Living Shoreline and Oyster Reef Restoration in Pensacola Bay, FL
Supplementary Information Document
June 2012

Original application submitted February 2011 in response to the request for projects for early NRDA funding as a result of the Deepwater Horizon BP Oil Spill originally submitted

Submitted by

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Table of Contents

List of Table and Appendices

Title

Supplementary Information Document

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Presented by The Nature Conservancy Florida Chapter

Project Title: Living Shoreline and Oyster Reef Restoration in Pensacola Bay, FL

Project Implementation Partners and Roles:

- The Nature Conservancy Florida Chapter-Anne Birch, Project Manager.
- The Nature Conservancy Alabama Chapter and Gulf of Mexico staff, Jeff DeQuattro, Mary Kate Stubljar, and Jennifer Greene, Project expertise.
- Dauphin Island Sea Lab (DISL), Dr. Ken Heck, Scientific Expertise and pre and post construction monitoring.
- Santa Rosa County/IFAS Extension (SRC-IFAS), Christine Verlinde, Community outreach and volunteer recruitment.
- The project also has support from Eglin Air Force Base, Northwest Florida Water Management District, and the Santa Rosa Bay Area Resource Council (see Appendix B: Letters of Support).

Project Location: The project is located in Santa Rosa County in the East and Blackwater Bays, embayments within the Pensacola Bay system in Santa Rosa County, FL (Sections 14, 20, 19, 22, 23, 32, 33; Township 27 & 28; Range 1S) (Fig.1). The project is defined as the east shore of East Bay from Escribano Point south to the mouth of the East River, and the small bay along the east shore of Blackwater Bay immediately north of Escribano Point (Fig. 2). The project area located in Blackwater Bay is within the boundaries of the Yellow River Marsh State Aquatic Preserve. The entire project area is located in designated essential habitat for Gulf Sturgeon (*Acipenser oxyrinchus desotoi*). East Bay is part of the easternmost embayment within the Pensacola Bay Estuary and receives discharge from Blackwater Bay to the north and the East River to the southeast (Fig. 3). Blackwater Bay receives discharge from the Blackwater and Yellow Rivers.

The project is **located in a "Conditionally Approved" shellfish harvesting area** (Fig. 4) as defined by the Florida Department of Agriculture and Consumer Services (FDACS) Division of Aquaculture. FDACS defines Conditionally Approved as *periodically closed to shellfish harvesting based on pollutional events, such as rainfall or increased river flow. The 14/43 standard must be met when the management plan parameter (rainfall, river stage, and/or river discharge) is less than the adverse pollution condition during all other adverse pollution conditions.* Salinity and water quality conditions are generally suitable for oyster settlement and growth and the limiting condition seems to be availability of suitable substrate (EPA 2004).

Project Land Ownership: Current property land records show that the land directly adjacent to the project shoreline is either publicly owned by the Northwest Florida Water Management District, Department of Defense Eglin Air Force Base, or the US Forest Service, or is privately owned by one owner, American Bank of Texas (see Fig. 2).

Background Information:
Over the past century, there has been an estimated 85% global loss of native oyster reef habitats due to habitat degradation, overharvesting, reduced water quality, disease, boat wakes, and other factors (Beck et al. 2011). Beck et al. has documented that the Gulf of Mexico is the only location in North America where oyster reefs are considered in fair condition (50-90% lost). Other locations in North America are either poor (90-99% lost) or functionally extinct (>99% lost), and none are considered in good condition (<50% lost). In Pensacola Bay, the eastern oyster (*Crassostrea virginica*) was historically prevalent throughout the Bay area, but has declined over time. The decline is thought to be a result of a combination of factors including disease, degraded water quality, lack of suitable substrate due to dredge disposal, and sediment contaminants. Water quality has improved yet oyster populations have not rebounded significantly due, primarily, to lack of suitable substrate (EPA 2004).

Project Goals:
The proposed project will result in the creation of up to eight miles of non-contiguous living shoreline/oyster breakwater habitat and restoration of salt marsh behind the breakwater. The goals of the proposed project are to implement and monitor a large-scale, scientifically-based living shoreline project to:

1. Design a natural oyster reef breakwater to promote settlement and colonization of oyster larvae and other encrusting organisms, and become a healthy, functioning oyster reef habitat.
2. Restore fringe marsh habitat with specific value for coastal birds and increase foraging habitat available for shorebirds, wading and migratory birds (e.g. pelicans, terns, warblers, herons, egrets, passerines)
3. Increase the amount of 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).
4. Promote the growth of submerged aquatic vegetation (e.g. seagrasses) that in turn also support a diversity of species including those listed in this section.
5. Serve as a natural approach (e.g. green infrastructure) to help prevent further shoreline erosion along the east shores of East and Blackwater Bays, dampening of wave energy and decreasing erosion to help stabilize sediments and decrease turbidity**.**
6. Help protect significant archaeological and historical sites on the Department of Defense Eglin Air Force Base property that are increasingly vulnerable to the eroding shoreline.

The project is an integral part of The Nature Conservancy's Gulf of Mexico Program, a comprehensive program that includes the five states bordering the Gulf from Florida to Texas. The project complements the work the Conservancy and its partners are conducting in the Gulf and other areas of the United States to advance oyster reef restoration at the local, regional, national, and global scales. The Nature Conservancy has identified the Pensacola Bay Estuary as a region of marine conservation priority in Florida. In addition, the Conservancy has assisted in conservation of regional conservation lands such as the Blackwater River State Forest.

Overview of Project Development To Date:
The Nature Conservancy (Conservancy) originally proposed this project in May 2011 to the State of Florida, NOAA, and USFWS, the Natural Resource Trustees for Early Restoration

funding from BP Oil company as identified in the April 2011 *Framework for Early Restoration Addressing Injuries Resulting from the Deepwater Horizon Oil Spill* (Framework).

This supplemental information document provides additional information and data that was collected by the Conservancy and its partners after the Conservancy submitted the project proposal through the NOAA/DOI NRDA web site. The information and data were collected in preparation of a *Joint Application for Environmental Resource Permit* from Florida Department of Environmental Resources (FDEP) and the Army Corps of Engineers (ACOE). This document also contains a revised budget that more accurately represents the costs of the project.

On August 8, 2011, the Conservancy conducted a project site visit to collect preliminary data in preparation of a *Joint Application for Environmental Resource Permit* application. Nine pre-determined data points were identified along the project shoreline (East Bay) and the following information was gathered at each sampling point (Fig. 5). Attachment B provides a summary of this information for each sample point in East Bay.

- Temperature
- Salinity
- Conductivity
- Dissolved oxygen
- Seine net sample for faunal diversity
- General bottom sedimentation type (i.e. sandy, mud)
- Presence/absence of SAV
- Shoreline vegetation type and any other visible species (i.e., birds)

On November 2, 2011, Florida Department of Environmental Protection (FDEP), National Oceanic and Atmospheric Administration (NOAA), and Conservancy staff held a site visit to provide the opportunity for FDEP and NOAA staff to assess the project in person. Based on the site visit NOAA and FDEP staff recommended a project expansion to include a portion of the eastern shoreline of Blackwater Bay that lies immediately north of Escribano Point (see Fig. 2). Data on shoreline erosion rates for the Blackwater Bay area was not available at the time of the site visit. The erosion data is included in this supplementary information document. NOAA staff expressed some concern: (1) about the private ownership of the shoreline along a portion of the site, (2) that the project did not include multiple habitat benefits, (3) that the shoreline erosion did not appear to significant, and (4) also wanted to know if other areas had been considered for restoration. The Conservancy has addressed these concerns in this document as follows with additional details provided later in the document:

- *Private ownership of the shoreline* – the project will be phased to construct the living shoreline adjacent to the southern-most publicly owned properties in East Bay. This will be Phase 1 of the project. Subsequent phases will be constructed along the publicly owned shoreline in Blackwater Bay and the privately owned properties in Blackwater and East Bays once they are evaluated to determine the type of living shoreline that is feasible under the FDEP/ACOE permit rules. The feasibility of implementing Phase 1 is high and addresses Eglin Air Force Bases concerns regarding protection of the historical and archaeological sites that are in jeopardy of being lost due to shoreline erosion.

- *Multiple habitat benefits* –the project includes an oyster reef breakwater and restoration of salt marsh behind the breakwater. Oyster reefs and salt marsh provide numerous benefits to a variety of estuarine and terrestrial species and serve as a defense against erosion that helps protect and improve existing habitat.
- *Shoreline erosion* – The project area's average shoreline movement rates from 1934 to 2011 have been calculated at approximately 0.32 meters/year (1.05 feet/year) for a total of approximately 24.5 meters (almost 80 feet) lost to erosion. This is a significant loss of habitat available for the diversity of species using the region. In addition, the sediment contribution to the estuary from the eroding shoreline can be detrimental to the estuarine habitats and associated species by covering essential habitat used by species, e.g. seagrasses, salt marsh and oyster reefs, and changing the habitat structure to bare sand.

On December 13, 2012, a pre-permit project meeting was held with FDEP and ACOE regulatory staff and Conservancy staff. The purpose of the meeting was to introduce the project concept and goals to the permitting agencies and discuss the type of information that would be necessary for submittal of a complete permit application to help facilitate permit review and approval.

Current Status and Next Steps:
The Conservancy researched the acquisition status of the private ownership. The property is a very high priority for conservation by both the State of Florida and Department of Defense and they are in negotiations with the owner to purchase the property.

- In order to initiate the project in a timely manner, the Conservancy and partners have revised the implementation strategy into phases (Fig. 6).
    - Phase 1: implement the living shoreline along the approximately 1.9 miles of shoreline adjacent to the publicly owned Eglin Air Force Base and Northwest Florida Water Management District properties.
    - Phase 2: implement the living shoreline along approximately 1 mile of the northernmost shoreline adjacent to the publicly owned Northwest Florida Water Management District properties shoreline in Blackwater Bay.
    - Phase 3: implement the living shoreline along the approximately 5.2 miles of the remainder of the shoreline adjacent to the privately owned land in Blackwater and East Bays (same ownership). Note that the extent of the shoreline in this Phase exceeds 6 miles and could be broken down into additional phases if necessary due to funding or other constraints that may arise.
- Revise the draft permit application to include only the Phase 1 portion of the project and submit to FDEP and the Army Corps of Engineers by the end of July 2012.
- Initiate engineering specifications, based on available funding.
  The project partners cannot currently fund the engineering work due to the expected costs without a verification of implementation funding from an outside source. If awarded, the early NRDA funding would be used for this step. The Conservancy has experience with firms due to our experience implementing similar large-scale projects in Texas, Louisiana and Alabama and, therefore, would be able to quickly contract with a firm once funding is available.

Project Relevance to NRDA:
The *Deepwater Horizon* NRDA Trustees have identified injuries to the ecosystem resources/habitats and human use from the deep ocean to the coastlines within thirteen resource categories. Resource Technical Working Groups are assessing the extent of injury for each category. This living shoreline/oyster breakwater project aligns with ten of the 13 categories as described in Table 1.

Table 1. Alignment of the project with the 13 NRDA Resources categories.

NRDA Resources Category	Project Alignment	Examples of how the proposed Living Shoreline/Oyster Breakwater Project will help recover the NRDA Resources
Deepwater Communities	NA	
Water column and invertebrates	✓	• Healthy oyster reefs contribute larvae as a free-swimming plankton that, in turn, serve as a food source for other larger nekton and benthos organisms such as crabs and adult oysters • Living shorelines provides habitat for estuarine nekton such as fish and benthos organisms such as crabs and adult oysters
Marine fish	✓	• Living shorelines increase fishery species abundance by providing nursery and structural habitat for the health and recovery of recreational and commercial estuarine species (redfish, snapper, blue crab, stone crab, shrimp)
Marine mammals	✓	• The diversity of fish species using living shorelines are prey species for estuarine bottlenose dolphin populations • Oyster reefs can improve water clarity for seagrass habitat that is essential for the survival of the endangered West Indian manatee and economically important fishery species such as spotted trout, red drum, black drum, mangrove snapper, gag grouper, spot, croaker, mullet, blue crab, stone crab, and shrimp.
Sea turtles	NA	
Nearshore sediment and resources	✓	• Living shorelines increase habitat and available food sources for health and recovery of crabs, shrimp, fish, birds and terrestrial wildlife • Living shorelines can help trap sediment and reduce shoreline erosion.
Submerged aquatic vegetation	✓	• Oyster reefs can improve water clarity for seagrass habitat (ex. one adult oyster can

		filter up to 50 gallons of water a day) • Oyster reefs stabilize sediments and enhances seagrass recruitment • Seagrasses help maintain water clarity and provide nursery habitat for a diversity of species.
Oysters	✓	• Oyster reefs can improve water clarity through filtration (ex. one adult oyster can filer up to 50 gallons of water a day) • All stages of the oyster (larvae, spat and adult) are a critical base of the food chain for the health and recovery of valuable commercial and recreationally fish, crab and shrimp species, wading and shorebirds, bottlenose dolphin, pelagic fish • Oyster reefs serve as a source of oyster larvae to benefit establishment and maintenance of nonharvestable and harvestable oysters reefs in the system
Shallow water coral	NA	
Shorelines	✓	• Living shorelines are a natural line of defense, protecting developed and natural shorelines such as salt marsh, uplands and coastal communities from erosion, storm surges and other coastal hazards
Birds	✓	• Living shorelines provide food for the health and recovery of wading, shore, foraging seabirds, and migratory bird species
Terrestrial species	✓	• Living shorelines are a critical base of the food chain for health and recovery of terrestrial based species such as turtles, alligators, crabs, birds and other species
Human use	✓	• Oyster reefs can improve water quality for recreational activities including fishing, swimming, tourism • Living shorelines provide habitat for economically important fish species such as blue crab, spotted seatrout, red drum, an shrimp • Healthy oyster reefs serve as a source of oyster larvae to maintain or establish other reef areas such as harvestable oyster reefs • Living shorelines enhance watchable wildlife opportunities for birding, bottlenose dolphin and other estuarine life

		• Living shorelines can help buffer shorelines, natural and developed, from coastal hazards such as storms and storm surges • Buffering shorelines can help protect archaeological and historical structures at risk from shoreline erosion (e.g. Eglin Air Force base)

In addition to the information in Table 1, the following illustrates the project's relevance to each of the five criteria outlined in the *Framework for Early Restoration Addressing Injuries Resulting From the Deepwater Horizon Oil Spill* (2011)

Criteria 1: Contribute to making the environment and the public whole by restoring, rehabilitating, replacing or acquiring the equivalent of natural resources or services injured as a result of the Deepwater Horizon oil spill or response, or compensating for interim losses resulting from the incident.

It is well established that salt marshes and coastal shallow water habitats (including shellfish reefs), natural and restored, are used by fish, invertebrates, marine mammals and birds for feeding, reproduction, and refuge from predators (Kneib 1997; Melvin and Webb 1998; Peterson and Turner 1994).

Restoring shorelines with salt marsh and shellfish reef structures in the Gulf of Mexico provides the restoration of multiple ecological functions, including three critical benefits: protection and rebuilding of shoreline, creation of near shore shallow water habitat (used by fish, shrimp, crabs, dolphins and birds), and water filtration. In fact, many shellfish have been labeled 'ecosystem engineers' in recognition of the multiple roles they play in shaping the environments in which they live (Jones et al. 1994; Lenihan 1999). Figure 7 shows the diversity of ecosystem services - benefits nature provides for people and the environment - which can be provided by living shorelines.

Fish species associated with oyster reefs in the northern Gulf of Mexico include speckled trout, red drum, black drum, mangrove snapper, gag grouper, spot, croaker, mullet, and occasionally several species of sharks, as well as blue crabs and stone crabs (Heck, pers. comm.). A study by Scyphers (2011) showed that living shoreline structures with oyster reef breakwater and salt marsh support a higher abundance and diversity of fish species than oyster reef habitat alone in Mobile Bay, Alabama (Scyphers, 2011). The habitats in Mobile Bay are similar to those found within the Pensacola Living Shoreline project and, therefore, similar results are expected. Species documented using oyster breakwater/salt marsh living shorelines are also economically important and include blue crabs (*Callinectes sapidus*), red drum (*Sciaenops ocellatus*), spotted seatrout (*Cynoscion nebulosus*) and flounder (*Paralichthys sp*.). For instance, spotted seatrout was the most caught fish species (47%) by recreational anglers.

It is important to note that all of the Conservancy's proposed living shoreline/oyster reef breakwater projects across the Gulf are designed around the same goals and as such, this coordinated work has the potential to help restore Gulf Coast health across the whole system

without regard to state borders. For example, only xx miles away from the proposed Pensacola project, the Conservancy is coordinating numerous partners to implement *100-1000 Restore Coastal Alabama*, an ambitious living shoreline program to build 100 miles of oyster reefs to support and promote more than 1000 acres of coastal marsh and seagrass along Mobile Bay's shorelines. Now in its second year, the first project site, Helen Wood Park, was monitored in May 2012. The following are the monitoring results for the quarter mile long living shoreline 1.5 years post-installation:

- Marsh near the living shoreline exhibited a 7.35% increase in area over the two year post-restoration period.
- *Ruppia maritima*, the primary seagrass at Helen Wood Park, was present behind the entire stretch of the quarter-mile living shoreline at the time of field investigation. While there was already a substantial root mat of *Ruppia* at the site from past surveys before installation of the living shoreline, this was the first time that staff observed itin bloom in this area .
- Mussels, oysters, barnacles, crabs, shrimp, and fish were all present
- An osprey platform constructed six months prior to the monitoring event now has a solid nest in place.

The Pensacola Living Shoreline/Oyster Breakwater s project provides a comprehensive science-based approach to restoration that includes pre-restoration monitoring, project design and permitting, implementation of restoration activities and post-restoration monitoring. The project will select the most appropriate methodology(s) to meet the project goals. The selected methodology(s) will use the most appropriate natural substrate for oyster larvae to settle and colonize, ultimately serving as nursery habitat for commercially and recreationally important finfish and shellfish, providing forage and nesting areas for birds, dampen wave energy, and decrease shoreline erosion.

In addition to enhancing fisheries, the project will help protect several significant archaeological and historical sites located adjacent to the shoreline located on Eglin Air Force property that are at risk from shoreline erosion (Mark E. Stanley, Eglin AFB Cultural Resources Manager (pers. comm.), as well as reduce and repair the significant shoreline erosion that has occurred along the entire project area. The shoreline along the project has been eroding over the past 70+ years at an average rate of -0.32 meters/year. This estimate was generated by using data accessed from NOAA's Digital Shoreline website (http://shoreline.noaa.gov). We compared shoreline data from 1934, 1935, and 1978 with shoreline profile data collected along the southernmost five miles of the project area in East Bay by Conservancy staff on August 8, 2011 and a shoreline dataset that was created based on aerial photography taken during October 2010 (see Fig. 5).

Data was collected at nine sample points along the length of the shoreline (Figs. 8a-i) from south to north, respectively). Only the southernmost point (#1) showed a positive movement of 0.34 meters/year (i.e., accretion of shoreline). The other eight points ranged from an average of -0.16 to -0.74 meters/year with the highest level of movement (loss) documented at the northernmost point (#9). An additional area of approximately 3 miles was added to the project following discussions with FDEP and NOAA in November 2011. Field data has not yet been collected for this section. Figures 9a-h show the shoreline profile changes using data from 1934, 1935, and 1978 for this section of the project area.

Criteria 2: Address one or more specific injuries to natural resources or services associated with the incident:

Estuarine habitats such as oyster reef and salt marsh were directly impacted by the Deepwater Horizon oil spill throughout the Gulf of Mexico. In turn, the impacts negatively affected the public use and local economies dependent on healthy habitats and their associated species, such as recreational and commercial fisheries. This is especially true in Florida and the Pensacola Bay area where public use of the waters and natural resources were significantly reduced.

West Florida is an economically important region in the Gulf of Mexico, especially in terms of supporting the commercial and recreational fisheries and watchable wildlife industries. Tourism is Florida's largest industry. In 2011 it accounted for $85.1 million in value with over 1 million people directly employed in the industry. In 2010 it generated $4 billion in sales tax revenue (Visit Florida, 2012). The following statistics are provided to highlight the important role that increased living shorelines/oyster reefs can play in boosting the health and recovery of the Gulf economy especially in Florida with a focus on West Florida. Unless otherwise noted the data is from the NMFS 2012 and NOAA 2010 references in which additional details on the importance of fisheries to the Gulf and West Florida's economy can be found.

- In 2009, recreational fishing accounted for more than 22 million fishing trips in the Gulf of Mexico Region made by 2.8 million anglers, the majority of which were coastal county residents (almost 90%)
- In 2009, West Florida's commercial finfish and shellfish industries brought in $49 million and $67 million, respectively.
- In 2009, West Florida ranked #1 in employment jobs generated and sale and added value impacts associated with recreational fishing industry
- In 2009, Florida generated 65,000 jobs and income of $2.4 billion to the Gulf's seafood economy.
- Blue crab landings and dockside value for West Florida in 2008 was 2.7 million pounds, $3.3 million, respectively (ranked 1st among Gulf states)
- Red snapper landings and dockside value for West Florida in 2008 was 847,884 pounds, $2.94 million, respectively (ranked 2nd among Gulf states)
- Spotted seatrout, a species associated with oyster reefs, was the most frequently caught species by Gulf recreational anglers
- More people travel to Florida to view wildlife than any other state - 24 percent more than the second-place state, California (U.S. Fish and Wildlife Service 2006)
- Florida ranks as the second highest state (after California) in the number of people participating in wildlife-viewing recreation (U.S. Fish and Wildlife Service 2006)

Oyster reefs and associated marshes and seagrass meadows are the foundational habitats that are important to the protecting and expanding the economic benefits of the fisheries. While this project will enhance a suite of fish and wildlife populations and their supporting habitats, these habitat and resource improvements will also provide benefits to the public through (1) enhanced fisheries that can feed the coastal economy, (2) stabilized shorelines which improve water quality (3) protected private and public properties and important cultural and historical resources, (4)

improved coastal community resilience, and (5) improved quality of life with a healthy environment.

Criteria 3: Seek to restore natural resources, habitats or natural resource services of the same type, quality and of comparable ecological and/or human-use value to compensate for identified resource and service losses resulting from the incident.

Living shoreline projects apply natural principles and construction elements that create habitat and provide other services important for estuarine function, including structural and foraging habitat for economically important estuarine fishes, vertebrates and invertebrates, increased light penetration for seagrass, and decreased wave energy and shoreline erosion.

Designing and implementing successful science-based living shoreline/oyster reef projects that provide a suite of ecosystem services is an integral part of this work. The project will help inform and add to the growing database of information on restoration of oyster reefs and living shoreline methodologies that promote creation of oyster habitat such as the projects The Nature Conservancy has been leading similar scale projects in Texas (Half Moon Bay), Louisiana (Grand Isle) and Alabama (Coastal Alabama 100-1000).

Criteria 4: Are not inconsistent with the anticipated long-term restoration needs and anticipated final restoration plan; and

The proposed project specifically aligns with the Framework (April 2011) and the Restoration Plan from (Dec 2012) as presented above and in Table 1. The project is a restoration and enhancement based-project that complements the Pensacola Bay SWIM Plan. The project also complements or supports living shoreline work being implemented by FDEP as part of Project GreenShores and oyster reef restoration proposed by the FDACS for the East Bay and Pensacola Bay area. This work will not impede navigation. We will exercise care to ensure water quality standards are not violated. It is likely that the project areas contain sovereign submerged lands and we will request consent of use to complete the restoration activities contained within this application. The design of the living shoreline will not be contiguous to allow breaks for fish passage.

Criteria 5: Are feasible and cost-effective.
The total project investment cost estimate is $16.7 million. This includes construction costs during years 1-3 at approximately $12.3 million followed by five years of monitoring. The cost estimate is based on real costs to construct living shoreline reefs in Mobile Bay Alabama as well as our experience managing large-scale restoration projects such as those funded by the American Recovery and Reinvestment Act of 2009. The Conservancy would welcome discussions with the NRDA Trustees on the project scope, budget, and implementation.

Additional Information:

Oyster reefs in East Bay have declined over the past century. The earliest data available for the region is a map by the United States Fish Commission dated 1883 showing that oyster reefs were located throughout the East and Blackwater Bays region (Fig. 10). This map is the only known

historical information available on oyster reefs in this region. There is no known recent mapping data on oyster reefs in East or Blackwater Bay. Gaps in historical or current extent of oyster reefs are common wherever oysters occur(ed). Mapping the extent of current reef locations throughout the eastern oyster's range represents a research need that would benefit future restoration but the lack of mapped reefs should not delay restoration activities from taking place.

As stated earlier, many species of oysters, including the eastern oyster, have declined dramatically throughout their ranges. The ecological, social, and economic services provided through restoration of oysters and their reef forming habitats are critically important to maintaining and improving the health of estuaries and human needs. Additionally, this type of restoration project would leverage other restoration efforts occurring across the Gulf of Mexico, enhancing restoration benefits exponentially.

Seagrasses historically were patchy to continuous in 1980 in Pensacola Bay and have since declined to almost nonexistent in the project area (EPA, 2004). The Conservancy's August 2011 site visit revealed no SAV at the nine project area sampling points. The project area will be surveyed for presence of SAV within two weeks prior to proposed restoration work to verify that no seagrass will be impacted by the restoration activity.

The project area can be accessed by shallow hulled boats from a boat ramp located on the southwest end of Garcon Point. This boat ramp is used for access and staging area for living shoreline projects being implemented by FDEP Ecosystem Restoration Program (partner on this project). There are numerous unpaved roads on the private property directly adjacent to the project area that could provide access as well as potential access through Eglin Air Force Base property.

Project Plan:
This project has been listed on the State of Florida's List 2 (short list) of eligible projects for funding per the Agreement. The Conservancy has developed a project timeline of three years to complete the project, followed by five years of monitoring. An essential component for success of the project is the expertise brought by the partners – DISL, SRC-IFAS and the Conservancy. DISL offers the principal science expertise and, through Dr. Ken Heck, who has been involved in estuarine restoration projects throughout the Gulf of Mexico and is a key partner with the Conservancy implementing and monitoring the *100-1000 Restore Coastal Alabama* program. The project will benefit from the partner's collective expertise in implementing living shoreline and oyster reef restoration projects throughout the Gulf.

Reputable firms with expertise in constructing living shorelines/oyster reef habitat will be contracted to implement construction to ensure that the proposed project will be restored/enhanced according to permit requirements.

Construction Methods:
Results from projects by the Conservancy work on 100-1000 in Alabama and its partners show that living shorelines as a breakwater are effective in enhancing fisheries habitat and stabilizing shorelines. Building upon these prior 'proof of concept' projects, this project will consider using living shoreline methods that are best suited for this project area. The specific technologies

selected will maximize ecosystem service benefits, while providing cost effective solutions for the project.

Based on the initial site visit by Conservancy staff, the living shoreline/reef breakwaters will be placed between 20 m and 100 m from the shoreline to provide adequate shoreline protection. Breakwater lengths will range from 15 m to 125 m based on the site shoreline length and will be spaced to allow for tidal flushing. The actual location and breakwater length will be determined once engineered construction specifications are obtained.

Native coastal marsh planting will occur along the shoreline, as needed, to help stabilize the sediment and re-establish a diverse estuarine system. FDEP-ERP has experience in this type of planting through Project GreenShores. The living shoreline should provide conditions suitable for re-establishment of native marsh plant species due to protection of the shoreline from wave energy. One year post installation of the living shoreline/breakwater the shoreline will be assessed to determine if vegetation is naturally re-establishing or if native plantings are needed to jump start the process.

Monitoring: Dr. Ken Heck at DISL has developed the following monitoring protocol. This is the same protocol used for the *100-1000 Restore Coastal Alabama* sites and, therefore, offers a science-based approach to compare ecological and structural success of living shorelines among diverse sites in the Gulf of Mexico and add to the growing body of knowledge on living shoreline and oyster reef restoration. Some basic parameters will be tracked at every restoration site: Project design area vs. actual footprint, shoreline position, depth profile, marsh/SAV survey. Some specific locations will be selected for more comprehensive monitoring (finfish, shellfish, encrusting organisms, water quality, marsh diversity), based on site conditions, location or other science needs.

Functional: Pre-restoration monitoring will include the basic parameters outlined above to establish a baseline to assess changes. Post-reef restoration monitoring will occur at semi-annual intervals for a 5-year required monitoring period. In addition to directly measuring the response of marine habitats to the restoration efforts, these data will measure the change in available habitat and food resources for birds and other marine animals that may use this habitat. Our surveys will determine the success of the following targeted goals:

- *Oyster presence*: Species richness and abundance
- *Shellfish and finfish*: Species richness and abundance
- *Seagrass beds*: Density, percent cover and mapping
- *Shoreline dynamics*: Shoreline profile and change over time
- *Marshes*: Species richness and abundance

Oyster counts: Juvenile and adult oysters, as well as other settlers (e.g., mussels), and dead oysters will be counted using a 0.25 m^2 quadrat placed on the reef. Triplicate measurements will be taken on each reef at each sampling time. Should high water and turbidity hinder quadrat sampling, volumetric sampling will be used for treatments involving oyster shell and a total surface count will be performed for artificial structures.

Shellfish and finfish: For juvenile fishes and larger mobile invertebrates (e.g., crabs and shrimp), samples will be collected using 8-m (26 ft) wide bag seines. Triplicate seines per breakwater or control area on each sampling date will be pulled by hand towards the shoreline, which will prevent animals from escaping the seine. Animals retained will be placed in plastic bags, put on ice and returned to the lab where enumeration of species will be performed.

Seagrass beds: Because the presence of the reef is expected to have a positive effect on shoreline vegetation and may have a positive effect on SAV near the reef, we will monitor the density (shoots m^{-2}) and cover (% of bottom area covered) of SAV before and after restoration efforts. Stations located at equidistant intervals between the breakwaters or control edge and the shoreline will be visited on each sampling date and the benthic community sampled with a 20 cm-diameter corer. The abundance (number of shoots per m^2) and morphological characteristics (number of leaves per shoot, leaf length and width) of the seagrass at those stations will be measured. In addition, using submerged scanning technology (Ceeducer), the bottom between the breakwater or control edge and shoreline will be scanned for seagrass presence during the summer.

Shoreline dynamics: Shoreline elevation and slope will be measured along three transects extending from the upland marsh into 0.5 m mean water depth using a Radio Tele-Kinematic GPS. The horizontal accuracy of this technology is 5 cm and the vertical accuracy is 3 cm, thus allowing portrayal of changes in shoreline shape (i.e. accrual or erosion) with unprecedented sensitivity. In addition, current meters, to determine the impact of breakwaters on water flow and direction, and water level loggers, to determine the impact on wave height, will be deployed leeward of the breakwaters and control edges.

Marshes: The abundance, diversity and morphological characteristics of marsh plants will be measured along the same transects used for shoreline dynamics. Two stations (high and low marsh) will be monitored per transect. Marsh vegetation will be quantified within 1-m^2 quadrats. Beginning at the shoreline edge, quadrat samples will be collected at 0.5 m and 2.0 m (defined as low marsh and high marsh respectively) along a transect perpendicular to the shoreline. All vegetation will be quantified, classified and characterized by growth state (e.g., live, dormant, and dead).

Historic shoreline information was compiled to showcase rates of change over time at nine points along this project area. This historic information will be combined with baseline pre-construction measurements (see shoreline dynamics section above) to define the pre-restoration site conditions. Existing Project GreenShores oyster reef breakwater sites will be used as reference for target conditions and realized habitat change. The same parameters will be monitored on the same schedule at these reference locations to provide comparison data for robust comparison and cost-efficacy analyses.

Monitoring results will be evaluated annually to determine any obvious positive or negative trends. Those trends will be examined in annual reports and used as points of discussion for any needed adaptive management strategies.

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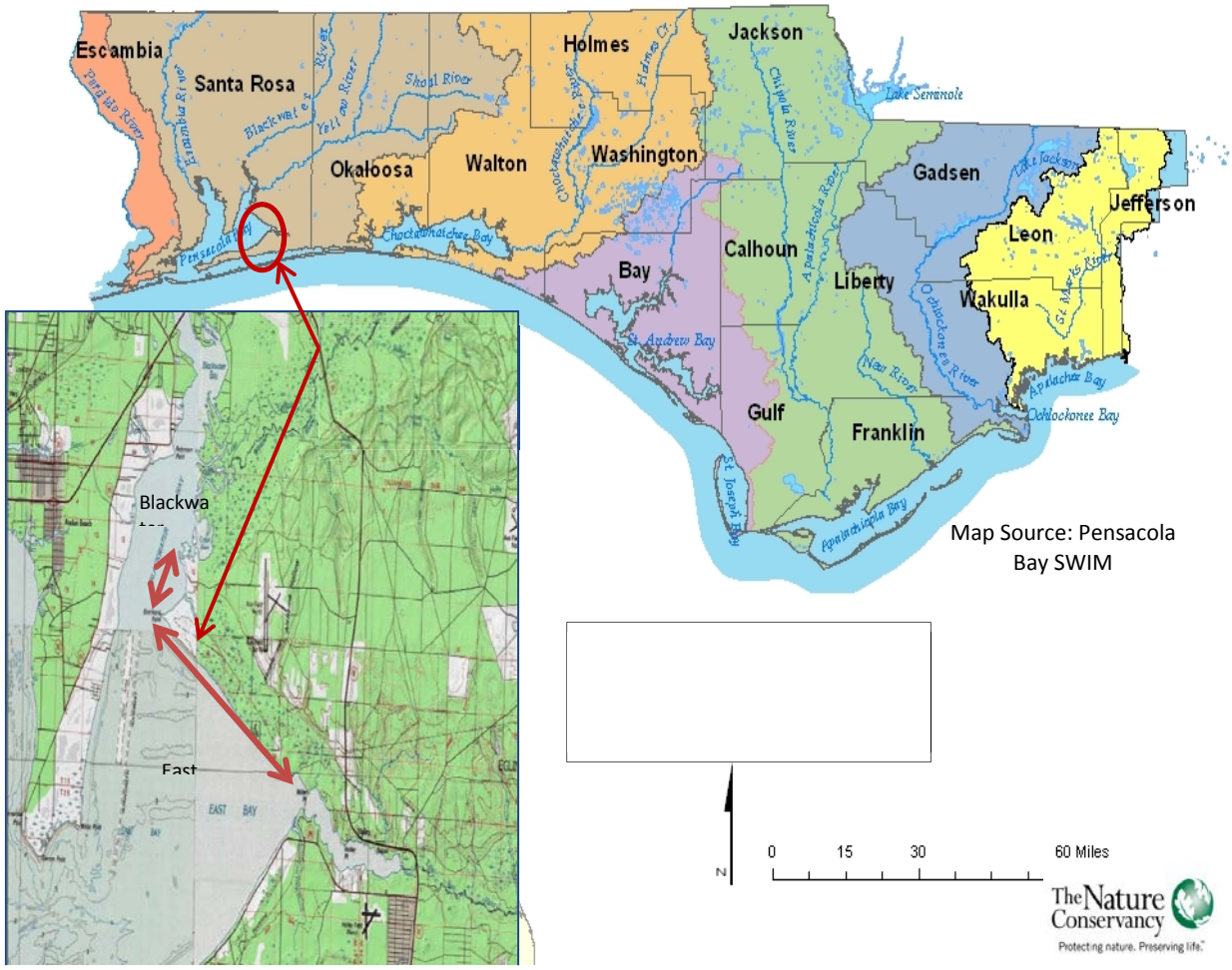
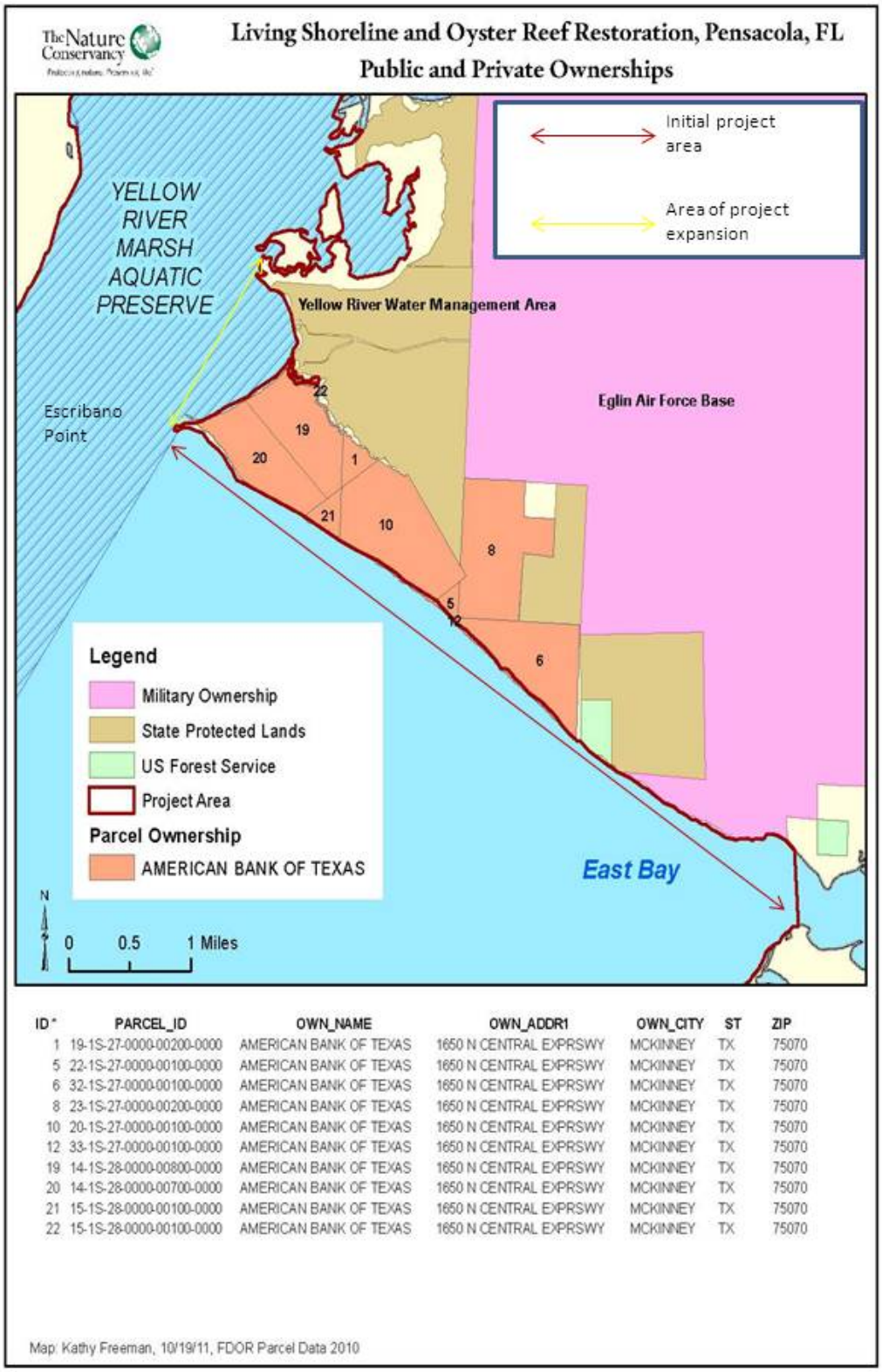
APPENDIX A
Figures 1-10

Figure 1. Project Site Location Map



Map Source: Pensacola Bay SWIM

Figure 2. Map showing general location of the proposed project and land ownerships adjacent to the project

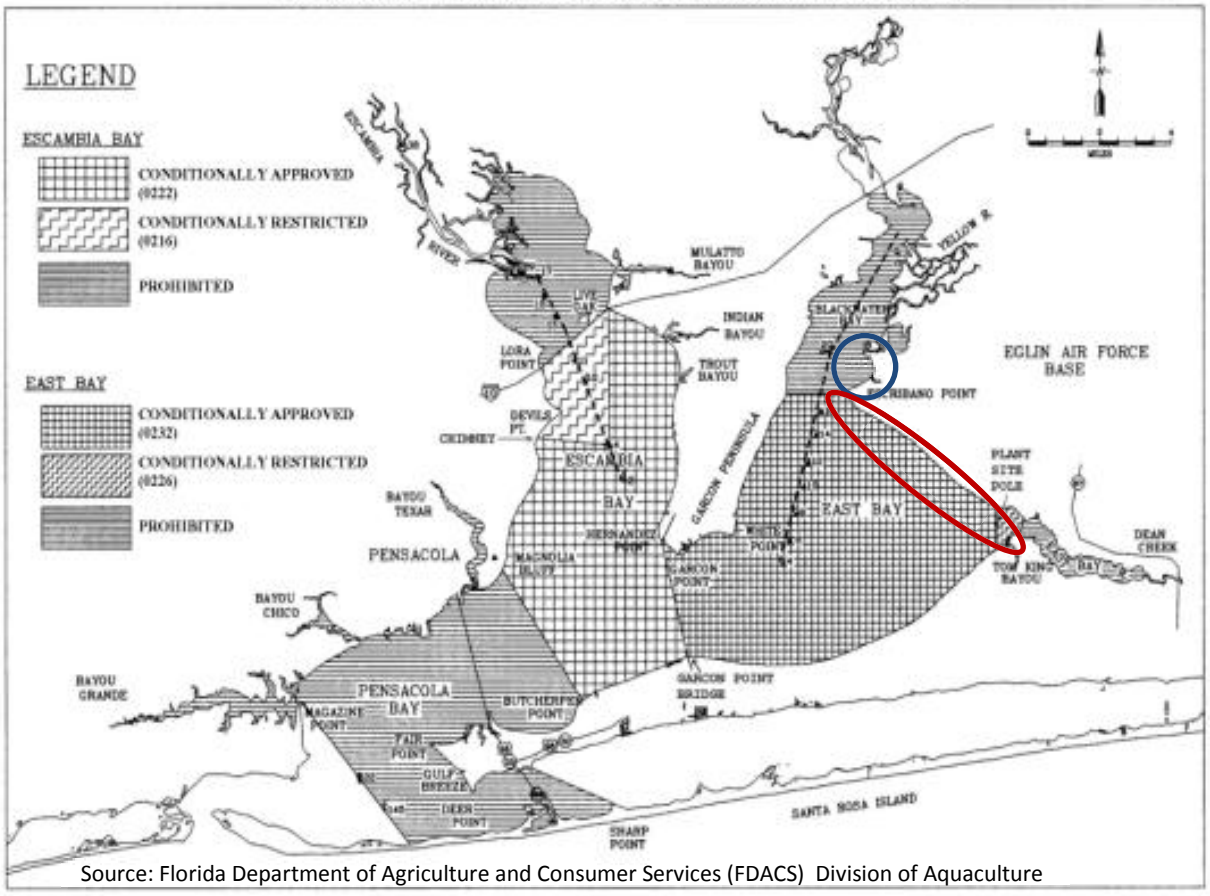


ID *	PARCEL_ID	OWN_NAME	OWN_ADDR1	OWN_CITY	ST	ZIP
1	19-1S-27-0000-00200-0000	AMERICAN BANK OF TEXAS	1650 N CENTRAL EXPRSWY	MCKINNEY	TX	75070
5	22-1S-27-0000-00100-0000	AMERICAN BANK OF TEXAS	1650 N CENTRAL EXPRSWY	MCKINNEY	TX	75070
6	32-1S-27-0000-00100-0000	AMERICAN BANK OF TEXAS	1650 N CENTRAL EXPRSWY	MCKINNEY	TX	75070
8	23-1S-27-0000-00200-0000	AMERICAN BANK OF TEXAS	1650 N CENTRAL EXPRSWY	MCKINNEY	TX	75070
10	20-1S-27-0000-00100-0000	AMERICAN BANK OF TEXAS	1650 N CENTRAL EXPRSWY	MCKINNEY	TX	75070
12	33-1S-27-0000-00100-0000	AMERICAN BANK OF TEXAS	1650 N CENTRAL EXPRSWY	MCKINNEY	TX	75070
19	14-1S-28-0000-00800-0000	AMERICAN BANK OF TEXAS	1650 N CENTRAL EXPRSWY	MCKINNEY	TX	75070
20	14-1S-28-0000-00700-0000	AMERICAN BANK OF TEXAS	1650 N CENTRAL EXPRSWY	MCKINNEY	TX	75070
21	15-1S-28-0000-00100-0000	AMERICAN BANK OF TEXAS	1650 N CENTRAL EXPRSWY	MCKINNEY	TX	75070
22	15-1S-28-0000-00100-0000	AMERICAN BANK OF TEXAS	1650 N CENTRAL EXPRSWY	MCKINNEY	TX	75070

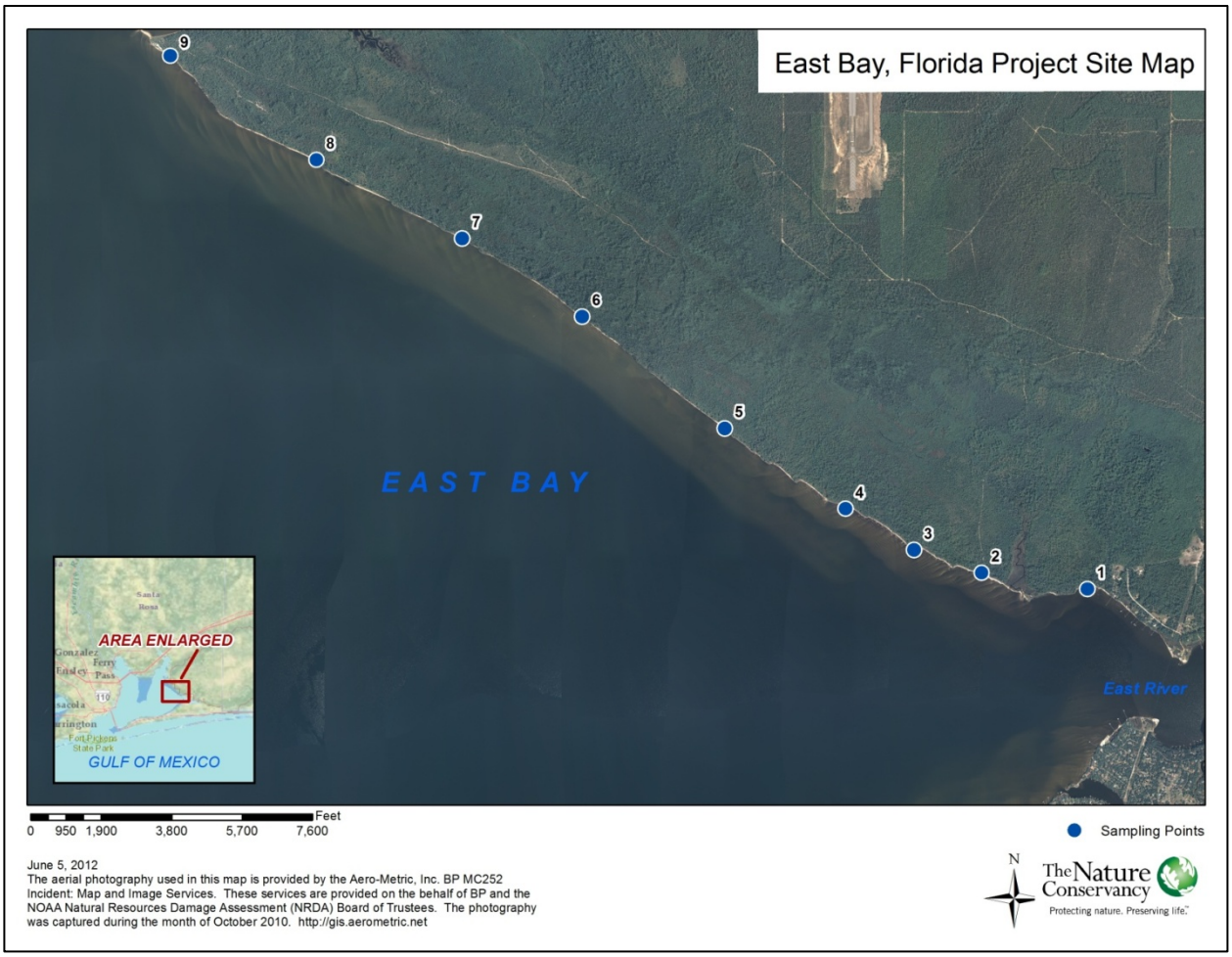
Map: Kathy Freeman, 10/19/11, FDOR Parcel Data 2010


Blackwater River
Yellow River
Blackwater Bay
East River
East Bay
Image U.S. Geological Survey
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Google earth
Imagery Date: 1/3/2012
30°30'48.59" N 86°53'13.81" W elev 115 ft
Eye alt 25.35 mi

SHELLFISH HARVESTING AREA CLASSIFICATION MAP #02 (Effective: August 17, 2004)
Pensacola Bay System (#02) Shellfish Harvesting Area in Escambia and Santa Rosa Counties



Source: Florida Department of Agriculture and Consumer Services (FDACS) Division of Aquaculture



June 5, 2012
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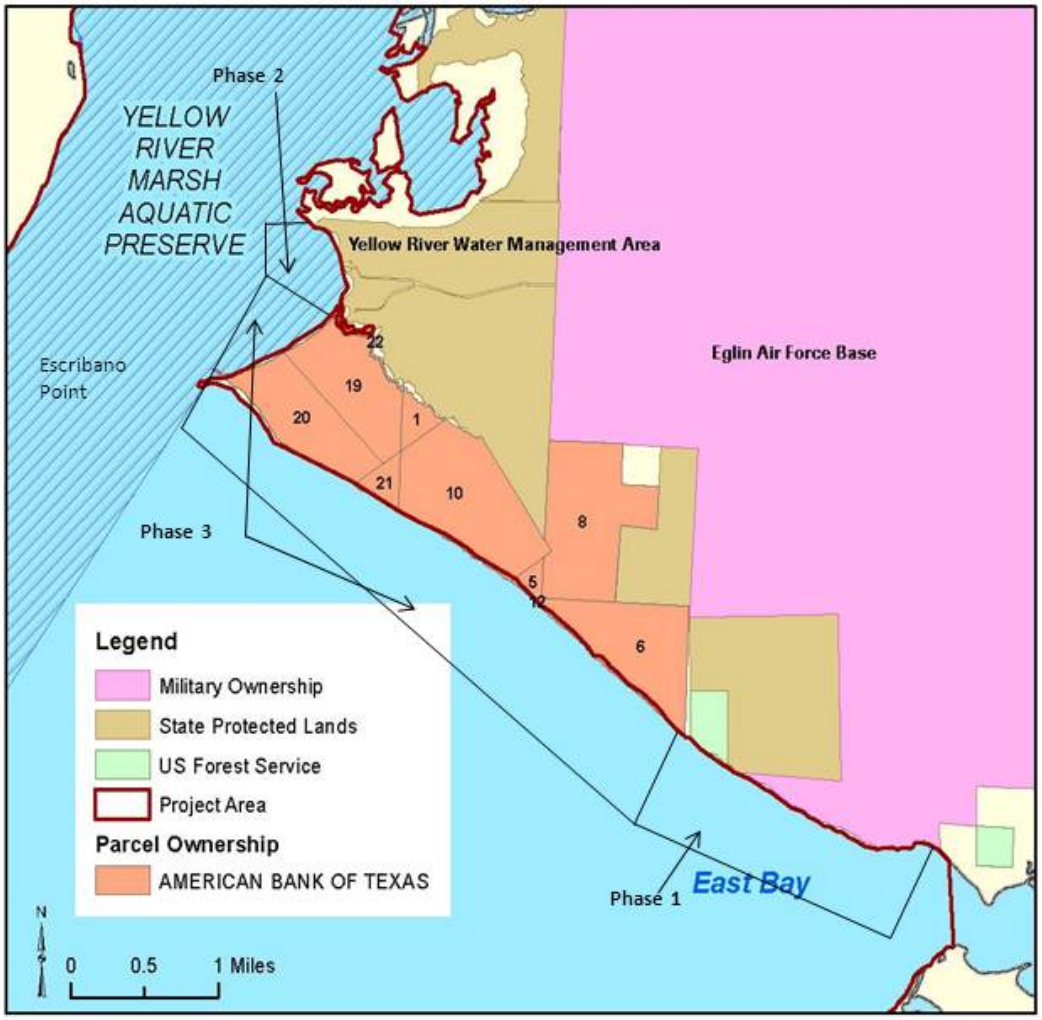
The Nature Conservancy

Living Shoreline and Oyster Reef Restoration, Pensacola, FL
Public and Private Ownerships



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6	32-1S-27-0000-00100-0000	AMERICAN BANK OF TEXAS	1650 N CENTRAL EXPRSWY	MCKINNEY	TX	75070
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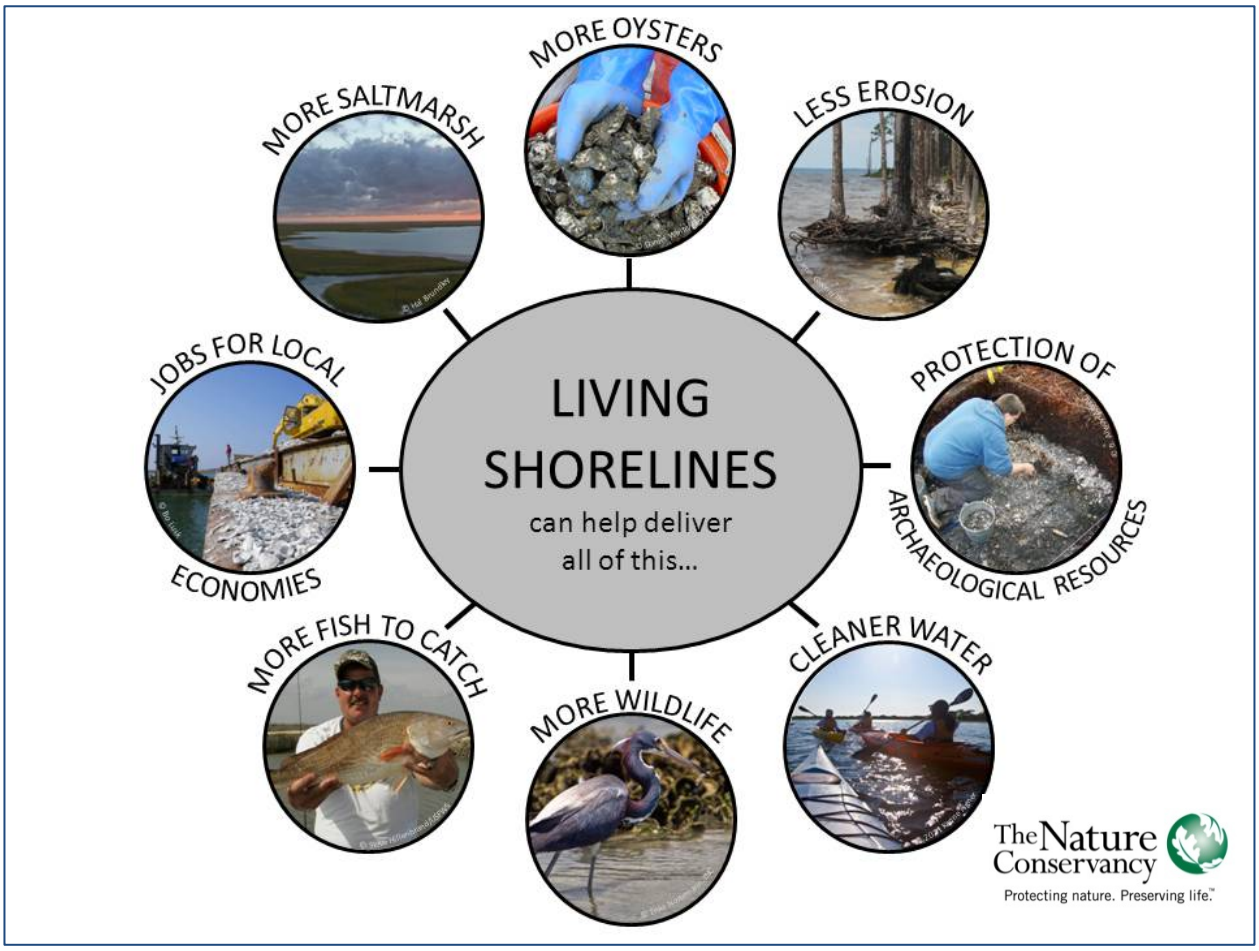
10	20-1S-27-0000-00100-0000	AMERICAN BANK OF TEXAS	1650 N CENTRAL EXPRSWY	MCKINNEY	TX	75070
12	33-1S-27-0000-00100-0000	AMERICAN BANK OF TEXAS	1650 N CENTRAL EXPRSWY	MCKINNEY	TX	75070
19	14-1S-28-0000-00800-0000	AMERICAN BANK OF TEXAS	1650 N CENTRAL EXPRSWY	MCKINNEY	TX	75070
20	14-1S-28-0000-00700-0000	AMERICAN BANK OF TEXAS	1650 N CENTRAL EXPRSWY	MCKINNEY	TX	75070
21	15-1S-28-0000-00100-0000	AMERICAN BANK OF TEXAS	1650 N CENTRAL EXPRSWY	MCKINNEY	TX	75070
22	15-1S-28-0000-00100-0000	AMERICAN BANK OF TEXAS	1650 N CENTRAL EXPRSWY	MCKINNEY	TX	75070

Map: Kathy Freeman, 10/19/11, FDOR Parcel Data 2010


MORE OYSTERS
MORE SALTMARSH
LESS EROSION
JOBS FOR LOCAL ECONOMIES
LIVING SHORELINES
can help deliver all of this...
PROTECTION OF ARCHAEOLOGICAL RESOURCES
MORE FISH TO CATCH
MORE WILDLIFE
CLEANER WATER
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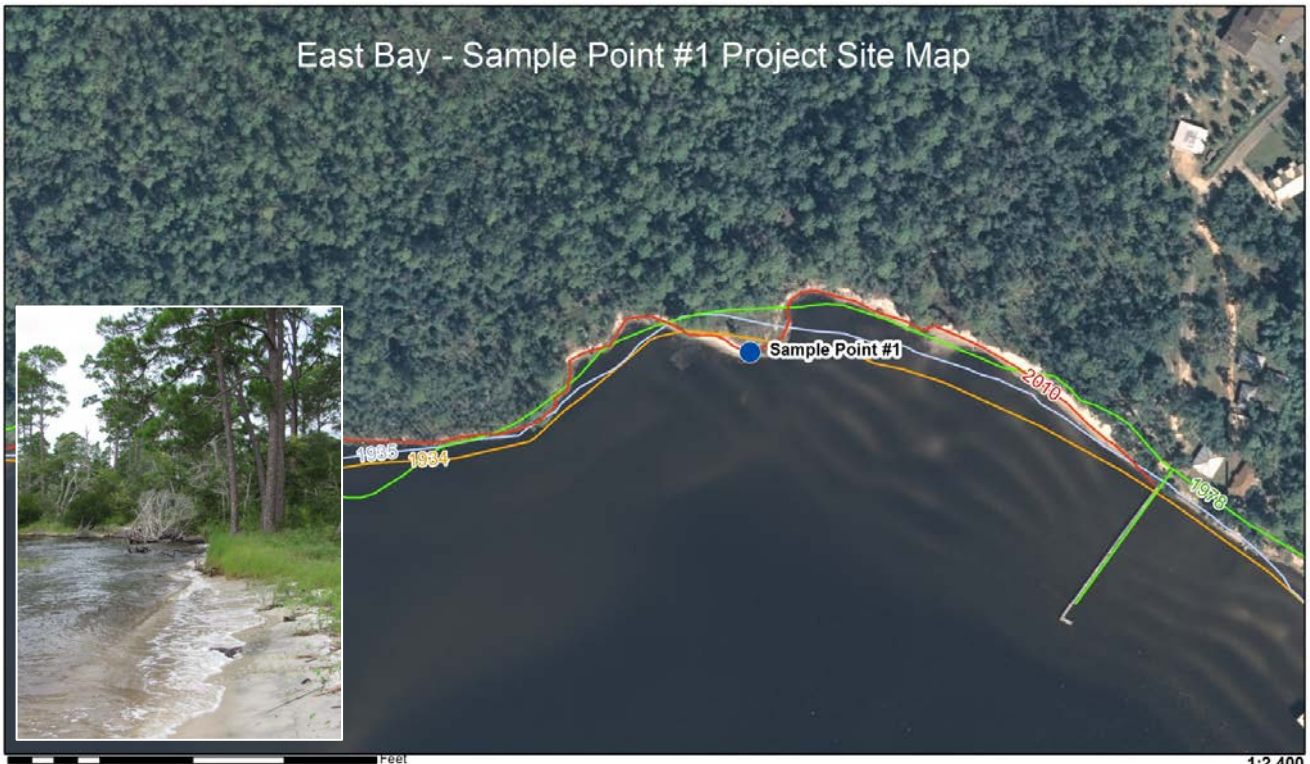
East Bay - Sample Point #1 Project Site Map



0 75 150 300 450 600 Feet

1:2,400

June 5, 2012
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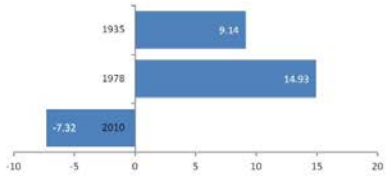
The 2010 shoreline data was created by The Nature Conservancy, Alabama through field data collection and visual delineation using aerial photographs.

Shoreline Retreat

Distance from the 1934 line (meters)



Sampling Points
2010 Shoreline
1978 Shoreline
1935 Shoreline
1934 Shoreline

N

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East Bay - Sample Point #2 Project Site Map

0 75 150 300 450 600 Feet

1:2,400

June 5, 2012
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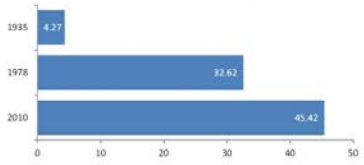
Shoreline Retreat
Distance from the 1934 line (meters)



- Sampling Points
- 2010 Shoreline
- 1978 Shoreline
- 1935 Shoreline
- 1934 Shoreline

N

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Blackwater Bay - Sample Point #3B
Project Site Map

0 30 60 120 180 240 Feet

1:1,200

June 5, 2012
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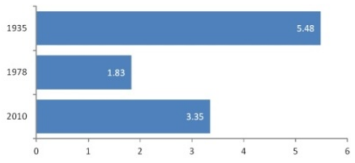
Shoreline Retreat
Distance from the 1934 line (meters)



- Sampling Points
- 2010 Shoreline
- 1978 Shoreline
- 1935 Shoreline
- 1934 Shoreline

N

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East Bay - Sample Point #4 Project Site Map

0 75 150 300 450 600 Feet

1:2,400

June 5, 2012
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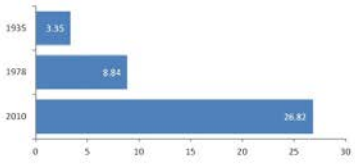
Shoreline Retreat
Distance from the 1934 line (meters)



- Sampling Points
- 2010 Shoreline
- 1978 Shoreline
- 1935 Shoreline
- 1934 Shoreline

N

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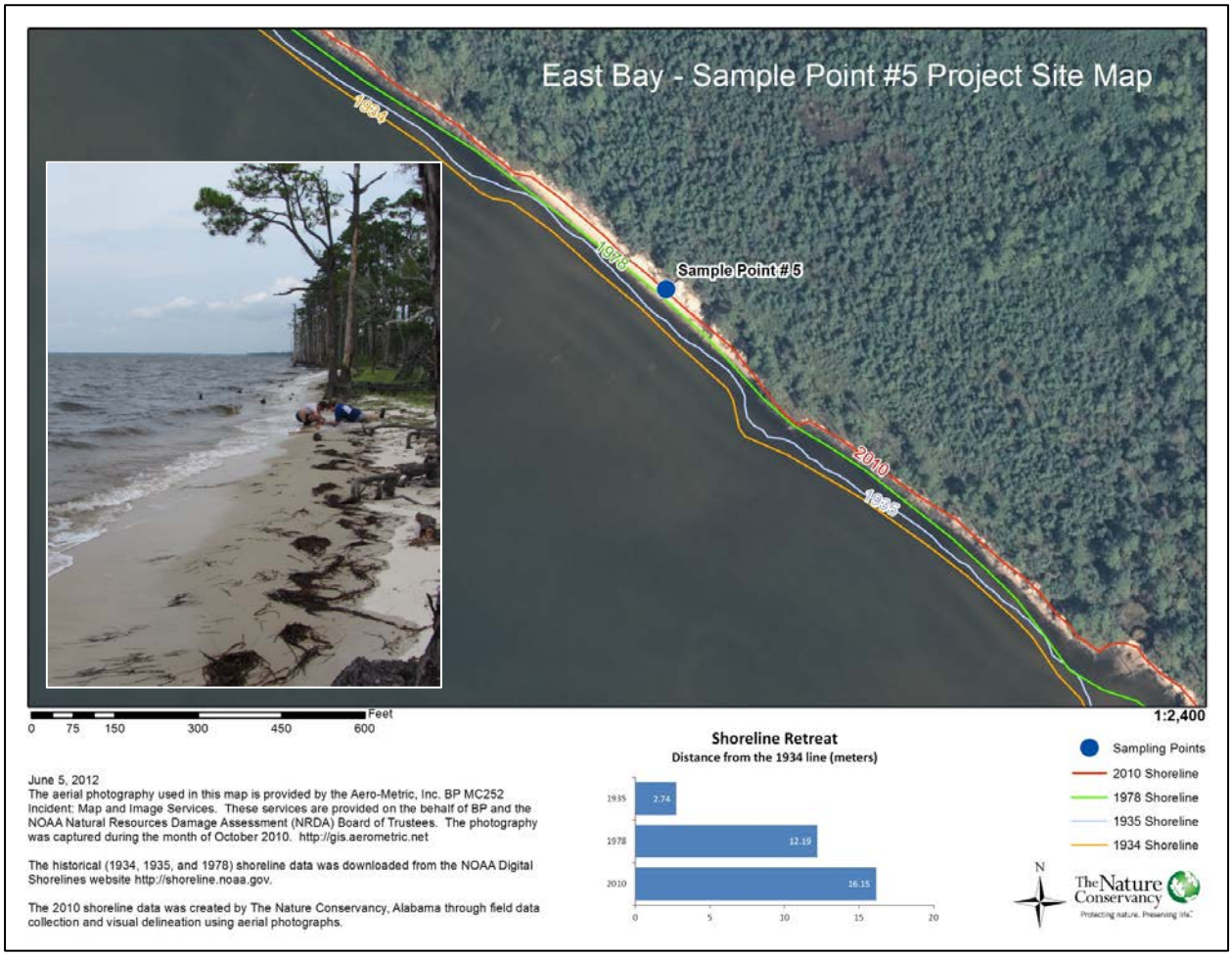

June 5, 2012
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East Bay - Sample Point #6 Project Site Map

0 75 150 300 450 600 Feet

1:2,400

June 5, 2012
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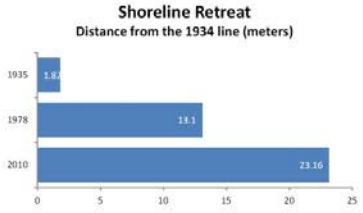

Sampling Points
2010 Shoreline
1978 Shoreline
1935 Shoreline
1934 Shoreline

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June 5, 2012
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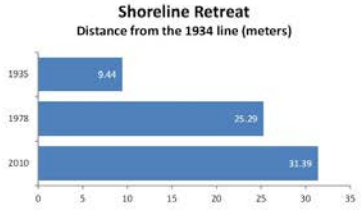
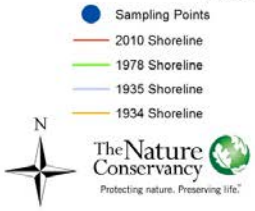
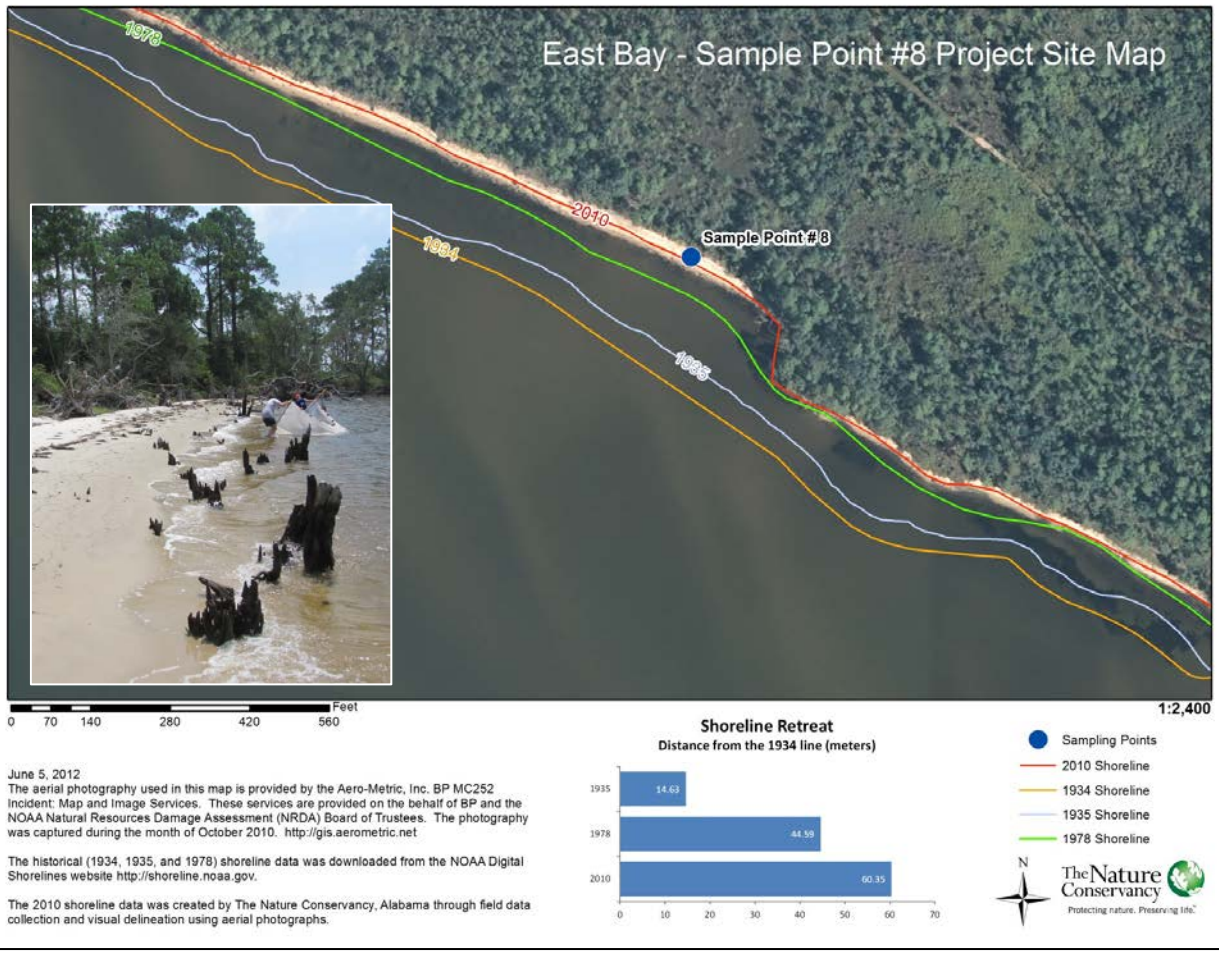




East Bay - Sample Point #8 Project Site Map



June 5, 2012
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Sampling Points
2010 Shoreline
1934 Shoreline
1935 Shoreline
1978 Shoreline

N

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East Bay - Sample Point #9 Project Site Map

0 70 140 280 420 560 Feet

1:2,400

June 5, 2012
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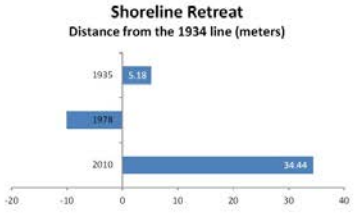

- Sampling Points
- 2010 Shoreline
- 1978 Shoreline
- 1935 Shoreline
- 1934 Shoreline

N

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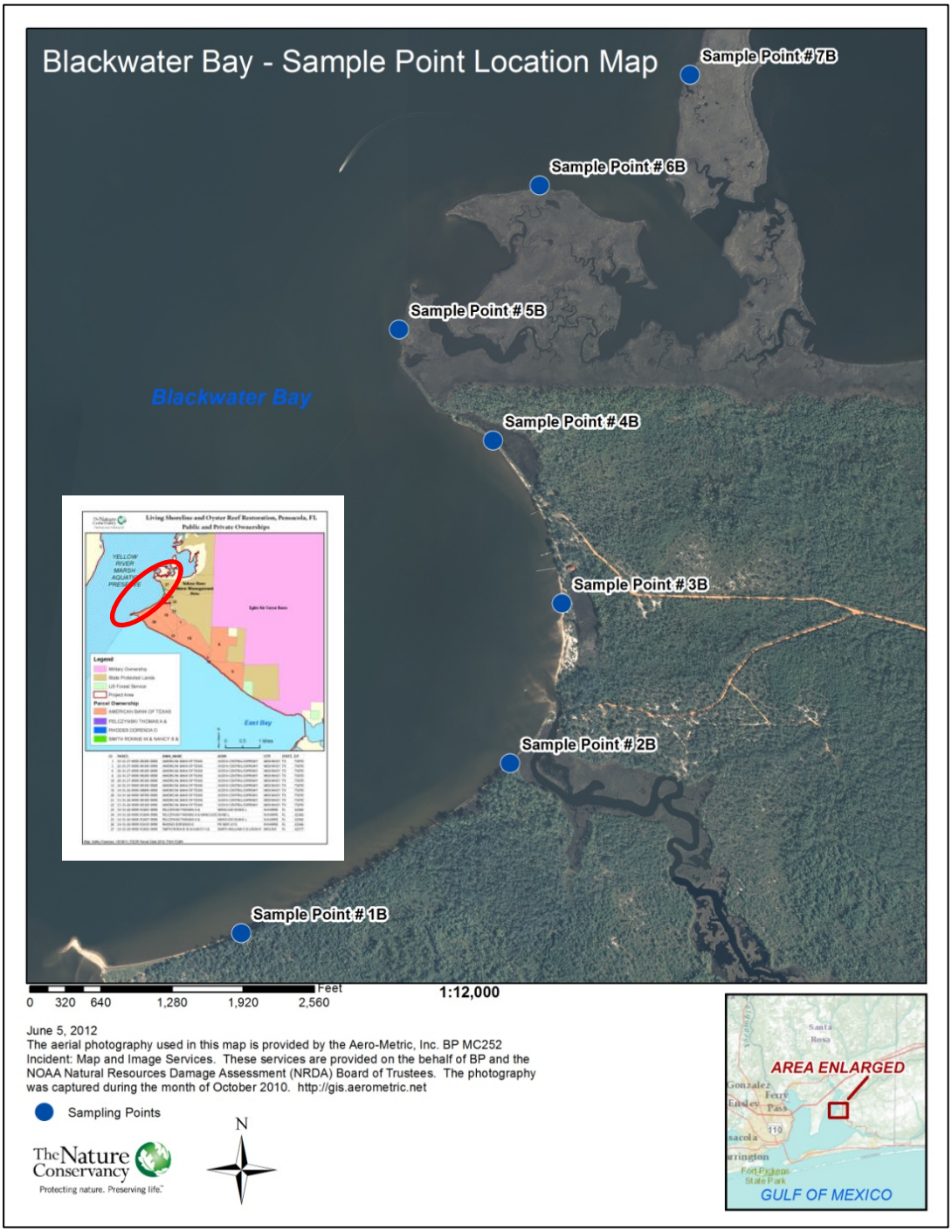

June 5, 2012

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Sampling Points

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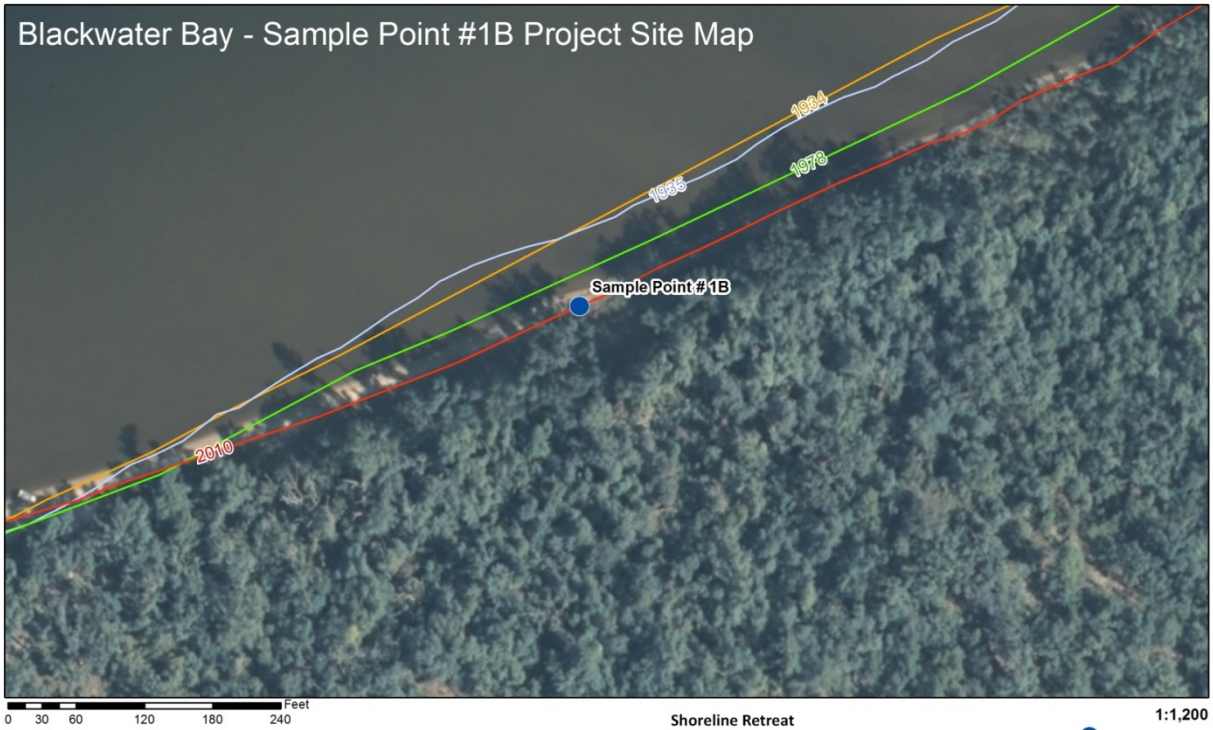
N



0 30 60 120 180 240 Feet

June 5, 2012
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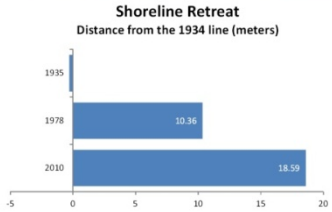

1:1,200

Sampling Points
2010 Shoreline
1978 Shoreline
1935 Shoreline
1934 Shoreline

N

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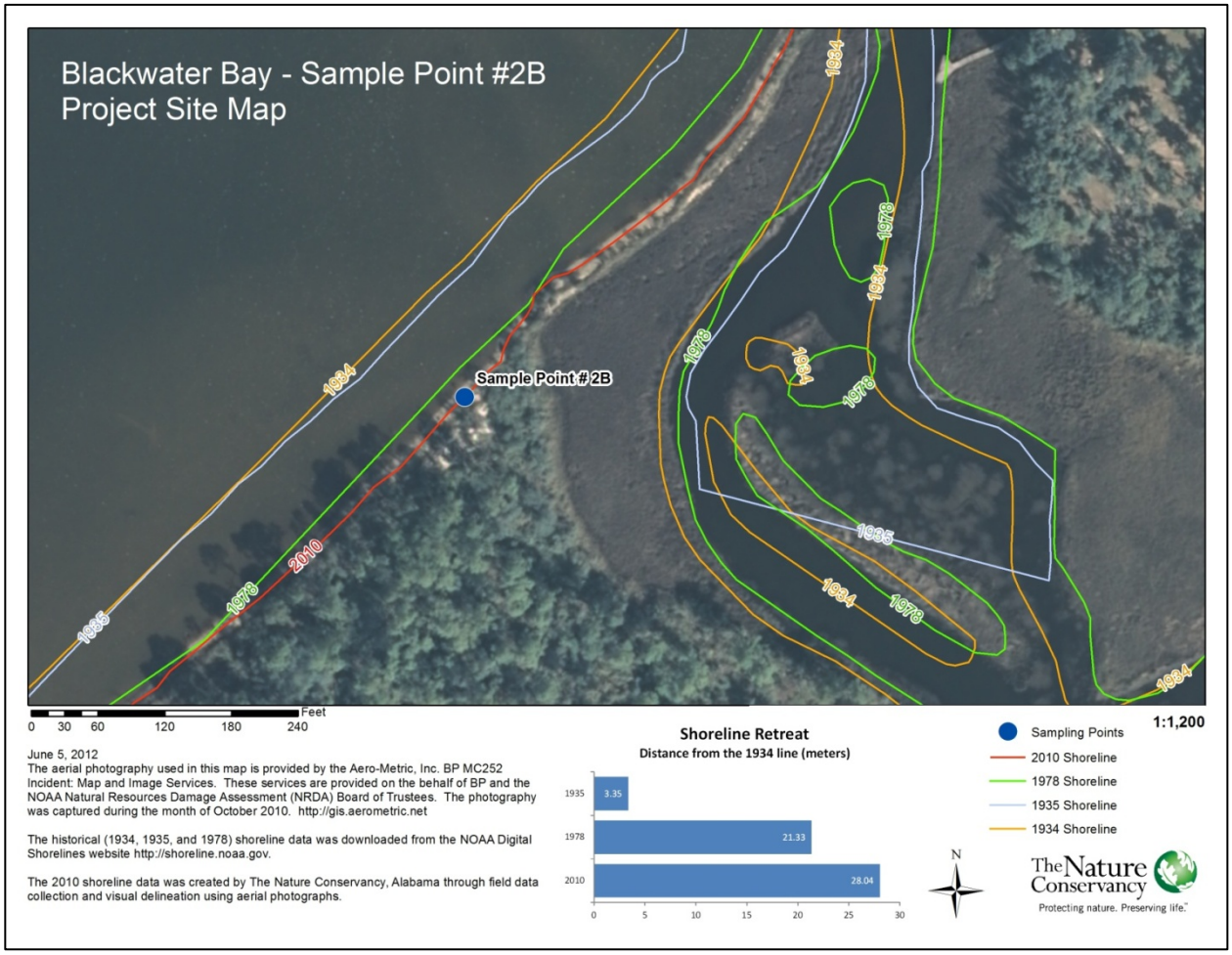

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Blackwater Bay - Sample Point #3B
Project Site Map

0 30 60 120 180 240 Feet

1:1,200

June 5, 2012
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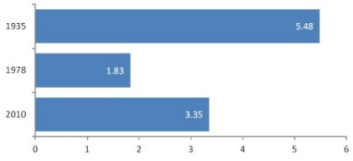
The 2010 shoreline data was created by The Nature Conservancy, Alabama through field data collection and visual delineation using aerial photographs.

Shoreline Retreat
Distance from the 1934 line (meters)



- Sampling Points
- 2010 Shoreline
- 1978 Shoreline
- 1935 Shoreline
- 1934 Shoreline

N

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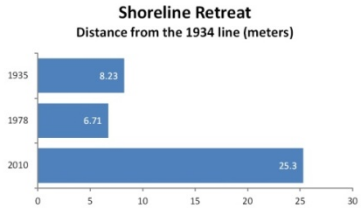
June 5, 2012
The aerial photography used in this map is provided by the Aero-Metric, Inc. BP MC252 Incident: Map and Image Services. These services are provided on the behalf of BP and the NOAA Natural Resources Damage Assessment (NRDA) Board of Trustees. The photography was captured during the month of October 2010. http://gis.aerometric.net

The historical (1934, 1935, and 1978) shoreline data was downloaded from the NOAA Digital Shorelines website http://shoreline.noaa.gov.

The 2010 shoreline data was created by The Nature Conservancy, Alabama through field data collection and visual delineation using aerial photographs.



Sampling Points
2010 Shoreline
1978 Shoreline
1935 Shoreline
1934 Shoreline

N

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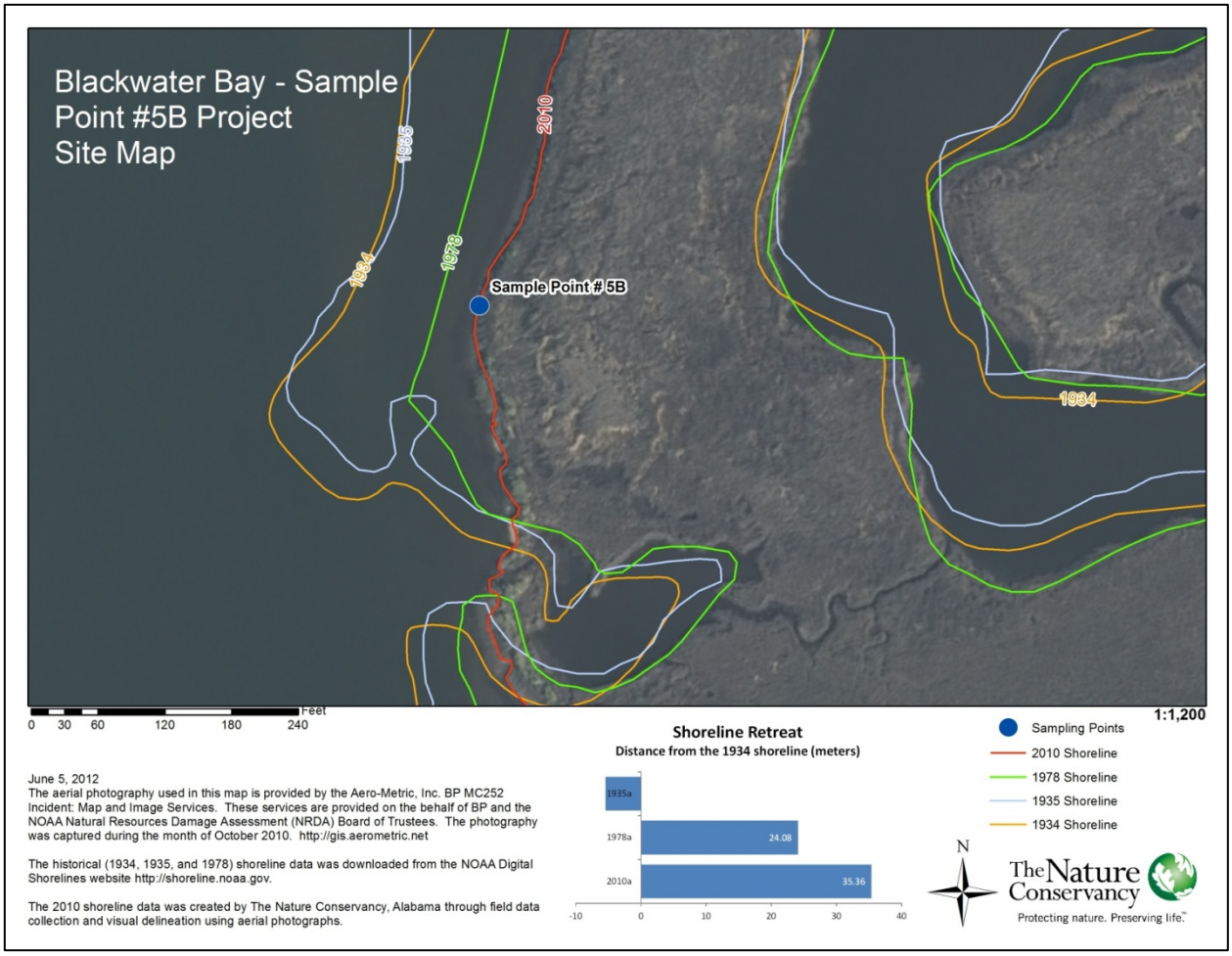

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