal Engineering Research Center (CERC) equation. The so-called CERC equation is an often-applied empirical tool for describing longshore sand transport behavior. Though the magnitudes it predicts are subject to scrutiny, given the many assumptions inherent in its derivation and application, its results are nevertheless illustrative. The CERC equation is especially useful as a tool for estimating net, annual and long-term transport behavior associated with locally generated waves.

The CERC equation is a function of breaking wave height, breaking wave angle, descriptions of the native sediment's specific gravity and porosity, and some empirical coefficients. To determine breaking wave height and angle, the empirical wave modeling results were "transformed" through both wave shoaling and wave refraction using small-amplitude wave theory. So, for every hourly wind measurement between 2007 and 2018 we have estimated a corresponding wave height, wave period, breaking wave height, breaking wave angle, and longshore sand transport rate.

Briefly, Sites A and C exhibit strong net transport tendencies. Over the measurement period considered in this study, net transport at those sites has been to the left for an observer standing on the shoreline and looking toward the bay. In other words, net transport has been to the north at Site A, and to the north and northeast at Site C. Site B exhibits some traits of a bimodal transport system where, over the +10-yr period of analysis, similar volumes of sand have moved to the north and south annually. The full results of the empirical longshore sand transport analysis are presented and described below.

These empirical results are consistent with the observed trends in shoreline position over recorded history. The shorelines along Site B have been far more stable than those at Site A and Site C. At Site A (White Island), which was cut off from its original sand supply when the channel was dredged and stabilized at Magazine Point, the continued northerly transport of sand has resulted in a broad expanse of shoals in between the mainland shoreline and Rock Island. The northerly transport and redistribution of sediments during over washing events have resulted in a substantial decrease in subaerial island volume. At Site C, the north and northeasterly net transport behavior explains the substantial shoreline retreat observed there, but not entirely. The net transport to the north should have produced a corresponding increase in volume and shoreline advancement along that reach. Such a feature is not evident in historical shoreline position data or aerial imagery. Therefore, cross-shore transport may also play an important role in shoreline dynamics here where the shoreline is exposed to both locally generated wind-waves and offshore forcing from the Gulf of Mexico.

Our empirical tools for estimating longshore sand transport are applied more often than those for cross-shore transport. This is because existing empirical methods for estimating cross-shore transport are either over complex or yield questionable results. However, we know that a functional design that does not prohibit cross-shore sand transport is vital to long-term project success. In terms of functional design, this means avoiding excessively long, linear structures without gaps placed within the active surf zone.

Historical Shoreline Positions

A review of historical shoreline positions was conducted as part of this preliminary design phase. The general timeframe associated with available shoreline positions is 1961 to present day. Those shoreline positions provide nearly 60 years of historical information regarding the retreat and reorientation of shorelines at each project location. Sites A and C have seen the most dramatic changes over this period of time, with a majority of the shoreline along Site B being comparatively stable. The shoreline positions are shown in Section 7, Figure 5 (Site A), Figure 8 (Site B), and Figure 11 (Site C).

Return Period Storm Water Levels

Although living shoreline elements are not necessarily designed to protect upland infrastructure during extreme events, they are expected to survive storm events having reasonable return periods. One of the key considerations in the design of living shoreline is the crest elevation of structures that are impacted by waves. Structure crest elevations should be high enough to provide the expected wave attenuation benefits under most conditions, but low enough to submerge quickly during extreme events. Submergence of the structure early, and quickly, in an extreme event leads to project resilience as elements (e.g., structures, plants, etc.) are not exposed to very large waves for an extended period of time.

The preliminary FEMA Flood Insurance Study (FIS) report for Escambia County, dated 27 January 2017, contains return period storm water levels and some wave characteristics near each of the project sites. There are two “coastal transects” near Site A: transects 52 and 53. There is one coastal transect at Site B: transect 51. There are two coastal transects at Site C: transects 47 and 48. The data for each transect are provided in Table D.

Table D2. Return period still water level elevations and wave characteristics.

Location	Transect #	100-yr Wave Characteristics		Still Water Levels (ft, NAVD88) by Return Period				
		H_s (ft)	T_p (s)	10 yrs	25 yrs	50 yrs	100 yrs	500 yrs
Site A	53	3.49	4.49	4.83	6.91	8.21	9.98	13.68
	52	7.28	4.96	4.88	6.72	8.09	9.55	13.01
Site B	51	6.24	4.97	4.87	6.69	8.04	9.47	12.84
Site C	48	7.01	4.8	5	6.93	8.38	9.94	13.52
	47	7.08	4.72	5.23	7.29	8.86	10.25	14.23

Relative Sea Level Rise

As with most locations along the US coast, Pensacola is experiencing relative sea level rise. Relative sea level rise is the combination of eustatic sea level rise, which is the global rise in the average sea level position with land effects removed, and local effects such as land subsidence (vertical land movement) and other factors. As measured by the Pensacola NOAA tide station, the most recent linear trend in relative sea level rise is +2.4 mm/yr or approximately 0.8 feet per century (Figure D5). The most recent estimate of global mean sea level rise is just over +3 mm/yr, which is greater than the rate that Pensacola is experiencing even with land and other local effects included. This suggests that Pensacola has relatively low subsidence rates and is potentially experiencing a combination of local and regional processes that yield lower than average sea level rise rates. The lower rate notwithstanding, future projections are for higher rates of global sea level rise and changes to the local and regional sea level rise processes that lead to relative sea level rise.

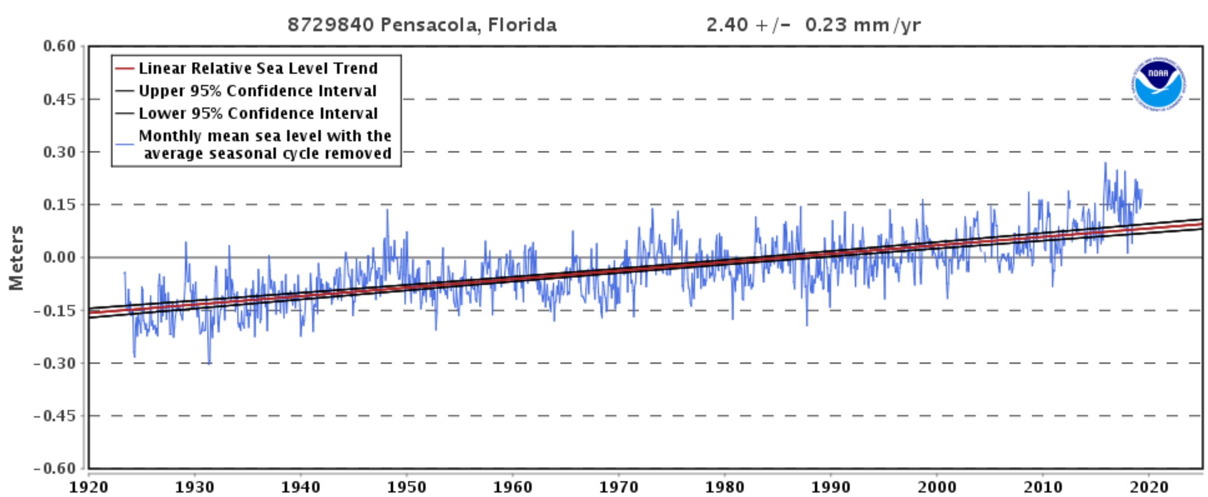


Figure D5. Sea level trends measured and interpolated for Pensacola, FL.

The latest interagency guidance on future sea level rise projections, "Global and Regional Sea Level Rise Scenarios for the United States," published by NOAA in 2017, provides incremental planning scenarios that range from low (0.3 m or 1 ft) to extreme (2.5 m or 8.2 ft) increases in global mean sea level by the year 2100. While these scenarios are not predicated on future climate scenarios, they each have a corresponding probability of exceedance. For example, the low scenario (1 ft increase between 2000 and 2100) has a 94 percent probability of being exceeded even under the most stringent climate emissions scenario and has a 100 percent probability of being exceeded under an aggressive increase in CO_2 emissions. By comparison, the extreme scenario (8.2 ft increase between 2000 and 2100) has a <0.1 percent probability of being exceeded under either future emissions scenario.

The NOAA 2017 interagency projections are shown in Figure D6 for Pensacola, Florida. The curves shown in this figure account for the local and regional effects that add to or subtract from the interagency projections of global mean sea level rise. For example, the low scenario projection at this location is 1.21 ft by 2100, which is greater than the 1 ft estimated by global mean sea level rise alone. Similarly, the extreme scenario projection at this location is 10.17 ft by 2100, which again is greater than the global value of 8.2 ft. So, while the linear trend of relative sea level rise at Pensacola has been, on average, lower than the global average these projections indicate a change in that relationship.

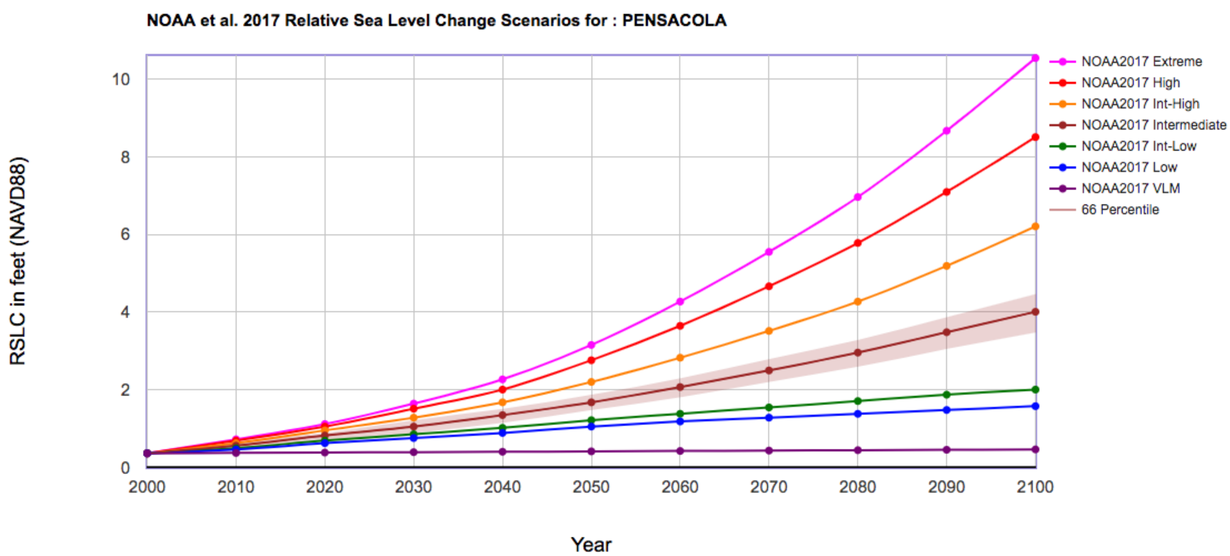


Figure D6. NOAA 2017 projections of relative sea level rise for Pensacola, FL.

When project performance is neither extremely critical or extremely sensitive to mean sea level, the intermediate-low and intermediate planning scenarios constitute a reasonable range of values from which to select an engineering design value. By 2100, this range of values for Pensacola, FL could be 2.01 ft to 4.01 ft. However, we are not expecting the design of this living shoreline to remain fixed until 2100. A more reasonable “design life” for a living shoreline project might be 30 yrs. With an estimated project start date of 2020, the end of the design life would be 2050. By 2050 that same range of engineering design values is 0.85 ft to 1.31 ft above the mean sea level position of 2000.

Higher future mean sea levels will potentially impact the project in at least four ways. First, as sea level rises so too do the tidal datums. Therefore, setting critical project elevations, like crest elevations, must account for the expected increase in the MHHW elevation over the life of the project. Second, sea level rise will lead to increased storm surge elevations and potentially larger wave heights that will impact the project. Third, mean sea level is the ultimate geologic control on shoreline position. As sea levels rise, the apparent shoreline position will retreat up the shoreline slope to a higher elevation. Finally, sea level rise will impact certain habitat components if they are not intentionally designed to ensure adaptive capacity. For example, tidal marshes attempt to adjust to sea level rise by retreating to higher elevations. This requires some lateral space, higher on the project profile, for the retreat to take place. Other habitat components that are sensitive to mean sea level, such as oyster reefs and/or submerged aquatic vegetation, must also be considered and accommodated in the final project design.

Topographic & Bathymetric Elevations

The proposed living shoreline designs will mimic historical topographic and bathymetric elevations at each site. For example, on sand shorelines the restored beach berm and dune elevations will mimic existing berm and dune elevations in areas of the project deemed suitable. Updated topographic and bathymetric elevations have not (yet) been collected as part of this project. They are vital to project design and estimating material quantities and costs. Without updated elevation data, our conceptual designs and quantity takeoffs for each site must be considered extremely preliminary and subject to change. We are currently using existing topographic and bathymetric digital elevation models fused using datasets of varying date, measurement technique, and source (see for example Figure 8 and Figure 9). We have also reviewed the Light Detection and Ranging (LiDAR) datasets from 2006, 2010, and 2017 that offer coverage within the study area. However, these LiDAR datasets do not provide data below the MLLW tidal datum nor do they provide any coverage on Site A (White Island).

Geomorphological Features

A properly designed living shoreline accounts for the existing geomorphological features that are supported by the: local geology; upland hydrology; estuarine hydrography; local wave climate; and the present location of mean sea level. The dominant geomorphological feature of each site today is a sandy bay shoreline consisting of a beach berm, storm berm, and vegetated dune and/or upland. Based on observation alone, Site A and Site B have generally lower beach berm and storm berm elevations than Site C. Site C has a much more established vegetated dune system than Sites A or B. The presence of tidal marshes at Site C is restricted to the tidal lagoon connected to the bay by Sherman Inlet. There are no tidal marshes or fringe marshes along the primary bay shoreline at Site C. However, the presence of *Spartina patens* and *Juncus roemerianus* were noted at Sites A and B, in addition to other upland vegetation. The presence, or lack thereof, of tidal marsh at these sites is consistent with the wave climate analysis: higher wave energy exposure tends to prohibit or discourage long-term tidal marsh viability.

Habitat Suitability

The design of living shoreline projects must also account for and accommodate appropriate types of habitat. Site A is a potentially suitable location to support sandy beach habitat; tidal marsh habitat; submerged aquatic vegetation (SAV) habitat; and possibly subtidal reef (fish and/or oyster) habitat. However, the persistent recreational uses of Site A may discourage the long-term success of SAV and subtidal habitat at this location. The restored conditions of Site A lends itself to the natural recruitment and facilitation of SAV habitat. Site B potentially supports all of the same habitat types as Site A. Because of the relative stability of shorelines along Site B, its protection within the NAS Pensacola exclusion zone, and more limited recreational use, this site can potentially support SAV, subtidal, and/or intertidal reef habitat components. At Site C, the primary focus is on augmenting and stabilizing the sandy beach and vegetated dune habitats.

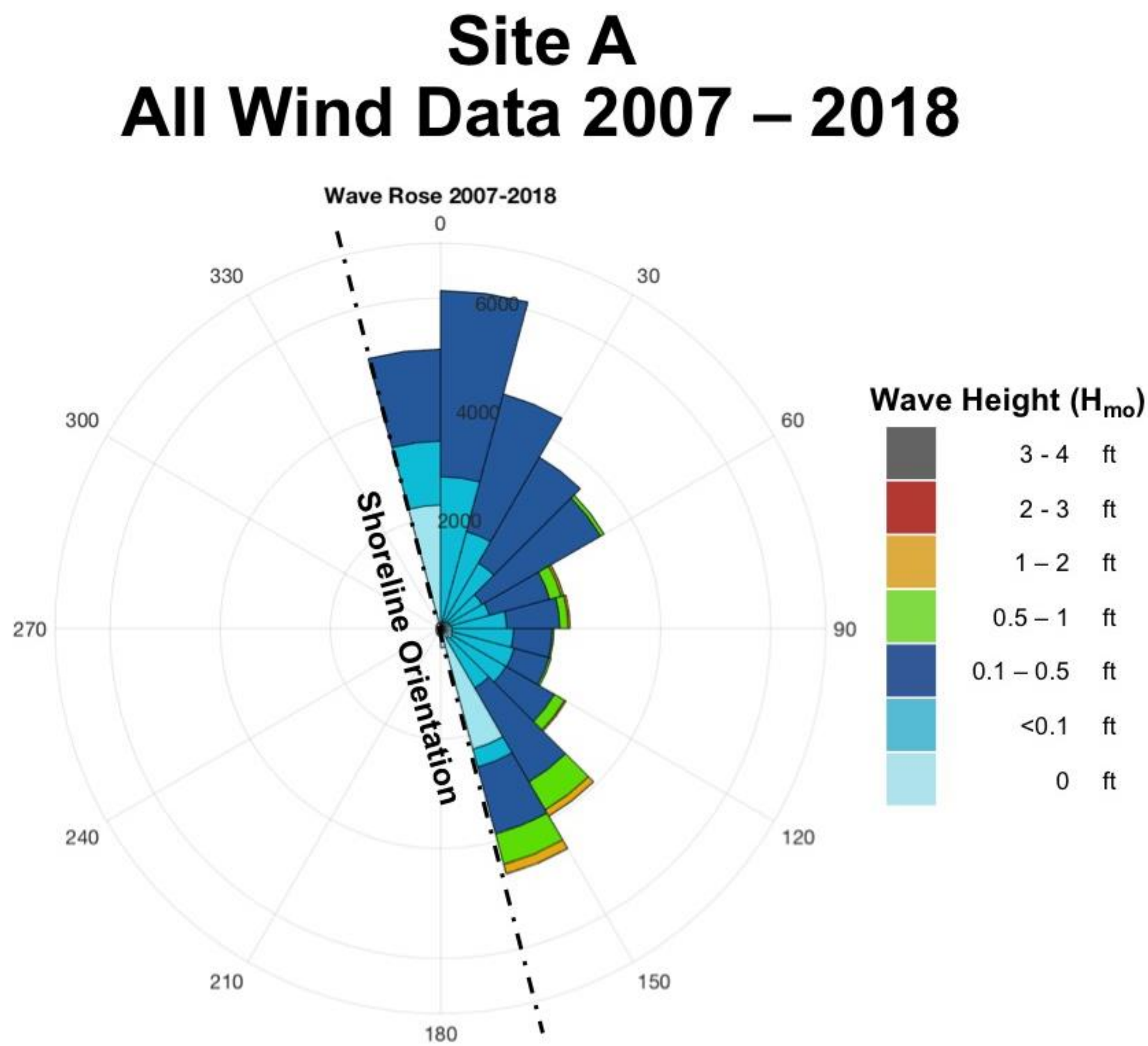


Figure D7. Wind-generated wave height magnitude and frequency distribution for Site A.

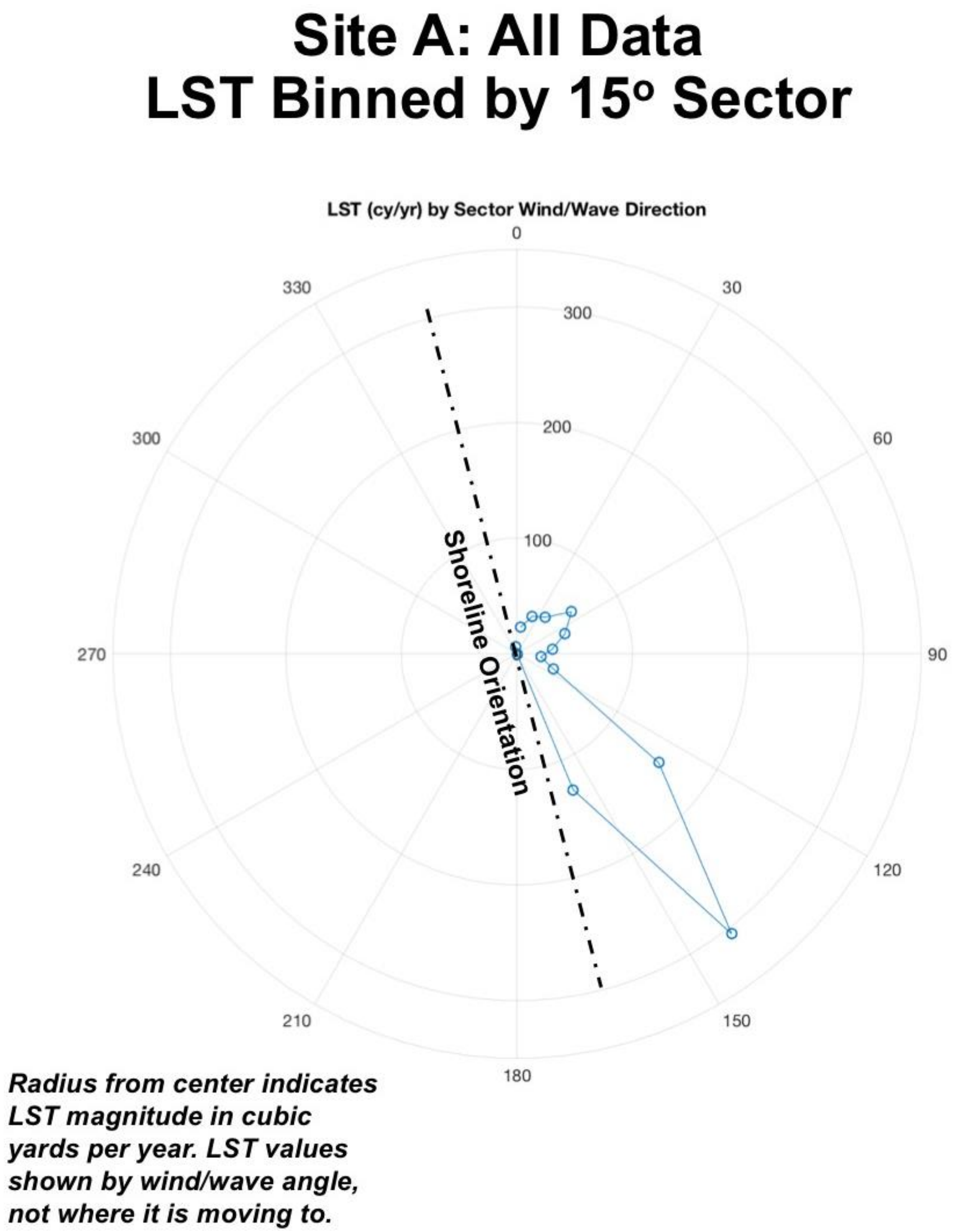


Figure D8. Average longshore sand transport rates, in cubic yards per year, by direction for Site A.

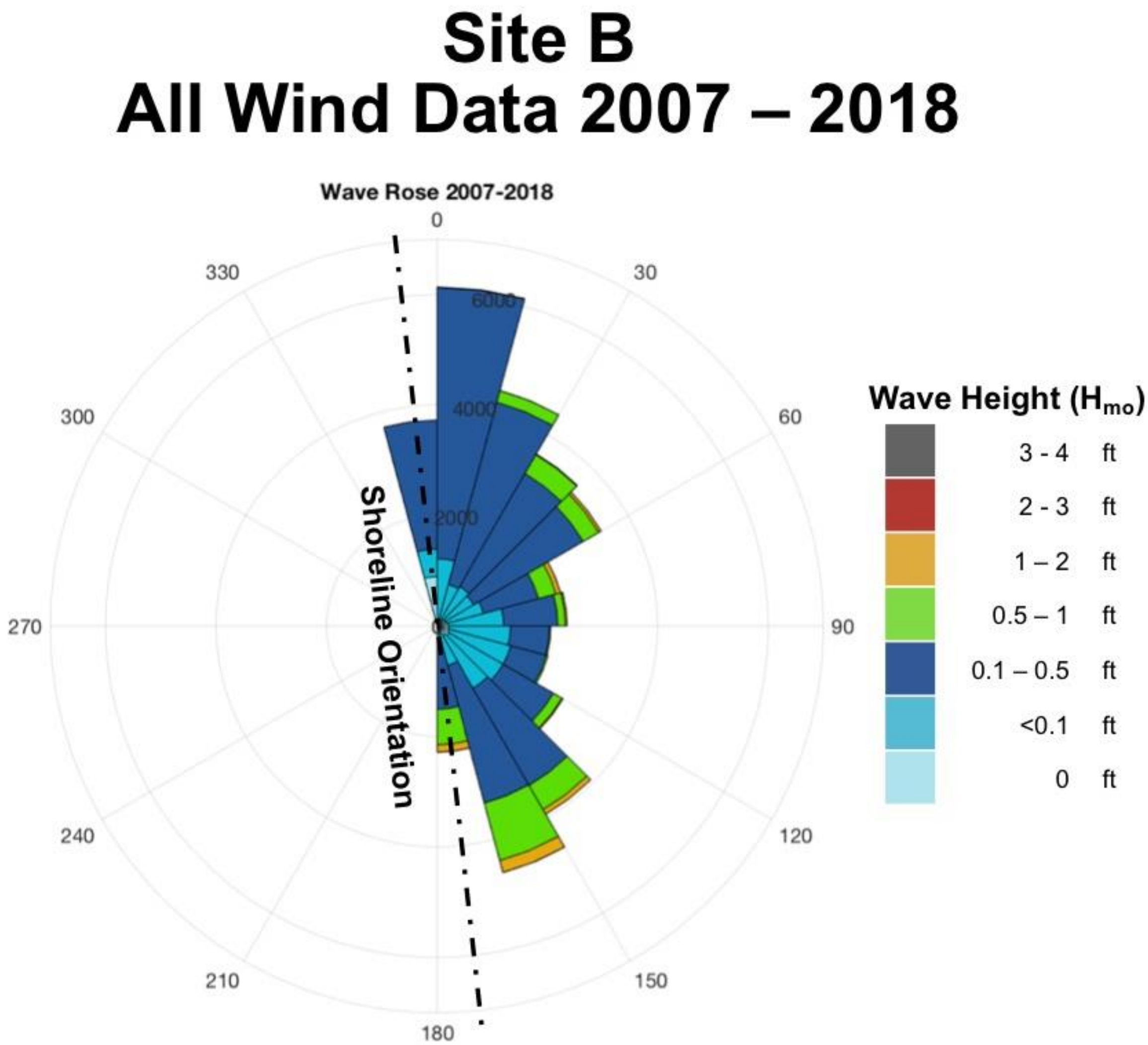
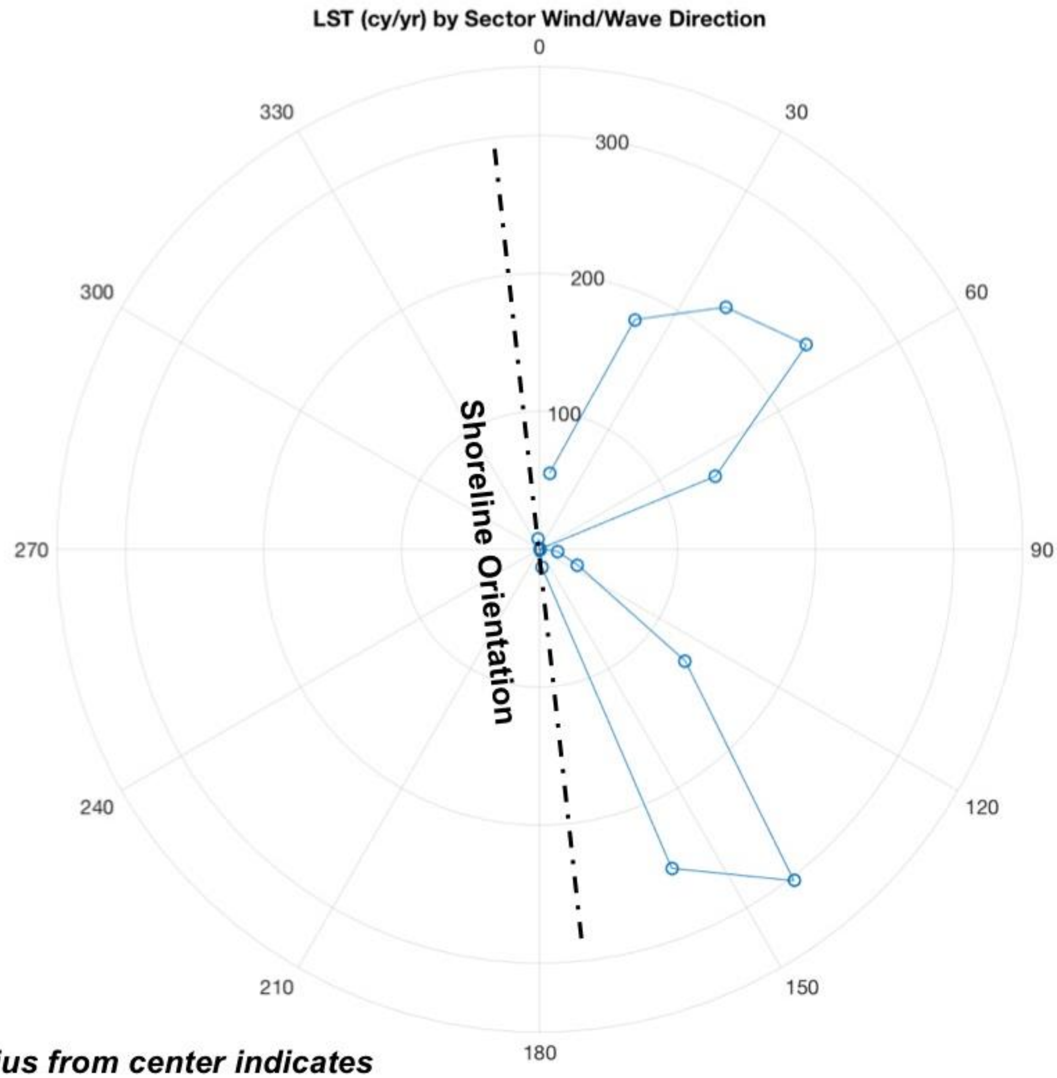


Figure D9. Wind-generated wave height magnitude and frequency distribution for Site B.

Site B: All Data
LST Binned by 15° Sector



Radius from center indicates LST magnitude in cubic yards per year. LST values shown by wind/wave angle, not where it is moving to.

Figure D10. Average longshore sand transport rates, in cubic yards per year, by direction for Site B.

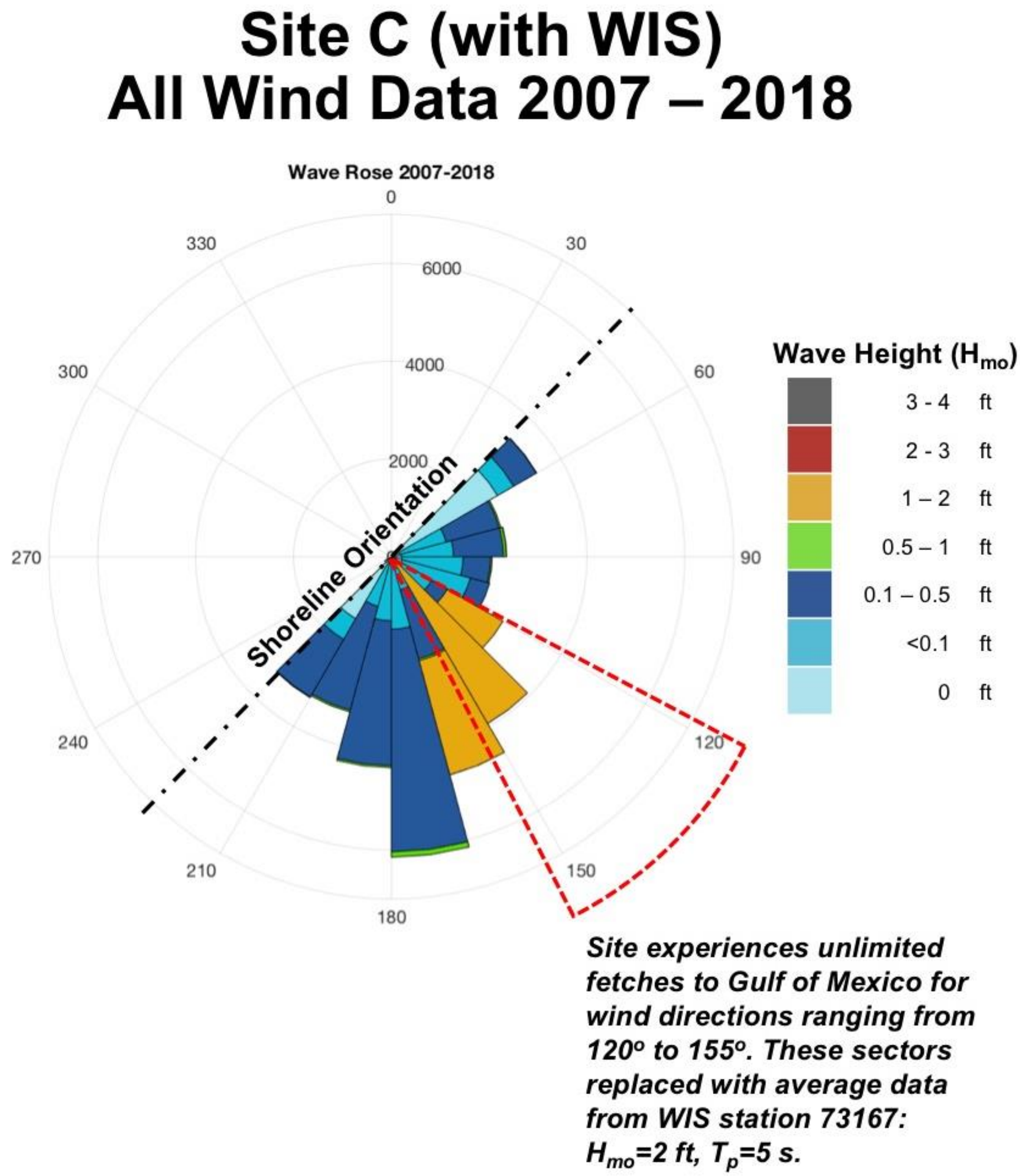
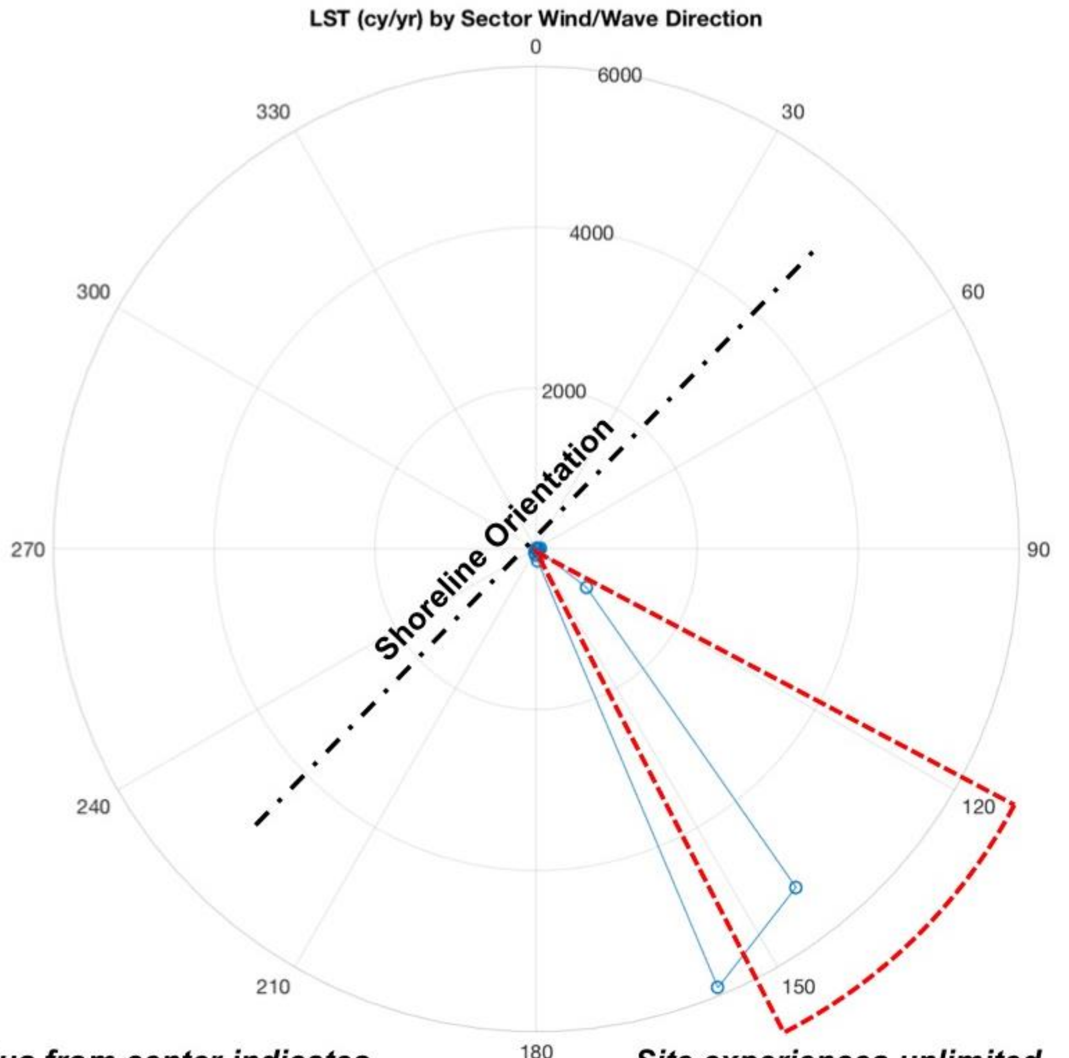


Figure D11. Wind-generated wave height magnitude and frequency distribution for Site C.

Site C: All Data (with WIS)
LST Binned by 15° Sector

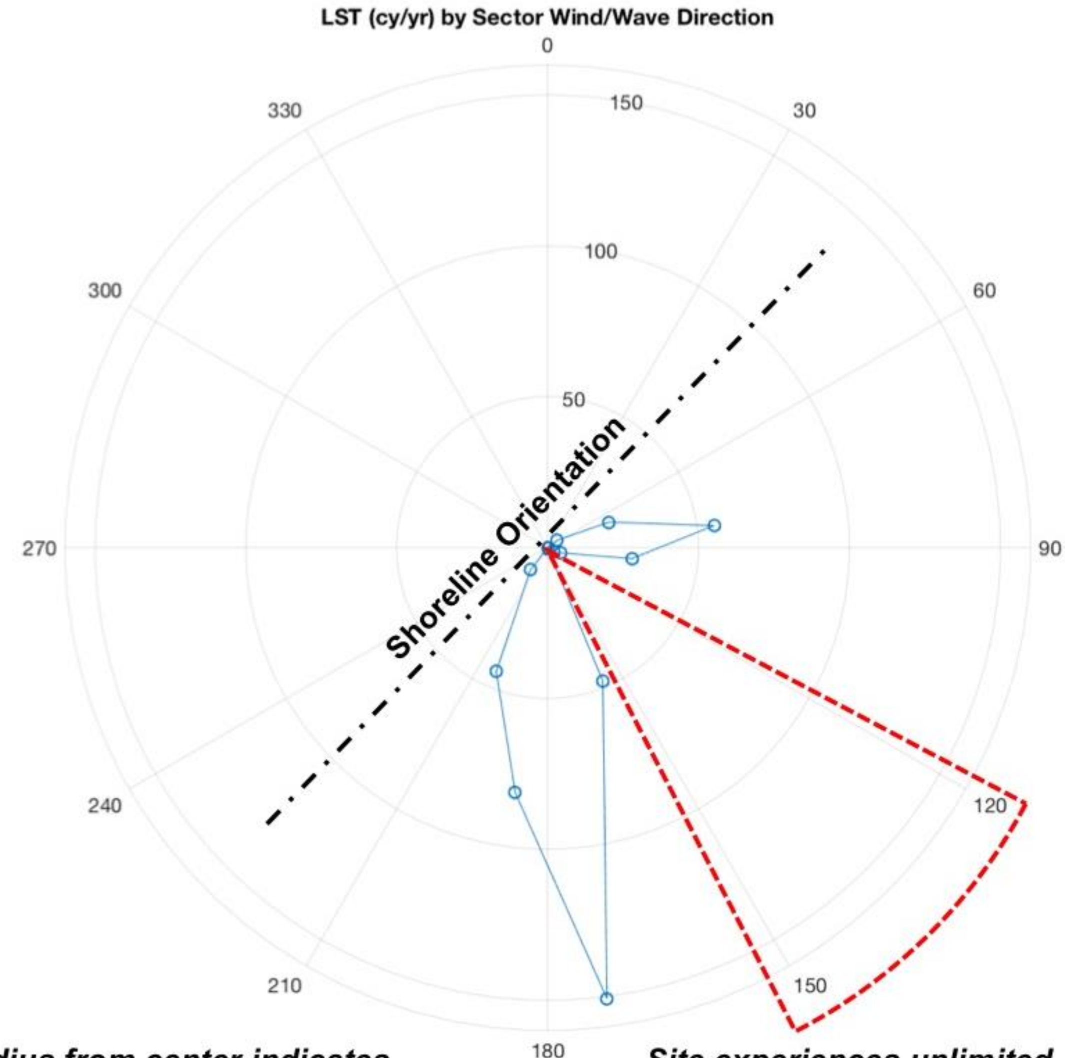


Radius from center indicates LST magnitude in cubic yards per year. LST values shown by wind/wave angle, not where it is moving to.

Site experiences unlimited fetches to Gulf of Mexico for wind directions ranging from 120° to 155°. These sectors replaced with average data from WIS station 73167: H_{mo}=2 ft, T_p=5 s.

Figure D12. Average longshore sand transport rates, in cubic yards per year, by direction for Site C.

Site C: All Data (without WIS)
LST Binned by 15º Sector



Radius from center indicates LST magnitude in cubic yards per year. LST values shown by wind/wave angle, not where it is moving to.

Site experiences unlimited fetches to Gulf of Mexico for wind directions ranging from 120º to 155º. These sectors replaced with blank values to neglect local wind-waves contributions.

Figure D13. Average longshore sand transport rates, in cubic yards per year, by direction for Site C without offshore wave contributions.

APPENDIX E

FEBRUARY 25, 2019 PUBLIC INPUT MEETING MATERIALS

Pensacola Bay Living Shoreline Project

- White Island
- NAS Eastern Shore
- Sherman Inlet

Note: Presentation given by Escambia County at a February 25, 2019 Davenport Bayou / Star Lake neighborhood meeting. The purpose of The meeting was to obtain additional input from local stakeholders prior to developing the conceptual project design. Escambia County's participation was at the request of meeting organizers.

What is a Living Shoreline?

"Living shorelines" are a different approach to shoreline stabilization patterned on the natural environment. Projects replace typical shoreline armoring such as bulkheads, seawalls, and riprap by incorporating natural materials such as oyster reefs, emergent marsh vegetation, submerged aquatic vegetation, and sand or other substrate.

Typical Living Shoreline Project Benefits

- Water Quality Improvement
- Riparian Habitat Protection or Enhancement
- Fisheries Habitat Creation or Enhancement
- Maintenance of Other Important Functions Provided by Natural Shoreline Ecosystems (e.g. sediment capture, nutrient cycling, biodiversity, wave attenuation, etc.)
- Shoreline Stabilization
- Recreational Opportunities (e.g. fishing, bird watching, etc.)

Typical Shoreline Stabilization

Living Shorelines

Pensacola Bay Living Shoreline Project

Design, permitting, and construction of a Large-scale, multi-phase, living shoreline project (White Island, NAS East Shore, and Sherman Inlet)

- Construction of 24,800 linear feet of rock and oyster reef breakwater
- Creation of 205 acres of emergent marsh and submerged aquatic vegetation (SAV) habitat

Project Goals…

- Restore, enhance, and protect fish & wildlife habitat
- Restore, improve, and protect water resources
- Protect and restore living coastal and marine resources
- Restore and enhance natural processes and shorelines
- Promote community resilience

Project Locations

Pensacola Bay Living Shoreline Project

Project Funding…

Design, Engineering, & Permitting

- Gulf Coast Ecosystem Restoration Council Grant (RESTORE Pot 2)
- Florida Defense Infrastructure Grant

Construction & Project Implementation

- Not secured yet, but…
- GCERC Funded Priorities List cycle 3 is a likely source
- White Island already identified as GCERC FPL Tier II project

Pensacola Bay Living Shoreline Project

Project Timeline…

- Gulf Oil Spill (2010)
- Project selection for GCERC Funded Priorities List (2015)
- Execution of funding agreement between GCERC & Florida Department of Environmental Protection (2016)
- Execution of funding agreement between FDEP & Escambia County (2017)
- Project Scope Development & Selection of Design Firm (2017/2018)
- Public Involvement (2018/2019)
- Design, Engineering, & Permitting (2019)
- Secure funding for construction (2019 -)
- Construction (TBD)

Pensacola Bay Living Shoreline Project

Design Team…

- Volkert, Inc. (Prime)

Subcontractors

- South Coast Engineering (Coastal Engineering)
- Moffatt & Nichol (Planning & Monitoring)
- McKim & Creed (fka Jehle-Halstead, Inc.) (Survey & Stormwater Modeling)
- Rowe Engineering & Surveying, Inc.(Bathymetric Survey)
- Southern Earth Sciences, Inc. (Geotechnical Engineering)

Stakeholder Input

Structured

Unstructured

1. Were you already aware of this project prior to learning about this meeting?

2. Have you taken the online county survey?

myescambia.com/open-government/projects/project-details/nas-pensacola-bay-living-shoreline-project

3. Which of the three project sites is of <u>most</u> interest to you?

4. Which of the three project sites is of <u>least</u> interest to you?

White Island Project Site

5. What do you currently enjoy most about White Island?

Pick two:

A) Birding
B) Fishing
C) Boating
D) Swimming / Snorkeling
E) Canoeing / Kayaking
F) Camping
G) Sunbathing / Reading
H) Scenic View

White Island Project Site

6. **What are the most important aspects of the proposed project?**

Pick two:

A) Recreational Opportunities
B) Fish & Wildlife Habitat
C) Aesthetics / Scenic View
D) Water Quality
E) Shoreline Protection
F) Public Safety
G) Dredging*

White Island Project Site

7. Could the project still be considered a success if only your top priority is not addressed to your satisfaction?

A) Recreational Opportunities
B) Fish & Wildlife Habitat
C) Aesthetics / Scenic View
D) Water Quality
E) Shoreline Protection
F) Public Safety
G) Dredging*

Offshore Breakwater

Most living shoreline projects include an offshore breakwater component. Breakwaters provide fish & wildlife habitat, but just as importantly, breakwaters serve to create calm conditions necessary to create stable conditions necessary to protect existing resources and establish submerged and emergent vegetation.

8. **Do you support the construction of an offshore breakwater for the White Island project site if required to assure project success?**

~~Dredging~~

Project will not include "dredging," but additional sandy substrate may be required in order to construct certain aspects of the design.

If necessary, project will evaluate potential sources of sandy substrate.

Recovery of sandy substrate in support of project implementation

9. Do you support recovery of sandy substrate if required for this project?

10. When you talk about "dredging" what areas do you mean?

J??

Open Discussion for Questions or Comments

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PENSACOLA BAY LIVING SHORELINE PROJECT
ESCAMBIA COUNTY, FLORIDA
February 24, 2020 Project Update and Public Input Meeting
Sign In / Comment Card

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Name and title (Please print legibly)

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Affiliation (Please print legibly)

____
Email address (Please print legibly)

Instructions: Please provide your written comments in the space below and on the back of this sheet. Space has been provided to provide comments on all 3 sites, you may provide comments on all or a subset of project locations. Please print legibly.

Comments Regarding Project Site A, White Island:

Comments Regarding Project Site B, Eastern Shore:

Comments Regarding Project Site C, Sherman Inlet

APPENDIX E-1

ONLINE SURVEY RESULTS

From:	Community & Media Relations
To:	Brent A Wipf
Subject:	New form entry is submitted - Shoreline Project Questionnaire
Date:	Sunday, March 17, 2019 6:31:38 AM

MyEscambia.com

https://myescambia.com/MyEscambia.com

New form submission

Shoreline Project Questionnaire

Submitted on 17 March 2019, via IP 99.43.190.3 by Anonymous

View Project Details

Click map to see a larger image

Escambia County has received funding from the Gulf Coast Ecosystem Restoration Council as a result of the Deepwater Horizon Oil Spill for the design and permitting of a large-scale living shoreline project in Pensacola Bay. The project will include three separate areas around Naval Air Station Pensacola (NAS). Project areas are generally identified on the map provided as sites "A," "B," and "C." The goal of the project is the creation of 24,800 linear feet and 205 acres of emergent marsh and submerged aquatic habitat. Escambia County considers public involvement a key component of this project. We are very interested in your current use of the highlighted areas, and your thoughts and ideas about the project design. Public comments received as a result of this survey will be used by the design team to guide the development of the overall conceptual design. Thank you for taking time to help us design the best possible project.

What zipcode do you live in?	32507
How did you hear about this survey?	Friends / Family / Co-workers
How familiar are you with the concept of living shorelines?	Slightly Familiar

The following questions apply to Site "A

Which answer best describes the frequency you visit Site "A"?	Monthly
When you visit Site "A" is it primarily by land or water? If by water, is it primarily by motorized or nonmotorized vessel?	Water by non-motorized vessel
When you visit Site "A" is it primarily for commercial or recreational	Recreational

purposes?	
Primary commercial activity	
Select your Primary Recreational Activity when you visit Site "A":	Canoeing/Kayaking
Select other Secondary Recreational Activities when visiting Site "A" (check all that apply	Swimming
Other Secondary Recreational Activities for Site A	Walking

Which answer best describes how the following items should be considered for development of a living shoreline design for Site “A”?

Maintaining or Expanding Recreational Opportunities	Very important
Enhancing Fish & Wildlife Habitat	Extremely important
Maintaining or Improving Aesthetics / Scenic View	Extremely important
Improving Water Quality	Very important
Providing Natural Means of Storm Protection / Shoreline Stabilization	Extremely important
Maintaining Public Safety	Very important

The following questions apply to Site "B"

Which answer best describes the frequency you visit Site "B"?	Never
When you visit Site "B" is it primarily by land or water? If by water, is it primarily by motorized or nonmotorized vessel?	
When you visit Site "B" is it primarily for commercial or recreational purposes?	
Primary commercial activity	
Select your Primary Recreational Activity when you visit Site "B":	
Select other Secondary Recreational Activities when visiting Site "B" (check all that apply	
Other Secondary Recreational Activities for Site B	

Which answer best describes how the following items should be considered for development of a living shoreline design for Site “B”?

Maintaining or Expanding Recreational Opportunities	Moderately important
Enhancing Fish & Wildlife Habitat	Extremely important
Maintaining or Improving Aesthetics / Scenic View	Moderately important
Improving Water Quality	Extremely important
Providing Natural Means of Storm Protection / Shoreline Stabilization	Extremely important
Maintaining Public Safety	Moderately important

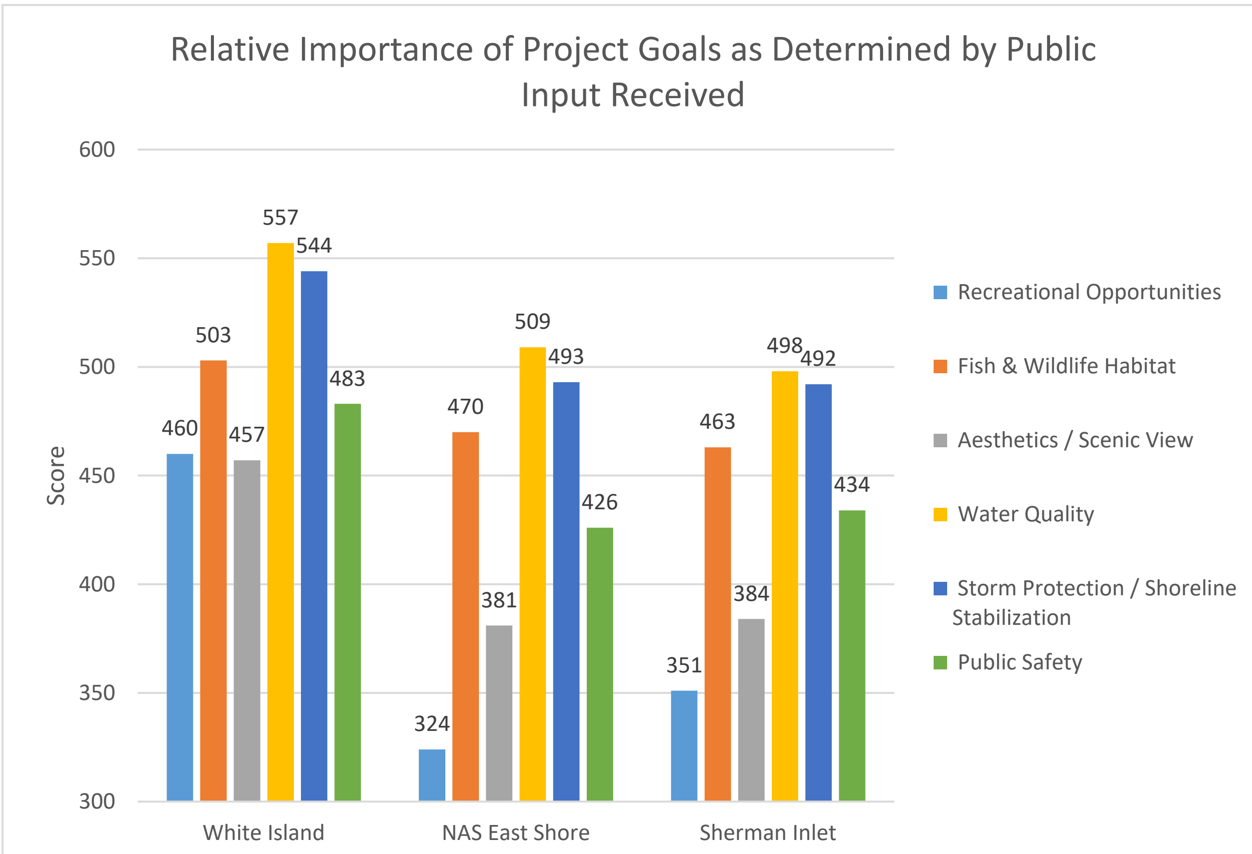
The following questions apply to Site "C"

Which answer best describes the frequency you visit Site "C"?	Never
When you visit Site "C" is it primarily by land or water? If by water, is it primarily by motorized or nonmotorized vessel?	
When you visit Site "C" is it primarily for commercial or recreational purposes?	
Primary commercial activity	
Select your Primary Recreational Activity when you visit Site "C":	
Select other Secondary Recreational Activities when visiting Site "C" (check all that apply	
Other Secondary Recreational Activities for Site C	

Which answer best describes how the following items should be considered for development of a living shoreline design for Site “C”?

Maintaining or Expanding Recreational Opportunities	Moderately important
Enhancing Fish & Wildlife Habitat	Extremely important
Maintaining or Improving Aesthetics / Scenic View	
Improving Water Quality	Extremely important

Providing Natural Means of Storm Protection / Shoreline Stabilization	Extremely important
Maintaining Public Safety	Moderately important
Other Comments or Questions	
Please provide your email address if you would like to receive updates about this project	jamesbriggs7089@att.net


Relative Importance of Project Goals as Determined by Public Input Received
600
550
500
450
400
350
300
Score
460
503
457
557
544
483
324
470
381
509
493
426
351
463
384
498
492
434
White Island
NAS East Shore
Sherman Inlet
Recreational Opportunities
Fish & Wildlife Habitat
Aesthetics / Scenic View
Water Quality
Storm Protection / Shoreline Stabilization
Public Safety

APPENDIX F

FEBRUARY 24, 2020 PUBLIC INPUT MEETING MATERIALS AND COMMENTS RECEIVED

Pensacola Bay Living Shoreline Project Conceptual Design

Project Update & Public Input Meeting

February 24, 2020
6:00 PM

Redeemer Lutheran Church

Agenda

- Purpose and Goals for Tonight
- Project Team Introductions
- Presentation: Project Concepts
  - Project Elements
  - Conceptual Designs
  - Next Steps
- Open House
- Public Feedback

Project Team

Gulf Coast Ecosystem Restoration Council (RESTORE)

Florida Department of Environmental Protection

Escambia County Florida

DEO Florida Department of Economic Opportunity

VOLKERT

SCE South Coast Engineers
Engineering for the Coast

Overview of Project

- Pensacola Bay Living Shoreline Project will enhance and protect approximately 3 miles of shoreline at 3 sites in Pensacola Bay
- Project Includes:
  - Design and construction of breakwaters
  - Creation, protection and/or enhancement of emergent marsh, submerged aquatic vegetation (SAV) and sandy shoreline habitat

What is a Living Shoreline?

- A protected and stabilized shoreline that is made of natural materials such as plants, sand, or rock.
- Replace typical shoreline armoring such as bulkheads, riprap, and seawalls
- Living shorelines can:
  - Minimize coastal erosion
  - Provide habitat for plants, wildlife, and people
  - Improve water quality
  - Increase biodiversity
  - Provide recreational opportunities
  - Make coastlines more resilient to storms

What Goes Into a Project?

Grant Goals	Site Conditions
Public Input	Regulatory Considerations

Success!

Goals of the Pensacola Bay Living Shoreline Project

Two grants are funding this project:

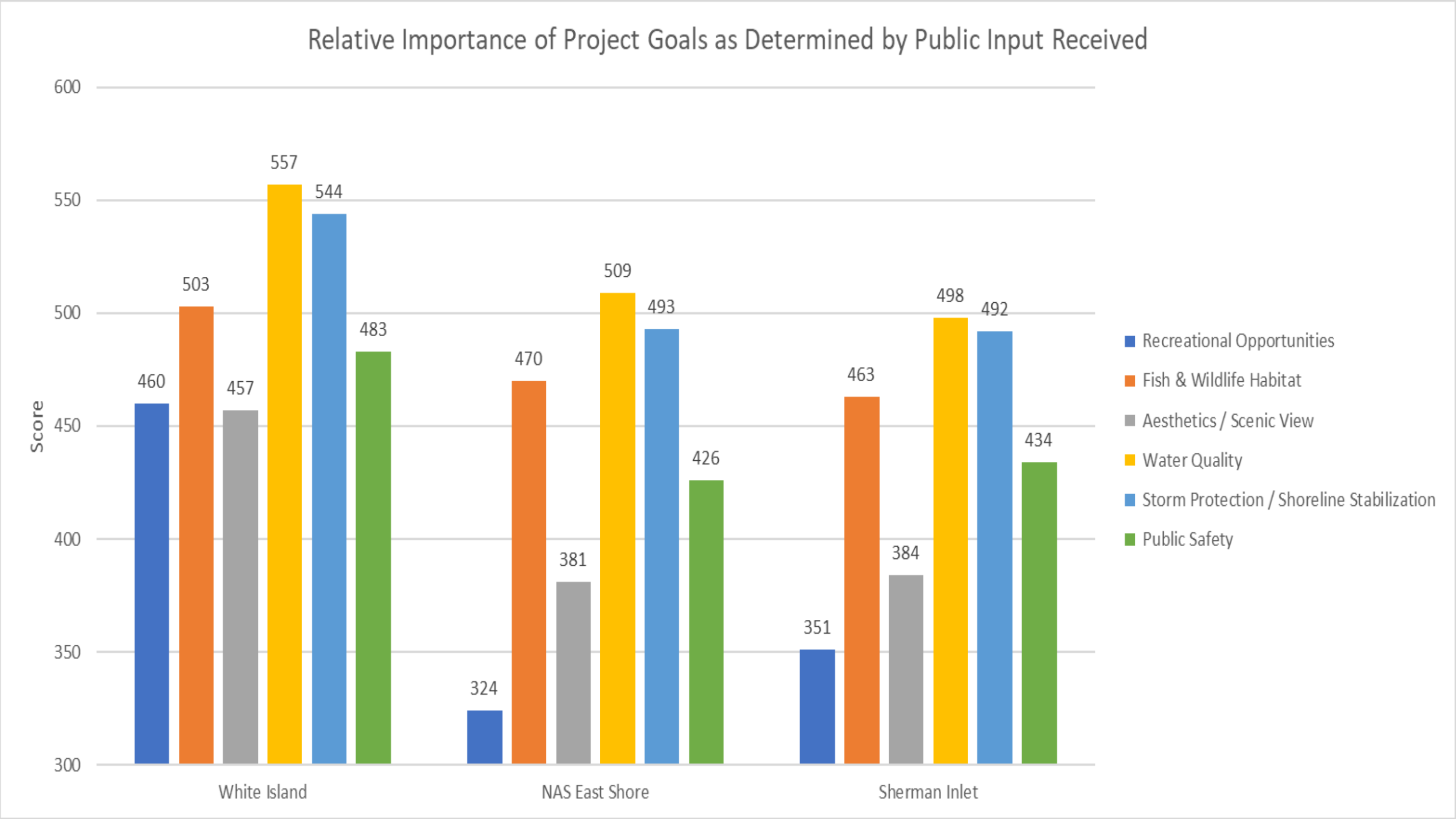
- RESTORE Council FPL 1 ($217,499.38 Planning)
- State of FL Defense Infrastructure Grant Agreement ($375,532.21)

Goals of Grants

- Use natural shoreline stabilization approaches to reduce shoreline erosion along the west shore of Pensacola Bay
- Design breakwaters to promote a healthy functioning reef habitat
- Create and protect marsh and submerged aquatic vegetation habitat
- Enhance force protection and delineation of the Military Exclusion Zone around the perimeter of NAS Pensacola

Results of Pre-Design Online Public Survey

- Recreational use was rated extremely important for White Island.
- Fish and Wildlife Habitat, water quality and storm/shoreline protection were rated as extremely or very important for all 3 sites.
- Protection of NAS mission was identified as critical for Sites B and C.



Other Input and Coordination

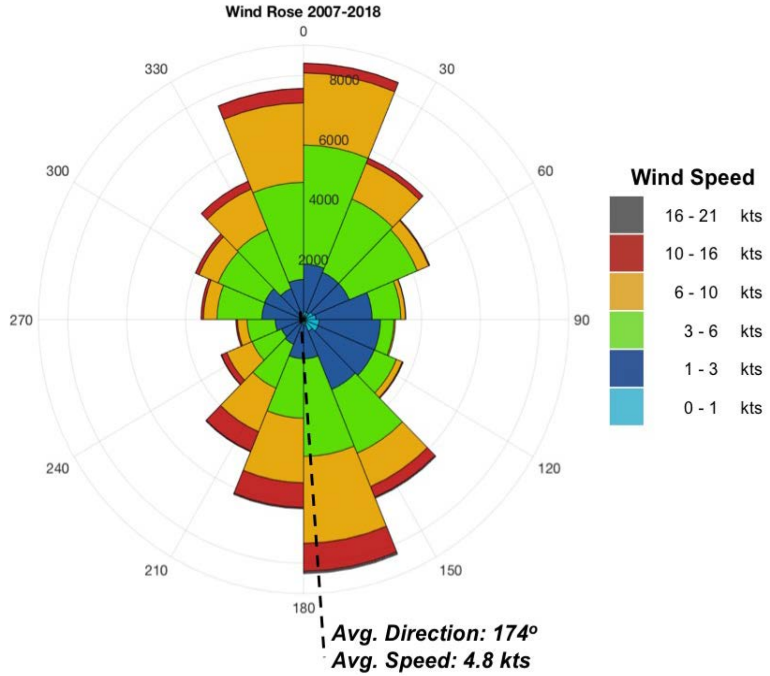
- This project serves as a pilot for the RESTORE Council's Interagency Regulatory Efficiencies Working Group
- Working group met in May, 2019
- Exploring opportunities to support completion of required permits in a timely manner.

Coastal Conditions Assessment

- A properly designed living shoreline accounts for the existing features of the environment.

- Data examined included information on:
  - tides
  - local wind characteristics
  - existing habitats
  - sediment transport
  - elevation of the land
  - depth of the water

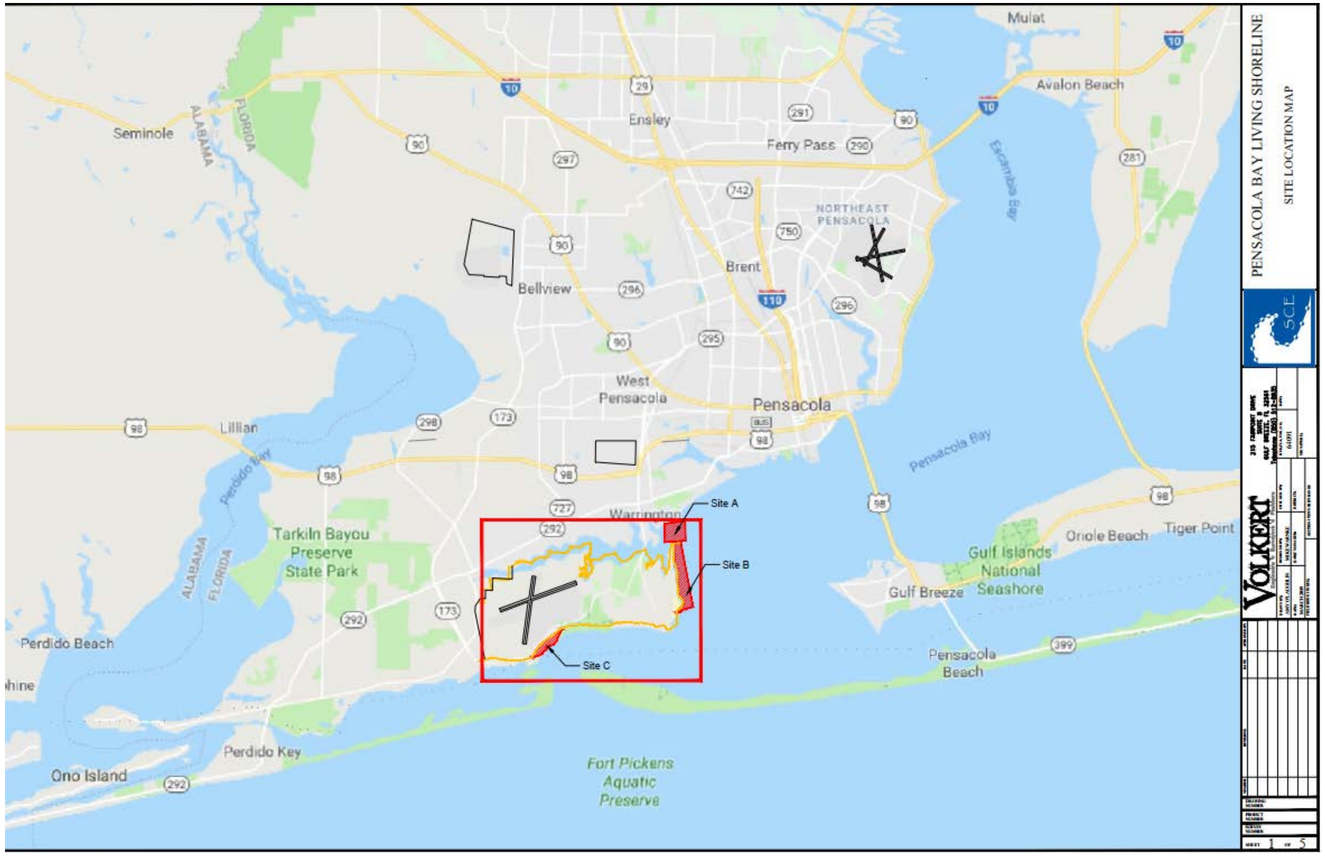
All Wind Data 2007 – 2018



Conceptual Designs

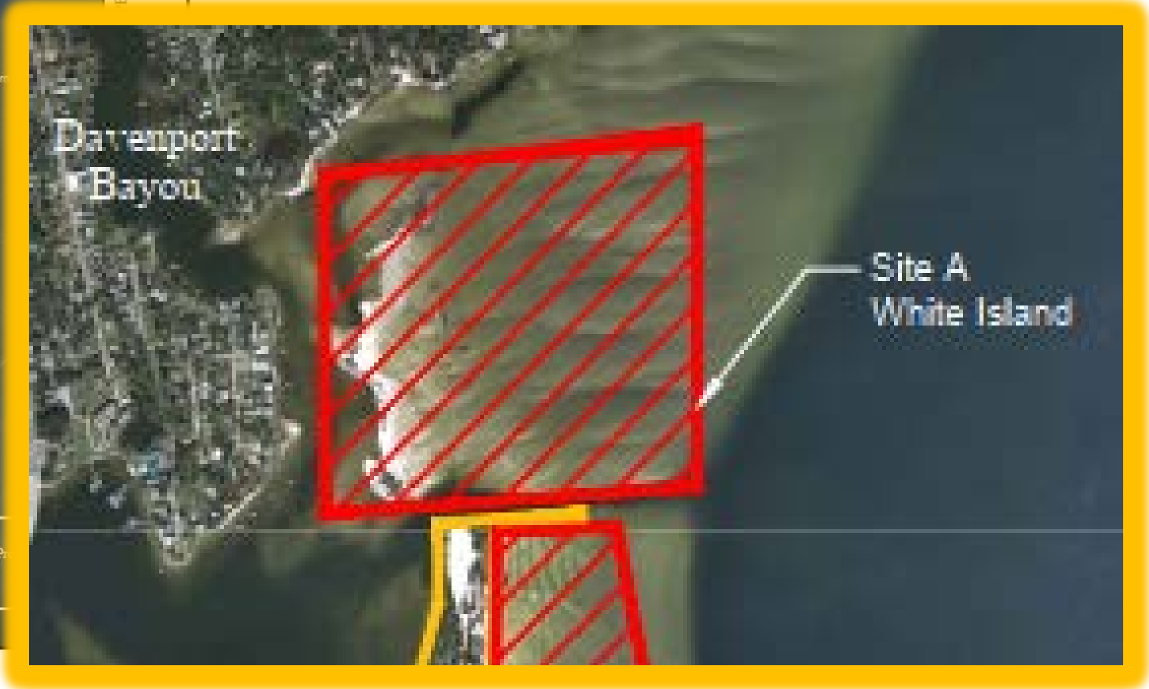
Tonight we will review:

- Historic and current conditions at the project sites
- Focus of design at site
- Key considerations for design development
- Overview of design concepts



**Designs are conceptual, and subject to change*

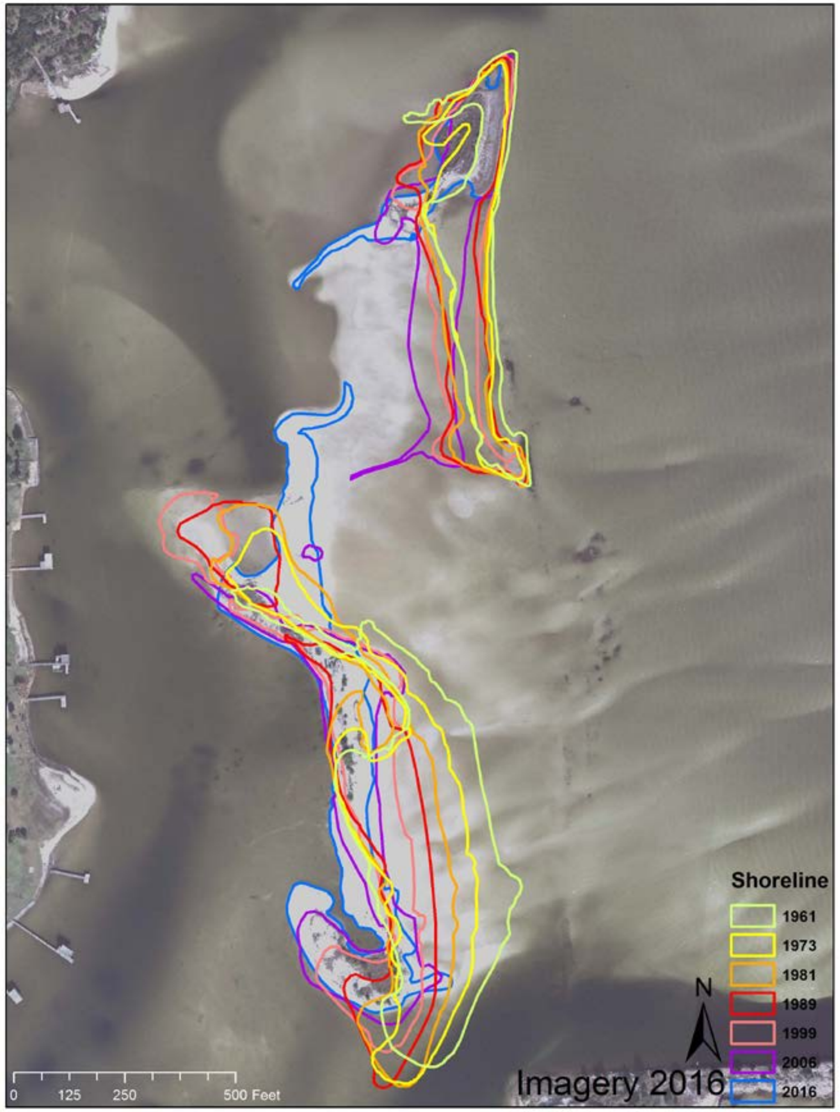
Site "A" White Island



Site “A” White Island- Change

- Now three islands: Rock Island, White Island North, White Island South
- Erosion happening quickly, losing large trees and marsh edge

White Island (north)
Looking to the north



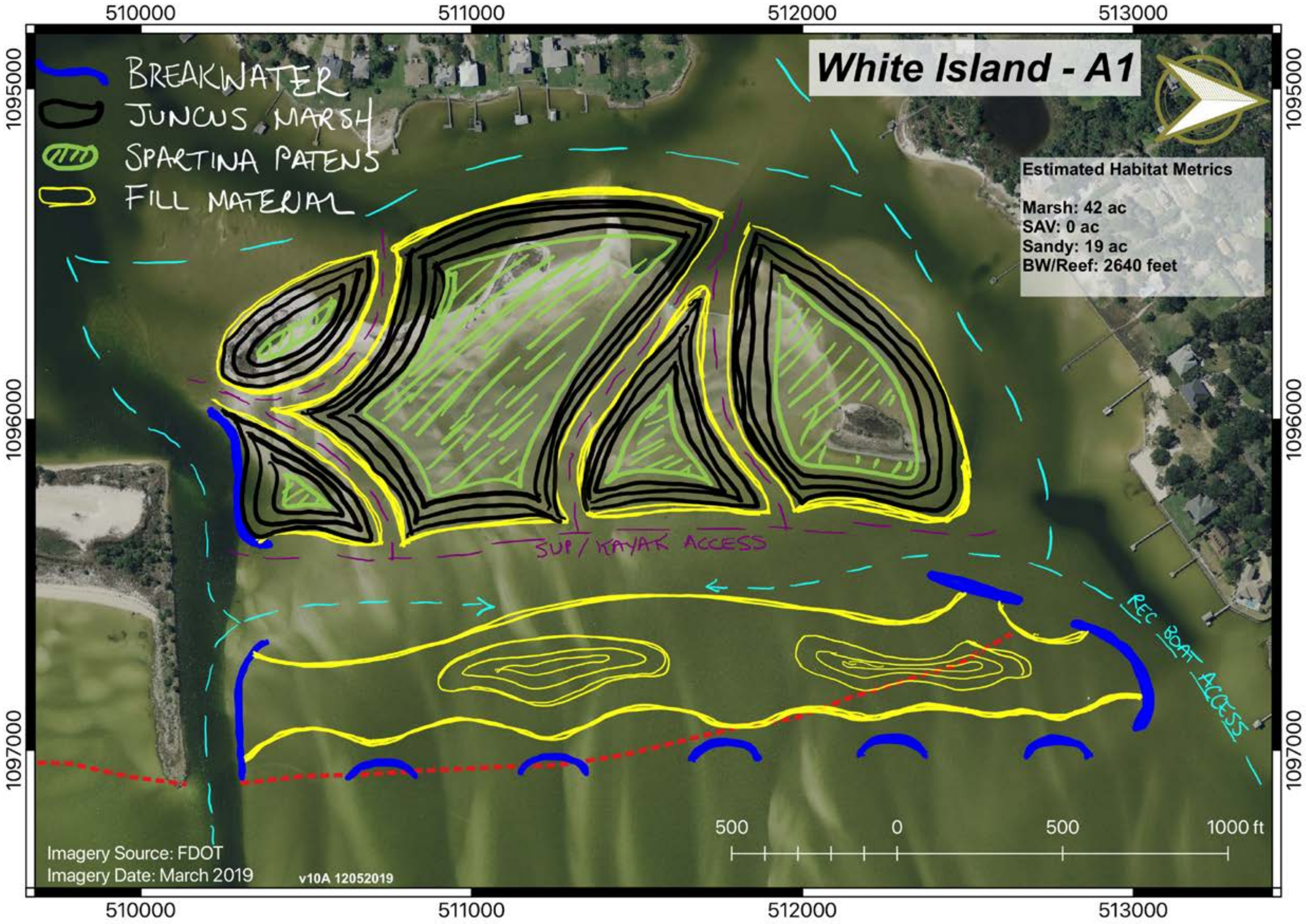
Site Focus and Goals:

- Maximize habitat benefits (marsh, beach and dune, SAV, finfish)
- Reestablish White Island through placement of sand and establishment of appropriate native vegetation
- Design features to maximize the long-term viability of the project by keeping sand in place as much as is feasible while still accounting for ecosystem dynamics
- Provide continued recreational access

Site "A" White Island

White Island Concept A1

- Sandy shoreline on the bay side (to the east)
- Marsh habitat behind the sandy shoreline (to the west)



Site "A" White Island

White Island Concept A2

- Marsh habitat on the bay side (to the east)
- Sandy shoreline behind the marsh habitat (to the west)

Site "A" White Island

Concept Summary

- Proposed construction of:
  - marsh habitat
  - enhancement of sandy shoreline for recreation
  - rock breakwaters
  - subtidal (limestone) reefs
- Preliminary estimate for sand required: approximately 250,000 cubic yards
- Rock Needed: approximately 8,000 tons
- **Creation of 60 – 65 acres of habitat and recreational opportunities**

Site B: Eastern Shore

Site "B" Eastern Shore -Change

Site Focus and Goals

- Maximize habitat benefits (marsh, SAV, finfish)
- Assist NAS in force protection through creation of emergent breakwaters and subtidal (limestone) reefs along exclusion zone
- Stabilize the shoreline to reduce sediment input to the bay
- Design features to maximize the long-term viability of the project by keeping sand in place as much as is feasible while still accounting for ecosystem dynamics

Site "B" Eastern Shore

Site B Eastern Shore

Concept B1

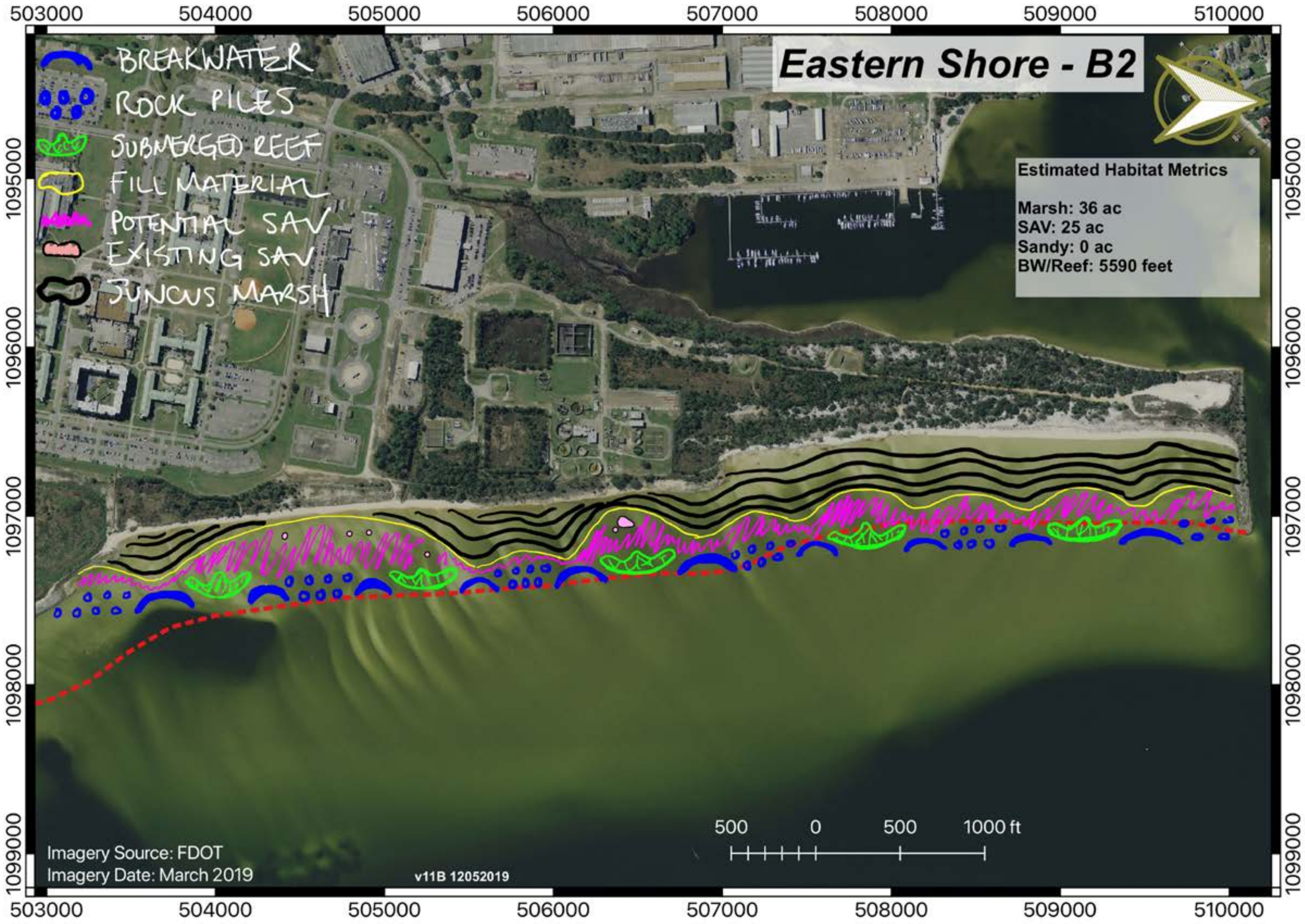
- Creates intertidal marsh and subtidal SAV habitats
- Maximizes intertidal marsh habitat
- Provides force protection for NAS through strategic placement of reefs and breakwaters

Site “B” Eastern Shore

Site B Eastern Shore

Concept B2

- Creates intertidal marsh and subtidal SAV habitats
- Maximizes SAV habitat
- Provides force protection for NAS through strategic placement of reefs and breakwaters



Site “B” Eastern Shore

Concept Summary

- Proposed construction of:
  - intertidal marsh
  - offshore segmented breakwaters
  - subtidal (limestone) reefs
- Preliminary estimate for sand required: approximately 150,000 cubic yards
- Rock Needed: approximately 12,000 tons.
- **Creation and facilitation of up to 60 acres of marsh and SAV habitat**

Site C: Sherman Inlet

Site "C" Sherman Inlet-Change

Site Focus and Goals

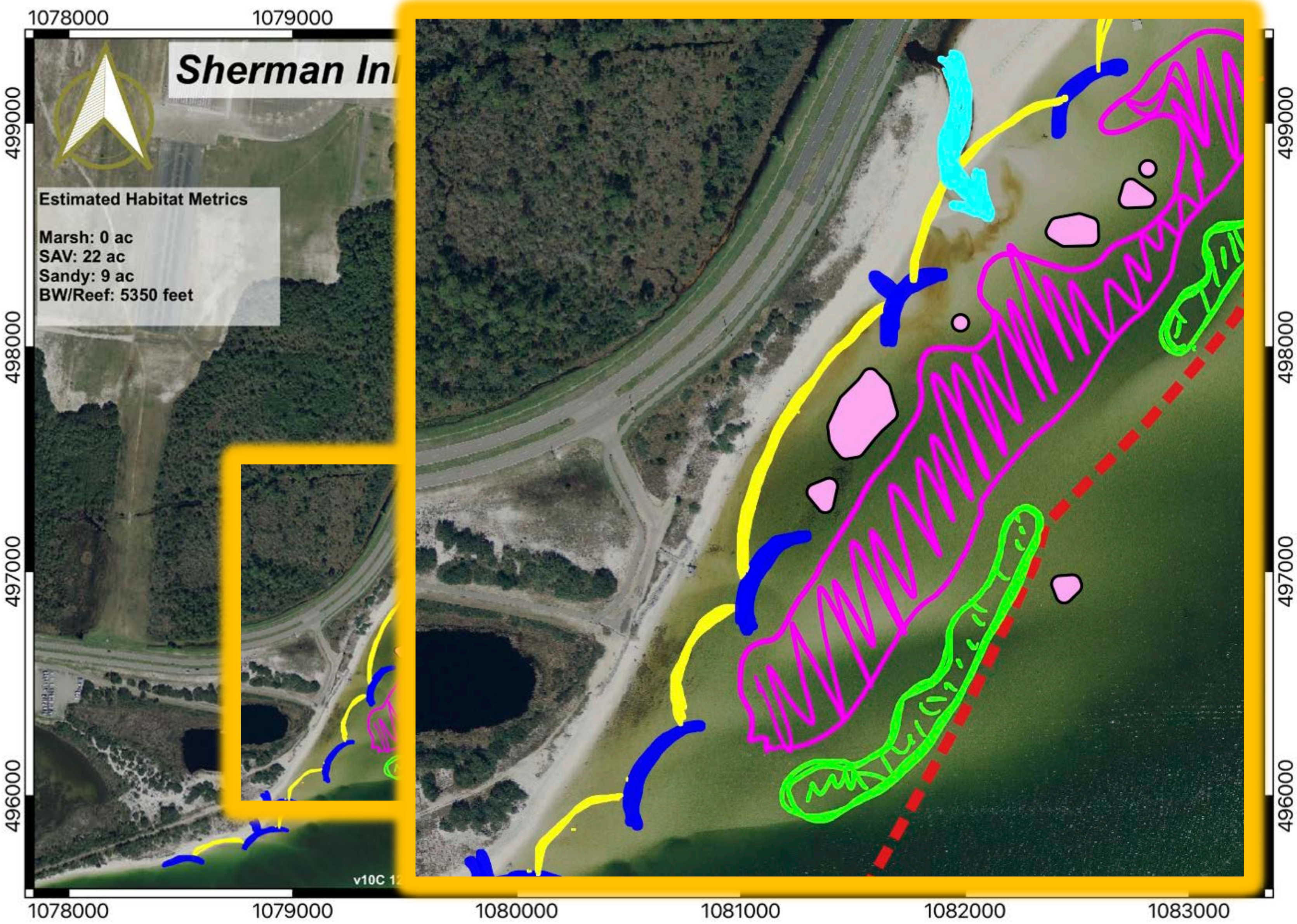
- Maximize habitat benefits (small shore birds, SAV, finfish)
- Assist NAS in force protection through creation of subtidal (limestone) reefs along exclusion zone
- Stabilize a rapidly eroding shoreline to reduce sediment input to the bay
- Design features to maximize the long-term viability of the project by keeping sand in place as much as is feasible while still accounting for ecosystem dynamics

Site "C" Sherman Inlet

Site C Sherman Inlet

Concept C1

- Stabilizes and enhances the emergent sandy shoreline habitat
- Facilitates expansion of existing SAV habitat behind reefs
- Offshore subtidal reefs to assist NAS in force protection



Site “C” Sherman Inlet

Concept Summary

- Proposed construction of:
  - headland breakwaters
  - subtidal reefs to stabilize the shoreline and facilitate SAV expansion
- Preliminary estimate for sand required: approximately 100,000 cubic yards
- Rock Needed: approximately 11,000 tons.
- **Creation of 9 new acres of sandy shoreline habitat, facilitation of up to 22 acres of SAV habitat**

Next Steps

- Hearing from you (tonight!)
- Finalizing concepts
- Additional data collection
- Determining Sediment Borrow Sites
- Engineering and Design- 30%, 60%, 90%
- Permitting and Regulatory Compliance
- Finalize Designs
- Secure construction funding

Next Opportunity For Public Input

Marine Advisory Committee
Meeting March 9, 5:30 pm
Escambia County COC

Public Input Tonight

Open House

This is your opportunity to ask questions about the designs, work done to date, etc.

Written Public Comments
Fill out a card and turn it in before leaving this evening.

Thank you!

Additional info can be found at:
https://myescambia.com/open-government/projects/project-details/nas-pensacola-bay-living-shoreline-project

Brent Wipf- Water Quality Division Manager
bawipf@myescambia.com
Terri Berry - Environmental Project Coordinator
Terri_berry@myescambia.com
Matt Posner - RESTORE Program Manager
mjposner@myescambia.com

Preference Site A	Preference Site B	Preference Site C	Summary of Comments for A2 (no other sites or preferences received comments)	
A2 = 26	B1 = 1	C1 = 2	1	want the island elevation increased
A1 = 0			2	do not want oysters
			1	want the west side of the island dredged
			16	want submerged local sand around the island (in general)
			1	do not want "No Wake" Signs
			2	want "No Wake" Signs
			1	want the mouth of Davenport Bayou dredged
			2	want the south side (Bayou Grande mouth) of W.I. dredged to deepen this channel for navig.
			5	want the navigable channels dredged (in general)
			1	want Site 3 to begin first
			Harold Green	says there are 2 Ship Wrecks located inside the Navy Exclusion Zone

Comment # (Based off PDF pg. #s)	Total Responses	Approved Project	Disapproved Project	Neither App/Dis.	Preference Site A	Preference Site B	Preference Site C	Comments	Questions	Email
1	36	1			No Preference					
2		1			A2		Begin with this site first	*A2 - use existing sand from the perimeter of the island*		
3		1			A2			*A2 - use breakwater to the East, give the island some elevation, and no oysters*		
4		1			A2			*A2 - restore the island at it's current location, no oysters*		
5		1			A2			*A2 - use local sand (sand between the mainland and the island), rock must be subtidal, need invasive species control (e.g. trees, etc), and add Dredge (sp.chk.) and Fill Permitting to Volkert Contract.*		
6		1			A2			*A2 - use submerged local sand, tell us a timeframe*		
7		1			A2			*A2 - use local sand from the former channel to max extent possible*		
8		1			A2			*A2 - use local sand that has washed away, also between W.I. and StarLake to Bayou Davenport needs to be re-nourished*		
9		1			A2			*A2 - use local sand lost from former W.I.*		
10				1				A2 - the main concern is hurricanes and what will happen to W.I after one hits. Referring to Green Shores, could we use sand from their to nourish W.I?	What will happen to design when the Hurricanes? Referring to Green Shores, could we use sand from their to nourish W.I?	
11		1								
12		1								
13		1			A2			*A2 - use No Wake Markers. All sites: Drains marked "Drain to Bay"*		
14		1			A2			*A2 - use local sand from encroaching areas around W.I. including mouth of Davenport Bayou - desirable from recreation and habitat maintenance*		
15		1			A2					
16		1			A2			*A2 - use local sand from the W.I. sand lost over the years. Restore in its existing location*		
17		1			A2			*A2 - Use No Wake Zone signs. Also, a major channel/thoroughfare is NOT preferred going in front of homes - main channel for boats needs to be on west side.*		
18		1			A2			*A2 - no channel thorough fare for recreational boats near the coastline.*		
19		1			A2					
20		1			A2			*A2 - use local sand, but not upland sand (beach sand).*		
21		1			A2					
22		1			A2			*A2 - use local sand, and boat access around the island is important.*		
23		1								
24				1					susanmckinnon@me.com. Wants these answers via email. Will the plants used for Site A be the same as the Pcola Bayfront Project? Has there been any data collectino that addresses the physical components (color, grain size, density and coarseness, etc.) of the sands from the borrow sites, and compared to the sands from W.I.? Can the sands from W.I. be considered as a borrow site?	
25		1			A2					
26		1			A2			*A2 - use local sand from Recreational Boating Lanes (all of that sand came from the island)*		
27				1					Is funding available to do proposed Contruction Project?	
28		1			A2	B1	C1			
29				1				***Site A Alt. Suggestion** : Stabilze W.I. so it does not choke off Bayou Davenport; doing this by developing the marsh and shoreline into the bay side with rip rap protecting boat channels.*		
30		1			A2			*Do not use "No Wake Zones" and use local sand (existing).*		
31		1			A2		C1			
32		1			A2			***Site A Alt. Suggetion** : Consider dredging the navigable channels around W.I. as a part of the plan*		
33		1			A2			*Sediement borrow leeward*		
34				1					See questions from Malina Swayne (Pg. 67 of PDF)	
35		1								
36		1			A2			*use local sand primarily, and new sand as necessary*	see questions from keith wilkins (last page of PDF)	

APPENDIX G

GULF COAST ECOSYSTEM RESTORATION COUNCIL INTERAGENCY WORKING GROUP MEETING MINUTES AND ACTION ITEMS

Project No. 1033000.WFE
Project Pensacola Bay Living Shoreline
Escambia County, Florida

RESUME OF MEETING

DATE:	May 23, 2019
LOCATION:	Pensacola, Florida
PURPOSE:	Gulf Coast Interagency Environmental Working Group Pensacola Bay Living Shoreline Site Visit & Regulatory Compliance Work Session

Name	Affiliation	Email	Phone
Mike Warnke	Volkert, Inc.	Mike.warnke@volkert.com	850-512-8935
Ben Scaggs	RESTORE Council	Ben.scaggs@restorethegulf.gov	228-297-5770
Gib Owen	U.S. Army	Gib.a.owen.civ@mail.mil	202-520-4867
Christy Overstreet	Volkert, Inc.	envir@volkert.com	251-342-1070
Paul Bradley	Volkert, Inc.	Paul.bradley@volkert.com	251-753-3472
Carrie Williams	NASP CR	Carrie.a.williams@navy.mil	850-452-3131 (ext. 3015)
Michael Hardy	NASP NRM	Mike.hardy@navy.mil	850-452-3131 (ext. 3016)
Steve Opalenik	NASP Community Planning Liaison Officer	Stephen.j.opalenik@navy.mil	850-452-8715
Beau Buhring	South Coast Engineers	beau@southeastengineers.com	251-295-2426
Scott Douglas	South Coast Engineers	scott@southeastengineers.com	251-510-2903
Brett Webb	South Coast Engineers	brettwebb@gmail.com	251-591-0588
Dan Holliman	EPA-NEPA	Holliman.daniel@epa.gov	404-562-9531
Matt Posner	Escambia County	mjposner@myescambia.com	850-595-0820
Matt Love	GCERC	Matt.love@restorethegulf.gov	504-228-7884
Robert Turpin	Escambia County	Rkturpin@myescambia.com	850-554-5869
Bethany Kraft	Volkert, Inc.	Bethany.kraft@volkert.com	504-638-8123
Terri Berry	ESC	Terry.berry@myescambia.com	850-595-3421
Brent Wipf	Escambia County	Bawipf@myescambia.com	850-595-3445
Lisa Robertson	FDEP	Lisa.robertson@dept.state.fl.com	850-245-2177
Channing St. Aubin	USFWS	Channing_staubin@fws.gov	850-532-9164
Josh Easton	RESTORE	Joshua.easton@restorethegulf.com	504-252-7717
John Ettinger	RESTORE	Justin.ettiner@restorethegulf.com	504- -
Mia Zarbo	USACE	Maria.d.zarbo@usace.army.mil	850-439-3474
Whitney Bretana	FDEP	Whitney.bretana@floridadep.gov	850-595-0658
Heather Young	RESTORE	Heather.young@restorethegulf.com	504-252-7716
Dana Morton	Escambia County	dmorton@myescambia.com	850-595-1865

Name	Affiliation	Email	Phone
Jason Aldridge*	Division of Historical Resources – Florida Department of State	Jason.aldredge@dos.myflorida.com	850-245-6344

*via telephone

MORNING SESSION:

Members of the Volkert team, Escambia County, Florida DEP and members of the RESTORE Council staff and Gulf Coast Interagency Environmental Working Group met at the Mahogany Mill Boat Ramp in Pensacola, FL to visit the 3 project sites. Throughout the field visit, working group members were provided information about the coastal dynamics of the area, site-specific information regarding potential project concepts, locations of potential sediment sources and information about site characteristics (see slides in Attachment 2 for information).

AFTERNOON SESSION:

After lunch, participants reconvened to discuss each site in detail, including design concepts, opportunities, constraints, public input and regulatory compliance questions. Discussions centered around opportunities to provide information to support the completion of permits in an efficient manner (e.g., reviewing Jacksonville District Biological Opinion) and the timing and nature of opportunities for collaboration Notes are provided below, as is a summary of action items and next steps. Slides are provided in Attachment 2.

SUMMARY OF ACTION ITEMS AND NEXT STEPS:

1. Heather Young to connect Mia Zarbo and ACoE with the protected resources staff at NMFS **(Heather Young).**
2. Need to determine a clear path and next steps to work through ownership and submerged lands issues **(Volkert team to coordinate).**
    a. Lisa Robertson and Whitney Bretana to start thinking about the right staff and appropriate timing at DEP.
        i. Do you determine the desired footprint first and then seek input, or determine relative comfort levels with project first and then base project footprints based on input received?

1. Response from project team: due to schedule constraints, we will work to develop design options first.

b. Steve Opalenik has started this process with the Navy and now needs to identify next steps. Project team to support as needed.

3. Determine existing relevant dredging schedules **(Mia Zarbo).**
   a. Mia Zarbo has reached out to her counterparts.
4. What about existing Navy Placement areas at Site B? Is it possible to use that sand **(Volkert Team to coordinate)?**
   a. Project team to explore this with Steve Opalenik and others.
5. Look to PatrickAir Force Base beach nourishment and how they have resolved legal issues **(Volkert team).**
   a. NAS already has an easement extending some 50 feet seaward of MHW. This could be a starting point.
6. Look at potential benefits to saltmarsh topminnow at White Island **(Volkert team to explore, coordinate with FWS as appropriate)**.
7. Mia Zarbo to send copy of Jacksonville Biological Opinion **(Mia Zarbo).**
8. Where NEPA is triggered, an effort will be made to get everyone on the same documents/let's continue to explore efficiencies **(Volkert Team with assistance from RESTORE Council staff)**.
9. Mia Zarbo to provide a checklist of what the ACoE will expect to see for project **(Mia Zarbo)**.
10. Please provide examples of great projects where things went well, especially as it relates to a smooth compliance process **(Regulatory agency participants).**
11. Decide on a regular update schedule to keep the project top of mind and moving forward **(Escambia County, RESTORE Council staff).**
12. Carrie Williams to share results of cultural resources surveys on the NAS property (Carrie Williams).
13.

<u>DISCUSSION</u>:

I. Welcome & Introductions

II. Schedule

1) Field review: April 3, 2019
2) Working Group Site Visit and Meeting: May 23, 2019
3) Basis of Design: July 16, 2019
   a) Would a Preliminary Draft be available before July? Mike Warnke replied that it would not be available.
4) 30 percent Construction: Pending Contract Approval

5) 60 percent Construction: Pending Contract Approval
6) 100 percent Construction: Pending Contract Approval

III. Project Site Summaries

1) Site A: White Island – Approximately 2,400 LF
2) Site B: NAS Eastern Shore - Approximately 8,090LF
3) Site C: Sherman Inlet – Approximately 5,080LF

IV. Summary of Public Input

1) Stakeholder meeting held February 25, 2019. Presentation given by Escambia County at the request of the Davenport Bayou/Star Lake neighborhoods.
2) The public was asked to rate the importance of project goals through a portal that was created and the results are as follows:

a) Recreational use was rated extremely important for White Island.
b) Fish and Wildlife Habitat, water quality and storm/shoreline protection were rated as extremely or very important for all three (3) sites.
c) Protection of NAS mission critical for Sites B and C.

i. Mia Zarbo, USACE, asked how the public was notified of the portal.
- Advertisement
- Social Media
- Meeting with neighborhood

V. Potential Permits and Approvals

1) Joint Section 10/404 Permit – USACE (Jacksonville District)/FDEP
2) Section 408 determination (Rivers & Harbor Act: Site C Gulf Intracoastal Waterway) – USACE (Mobile District)
3) Section 401 Water Quality Certification – FDEP
4) Essential Fish Habitat (Wetland & Water) – NMFS
5) Threatened and Endangered Species (Gulf Sturgeon) – USFWS/NMFS
6) Cultural Resources – SHPO
   i. Mia Zarbo, USACE, will ask about performing a CRS and ESA along with the public notice and response. Would it slow the process of the schedule?
   ii. Carrie Williams, NASP CR, stated that they have done cultural resources surveys on the NAS property and would be willing to share the results.
7) Wetlands – USACE/FDEP
8) Hydrographic Review/Analysis - FDEP

i. Heather Young is there enough money in the budget to perform the hydrographic work?
ii. There is money in the additional services. Volkert Team to assess and provide response to Escambia County

9) Mitigation – USACE/FDEP
10) Sovereign Submerged Land – FDEP
    i. Easement/Lease? Rate for lease restoration project? Special cost?
    ii. Restored shoreline vs. historic shoreline conservation easement or lease?
    iii. Site A: White Island & Rock Island.
    iv. Who owns the shoreline? Current & Historic?
    v. Schedule meeting with Board.
    vi. Terri Berry asked if we had enough information for an early meeting with FDEP? A meeting would be beneficial.
    vii. Paul Bradley stated that Nate Lovelace, USACE Beneficial Use Program Manager, would be a good contact for beneficial use of dredged material for the living shoreline areas.
11) Runway Air Space
    i. Site C: Would need a structure that would not attracts large birds.
    ii. Navy owns historic shoreline.
    iii. Brent Wipf stated that discussion started years ago on survey work with NAS.

VI. Site A: White Island

i. Has the most potential for recreation use.
ii. How do we mimic the islands replenishment of historic times?
iii. No historic link between Rock Island and White Island.
iv. Rock Island considered a bird habitat.
    a) Enlarging the island would help the "Rookery"
    b) Island is over washed
    c) Is the island species specific?
    d) Contact Audubon about bird survey.
v. White Island was considered a feeder beach prior to Navy channel. The Navy dredges out the channel when needed.
vi. White Island was created by cutting off sand supply.
vii. Over wash events will allow is to "move" but is near the Intercoastal Waterway.
viii. There are fewer constraints.
ix. Project Green Shores would be a good example of what White Island could be.
x. White Island channel important to locals.

VII. Site B: NAS Eastern Shore

i. Could we get dredge material from the Navy dredge channel/ disposal site?
   a) How much is available?
   b) Is it compatible?
   c) How much would it cost?

ii. How often does the Navy dredge the channel?

iii. Determination of dredge material to be considered.
   a) grain size
   b) quality
   c) quantity
   d) shape
   e) material content

iv. If material will be taken from Admiral Island (Robertson Island) an Incidental Take Permit may be required. (this was later retracted by USFWS after contact with their office)

v. What sea level projectionwill be utilized in design?

vi. Sea level rise will be considered in relation to a performance period of 20-30 years for the proposed project.

VIII. Site C: Sherman Inlet

i. Freshwater runoff

ii. Inlet might close during weather/wave activities

iii. Will building the structure first and back filling with dredge be the way to go or the other way around?

iv. Will have to keep in mind the Intracoastal Waterway and Navy Exclusion Zone (Bayou Grande Channel) when designing.

v. Who will be in charge of the maintenance?

vi. How can the project be designed to avoid attraction by large birds such as pelican and cormorants?
   a) Geotech/rock?
   b) Substrate?
   c) Materials used other than rock?

vii. The NAS exclusion zone is 500 feet offshore.

viii. SAV present? Response: Would not be successful due to wave energy.

Questions raised at the meeting:

1) Will Florida Sovereign submerged lands be an issue?
   a) Public Trust?
   b) Navy Property (Site B & C)?
   c) Ownership of Restorated Shoreline?

2) Are there any specific water quality concerns?
    a) Highest concern- water quality during construction or overall water quality?
3) Will Cultural Resources need to be done on borrow areas?
4) Placement and drift modeling?
    1. Site C will be the most difficult since sediment cannot go into the Federal Channel.

   Alternatives analysis.
    i. Least Environmental Damaging
    ii. Sand, rock, and breakwater justification
5) Communication, early coordination, expedite future projects.
6) NEPA issues, multiple agency documents, cooperating agency agreements? Team only needs to coordinate with one Corps district for project.
7) National Resource Management plan for NAS.
    a) NAS will perform the following reports in 2019
        i. Bird Survey
        ii. Marine Survey
        iii. 500-foot security zone (fisherman boundary)
        iv. BASH
        v. Sturgeon monitoring off base (2020-2021)

8) Beneficial Use – 408?
9) Monitoring success of project
10) Hot button issue that need to be addressed up front.
    a) Alternatives Analysis
    b) Project Description
11) Schedule?
12) Finding source of materials?
13) Timing of projects – birds, manatee protection, etc.?
14) Plans and actual impacts for CRS – dredge spoils to cut down on CRS and NEPA coordination with Navy.
15) Building from land will take time and will need permission from Navy. Infrastructure damage?
16) Modeling money in supplemental to cover cost? Timeline to be adjusted? Optional services in contract?
    a) Form design
    b) Modeling required by agency
17) Upcoming milestones and communication?
18) Minimize native impacts, public use waterway, marine species.
19) Implementation – grant, combine all three sites into one.

Attachment 1: Gulf Coast Interagency Environmental Working Group – Pensacola Bay Living Shoreline Project Site Visit and Regulatory Compliance Work Session Sign-In Sheet

Attachment 2: Presentation

Gulf Coast Interagency Environmental Working Group
Pensacola Bay Living Shoreline Project Site Visit and Regulatory Compliance Work Session
May 23, 2019

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Pensacola Bay Living Shoreline Project

Gulf Coast Interagency Environmental Restoration Working Group

MAY 23, 2019

Overview of Agenda

- Welcome and Introductions
- Mission of NAS Pensacola
- Site Overview and Considerations
- Regulatory Compliance Input and Discussion
- Next Steps
- Adjourn

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Goals for Today

- Visit sites to become familiar with site conditions and considerations; (done!)
- Discuss site considerations, opportunities and potential challenges;
- Obtain input on initial regulatory compliance considerations and questions;
- Identify opportunities for efficiencies and a path forward for collaboration; and
- Leave with clear action items and next steps.

Briefing and Introduction by NAS Pensacola

Project Partners

Goals of Project

- Create a breakwater to promote settlement and colonization for a healthy functioning reef habitat.
- Restore habitat with specific value for invertebrates and coastal birds to increase foraging habitat for shorebirds, wading birds, and migratory birds.
- Increase nursery and adult habitat available for recreationally and commercially important shellfish and finfish species in the region (e.g., spotted trout, red drum, black drum, mangrove snapper, gag grouper, spot, croaker, mullet, blue crab, stone crab, and shrimp).
- Promote the growth of SAV that supports a diversity of fish, shrimp, crabs, and other estuarine species.
- Serve as a natural shoreline stabilization approach (e.g., green infrastructure) to help prevent further shoreline erosion along the west shore of Pensacola Bay by attenuating wave energy, decreasing shoreline erosion, improving water clarity, decreasing turbidity, and improving water quality.
- Help protect the military mission, shoreline, and security of NAS Pensacola.

Summary of Activities

- Planning, engineering, design, environmental compliance and permitting for three sites.
- Total 15,570 linear feet of shoreline
- Protect/enhancing 205 acres of habitat (beach and dune, emergent marsh and SAV)

Site C: Looking at Sherman Inlet, which connects to Pensacola Bay.

Schedule

- Field review: April 3, 2019
- Working Group Site Visit and Meeting: May 23
- Basis of Design: July 16, 2019
- 30% Construction: Pending Contract Approval
- 60% Construction: Pending Contract Approval
- 100% Construction: Pending Contract Approval

Project Site Summaries

Site A: White Island Approx. 2,400 LF

Site B: NAS Eastern Shore: Approx. 8090 LF

Site C: Sherman Inlet: Approx. 5080 LF

Total Project: Approx. 15,570 LF

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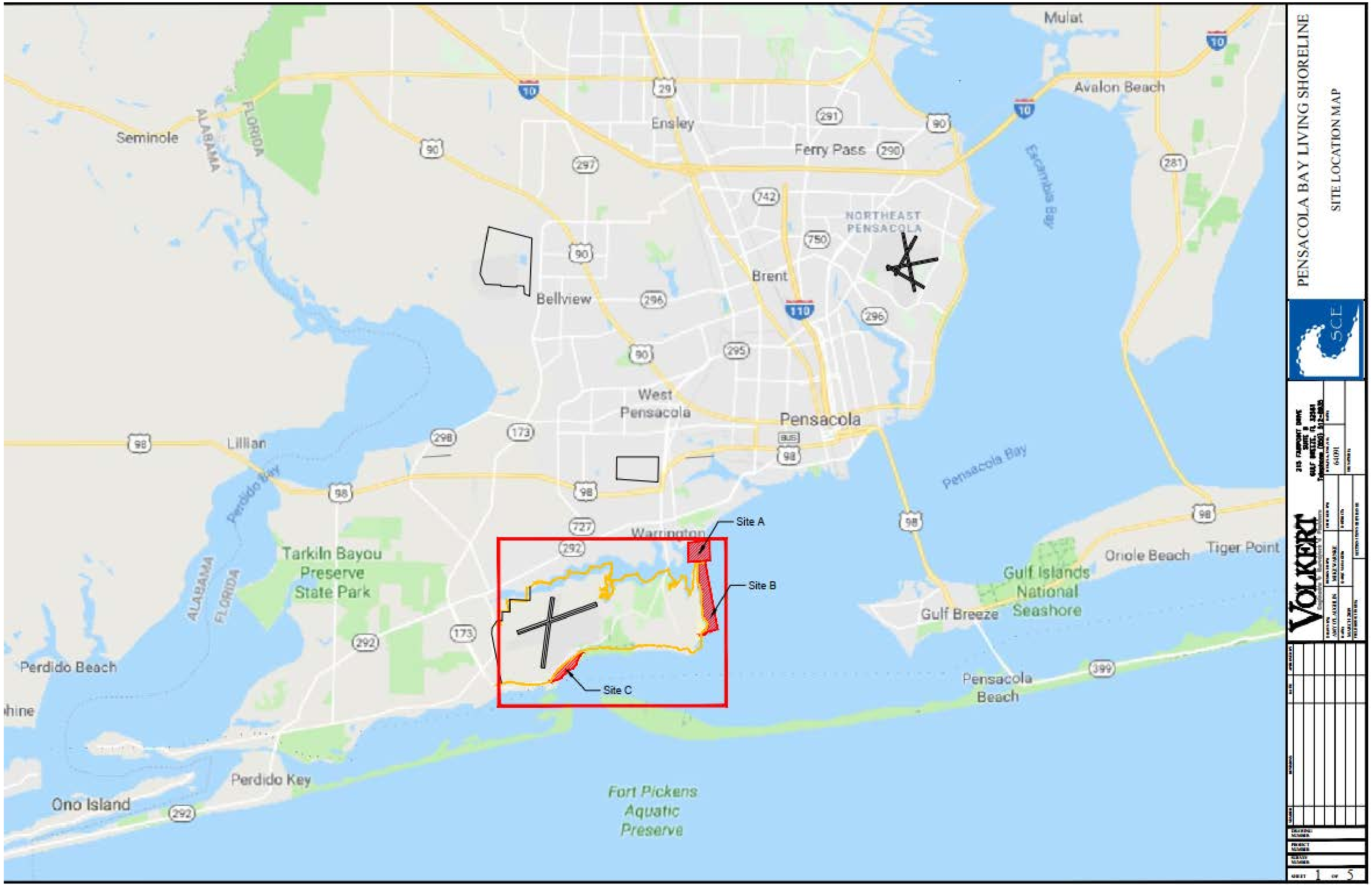
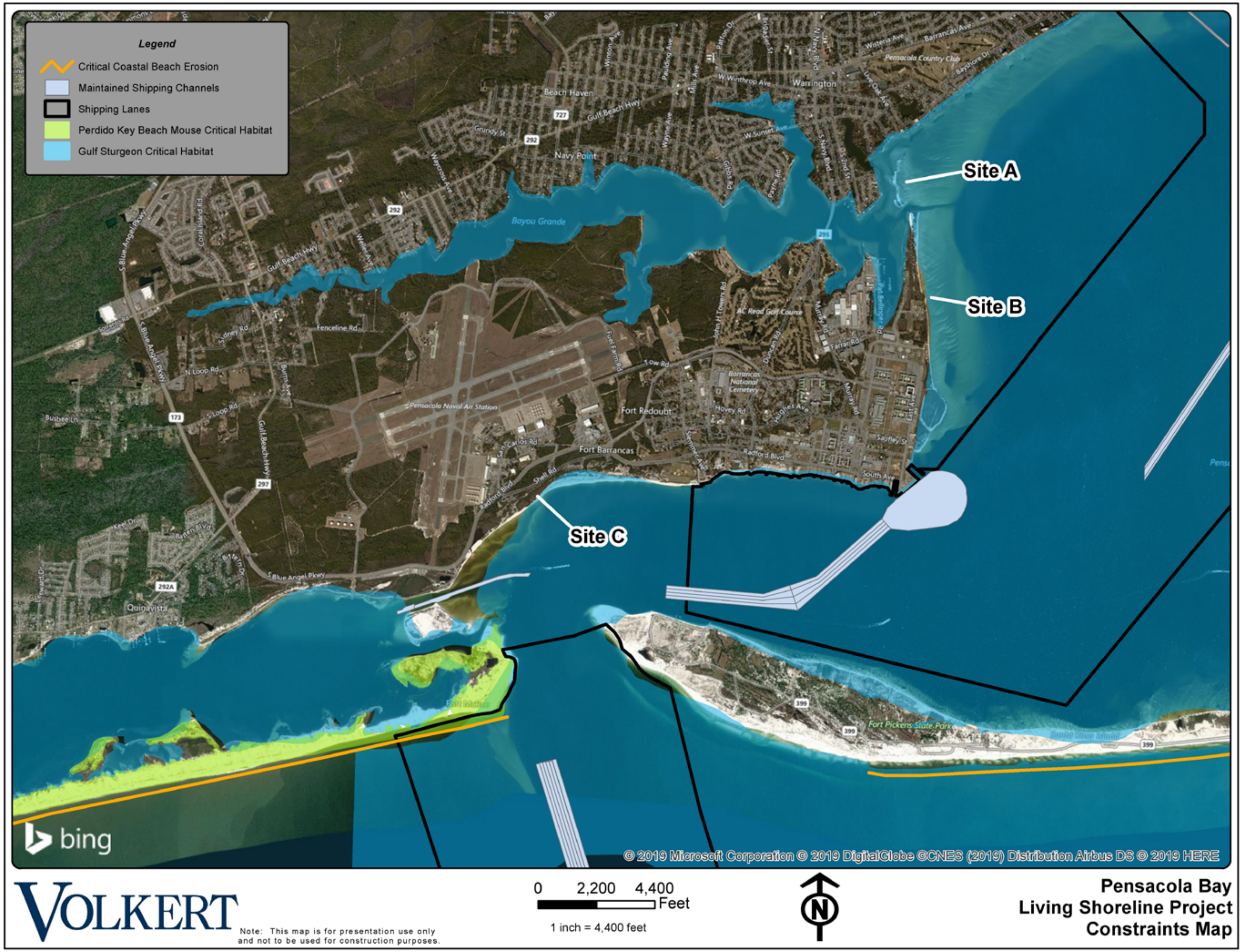
Project Location



Overview of Sites

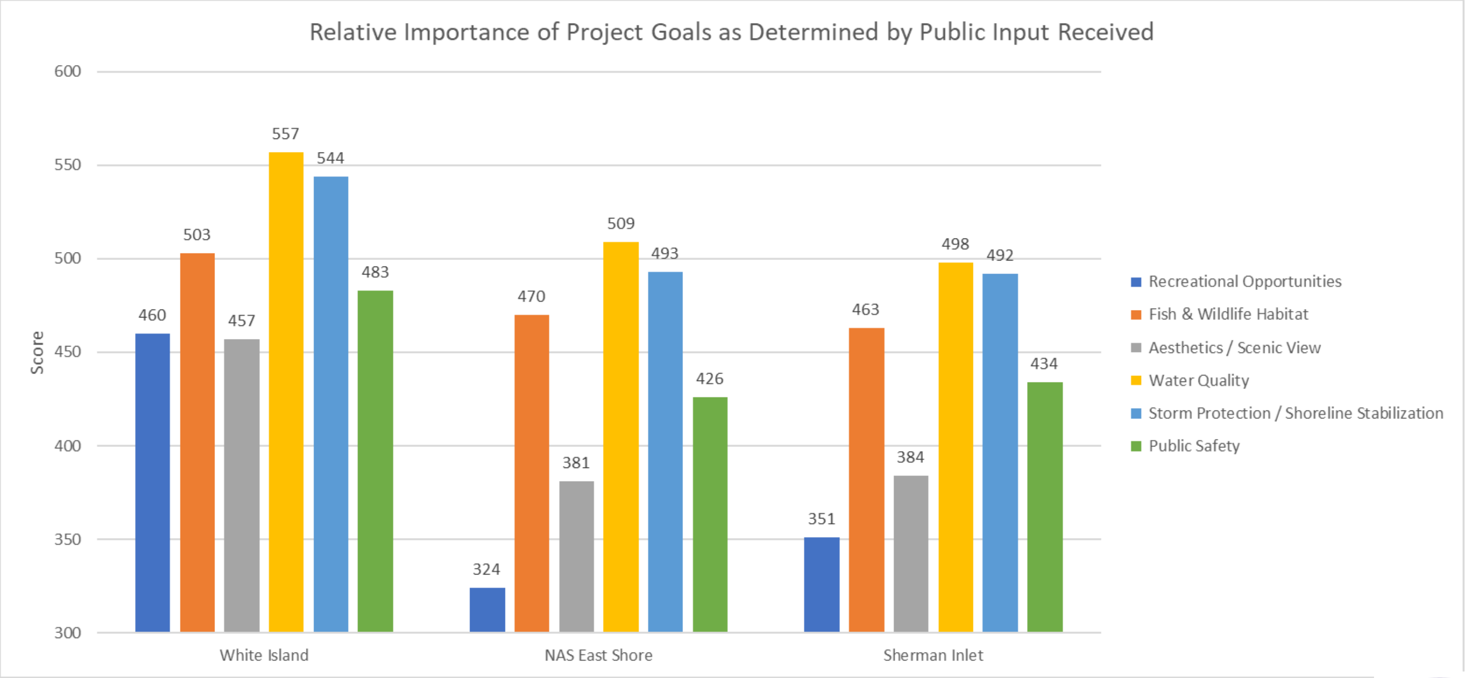
Constraints



Summary of Public Input

Stakeholder Meeting Held February 25, 2019. Presentation given by Escambia County at the request of the Davenport Bayou/Star Lake neighborhoods.

- Recreational use was rated extremely important for White Island.
- Fish and Wildlife Habitat, water quality and storm/shoreline protection were rated as extremely or very important for all 3 sites.
- Protection of NAS mission critical for Sites B and C.



Potential Permits and Approvals

Permit/Approval	Agencies
Joint Section 10/404 Permit	USACE/FDEP
Section 408 determination	USACE
Section 401 WQC	FDEP
Essential Fish Habitat	NMFS
Threatened and Endangered Species	USFWS/NMFS
Cultural Resources	SHPO
Wetlands	USACE/FDEP
Hydrographic Review/Analysis	FDEP
Mitigation	USACE/FDEP
Sovereign Submerged Land	FDEP
Runway air space	FAA/Navy

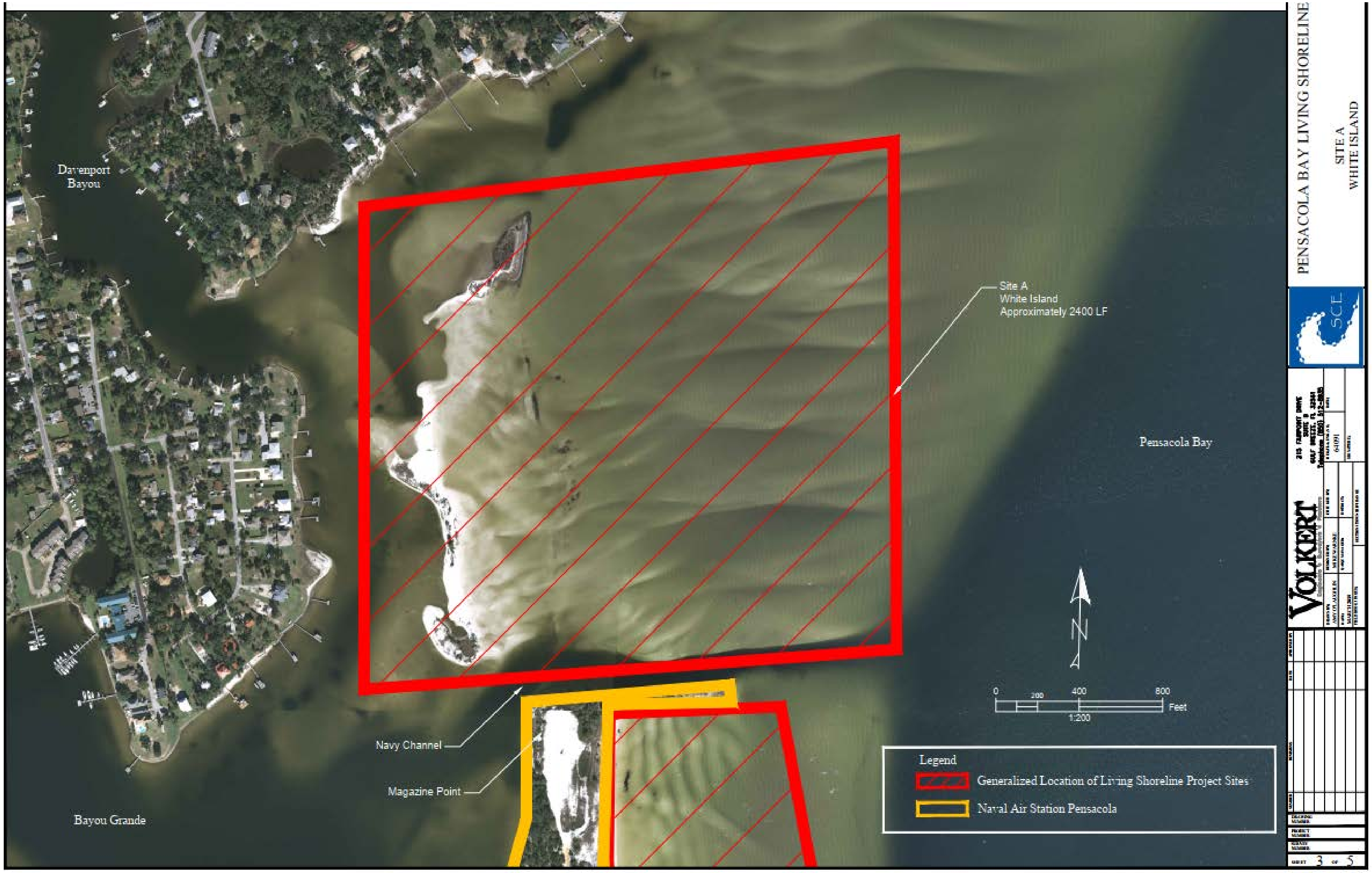
Questions for Input Common to All Sites

- Will Florida Sovereign submerged lands be an issue?
- What are economically/engineering/environmentally feasible sand sources for the shoreline restoration?
- Are there any specific water quality concerns?
- Is anyone aware of any riparian easements or leases in the area of the projects? If so, please explain. (Navy exclusion zones have been provided).
- Do you anticipate any issues with federally listed species? If so, are there any recommendations we should incorporate into our plans to minimize potential impacts and also help expedite the review process?

Questions for Input Common to All Sites (Cont'd)

- Will essential fish habitat be an issue?
- Does anyone have any SAV surveys for these areas?
- Are there any other cultural resource surveys in addition to what has been provided to us by the Navy?
- How will the Working Group interface with FDEP/USACE to expedite the permitting process?

Site A: White Island (~2400 feet)



Site A- White Island Conditions and Considerations

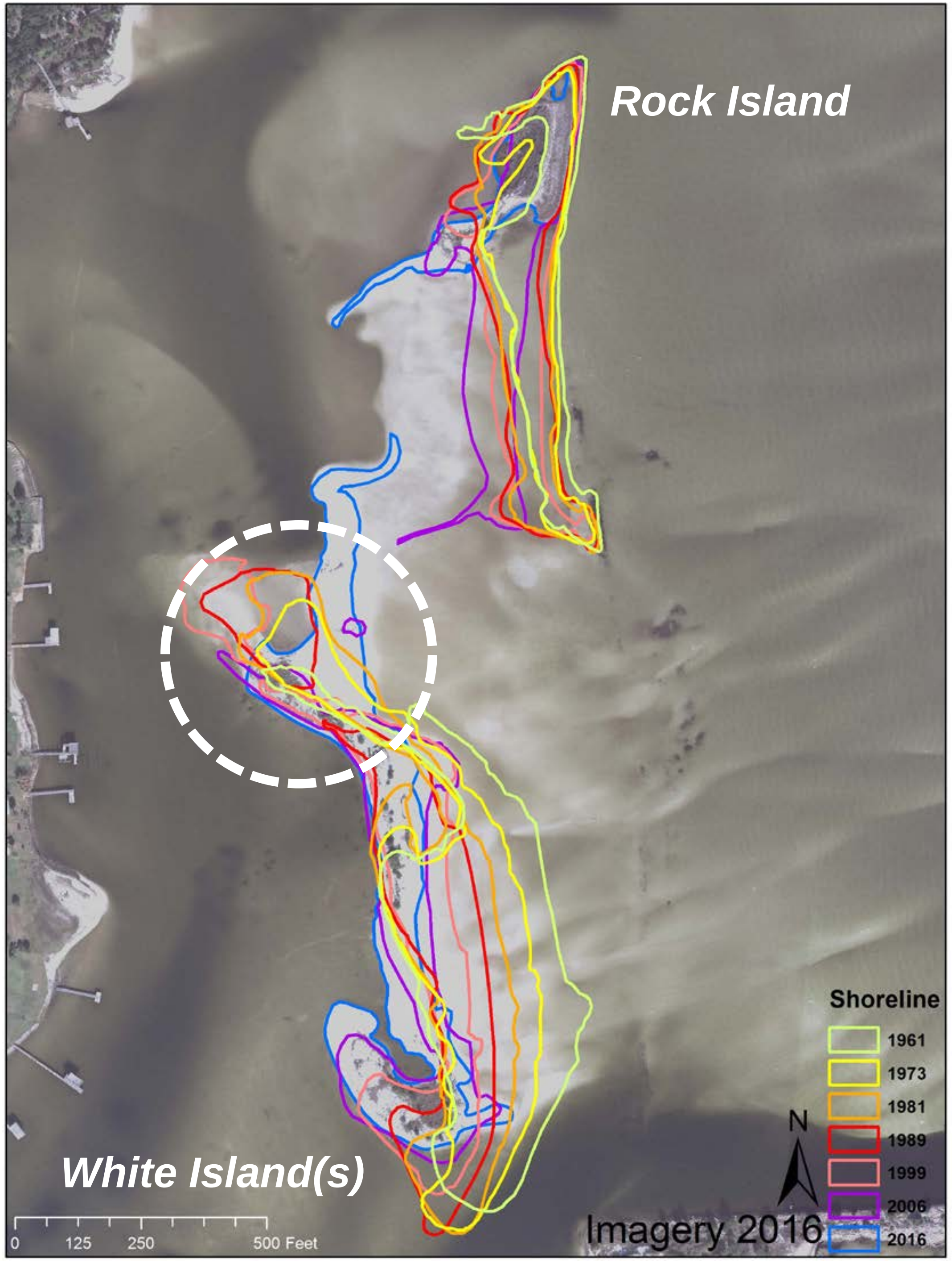
White Island (south)
Looking to the northwest

- Highly utilized by public for recreation (40% of respondents said they visit White Island weekly or more).
- Boating/canoeing and kayaking are primary uses, as are fishing and swimming.
- Rapid loss of elevation and volume
- Many different types of habitat still there:
    - Intertidal sand flats [fish, benthic]
    - Sandy shoreline [birds, crabs]
    - Vegetated dune [birds, crabs]
    - Marsh grasses [crabs, fish, birds]
    - Woody shrubs and trees [birds]
    - Tidal pond/pool [juvenile fish, crabs]

Shoreline Change: Site A White Island

- Now three islands: Rock Island, White Island North, White Island South
- Erosion happening quickly, losing large trees and marsh edge

White Island (north)
Looking to the north



Site A- White Island Opportunities

- Expand and preserve Rock Island as a rookery
- Restore White Island to an appropriate footprint and volume
- Allow White Island to serve as a recreational area
- Mimic historical features and habitats: sand, dunes, marsh, vegetation, etc.
- Combine structures with sand placement
- Salinity values here may be close(r) to the range needed for oysters

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Site A- White Island Compliance Considerations

- What are the viable options for sources of sand for White Island shoreline restoration?
- How will we complement the vegetation that is present along the existing shoreline?
- Is it desirable to design features to attract birds?
- Federal ownership of the island?
- Signing of affidavits re: MHW

Site B: NAS Eastern Shore (~8090 feet)

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Site B: NAS Eastern Shore Conditions and Considerations

- Very diverse shoreline
- Supplement shoreline with sand where possible
- Mixture of natural sandy, small revetment, marsh
- Some areas stable, others not (see next slide)
- Primary shoreline types/habitats:
  - Sandy shoreline [birds, crabs]
  - Vegetated dune [birds, crabs]
  - Marsh grasses [crabs, fish, birds]

NAS Eastern Shore
Looking to the south

Shoreline Change: Site B NAS Eastern Shore

Shoreline Change: Site B NAS Eastern Shore

- Marsh transitioning to sandy shoreline at south end of site
- This is a nice example of a failing revetment acting like a marsh sill… and doing a pretty good job at that!

NAS Eastern Shore
Looking to the southeast

Site B: NAS Eastern Shore Opportunities

NAS Eastern Shore
Looking to the north

- Supplement shoreline with sand where possible
- Identify appropriate locations/extents of structures
- Modify or remove existing revetment to expand marsh habitat
- Look for opportunities to "smooth" out and reorient the shoreline to balance annual sand transport
- Modify jetty at north end of Site B?
- Are salinity conditions appropriate for oysters?

Site B: NAS Eastern Shore Compliance Considerations

- Is the Navy Channel a suitable source of borrow material for placement on Site B?
- What are other potentially feasible sand sources?
- How will we complement the vegetation that is present along the existing shoreline?
- What about impacts to benthic resources and submerged bottomlands?
- Signing of affidavits re: MHW

Site C: Sherman Inlet (~5080 feet)

Site C Sherman Inlet Shore Conditions and Considerations

- Sandy shoreline with vegetated dunes
- Extensive shoreline retreat and erosion
- USCG/Navy infrastructure impacted (repeatedly)
- Some areas stable, others not (see next slide)
- Primary shoreline types/habitats:
  - Sandy shoreline [birds, crabs]
  - Vegetated dune [birds, crabs]
  - Marsh grasses [crabs, fish, birds]

Site C: Looking northeast. Note U.S. Coast Guard Range Tower leaning at eroded shoreline.

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Shoreline Change Site C: Sherman Inlet

Shoreline Change Site C: Sherman Inlet

- Highest exposure to wave energy
- Responding more to GOM waves than local winds/waves
- High boat traffic area… boat wakes may play a role
- Most sediment has moved offshore and to the north

Site C Sherman Inlet Opportunities

Sherman Inlet
Looking to the north-northeast

- Restore sandy shoreline and dunes
- Stabilize new shoreline with (limited use of) structure as needed
- Consider using structures to assist USN with maintenance of exclusion zone
- Incorporate Sherman Inlet into project design to ensure it functions as it has in the past

Site C Sherman Inlet Compliance Considerations

- Will the USACE have any Section 408 issues since the proposed project is near the Federal Channel (GIWW)?
- Are the GIWW or Robertson Island available sand sources for beneficial use in shoreline restoration at Site C? If so will the material require Section 404 testing?
- When was the last time the GIWW was dredged? When is the next proposed dredging cycle?
- Can USACE dredge the GIWW and place the material on Site C for beneficial use as opposed to Robertson Island?
- How can the project be designed to avoid attraction by large birds such as pelicans and cormorants?
- How can the project be designed to maintain or enhance the connection between Sherman Inlet and Pensacola Bay?
- Signing of affidavits re: MHW

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All Sites – Sand Resources for Restoration

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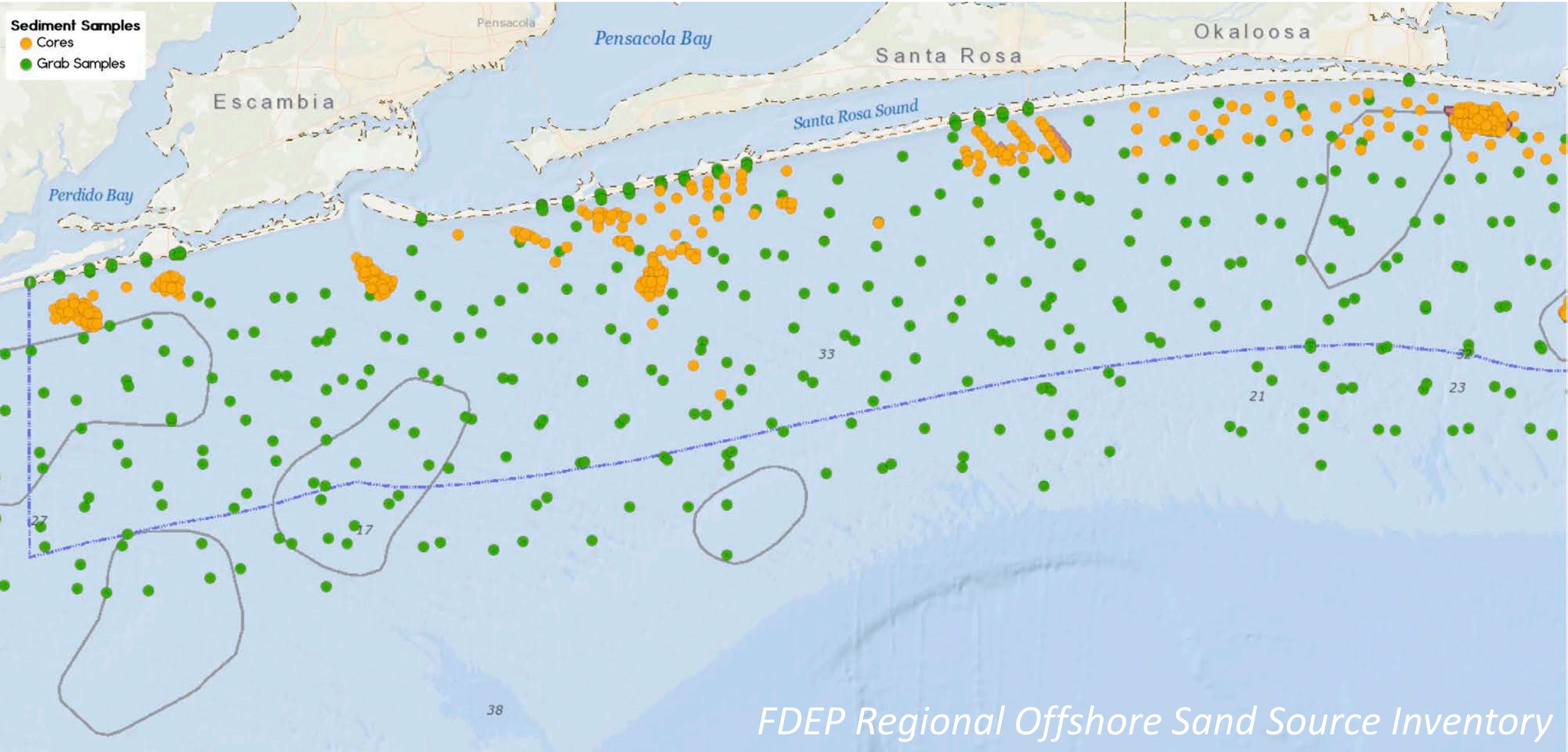
All Sites – Sand Resources for Restoration



FDEP Regional Offshore Sand Source Inventory

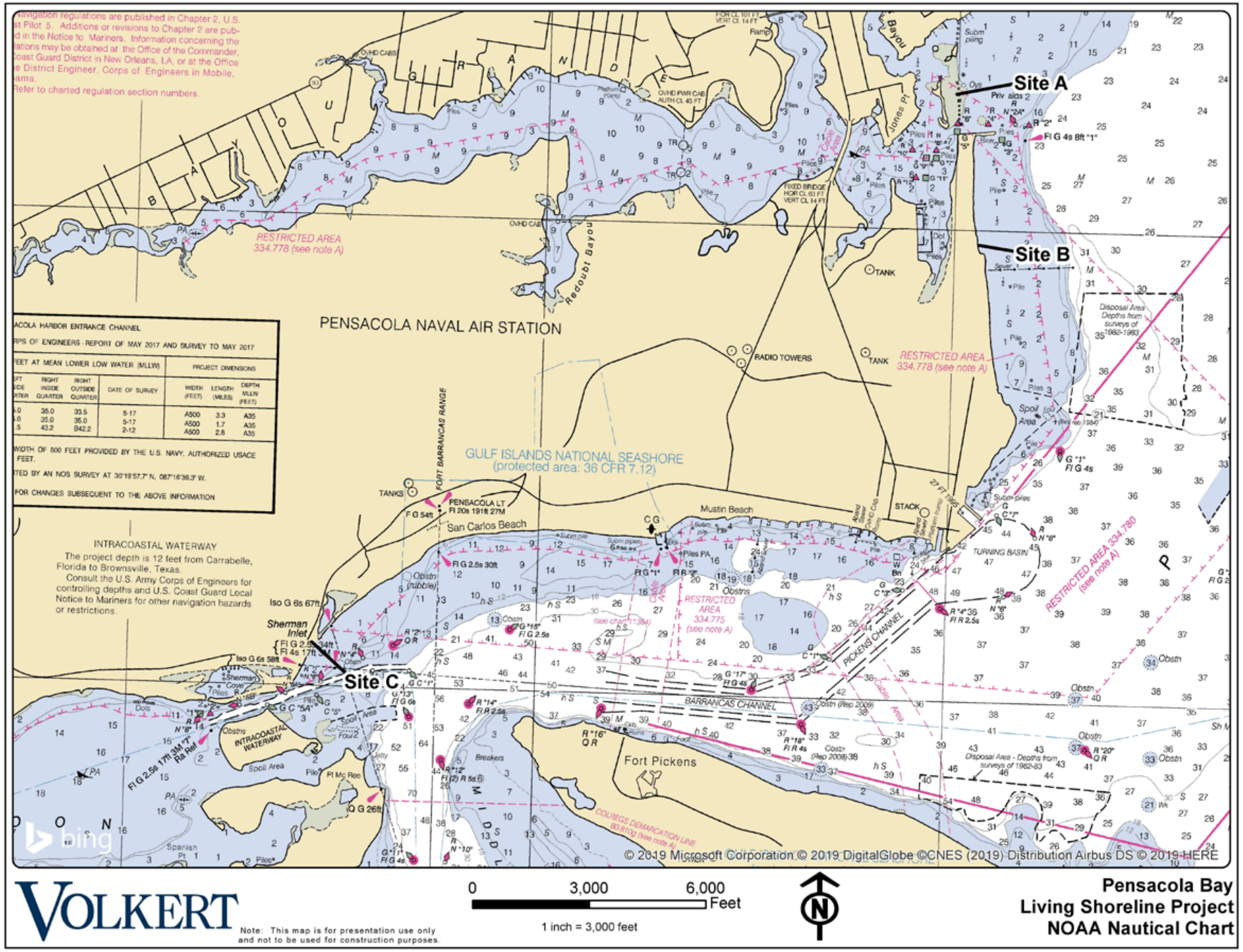
Questions for Input Common to All Sites

- Will Florida Sovereign submerged lands be an issue?
- What are economically/engineering/environmentally feasible sand sources for the shoreline restoration?
- Are there any specific water quality concerns?
- Is anyone aware of any riparian easements or leases in the area of the projects? If so, please explain. (Navy exclusion zones have been provided).
- Do you anticipate any issues with federally listed species? If so, are there any recommendations we should incorporate into our plans to minimize potential impacts and also help expedite the review process?

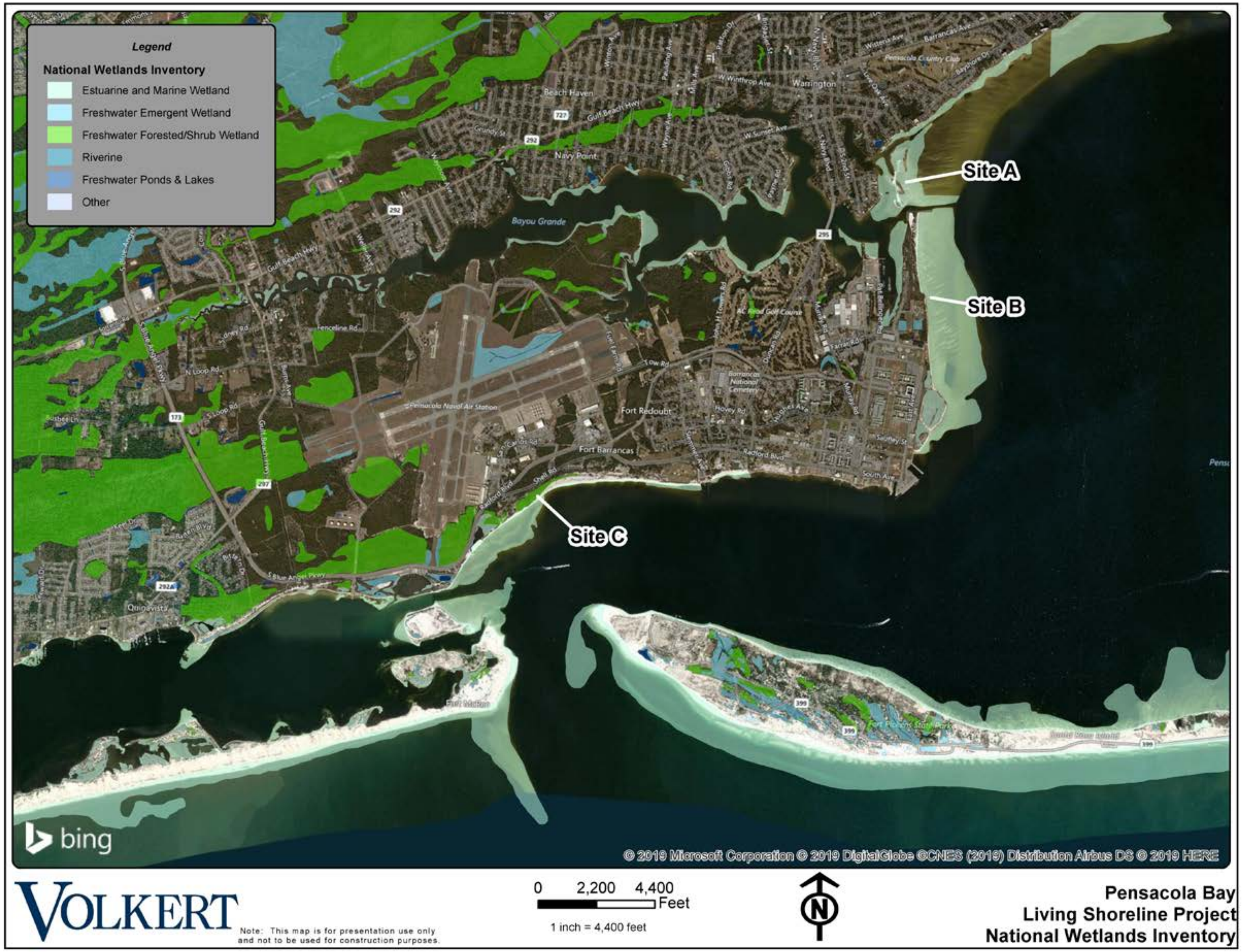
Questions for Input Common to All Sites (Cont'd)

- Will essential fish habitat be an issue?
- Does anyone have any SAV surveys for these areas?
- Are there any other cultural resource surveys in addition to what has been provided to us by the Navy?
- How will the Working Group interface with FDEP/USACE to expedite the permitting process?

Nautical Chart



Wetlands Inventory



Aerial, 1940

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Submerged Aquatic Vegetation

Thank you! Questions?

APPENDIX H

DATA/DOCUMENTS LIST AND GAP ANALYSIS

DATA/ DOCUMENTS	REMARKS/DATA GAPS
Grant Requirements	
Pre-design Public Comments	Additional Public Coordination/ Comments at 30% and 60% Design Phases
Living Shoreline Update Neighborhood Meeting 2/25/2019	
Living Shoreline Comment Sheets Neighborhood Meetiing 2/25/2019	
Living Shoreline 2/25/2019 Meeting Questions and Answers	
Attendance List 2/25/2019 Meeting	
Project Questionnaire	
Public Meeting 2/24/2020- comments	
NAS Data/Documents	Additional Coordination with NAS as project Progresses
Cultural Resources (ES01051, ES03548, ES03755**)**	
Historic and Current Aerial Photography	
NAS Response to RFI	
Email Exchange NAS and COE May 2018	
FDEP Permit Modification Maintenance Dredge Pensacola Pass Federal Channel	
NAS Naval Restricted Area	
NAS Sea Plane Restricted Area	
Magazine Point Shoreline Change 1961 to 2018	
NAS Restricted Area and Exclusion Zones Map	
Shoreline Detail Site C	
Aerial Photos Shoreline Changes Site C 1961 to 2000	
Dune Restoration Lake Frederick Area	
Aerial Photo Erosion Repair Area Lake Federick	
Erosion Repair Area Cross-Section	
Erosion Repair Area Quantities	
FDEP No Further Action Letter Unexploded Ordiance Areas Magazine Point	
Historical Shoreline Change Photos Site B and Site C	
Bayou Grande Sailing Facility Dredge Permits	
NASP Avian Survey Report 2015	
NAS Pensacola Integrated Natural Resources Management Plan 2018 update	
Final Biological Inventory Update NAS Pensacola January 2017	Priority Species observed near sites B and C during 2009-2010 /2015-2016 surveys: Brown Pelican, Black Skimmer (site C), Least Tern (site B), Osprey, godfrey's goldenaster,Chinese Tallow, Japanese Climbing Fern, Cogan Grass, Common Reed (site B).
e-mail NAS Stephen Opalenik 7/3/ 2019 additional information	
NAS Air Installations Compatible Use Zones Study, 2010	
NAS Pensacola 2019. CBIC/Naval Air Station Pensacola Home Page. Accessed Dec 2019. https://www.cnic.navy.mil/regions/cnrse/installations/nas_pensacola.html	
FAA 2019. Federal Aviation Administration, Aeronautical Information Services,Pensacola https://nfdc.faa.gov/nfdcApps/services/ajv5/airportDisplay.jsp?airportId=NPANAS/Forrest Sherman Field. Accessed Dec 2019.	
Submerged Land leases/Ownership	Additional cordination needed with Escambia County, NAS, and FDEP
(141374.pdf) State of Florida Board of Trustees Easement No. 25453 (2100-17)	
(141549.pdf) State of Florida Board of Trustees Easement No. 25006 (2256-17**)**	
(145852.pdf) State of Florida Board of Trustees Easement No. 24799 (2100-17)	
(CFR 2011-title33-Vol.3-part 334.pdf) NAS Restricted Area	
(DB140PG379.pdf) Deed McMillan Mill Company to E.D. Shields and John Shields	
(STMC T02SR30W.pdf) 1852 map of Privated Claims	
(STMC T03SR30Wa.pdf) Land Dristict map	
Historic and Current Nautical Information	
NOAA Charts 11378,11382,11383, 11384	
Historic meteorological data	
NOAA/CO-OPS Station 8729840	2000-present with some minor gap
NOAA/NDBC Station PCLF1	2005-present with some small gaps
USACE Wave Information Studies (WIS) http://wis.usace.army.mil	
Tide and Current Data	
NOAA/CO-OPS Station 8729840	1923-present with some minor gaps

DATA/ DOCUMENTS	REMARKS/DATA GAPS
Grant Requirements	
Sea Level Rise and Subsidence	
NOAA/CO-OPS Station 8729840	1923-present with some minor gaps
NOAA Technical Report 083 (2017)	Sweet, W.V., R.E. Kopp, C.P. Weaver, J. Obeysekera, R.M. Horton, E.R. Thieler, and C. Zervas, 2017: Global and Regional Sea Level Rise Scenarios for the United States. NOAA Technical Report NOS CO-OPS 083. NOAA/NOS Center for Operational Oceangraphic products and Services
Bathymetric and Topographic Surveys	Limited data available from NOAA Charts, USGS topographic maps, and NAS data. Will need additional site specific surveys TBD
USGS topographic Quandrangle maps Ft. Barrancas 1944 to 2018	

DATA/ DOCUMENTS	REMARKS/DATA GAPS
Grant Requirements	
Water Quality Data	Water Quality impact is not anticipated to be significant. Water quality to be a consideration in project design. Concern raised by the Inerangency Working Group was turbidity during construction to be addressed during the permitting process.
WQ data obtained from Jim Hagy Gulf Breeze EPA office	Obtained by SCE.
SWIM. 1997. The Pensacola Bay System Surface Water Improvement and Management Plan. Program Development Series 17-06. Northwest Florida Water Management District. 146p.	
SWIM. 2017. The Pensacola Bay System Surface Water Improvement and Management Plan. Program Development Series 97-2. Northwest Florida Water Management District. 132p.	
FDEP 2017. Statewide Comprehensive Verified List of Impaired Waters. Accessed Dec 2019. http://www.dep.state.fl.us/water/watersheds/assessment/a-lists.htm.	
Historic and Active State and Federal Permits	Ongoing Coordination with NAS, USACE and FDEP. Need additional coordination with USACE on Section 408 considerations, borrow sites, and permitting requirements (Mobile and Jacksonville Districts). Need additional coordination with FDEP on permitting requirements.
FDEP Permit time Extension Maintenance Dredge Pensacola Pass Federal Channel 2/26/2018	
Pensacola Five year Time Extension 5/23/2016	
Final Navy Channel Permit 11/07/2008	
Pensacola Harbor Permit 12/09/2010	
GIWW Permit 10/10/2012	
Pensacola Navy Channel Physical Sediment Samples 3/2004	
Pensacola Navy Channel Grain Size Distribution 6/01/2007	
Materials Testing NAS Pensacola Channel 4/19/2007	
Permit Application to dredge Sherman Inlet	
Final Programmatic Biological Opinion ("JAXBO") Nov. 30, 2017	
Historic/Archeological Data	See information provided by NAS. Additional data may be required through Joint Permit Process
Dredging Records	Ongoing coordination with USACE for potential borow areas and Federal Channel Info.
Dredging records GIWW and Pensacola Channel	
Channel Condition Surveys GIWW and Pensacola	
Scientific Studies	
FDEP (2010) Offshore Sand Search Guidelines	Programmatic information for offshore sand resources
Cox (2015) Engineering of an Island-Style Breakwater System for the Ft. Pierce Marina	Example of island restoration, possible ideas for White Island
NOAA (1993) Salinity Characteristics of Gulf of Mexico Estuaries	Historical/general information about salinity in Pensacola Bay
Lores et al. (2000) Mapping and Monitoring of Submerged Aquatic Vegetation in Escambia-Pensacola	SAV info for Pensacola Bay
Lehrter and Le (2017) Satellite Derived Water Quality Observations Are Related to River Discharge and Nitrogen Loads in Pensacola Bay, Florida	Water quality issues in Pensacola Bay
Hagy et al (2006) Effects of Hurricane Ivan on Water Quality in Pensacola Bay, FL	Water quality issues in Pensacola Bay
Xu and Huang (2008) Integrated Hydrodynamic Modeling and Frequency Analysis for Predicting 1% Storm Surge	Probabilistic storm surge predictions for Pensacola Bay
USEPA (2005) The Ecological Condition of the Pensacola Bay System, Northwest Florida	Ecological assessment of Pensacola Bay
Sheppard and Miller (2003) Design Storm Surge Hydrographs for the Florida Coast	Design (offshore) storm surge hydrographs for hydrodynamic modeling
FEMA (2017) Flood Insurance Study Volume 1 of 1 Escambia County, Florida	FIS data for Escambia Co
Schwenning et al (n.d.) Pensacola Bay	General estuarine characteristics
Olsen Associates (2017) Pensacola Pass, Florida Inlet Management Study	Inlet management plan/study
Work et al. (1991) Perdido Key Historical Summary and Interpretation of Monitoring Programs	Wind, wave, surge, and context data for site near project area.
Browder and Dean (1999) Pensacola Pass, Florida Inlet Management Study	Inlet management plan/study.
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Fisheries Data	Interagency working Group suggested looking for opportunities for Topminnow at White Island

DATA/ DOCUMENTS	REMARKS/DATA GAPS
Grant Requirements	
Threatened and Endangered Species USFWS IPaC list	Additional coordination with the State, USFWS and NMFS during the permitting process
Habitat Surveys Escambia County 2019 Preconstruction SAV Survey, Pensacola Bay Living Shoreline Project NWI map, SAV Map, Gulf Sturgeon Critical Habitat Map	Navy to perform Bird survey and Dolphin Density survey in 2019-2020 and sturgeon monitoring 2020-2021.
Aerial Photography Aerial photos 1944 to 2018	
Modeling	Need additional concept modeling, hydrodydynamic analysis, Sediment transport and shoreline change modeling
Other Florida Community Resiliency Initiative Pilot Project Adaptation Plan 2017 http://ca.dep.state.fl.us/mapdirect/?focus=none NOAA Bathymetric Digital Elevation Model, Pensacola Bay https://catalog.data.gov U.S. Army Corps of Engineers Shore Protection Manual Volume 1 (1984) Applied Technology Council (ATC) wind speeds https://hazards.atcouncil.org Encyclopedia Britannica 2019. Pensacola Florida. Acessed December 19, 2019 https://www.britannica.com/place/Pensacola Wikipedia 2019. The History of Pensacola Florida, Wikipedia accessed December 19, 2019 https://en.wikipedia.org/wiki/History_of_Pensacola,_Florida	

APPENDIX I

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Appendix I
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