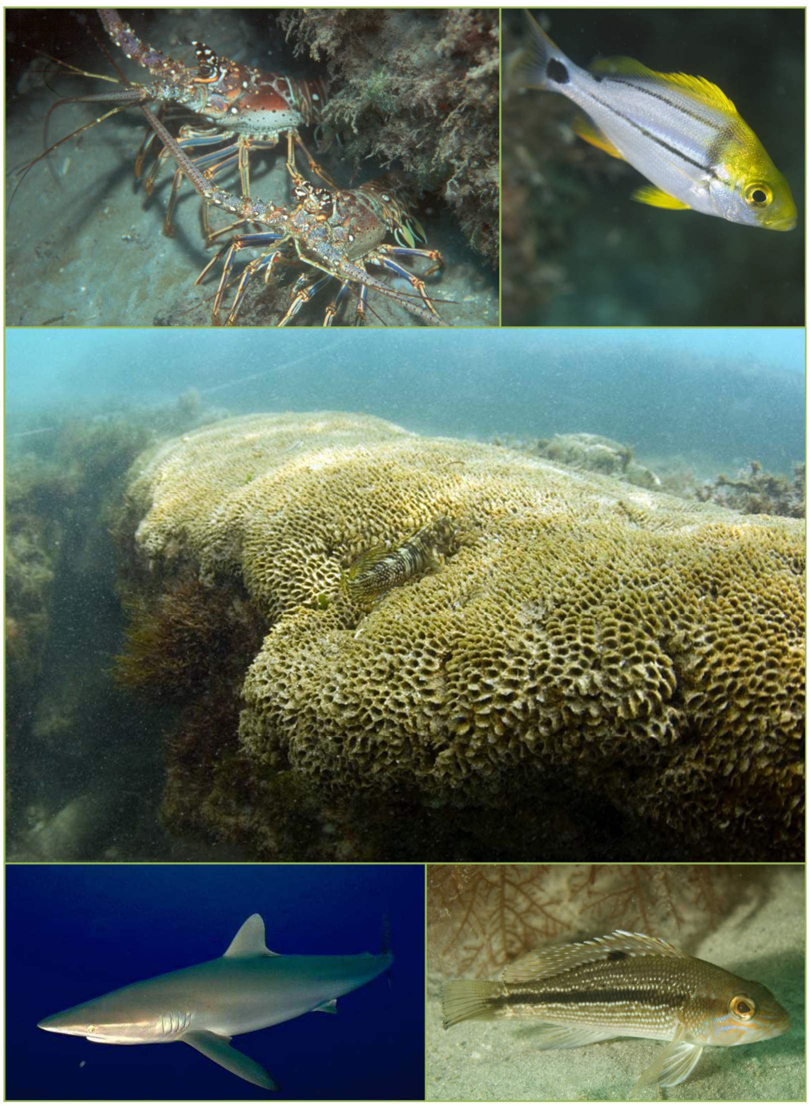
APPENDIX N

ESSENTIAL FISH HABITAT ASSESSMENT

November 2011
(Revised January 2012)

The St. Lucie County South Beach and Dune Restoration Project, St. Lucie County, Florida

Essential Fish Habitat Evaluation



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1. INTRODUCTION

St. Lucie County, Florida (the Applicant) proposed placement of approximately 610,000 cubic yards (cy) of sand over about 3.4 mi of shoreline in St. Lucie County, Florida in a Joint Coastal Permit Application, (SAJ-2009-03448) submitted to the United States Army Corps of Engineers (Corps) Jacksonville District Regulatory Division. The Corps, in reviewing the permit application for the proposed project, determined that the project required an Essential Fish Habitat (EFH) Evaluation as part of an Environmental Impact Statement for the proposed project.

For the St. Lucie County South Beach and Dune Project Environmental Impact Statement (EIS), the Corps serves as the lead federal agency for Endangered Species Act (ESA) Section 7 and the EFH consultations. Under the Outer Continental Shelf (OCS) Lands Act, the Bureau of Ocean Energy Management (BOEM) has jurisdiction over mineral resources on the OCS. As a federal agency, the BOEM is also subject to the requirements of the ESA and Magnuson Stevens Fishery and Conservation Management Act. While the proposed project includes a borrow area in state waters, the permit application also indicates plans to potentially dredge locations under BOEM jurisdiction. In addition, the Corps is currently developing a study for a federal project on part or all of the proposed project area and for OCS sand borrow sources. The EIS with this EFH evaluation may become part of the Corps feasibility study documentation. Therefore, BOEM serves as a cooperating federal agency for this project.

This document presents an EFH evaluation of the Applicant's preferred plan for nourishing the shoreline along the south St. Lucie County shoreline on Hutchinson Island, Florida as described in its permit application to the USACE. The applicant originally proposed nourishment of two areas of the shoreline extending from Florida Department of Environmental Protection (FDEP) Monuments R-87.7 south to R-115 +1,000 ft (**Figure 1**). The northern segment extends from FDEP Monuments R-87.7 to R-90.3, and the southern segment extends from FDEP Monuments R-98 to R-115 +1,000 (the St. Lucie County – Martin County line). On January 5, 2012, after the EFH analysis was substantially complete, the county provided the USACE a letter deleting the northern project component (from Monument R-87.7 to R-90.3) of the applicant's preferred plan. This results in a reduction of hardbottom impact to 0.57 acres of lower quality habitat (HB2 – see below), a considerable reduction in the hardbottom impacts of the preferred plan considered in this document. Other project components remain the same. The text of the EFH assessment has been adjusted only to reflect the changed project limits. The analysis has not been changed, and for the purposes of this assessment remains accurate and appropriate.

The assessment includes 1) a description of EFH in the project area; 2) a description of managed species and life stages within EFH and Habitat Areas of Particular Concern (HAPCs) in the project area; 3) an assessment of expected impacts to EFH; and 4) a discussion of mitigation measures required to avoid or lessen the severity of impacts to EFH.

The Applicant proposes the nourishment of portions of the St. Lucie County shoreline in the south portion of Hutchinson Island. Potential impacts to EFH could occur as a result of the offshore dredging and beach placement of sand along the existing beach.

The Applicant's preferred plan entails dredging sand sand from an offshore borrow site (**Figure 1**) and depositing it on the beach to rebuild the shoreline. The Applicant's preferred project design creates a 35-ft seaward extension of the existing beach. Dredging sand from the borrow site and placing it on the beach will affect components of soft bottom, hardbottom, and water column habitats in the project area (beach fill and borrow areas). On January 5, 2012, after substantial completion of the Biological Assessment, the applicant provided a letter to the USACE deleting the northern project segment (R-87.5 to R-90.3). This change significantly reduces the amount of hardbottom habitat impact of the applicant's preferred plan. The revised plan would require 596, 000 cy of sand. Other project components remain the same. Changes to this EFH includes revision here only to reflect the recently changed project area, volume, and impact acreage.

This assessment analyzes ramifications of sand dredging and sand placement on EFH. The EIS describes in detail alternatives to the Applicant's proposed action. This document addresses only the Applicant's proposed action as originally submitted in the permit applications.

The Applicant's preferred plan includes the use of an offshore sand source within St. Lucie Shoal, in state waters about three miles offshore of the project. Thus, the project includes three general construction activities: dredging, conveyance and pumping of dredged material from the hopper dredge to the beach, and fill grading on the beach.

A hopper dredge comprises a self-propelled floating plant capable of dredging material from the ocean bottom, storing it on board, transporting it to a disposal point, and dumping or pumping it. Ocean-going hopper dredges are typically large vessels (>200 ft in length) capable of storing 2,000 cy or more of sediment in their holds. These vessels typically operate on a 24-hr/day 7-day/week schedule with a crew of several dozen or more. During dredging operations, hopper dredges travel at a ground speed of 2 to 3 mph. They can dredge in depths up to about 80 ft and are equipped with twin propellers and twin rudders as well as bow and stern thrusters to provide the required maneuverability. Precise vessel location and elevation typically provided by a Real-time Kinematic (RTK) Global Positioning System (GPS) hardware/software system ensures accurate elevation and location control of the dredging activity.

For this project, the hopper dredge will dredge sand by dragging two suction heads across the approved borrow area. As the sand and water slurry fills the ship's hoppers, sand falls out of suspension, and the excess seawater flows overboard. When full of sand, the hopper dredge will move to a location offshore of the beach disposal area and pump the stored sand onto the beach through a submerged pipeline (subline) lying on the nearshore ocean bottom and emerging on the beach. The hopper dredge will always locate outside of the nearshore hardbottom areas to avoid any impacts to that habitat. Workboats (likely 2 or more 35 ft or larger vessels) will transport workers, required materials, and supplies to and from the hopper dredge. At least one and potentially two hopper dredges will likely work the project to provide continuous sand supply to the beach. The dredger will deploy a sufficient number of vessels to keep the operation running continuously (24 hr/day, 7 days/week).

On the beach, bulldozers will grade the discharged sand to the permitted cross section templates. Two bulldozers typically provide the necessary grading equipment. When necessary, a front-end loader with a rake bucket or similar attachment will attach additional sections of pipeline to allow construction to progress down the beach. In addition to this equipment, a few off-road, all-terrain vehicles and one or two pickup trucks provide the typical equipment set associated with a beach construction crew. The site will also typically include a construction shed on a skid, a porta-potty, and a double-walled fuel tank approved for use in this environment. The contractor may choose to work two locations (two crews) simultaneously as a cost-effective means of operating the project. Lights placed on the beach will allow nighttime work. State and Federal permits will specify conditions, including text and drawings defining the required lighting arrangements to avoid and minimize impacts to nesting turtles; however, the work will occur outside of peak turtle nesting season. An off-beach location provides Typically, contractors do not employ booster pumps to extend the beach pipeline beyond the capacity of the hopper dredge to pump the sand. As necessary, the contractor will extend the discharge pipe along the beach and/or move the location of the submerged pipeline running from the shore to the hopper dredge to pump sand efficiently. For a project this long (3.4 mi) with several “no-impact” access points through the nearshore hardbottom zone, the contractor may choose to move the location of the subline several times. This method allows the contractor to reduce the required total length of shore-parallel discharge pipeline, providing lower equipment costs and easier pumping of the sediments. St. Lucie County has identified and performed biological surveys on five subline locations. As discussed in the Pipeline Monitoring Plan (EIS Appendix P in the EIS), St. Lucie County has surveyed the pipeline corridors for presence of hardbottom, and will again survey the routes the summer prior to the construction. During construction, divers will inspect the submerged pipeline daily. They will collect pipe location information and check for any leaks or breaks in the pipe. Inspection will verify that the submerged pipeline has not moved outside the approved corridor, which would result in impacts to hardbottom additional to those identified for the permit.

To construct the submerged pipeline connecting the hopper dredge to the shoreline discharge pipeline, the contractor will connect multiple sections of fabricated pipe at an off-site location. When the submerged pipeline stretches to the desired length, the contractor seals the pipe ends. The contractor then pressurizes the pipe to test for leaks. When the pipe passes this test, the contractor floats the pipe into place and sinks it. The final location of the subline will be diver-verified. . The contractor may deploy up to five sublines at locations previously identified and approved by the FDEP and the USACE. Dredge pipeline running along the beach will extend about half of the way between pipeline corridors to the north and south, a maximum of about 3,000 ft, based on proposed and biologically surveyed corridors. space for the beach work crew to park and store some materials.

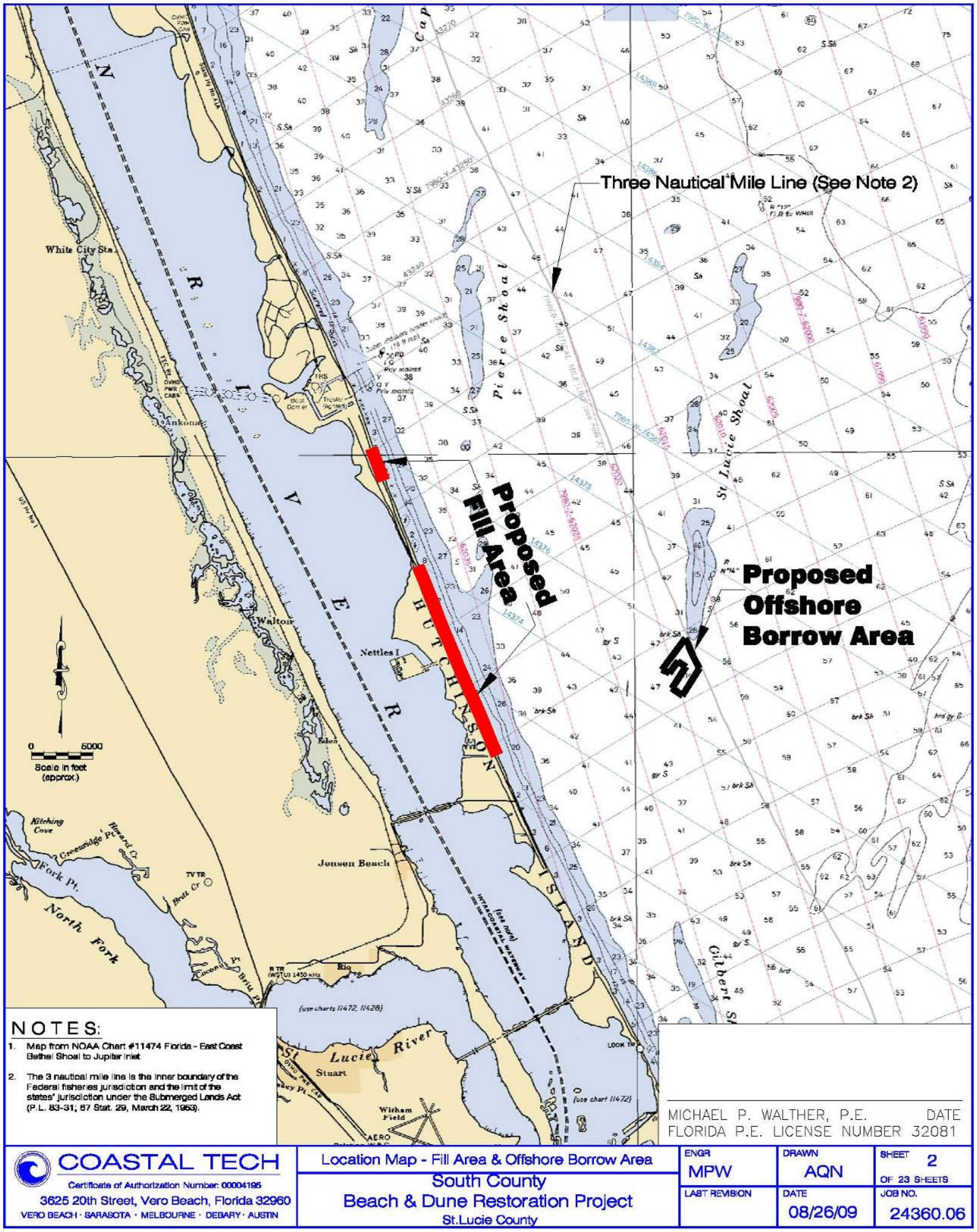

Figure 1. Project area along the St. Lucie County shoreline. Northern Project Segment Removed from the plan by St. Lucie County on January 5, 2012

On the beach, the contractor will create a long shore-parallel dike (several hundred feet) to provide a settling basin for the sand to fall from suspension within the sand-water slurry created to pump the material from the hopper dredge to the beach. Bulldozers continually maintain these dikes and move sand from the settling area into the beach template to maintain the settling basin while shaping the material into the beach template. Maintaining the settling area helps maintain water quality (measured as turbidity) within permitted limits.

If sand from upland mines provides the beach nourishment material, no in-water activity will occur and no pipelines will be required along the beach or in the water. Trucks filled at the sand mine will traverse the beach and deposit sand at the necessary location, where bulldozers shape the sand to fill the template. The same set of equipment remains necessary to shape the sand whether discharged through a pipeline or transported with a dump truck.

The Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. § 1801-1882) established regional Fishery Management Councils (FMCs) and mandated development of Fishery Management Plans (FMPs) to responsibly manage exploited fish and invertebrate species in U.S. Federal waters. The 1996 congressional re-authorization of this act as the Sustainable Fisheries Act included several reforms and changes. The Act charged the National Marine Fisheries Service (NMFS) with designating and conserving EFH for species managed under existing FMPs. The purpose of this change was to minimize, to the extent practicable, any adverse effects on habitat caused by fishing or non-fishing activities and to identify other actions that would encourage the conservation and enhancement of such habitat.

EFH is defined as “those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity” [16 U.S.C. § 1801(10)]. The final rule summarizing EFH regulations (50 CFR Part 600) outlines additional interpretation of the EFH definition. Waters, as previously defined, include aquatic areas and their associated physical, chemical, and biological properties used by fish and may include aquatic areas historically used by fish. Substrate includes “sediment, hardbottom, structures underlying the waters, and associated biological communities”. Necessary means “the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem”. Fish include finfishes, mollusks, crustaceans, and all other forms of marine animal and plant life other than marine mammals and birds, whereas “spawning, breeding, feeding, or growth to maturity” covers the complete life cycle of species of interest.

The South Atlantic Fishery Management Council (SAFMC), the FMC responsible for managing fisheries and habitat found in the project area waters, has produced several FMPs for single and mixed groups of species. A single document published by the SAFMC (1998) amended all of these FMPs — including those for penaeid shrimps, spiny lobster, red drum, snapper-grouper (reef fishes), and coastal migratory pelagics — to address EFH within the South Atlantic region. In addition to the FMPs prepared by the SAFMC, the Highly Migratory Species Management Unit, Office of Sustainable Fisheries, NMFS manages highly migratory species (e.g., tunas, billfishes, sharks, and swordfish). This NMFS office prepared an FMP for highly migratory species including descriptions of EFH for sharks, swordfish, and tunas (NMFS 2009). Some of the species managed by SAFMC and NMFS also fall under the jurisdiction of the Atlantic States Marine Fisheries Commission (ASMFC).

Within the EFH designated for various species, particular areas termed HAPC also are identified. These areas either play important roles in the life history (e.g., spawning areas) of federally managed fish species or are especially vulnerable to degradation from fishing or other human activities.

2. EFH IN THE PROJECT AREA AND MANAGED SPECIES

2.1. EFH IN THE PROJECT AREA

The comprehensive EFH amendment (SAFMC 1998) and Fishery Ecosystem Plan (SAFMC 2009b) broadly divided important habitats of the South Atlantic region into two categories (estuarine/inshore and marine/offshore), with many subcategories under each. Marine/offshore habitats include coastal, open shelf, live/hardbottom, shelf edge, and lower shelf (SAFMC 1998). The project area encompasses only marine/offshore habitats, specifically nearshore hardbottom, soft bottom (surf zone and sand shoals), and water column EFH. The following sections address these broad habitats in terms of salient characteristics in and near the project area.

2.1.1. HARDBOTTOM

Nearshore hardbottom, the primary EFH found in the project fill area, supports more species than either the soft bottom or water column habitats. Nearshore hardbottom provides EFH for federally managed coral, coral reefs, and live/hardbottom, spiny lobster, coastal pelagic species, and reef fishes. In a review of available information concerning nearshore hardbottom, CSA International, Inc. (2009) reported that 257 fish species from 68 families use nearshore hardbottom in eastern Florida. Beach rock (coquina) of the Anastasia Limestone Formation forms the nearshore hardbottom outcrops along the eastern Florida shoreline (Davis 1997; CSA International, Inc. 2009). High wave energy of the surf zone subjects these hardbottom features, which parallel the current shoreline, to frequent burial and erosion.

Nearshore hardbottom features in the project area are augmented by the reef-building activities of the sabellariid polychaete *Phragmatopoma lapidosa*. This species, which forms large colonies commonly referred to as worm reefs (Kirtley and Tanner 1968; McCarthy 2001), is a foundational or structural species. The worm reef colonies, composed of sand grains cemented together to form rugose structures, add relief and structural complexity to existing natural and artificial hardbottom. The growth of worm reef depends on a combination of the available hard substrate, wave energy, sediment availability, and larval supply (McCarthy et al. 2003). Worm reef supports associated assemblages of organisms, such as decapod crustaceans (Gore et al. 1978), which attract fish species.

Total acreage estimates for nearshore hardbottom in the project area determined from aerial imagery were 10.4 acres in August 2008 photographs and 12.97 acres in October 2010 photographs. While the exact cause of differences in acreage of hardbottom between 2008 and 2010 is unknown, it can be attributed, in part, to the months the photos were collected and the ephemeral nature of portions of the reef. Later summer/fall storms often erode project area beaches, and may thus expose or bury nearshore sedimentary rock. CSA International, Inc. (2010a) surveyed cross-shelf transects to quantify the physical and biological characteristics of nearshore hardbottom and ground truth aerial imagery shot in the project area. The field survey was based on

22 permanent transects installed at R-77.7, R-78.7, R-80.4, R-82.8, R-85, R-86.3, R-88.7, R-90.4, R-92, R-93.5, R-100, R-101, R-102, R-103.2, R-104.5, R-105.9, R-109.2, R-110, R-110.5, and R-112 in St. Lucie County and R-1 and R-3 in Martin County. Each transect extended from the landward edge of exposed nearshore hard bottom to the easternmost extent of exposed hard bottom does not exceed 150 m in length. Water depths along the transects range from 0 m to 7 m (0 ft to 23 ft). Transects were sampled with diver-held video, in-situ quadrats, and point intercept assessments to quantify biota and physical habitat attributes. .

Physical structure of the hardbottom included larger shore-parallel features with low to medium relief, isolated low-relief ledges, and large flat boulders (the latter found only along the offshore extent of the existing hardbottom features). Algae dominated the recorded biota, but the community also included sessile invertebrates such as hydrozoans, sponges, and wormrock (*Phragmatopoma lapidosa*). Divers observed very few octocoral colonies and these located outside of the project area along Transect R-78.7. The only stony corals observed were solitary cup corals (*Phyllangia americana americana*). These were recorded in a single quadrat along transect R-110.5. Based on the spatial distribution of the biota three nominal communities were recognized. These are not bounded discrete "communities" but simply assemblages of differing biotic composition that reflect different patches within a larger mosaic of patches exhibiting different disturbance-colonization patterns. Community One (HB1) consists of low- to medium-relief hardbottom with a significant wormrock component (approximately 10% coverage along monitoring transects) relatively close to shore. HB1 is composed of hydroids, encrusting sponges, macroalgae, and turf algae. The physical characteristics and location of this community type facilitate the establishment and proliferation of wormrock, while also supporting a large percent cover of canopy-forming red algae. HB1 provides shelter and nutrient source to many invertebrate, fish, and turtle species. Additionally, wormrock builds reef and contributes to the habitat complexity and biological diversity of the nearshore environment.

Community Two (HB2) consists of less biologically complex, low relief, consolidated coquina rock ledges. The well-defined, undercut ledges include exposed coquina rock with little or no biotic cover. The habitat mostly provides physical refuge space (CSA International 2010a). This community did not have the wormrock component or robust macroalgae evident in HB1. The Applicant concluded that HB2 represented hardbottom substrate located in areas subject to the relatively constant physical dynamics of the nearshore environment, specifically sand movement, scouring, and alternating sand burial and subsequent re-exposure.

Community Three (HB3) consists of faunal species that were not observed in the more nearshore hard bottom areas including spiny lobster (*Panulirus argus*), octocorals (*Leptogorgia* sp.), holothuroids, and a variety of encrusting sponges. The hardbottom is characterized by large (1 to 3 m diameter), flat rock structures found in deeper (3 to 4 m) water farther from the shoreline than HB1 or HB2. Because HB3 is further offshore, it will not incur impacts from the proposed project and thus will not receive detailed assessment in further sections of the document.

An investigation conducted during 2009 (CSA International, Inc. 2010b) documented the fish assemblage associated with the nearshore hardbottom located in the project fill area. The extant assemblage included primarily reef-associated species generally expected for the region (Gilmore et al. 1981; CSA International, Inc. 2009). Of 70 species recorded, the numerically dominant species included black margate (*Anisotremus surinamensis*), silver porgy (*Diplodus argenteus*), newly settled grunts (*Haemulon* spp.), sailors choice (*H. parra*), hairy blenny (*Labrisomus nuchipinnis*), and porkfish (*A. virginicus*). Represented by nine taxa, the grunt family (Haemulidae) also provided part of the taxonomic and numeric dominance structure in the project area. In total, 24 federally managed species occurred on the nearshore hardbottom (**Table 1**). Represented primarily by the grunt and jack families, many of these managed species also occurred as newly settled or juvenile stage individuals, indicating that the area serves as effective juvenile habitat for most of the managed species recorded. The snapper-grouper complex accounted for most of the managed species, but CSA International, Inc. (2010b) also recorded two other managed species, a coastal pelagic species (Spanish mackerel, *Scomberomorus maculatus*) and a coastal shark (nurse shark, *Ginglymostoma cirratum*). During the survey, divers also observed other economically important, but not federally managed species (e.g., snook [Centropomus undecimalis]. Biologists saw bonnethead shark (*Sphyrna tiburo*), tarpon (*Megalops atlanticus*), cobia (*Rachycentron canadum*), king mackerel (*Scomberomorus cavalla*), and Florida pompano (*Trachinotus carolinus*) near or over hardbottom, but did not report these species during timed swims or in strip transects. Although not a managed species, the divers recorded striped croaker (*Bairdiella sanctaeluciae*), a species of special concern (Gilmore and Snelson 1992), at five of the survey transects.

Table 1. Fish taxa and families observed during timed swims and along strip transects in the St. Lucie County South Beach Project area (Species shown in bold are managed by the South Atlantic Fishery Management Council [From: CSA International, Inc. et al. 2009]).

Family		Species		Timed Swim	Strip Transect
Common Name	Scientific Name	Common Name	Scientific Name		
Carpet sharks	Ginglymostomatidae	**Nurse shark**	***Ginglymostoma cirratum***	●	●
Moray eels	Muraenidae	Green moray	*Gymnothorax funebris*	●	●
		Purplemouth moray	*Gymnothorax vicinus*		●
Lizardfishes	Synodontidae	Inshore lizardfish	*Synodus foetens*	●	●
Toadfishes	Batrachoididae	Oyster toadfish	*Opsanus tau*	●	
Scorpionfishes	Scorpaenidae	Spotted scorpionfish	*Scorpaena plumieri*		●
Snooks	Centropomidae	Common snook	*Centropomus undecimalis*	●	●
Sea Basses	Serranidae	Belted sandfish	*Serranus subligarius*	●	●
		Black sea bass	***Centropristis striata***	●	●
		Sand perch	*Diplectrum formosum*		●
		Whitespotted soapfish	*Rypticus maculatus*		●
Cardinalfishes	Apogonidae	Twospot cardinalfish	*Apogon pseudomaculatus*	●	●
Jacks	Carangidae	Atlantic bumper	*Chloroscombrus chrysurus*		●
		Bar jack	***Caranx ruber***		●
		Blue runner	***Caranx crysos***		●

Table 1. (Continued).

Family		Species		Timed Swim	Strip Transect
Common Name	Scientific Name	Common Name	Scientific Name		
		Crevalle jack	***Caranx hippos***	●	●
		Greater amberjack	***Seriola dumerili***		●
		Lookdown	*Selene vomer*		●
		Round scad	*Decapterus punctatus*		●
		Yellow jack	***Caranx bartholomaei***	●	●
Snappers	Lutjanidae	**Gray snapper**	***Lutjanus griseus***	●	●
		Lane snapper	***Lutjanus synagris***	●	●
		Mahogany snapper	***Lutjanus mahogoni***		●
		Yellowtail snapper	***Ocyurus chrysurus***		●
Mojarras	Gerreidae	Flagfin mojarra	*Eucinostomus melanopterus*		●
		Mojarras (newly settled)	Gerreidae (newly settled)	●	●
Grunts	Haemulidae	**Black margate**	***Anisotremus surinamensis***	●	●
		Cottonwick	***Haemulon melanurum***		●
		French grunt	***Haemulon flavolineatum***		●
		Pigfish	*Orthopristis chrysoptera*	●	●
		Porkfish	***Anisotremus virginicus***	●	●
		Sailors choice	***Haemulon parra***	●	●
		Spanish grunt	***Haemulon macrostomum***		●
		Tomtate	***Haemulon aurolineatum***	●	●
		White grunt	***Haemulon plumieri***	●	●
Porgies	Sparidae	**Sheepshead**	***Archosargus probatocephalus***	●	●
		Silver porgy	*Diplodus argenteus*	●	●
		Spottail pinfish	*Diplodus holbrooki*		●
Drums	Sciaenidae	Cubbyu	*Pareques umbrosus*	●	●
		Drums (newly settled)	Sciaenidae (newly settled)		●
		High-hat	*Pareques acuminatus*	●	●
		Striped croaker	*Bairdiella sanctaeluciae*	●	●
Goatfishes	Mullidae	Spotted goatfish	*Pseudupeneus maculatus*	●	●
Sweepers	Pempheridae	Glassy sweeper	*Pempheris schomburgkii*	●	●
Spadefishes	Ephippidae	**Atlantic spadefish**	***Chaetodipterus faber***	●	●
Angelfishes	Pomacanthidae	Blue angelfish	*Holacanthus bermudensis*		●
		French angelfish	*Pomacanthus paru*		●
		Gray angelfish	*Pomacanthus arcuatus*	●	●
Damselfishes	Pomacentridae	Cocoa damselfish	*Stegastes variabilis*	●	●
		Dusky damselfish	*Stegastes fuscus*		●
		Sergeant major	*Abudefduf saxatilis*	●	●
Wrasses	Labridae	Blackear wrasse	*Halichoeres poeyi*	●	●
		Bluehead	*Thalassoma bifasciatum*	●	●
		Puddingwife	***Halichoeres radiatus***	●	●
		Slippery dick	*Halichoeres bivittatus*	●	●
Parrotfishes	Scaridae	Parrotfish (newly settled)	Scaridae (newly settled)	●	●
Labrisomid blennies	Labrisomidae	Hairy blenny	*Labrisomus nuchipinnis*	●	●
		Saddled blenny	*Malacoctenus triangulatus*	●	●
Combtooth blennies	Blenniidae	Molly miller	*Scartella cristata*	●	●
		Seaweed blenny	*Parablennius marmoreus*	●	●

Table 1. (Continued).

Family		Species		Timed Swim	Strip Transect
Common Name	Scientific Name	Common Name	Scientific Name		
Gobies	Gobiidae	Bridled goby	*Coryphopterus glaucofraenum*		●
Surgeonfishes	Acanthuridae	Blue tang	*Acanthurus coeruleus*	●	
		Doctorfish	*Acanthurus chirurgus*	●	●
		Ocean surgeonfish	*Acanthurus bahianus*		●
Barracudas	Sphyraenidae	Great barracuda	*Sphyraena barracuda*	●	
		Guaguanche	*Sphyraena guachancho*	●	●
Mackerels	Scombridae	**Spanish mackerel**	***Scomberomorus maculatus***	●	●
Triggerfishes	Balistidae	**Gray triggerfish**	***Balistes capriscus***		●
Puffers	Tetraodontidae	Bandtail puffer	*Sphoeroides spengleri*	●	●
		Sharpnose puffer	*Canthigaster rostrata*		●
			Total Taxa	**70**	
			Total Families	**29**	

2.1.2. SOFT BOTTOM (NEARSHORE)

Nearshore soft bottom (or surf zone) comprises the innermost portion of the sedimentary habitat within the project area. SAFMC (1998, 2009b) identified this soft bottom nearshore as EFH for penaeid shrimps, coastal pelagic fishes and red drum. Along the St. Lucie County project shoreline, nearshore soft bottom occurs continuously, punctuated by hardbottom outcrops. This habitat supports a variety of infaunal (e.g., annelid worms, bivalves, gastropods, and crustaceans) and epifaunal (e.g., crabs, shrimps, and other crustaceans) invertebrates, many of which fishes feed upon. Species such as kingfish (*Menticirrhus* spp.), sand drum (*Umbrina coroides*), and pompano feed extensively on infaunal invertebrates in soft bottom habitat. Mole crab (*Emerita talpoida*) and beach clam (*Donax* sp.) are also important prey species. Small fishes such as anchovies (*Anchoa* spp.) and herrings (*Harengula* spp.), important prey for larger managed species, also use the nearshore soft bottom as habitat.

The spread of sand produced by the Applicant's proposed action will permanently bury and/or asphyxiate most infaunal and epifaunal soft bottom organisms. Most of these species are able to recolonize the newly placed sand by larval recruitment or immigration by adults but their survival and growth will depend on how well the borrow site sand matches the existing/native beach sand (Peterson et al. 2000).

2.1.3. SOFT BOTTOM (OFFSHORE)

The sand shoals comprising the offshore borrow area include well-developed, shore-face connected and isolated linear shoals with a north-to-south orientation. These features are depositional in nature and exhibit varying degrees of morphological change in response to local hydrodynamic conditions. Sand shoals form as an irregularity on the seafloor and then grow in response to local coastal processes (i.e., waves, tides, and currents). Duane et al. (1971) suggest that the shoals are from the Holocene age.

Sand shoals, sedimentary habitats identified as EFH, support a variety of invertebrates and demersal fishes, coastal pelagic species and some highly migratory species, particularly coastal sharks.

Invertebrates utilizing shoals include infaunal and epifaunal species represented primarily by annelid worms, gastropods, bivalves, crustaceans, and echinoderms (Table 2; revised from CSA 2011 to include total density values). Sites sampled included reference sites outside the shoal and borrow area, several borrow area sites, and samples of the refuge patch that all dredging will avoid (CSA (2011) provides a full description of sampling locations and methods.

Table 2. Benthic Infauna found at three Characteristic Sites Associated with Proposed Borrow Area

		Reference Sites		Borrow Area Sites		Refuge Patch Sites	
Class	**Taxon**	**Counts**	**% Total Counts**	**Counts**	**% Total Count**	**Counts**	**% Total Count**
CRUSTACEANS	Copepoda	491		597		2374	
	Ostracoda	16		31		22	
	Amphipoda	26		62		21	
	Decapoda	13		19		27	
	Cirripedia	14		60		955	
	Isopoda	4		-		6	
	Mysida	3		7		10	
	Cumacea	1		2		-	
	Insecta	-		-		1	
Subtotal		*568*	*9.06*	*778*	*6.73*	*3416*	*31.99*
MOLLUSCS	Bivalvia	1241		1490		1002	
	Gastropoda	67		189		52	
	Scaphopoda	36		4		8	
	Polyplacophora	-		8		8	
Subtotal		*1344*	*21.44*	*1691*	*14.64*	*1070*	*10.02*
ANNELIDS	Polychaeta	2221		4703		2409	
Subtotal		*2221*	*35.43*	*4703*	*40.71*	*2409*	*22.56*
ECHONODERMS	Echinoidea	26		56		29	
	Holothuroidea	8		12		3	
	Ophiuroidea	-		12		1	
	Echinozoa	-		10		-	
Subtotal		*34*	*0.54*	*90*	*0.78*	*33*	*0.31*
OTHERS	Nemata	1731		3782		3277	
	Nemertea	349		435		423	
	Osteichthyes	4		11		16	
	Hydrachnidae	2		9		4	
	Platyhelminthes	2		18		9	
	Salpida	9		23		8	
	Tunicata	4		6		14	
	Chaetognath	-		1		-	
	Sipuncula	-		4		-	
	Unknown	-		2		1	
Subtotal		*2,101*	*33.52*	*4,291*	*37.14*	*3,752*	*35.13*
TOTAL ORGANISMS		***6,268***		***11,553***		***10,680***	
Density (organisms/m^2)		***33,483/m^2***		***49,372/m^2***		***45,641/m^2***	

Most of the species in Table 2 are used as a food source by demersal feeding fishes. A number of fishes have been documented to use sand shoals as habitat along the eastern coast of the United States (Able and Hagan 1995; Slacum et al. 2006; Walsh et al. 2006; Vasslides and Able 2008; Estuarine, Coastal and Ocean Science, Inc. 2009). CSA International, Inc. (2009) generally characterized the use of sand shoals by fishes at several spatial scales.

- At broad scales (i.e., 1 to 100 km^2), fishes may use shoal features as guideposts during migrations, local movements, or spawning.
- At intermediate scales (i.e., tens to hundreds of square meters), different parts of individual shoals may represent different foraging areas or shelter from predators or waves and currents.
- At smaller scales (i.e., <10 cm^2), sediment texture (i.e., fine sand to shell fragments), variable bedform structures, and biogenic structures may provide important predator refuge or foraging areas.

To gain a better understanding of the importance of the east Florida sand shoals, including the St. Lucie Shoal, to fishes, Estuarine, Coastal and Ocean Science, Inc. (2009) synthesized unpublished information, available data, and findings of interviews with local fishers. The report inferred that more than 200 species potentially use shoals for orientation, refuge, spawning, and feeding sites. Interviews with fishermen confirmed that shoals provide aggregation points for small pelagic fishes such as menhaden (*Brevoortia tyrannus*), Spanish sardine (*Sardinella aurita*), thread herring (*Opisthonema oglinum*), and false pilchard (*Harengula jaguana*). These species are important prey for numerous managed species, particularly those from the coastal pelagic and highly migratory fish species groups. The analysis concluded that adequate assessment of shoal fish habitat functions would require field sampling. The most recent field assessment of the shoals in the region (Hammer et al. 2005), focused sampling efforts in federal waters offshore the proposed St. Lucie Shoal borrow area. This field assessment encompassed eight sand resource areas offshore central and south Florida, bounded to the north by Brevard County and to the south by Martin County (inclusive). Within the sand resource areas, six specific borrow areas were examined. One of these borrow areas included the portion of the St. Lucie Shoal located in Federal waters. The study concluded, "fishes collected by trawling in the nine sand resource areas reflected the transitional regional species pool of east-central Florida that includes a complex of tropical, subtropical, and warm temperate taxa."

2.1.4. WATER COLUMN

The water column provides support to *Sargassum*, coastal pelagic fishes, dolphin, wahoo, and highly migratory species, as well as the planktonic larvae of most of the managed fishes and invertebrates in the region. Important attributes of the water column include hydrodynamics, temperature, salinity, and dissolved oxygen. The hydrodynamic regime of the project area is driven by winds, tides, and currents (especially the Gulf Stream). Tropical and extra-tropical storms generate ground swells that will break as high-energy waves on the shoreline. This wave energy re-suspends fine sediments into the water column for extended periods and moves considerable amounts of sand in the nearshore environment. Temperature of the water column in the project area frequently drops to very low levels (~6ºC) due to summer upwelling events (Smith 1983; McCarthy 2005). Plumes of cold water will kill or stun fishes and invertebrates in the area especially those with tropical affinities. Limited salinity data for the area indicates expected values for the coastal ocean (~34 psu - practical salinity units) with uncomplicated depth profiles (Hammer et al. 2005). Salinity in the project area is subject to change following large discharges of freshwater from St. Lucie Inlet. These discharges are generally associated with summer months, particularly during the peak of hurricane season (August and September).

2.2. MANAGED SPECIES

Species distribution maps and habitat association tables provide the foundations of EFH determinations. SAFMC reviewed its maps of managed species and defined EFH for species groups when fish distributions coincided with hardbottom, soft bottom, or water column of the mapped areas.

Of the species or species groups managed by the SAFMC and NMFS, the following may occur within the project area:

- Sargassum
- Coral, coral reefs, and live/hardbottom habitats
- Penaeid shrimps
- Spiny lobster
- Red drum
- Coastal pelagic fishes
- Reef fishes (snapper-grouper complex)
- Dolphin and wahoo
- Highly migratory species

Members of these groups occur in the project area for, at minimum, a portion of their life history. The following subsections briefly describe the EFH for these species and their respective life stages, as described in the relevant FMPs.

2.2.1 SARGASSUM

Sargassum is a seaweed that permanently drifts at the surface in warm waters (SAFMC 2002). The FMP for *Sargassum* states that EFH-HAPC includes all life stages in South Atlantic State Waters (SAFMC 2002). Drifting *Sargassum* occurs in the water column of the project area, particularly over the borrow site. *Sargassum* covers nearly 2,000,000 mi^2 at a density of 2 to 5 tons/mi^2 (Dooley 1972). *Sargassum* normally occurs in scattered individual mats ranging from 10 to 50 cm (4 to 20 in.) in diameter. Mats typically remain several hundred meters apart from one another (Butler et al. 1983). Accumulation of *Sargassum* and other flotsam in lines often indicates a convergence zone between water masses. Many species (including juvenile sea turtles and pelagic fishes) will gather along convergence zones regardless of *Sargassum* or other flotsam presence (Carr 1986).

As many as 100 fish species associate closely with floating *Sargassum* at some point in their life cycle, but only two spend their entire lives there: the sargassumfish and the sargassum pipefish (Adams 1960; Dooley 1972; Bortone et al. 1977; SAFMC 2002). Most fishes associated with *Sargassum* are temporary residents, such as juveniles of jacks, triggerfishes, flyingfishes, and filefishes, which reside in shelf or coastal waters as adults (McKenney et al. 1958; Dooley 1972; Bortone et al. 1977; Moser et al. 1998; Comyns et al. 2002). However, several larger species of recreational or commercial importance, including dolphin, yellowfin tuna, blackfin tuna, skipjack tuna, little tunny, and wahoo, feed on the small fishes and invertebrates attracted to *Sargassum* (Morgan et al. 1985). The abundance and diversity of fishes associated with *Sargassum* are related to the size and morphology of the floating mat (Moser et al. 1998). *Sargassum* is also considered an HAPC for dolphin and wahoo (SAFMC 2003).

2.2.2. CORAL, CORAL REEFS, AND LIVE/HARDBOTTOM HABITATS

The FMP for coral, coral reefs, and live/hard bottom habitats cover a range of organisms and structural features, including reef-building stony corals, black corals, octocorals, sea pens, sea pansies, and hardbottom. The regional distributions and ecological requirements of sea pens and sea pansies are not well known, but their recognized EFH includes muddy, silty bottoms in subtidal to outer shelf depths within a range of salinity and light penetration that includes the offshore borrow site proposed for this project.

The FMP also covers a live/hardbottom category that includes nearshore hardbottom. **Section 2.1.1** describes nearshore hardbottom habitat occurring in the project area. On a broad scale, patches of nearshore hardbottom are distributed along the east coast of Florida. This habitat, which provides important ecological functions for plants, invertebrates, marine turtles, and fishes of the region (CSA International, Inc. 2009), is considered EFH for coastal pelagic and reef fish management units (SAFMC 1998, 2009b). The reef-building polychaete *Phragmatopoma lapidosa* augments the structural complexity of regional nearshore hardbottom. *Phragmatopoma* worm reefs found on nearshore hardbottom in water depths of 0 to 4 m comprise the only HAPC for coral, coral reefs, and live/hardbottom within the project area..

2.2.3. PENAEID SHRIMPS

Penaeid shrimps managed by the SAFMC and found in the project area include brown shrimp (*Farfantepenaeus aztecus*), pink shrimp (*F. duorarum*), and white shrimp (*Litopenaeus setiferus*).

EFH for penaeid shrimps encompasses the series of habitats used during their life history (SAFMC 1998), which has two basic phases: the adult/juvenile benthic phase and the planktonic larval/post-larval phase. Benthic adults aggregate to spawn in shelf waters over coarse, calcareous sediments. Eggs attached to the females' abdomen hatch into planktonic larvae. These larvae and subsequent post-larval shrimps feed on zooplankton in the water column and make their way into inshore waters. For the inshore phase of their life history, post-larval shrimps settle to the bottom and resume a benthic existence in estuaries such as the Indian River Lagoon where they seek rich food sources as well as shelter from predation. Juvenile penaeid shrimps prefer shallow-water habitats with nearby sources of organic detritus such as estuarine emergent wetlands or mangrove fringe.

2.2.4. SPINY LOBSTER

Spiny lobster EFH consists of hardbottom, coral reefs, crevices, cracks, and other structured bottom in shelf waters. Juvenile habitat occurs in nearshore waters and ranges from massive sponges, mangrove roots, and seagrass meadows to soft bottom with macroalgal clumps. Spiny lobster has a complex series of planktonic larvae that are transported by small-scale currents as well as the Gulf Stream (SAFMC 1998). At least two life stages (adults and planktonic larvae) occur in the project area. Adult spiny lobsters frequently occur in holes, crevices, and under ledges provided by nearshore and offshore hardbottom habitats in the region. On occasion, these adults migrate, walking in groups or single file lines along the open seafloor (Kanciruk and Herrnkind 1978). Various stages of planktonic spiny lobster larvae are expected to occur in the water column of the project area, mostly in the vicinity of the borrow site where the advective effect of offshore currents would prevail.

2.2.5. RED DRUM

Red drum (*Sciaenops ocellata*), a member of the drum family Sciaenidae, occur in the project area. EFH for red drum includes tidal freshwater, estuarine emergent vegetated wetlands (e.g., flooded salt marshes, brackish marsh, and tidal creeks), mangrove shorelines, seagrasses, oyster reefs and shell banks, unconsolidated bottom (e.g., soft sediments), ocean high-salinity surf zones, and artificial reefs (SAFMC 1998, 2009b). Red drum EFH particular to the project area includes ocean high-salinity surf zone.

HAPCs for red drum include coastal inlets, state-designated nursery habitats of particular importance to red drum, documented sites of spawning aggregations, and habitats for submerged aquatic vegetation (SAFMC 1998). In many areas throughout the geographic range of red drum, mature adults migrate from inshore waters to spawn in coastal and offshore areas. Tagging studies conducted in inshore waters have documented that red drum migrate to ocean inlets such as St. Lucie Inlet or Ft. Pierce Inlet, presumably to spawn (Stevens and Sulak 2001; Tremain et al. 2004). Adult and subadult red drum occur in the nearshore waters of the region during late summer and fall months.

Other sciaenids found in the project area include kingfish, sand drum, and striped croaker. These species, not managed by the SAFMC, may serve as prey for other managed species in the project area (e.g., reef fishes and coastal pelagic species). The State of Florida lists striped croaker as a species of special concern.

2.2.6. COASTAL PELAGIC FISHES

The major coastal pelagic families occurring in nearshore waters of the project area are ladyfish (*Elops saurus*), anchovies (*Anchoa* spp.), herrings (*Harengula* spp., *Opisthonema oglinum*, and *Sardinella aurita*), mackerels (*Scomberomorus* spp.), jacks (*Caranx* spp., *Trachinotus* spp.), mullets (*Mugil* spp.), bluefish (*Pomatomus saltatrix*), and cobia. Coastal pelagic species migrate over the region's shelf waters throughout the year. Some species form large schools (e.g., Spanish mackerel), while others travel alone or in smaller groups (e.g., cobia). Many coastal pelagic species inhabit the nearshore environment along beaches and barrier islands of eastern Florida (Gilmore et al. 1981; Peters and Nelson 1987). Commonly occurring species in the project area include anchovies, menhaden, scaled sardine (*Harengula jaguana*), striped mullet (*Mugil cephalus*), hardhead catfish (*Ariopsis felis*), and Florida pompano (*Trachinotus carolinus*). Larger concentrations of anchovies, herrings, and mullets that aggregate in nearshore soft or hardbottom areas may attract larger predatory species (particularly bluefish, blue runner [*Caranx crysos*], jack crevalle [*Caranx hippos*], requiem sharks [*Carcharhinus* spp., *Negaprion brevirostris*, and *Galeocerdo cuvier*], and Spanish and king mackerel). The distribution of most species depends on water temperature and quality, which vary spatially and seasonally.

Coastal pelagic species managed by the SAFMC include cobia, Spanish mackerel, king mackerel, cero (*Scomberomorus regalis*), and little tunny (*Euthynnus alletteratus*) (SAFMC 1998). Cero rarely occurs north of Jupiter Inlet and, therefore, is not included in **Table 2**. Various life stages of all these species may occur in the project area (**Table 2**).

Table 2. Coastal pelagic fishes and life stages with Essential Fish Habitat identified within the project area (Adapted from: South Atlantic Fishery Management Council, 1998).

Common Name	Species	Eggs and Larvae	Juveniles/Subadults	Adults
Cobia	*Rachycentron canadum*	Shelf waters	Shelf waters; artificial and natural hardbottom; associates with larger nekton (i.e., sharks, rays, sea turtles)	Shelf waters; artificial and natural hardbottom structures; associates with larger nekton (i.e., sharks, rays, sea turtles)
Spanish mackerel	*Scomberomorus maculatus*	Shelf waters	Shelf and inshore waters; associated with artificial and natural hardbottom	Shelf and inshore waters; associated with artificial and natural hardbottom
King mackerel	*Scomberomorus cavalla*	Shelf waters	Shelf waters; associated with artificial and natural hardbottom	Shelf waters; associated with artificial and natural hardbottom
Little tunny	*Euthynnus alletteratus*	Shelf waters	Shelf waters; artificial and natural hardbottom	Shelf waters; artificial and natural hardbottom

EFH for coastal pelagic species includes *Phragmatopoma* reefs (worm reefs) off the central coast of Florida, ocean high-salinity surf zone, and nearshore hardbottom south of Cape Canaveral. This EFH also includes sandy shoals of capes and offshore bars, high-profile rocky bottom, and barrier island ocean-side waters from the surf zone to the shelf break zone from the Gulf Stream shoreward (including *Sargassum)*. In addition, EFH for coastal pelagic species includes all coastal inlets and state-designated nursery habitats of particular importance to coastal migratory pelagics (SAFMC 1998).

2.2.7. REEF FISHES (SNAPPER-GROUPER COMPLEX)

The Reef Fish Management Unit consists of 73 species from 10 families. Although the fisheries and adult habitats of most of these species exist well offshore of the project area, the young stages of several reef fishes use nearshore hardbottom (Gilmore et al. 1981; SAFMC 1998; Lindeman and Snyder 1999; Lindeman et al. 2000). SAFMC (1998) identified the following habitats as EFH for early life stages of reef fishes: attached macroalgae, seagrasses, salt marshes, tidal creeks, mangrove fringe, oyster reefs and shell banks, soft sediments, artificial reefs, coral reefs, and hard/live bottom. The project area includes attached macroalgae, hard/live bottom, and soft sediment habitats. SAFMC (1998) identified nearshore hardbottom as an important habitat for many of the 73 members of the Reef Fish Management Unit. **Table 3** lists reef fish species with EFH in the project area.

Generally, reef fishes spawn offshore, releasing eggs and larvae into the water column. Tides transport the larvae of some species, such as gray snapper (*Lutjanus griseus*) and gag grouper (*Mycteroperca microlepis*); through inlets into estuarine areas where they settle on the bottom and occupy seagrass meadows or other structured habitats. As they grow, young gray snappers move from seagrass areas to more structured areas such as artificial hardbottom, mangrove fringe (prop roots), and nearshore hardbottom.

Other reef fishes such as lane snapper (*L. synagris*) and grunts (*Haemulon* spp., *Anisotremus surinamensis*, and *A. virginicus*) have similar life cycles, and their early life stages also occur in inshore waters (Lindeman et al., 2000; CSA International, Inc. 2009). Nearshore hardbottom provides an important connection of the cross-shelf developmental pathways undertaken by many reef species (Lindeman et al. 2000).

Table 3. Species by family from the Reef Fish Management Unit with Essential Fish Habitat presence in the project area (Adapted from: South Atlantic Fishery Management Council 1998)

Family	Common Name	Species	Spawning	Eggs	Larvae	Juveniles	Adults
Serranidae (sea basses and groupers)	Red grouper	*Epinephelus morio*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; hardbottom; inshore and shelf waters	Demersal; hardbottom; shelf waters
	Goliath grouper	*Epinephelus itajara*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; hardbottom; inshore and shelf waters	Demersal; hardbottom; shelf waters
	Gag grouper	*Mycteroperca microlepis*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; hardbottom; inshore and shelf waters	Demersal; hardbottom; shelf waters
	Scamp	*Mycteroperca phenax*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; hardbottom; shelf waters	Demersal; hardbottom; shelf waters
	Black sea bass	*Centropristis striata*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; hardbottom; inshore and shelf waters	Demersal; hardbottom; shelf waters
Carangidae (jacks)	Blue runner	*Caranx crysos*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; inshore waters	Demersal; hardbottom; inshore and shelf waters
	Crevalle jack	*Caranx hippos*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; inshore waters	Demersal; hardbottom; inshore and shelf waters
Lutjanidae (snappers)	Gray snapper	*Lutjanus griseus*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; inshore waters	Demersal; hardbottom; inshore and shelf waters
	Lane snapper	*Lutjanus synagris*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; inshore and shelf waters	Demersal; hardbottom; inshore and shelf waters
	Vermilion snapper	*Rhomboplites aurorubens*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; shelf waters	Demersal; hardbottom; inshore and shelf waters
Haemulidae (grunts)	White grunt	*Haemulon plumieri*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; inshore waters	Demersal; hardbottom; inshore and shelf waters
	Porkfish	*Anisotremus virginicus*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; inshore waters	Demersal; hardbottom; inshore and shelf waters
	Black margate	*Anisotremus surinamensis*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; inshore waters	Demersal; hardbottom; inshore and shelf waters
	Sailors choice	*Haemulon parra*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; inshore waters	Demersal; hardbottom; inshore and shelf waters
Sparidae (porgies)	Sheepshead	*Archosargus probatocephalus*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; inshore waters	Demersal; hardbottom; inshore and shelf waters
Ephippidae (spadefishes)	Atlantic spadefish	*Chaetodipterus faber*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; inshore and shelf waters	Demersal; hardbottom; inshore and shelf waters
Balistidae (triggerfishes)	Gray triggerfish	*Balistes capriscus*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; shelf waters	Demersal; hardbottom; inshore and shelf waters

2.2.8. DOLPHIN AND WAHOO

Dolphin (*Coryphaena hippurus*) and wahoo (*Acanthocybium solandri*), oceanic species associated with the western edge of the Gulf Stream, travel near this edge as they migrate. All life stages (i.e., eggs, larvae, juveniles, and adults) of these species closely associate with the Gulf Stream and could occur in the project vicinity near the offshore borrow site (**Table 4**). Dolphin and wahoo feed on small fishes and invertebrates associated with drifting *Sargassum* and other flotsam (Manooch et al. 1983; Manooch and Mason 1984; Morgan et al. 1985). HAPC for dolphin and wahoo is *Sargassum*.

Table 4. Highly migratory species, including dolphin and wahoo,
with Essential Fish Habitat presence in the project area
(Adapted from: South Atlantic Fishery Management Council 2003;
National Marine Fisheries Service 2009)

Common Name	Scientific Name	Eggs and Larvae	Juveniles/Subadults	Adults
Dolphin	*Coryphaena hippurus*	Oceanic and shelf waters	Oceanic and shelf waters, with flotsam and *Sargassum*	Oceanic and shelf waters, with flotsam and *Sargassum*
Wahoo	*Acanthocybium solandri*	Oceanic and shelf waters	Oceanic and shelf waters, with flotsam and *Sargassum*	Oceanic and shelf waters, with flotsam and *Sargassum*
Skipjack tuna	*Katsuwonus pelamis*	Oceanic and shelf waters	Oceanic waters, with flotsam and *Sargassum*	Oceanic waters, with flotsam and *Sargassum*
Blackfin tuna	*Thunnus atlanticus*	Oceanic and shelf waters	Oceanic and shelf waters, with flotsam and *Sargassum*	Oceanic and shelf waters, with flotsam and *Sargassum*
Atlantic sailfish	*Istiophorus platypterus*	Oceanic and shelf waters	Oceanic and shelf waters	Oceanic and shelf waters

2.2.9. HIGHLY MIGRATORY SPECIES

Worm et al. (2003) identified eastern Florida as an area supporting a high diversity of oceanic predators, such as sharks, billfishes (Istiophoridae), and tunas (*Thunnus* spp. and *Katsuwonus pelamis*), considered under the Highly Migratory Species Management Unit. Many species, including tunas, swordfish (*Xiphias gladius*), and billfishes, may occur in the project area near the offshore borrow site because of the proximity to the Gulf Stream current. Swordfish and bluefin tuna (*Thunnus thynnus*) migrate through the Florida Straits and into the eastern Gulf of Mexico to spawn (NMFS 1999, 2009). *Sargassum* is important habitat for various life stages of the swordfish, billfishes, and tunas. Sailfish (*Istiophorus platypterus*), blue marlin (*Makaira nigricans*), and white marlin (*Tetrapturus albidus*) regularly occur offshore east Florida. **Table 4** lists the species from this group most likely to occur in the vicinity of the project's offshore borrow area**.**

The highly migratory species group includes coastal sharks, which commonly occur during various life stages in inshore and nearshore shelf waters along the east coast of Florida. In the project area, several managed shark species occur, including nurse, hammerheads (*Sphyrna* spp.), and requiem (Gilmore et al. 1981; CSA International, Inc. 2009; Estuarine, Coastal and Ocean Science, Inc. 2009). Juveniles of several of these species also use the nearby Indian River Lagoon as nursery grounds (Snelson and Williams 1981; Snelson et al. 1984). Some of these species range very widely and loosely associate with a variety of habitats (e.g., soft bottom, hardbottom, and the water column). Others, particularly the nurse shark, are associated closely with hardbottom habitats. **Table 5** presents EFH identified by NMFS (1999, 2009) for the coastal shark species present within the project.

Table 5. Coastal shark species and life stages with Essential Fish Habitat identified within the project area (Adapted from: National Marine Fisheries Service 1999, 2009)

Common Name	Species	Neonate/Early Juveniles	Late Juveniles/Subadults	Adults
Great hammerhead	*Sphyrna mokarran*	Atlantic east coast from the Florida Keys to New Jersey; Eastern Puerto Rico	Atlantic east coast from the Florida Keys to New Jersey; Eastern Puerto Rico	Atlantic east coast from the Florida Keys to New Jersey; Eastern Puerto Rico
Scalloped hammerhead	*Sphyrna lewini*	Atlantic east coast from the mid-east coast of Florida to southern North Carolina	Atlantic east coast of Florida through New Jersey	Atlantic east coast of Florida to Long Island, New York
Nurse shark	*Ginglymostoma cirratum*	N/A	Atlantic east coast of Florida to southern Georgia	Atlantic east coast of Florida
Blacknose shark	*Carcharhinus acronotus*	Atlantic coastal areas from Georgia to southern North Carolina	--	---
Bignose shark	*Carcharhinus altimus*	N/A	Localized areas from east coast of Florida and South Carolina in the Atlantic	Localized areas from east coast of Florida and South Carolina in the Atlantic
Spinner shark	*Carcharhinus brevipinna*	Coastal waters along east coast of Florida to southern North Carolina	Coastal waters along east coast of Florida to southern North Carolina	Coastal waters along east coast of Florida to southern North Carolina
Bull shark	*Carcharhinus leucas*	Coastal areas along the Atlantic mid-east coast of Florida	Coastal areas localized from the mid-east coast of Florida to South Carolina	East coast of Florida to South Carolina
Blacktip shark	*Carcharhinus limbatus*	Atlantic coastal areas from northern Florida through Georgia; the mid-coast of South Carolina	Atlantic coastal areas localized off the southeast Florida coast and from West Palm Beach, Florida to Cape Hatteras, North Carolina	Atlantic coastal areas from southeast Florida to Cape Hatteras, North Carolina
Finetooth shark	*Carcharhinus isodon*	N/A	N/A	Atlantic east coast from the mid-coast of Florida to Cape Hatteras
Dusky shark	*Carcharhinus obscurus*	Atlantic east coast of Florida to the mid-coast of Georgia; South Carolina to southern Cape Cod	Atlantic east coast of Florida to the mid-coast of Georgia; South Carolina to southern Cape Cod	Atlantic east coast of Florida to the mid-coast of Georgia; South Carolina to southern Cape Cod
Sandbar shark	*Carcharhinus plumbeus*	---	---	Atlantic coastal areas throughout Florida to southern New England
Tiger shark	*Galeocerdo cuvier*	Along the Atlantic east coast from northern Florida to Cape Cod	Localized areas along the mid-east coast of Florida and South Carolina; North Carolina to mid-New Jersey coast	Localized areas along the mid- and northeast coasts of Florida, South Carolina, and southern North Carolina; Cape Lookout to southern New Jersey
Sand tiger shark	*Carcharias taurus*	Shallow coastal waters <25 m deep from Barnegat Inlet, New Jersey to Cape Canaveral, Florida	---	Shallow coastal waters <25 m deep from Barnegat Inlet, New Jersey to Cape Canaveral, Florida
Bonnethead shark	*Sphyrna tiburo*	East coast from the mid-coast of Florida to South Carolina	East coast from the mid-coast of Florida to South Carolina	East coast from the mid-coast of Florida to South Carolina
Lemon shark	*Negaprion brevirostris*	---	Coastal areas along the east coast of Florida	Localized areas along east coast of Florida

-- = Life stage does not occur within the project area; N/A = Information not available.

3. ASSESSMENT OF IMPACTS AND MITIGATION MEASURES

3.1. IMPACTS TO EFH

Because nearshore hardbottom occurs along most of the project fill area and sand shoals comprise the offshore borrow area, the proposed project will likely include impacts to EFH. The primary impact-producing factors include turbidity, sedimentation, and dredging.

3.1.1. TURBIDITY

Turbidity is caused by the suspension or resuspension of sediments into the water column. Turbidity can affect fish feeding activities, movement, and respiration. Many fish species are primarily visual feeders. The fishes' reactive distance decreases when turbidity reduces light penetration (Vinyard and O'Brien 1976). Light scattering caused by suspended sediment also can affect a visual predator's ability to perceive and capture prey (Benfield and Minello 1996). Some fishes have demonstrated the capability to capture prey at various turbidity levels, but the density of prey and amount of light penetration are important factors (Grecay and Targett 1996). Some species will actively avoid turbid water, while some species are attracted to turbid water. Experiments with pelagic kawakawa (*Euthynnus affinis*) and yellowfin tuna (*Thunnus albacares*) showed that these species would actively avoid experimental turbidity clouds, but that they also would swim directly through them during some trials (Barry 1978). Suspended sediment can abrade and clog gill cavities, preventing normal respiration and mechanically affecting food gathering in planktivorous species (Bruton 1985). Suspended sediment levels generated by storms have contributed to the death of nearshore and offshore fishes by clogging gill cavities and eroding gill lamellae (Robins 1957). Also, high concentrations of fine sediments can coat respiratory surfaces of the gills, preventing gas exchange (Wilber and Clarke 2001).

Elevated turbidity is expected at both the fill and dredging sites during the project construction period. Placement of dredged sand and subsequent spreading by earth-moving equipment along the two project shoreline segments will temporarily suspend fine sediments causing increased turbidity. Fill-related turbidity plumes will emanate from shoreline areas and depending on local winds, currents, and waves will move away from the area until suspended sediment has settled. St. Lucie County estimated that the water column potentially experiencing turbidity elevated above background could extend from the ETOF 65 m (213 ft) from shore and 150 m (492 ft) downcurrent from the discharge point (CTC, 2010a Turbidity and Mixing Zone Analysis). Turbidity at the borrow site will also increase during dredging. The action of the hopper dredge will suspend sediments where the drag arms contact the seafloor and at the surface where spillover containing suspended sediments from the container (hopper) washes overboard. In addition, the excess seawater that is decanted and discharged overboard by the hopper dredge during construction activities will temporarily increase turbidity around the dredge.

Turbidity spillover plumes or clouds will drift with local currents until suspended sediments settle. The extent of suspension/dispersion depends on the type of dredging equipment, techniques for operating the equipment, amount of dredging, thickness of the dredged layer, sediment grain size composition, and the depth of seawater discharged.

Understanding and predicting the effects of suspended sediments on fishes requires information on the range and variation of background turbidity levels at a project site prior to dredging (Wilber and Clarke 2001). Wanless and Maier (2007) determined that range and variation of turbidity depends greatly on the nature of the sediment in the borrow area. Sediment samples taken from the proposed borrow site indicated close similarity in grain size with natural beach sands (CTC 2009a, 2009b). However, the CTC report included no information on settling velocity, which is an important indicator of potential for turbidity (Wanless and Maier 2007).

3.1.2. SEDIMENTATION

Excess sedimentation can adversely affect individual organisms as well as entire hardbottom assemblages (Colosio et al. 2007). Primary impacts of sedimentation on sessile organisms include siltation, changes in ambient granulometric properties, and direct burial (Anthony et al. 2004; Jordan et al. 2010). Jordan et al. (2010) found that natural forcing by winds and storm waves influenced regional sedimentation, but that nourishment sites in Broward County, Florida displayed relatively high rates of sediment deposition. As with turbidity, sedimentation effects will ultimately depend on the nature of the material placed in the fill area (Wanless and Maier 2007).

Sand placement on the beach will bury nearshore hardbottom within the equilibrium toe-of-fill (ETOF) margin along two segments of the proposed project: a) from FDEP Monument R-101.4 to R-107; and b) from FDEP Monument R-112 to R-114.5 (**Figures 2** through **4**). A hopper dredge will extract sand from the offshore borrow site. The hopper dredge will transport the sand to a location near the beach project area and pump the dredged sand to the fill site through a submerged pipeline. Earth-moving equipment will then spread the sand into the approved template. Fill will gradually spread seaward, where much of the sedimentation of nearshore hardbottom will take place. **Figures 2** through **4** show the ETOF margin relative to nearshore hardbottom as interpreted from 2010 aerial imagery.

Figure 2-3 illustrate smaller patchy features affected in the project area. Thickness of the sand burying the hardbottom will depend on the existing grade of the shoreline at the nourished areas (CTC 2009a). The greatest amount of sedimentation is estimated to occur in the area around FDEP Monuments R-106 and R-107 (CTC 2009a). Based on the available hardbottom maps and ETOF estimates, the estimated amount of buried hardbottom is 0.55 acres. The submerged pipeline from the hopper dredge to shore will impact another 0.02 acre. The total 0.57 acres of impact includes 0.57 acres of HB2. Indirect, temporary effects from sedimentation are expected to occur with the settling of suspended sediment (described above under **Turbidity 3.1.1**) associated with the placement of sand at the fill sites. **Figures 3** and **4** illustrate the southern portion of the project area and the location of HB3. When turbidity plumes associated with the five fill placement sites (and corresponding to the five pipeline routes) were considered together and the area extrapolated over the existing hard bottom, the Applicant estimated 10.85 acres of turbidity effects prior to deleting the northern segment of the project. This turbid water is projected to extend out to the edge of the mixing zone, or approximately 65 m east of the ETOF line. The suspended sediment will settle as a very fine, ephemeral layer that is expected to incorporate rapidly into the surrounding soft bottom. The reduced project size no proposed will result in a lower acreage of temporary turbidity impacts.

As described above (**Section 1.0 Introduction**) dredging requires that sand from the offshore borrow site be transported through a submerged pipeline to the fill sites on shore. The placement of submerged pipeline can damage exposed hardbottom by direct contact. Six proposed pipeline corridors were diver-surveyed in 2009 (R-89.5, R-100, R-101, R-104, R-108, and R-114) (CSA International, Inc., 2010a). These dives resulted in the elimination of one proposed corridor at R-101 due to a 62 m (203 ft) extent of hard bottom in the nearshore region of that proposed pipeline corridor. Of the five selected submerged pipeline corridors, the northernmost pipeline corridor (approximately at R-89.5) contains variable presence of hard bottom (HB1) and partially exposed hard bottom (HB2). No practicable alternative (i.e. other route that would result in lesser impact) could be found in the northern portion of the project area. This corridor however was eliminated when the county deleted the northern project segment. The remaining four proposed pipeline corridors (R-100, R-104, R-108, R-114) consist almost completely of sand and shell hash, with some interspersed small expanses of hard bottom or partially exposed hard bottom. Thus, the total acreage of bottom contact by the submerged pipeline in these corridors was estimated to be 0.02 acres of HB2 impacted.

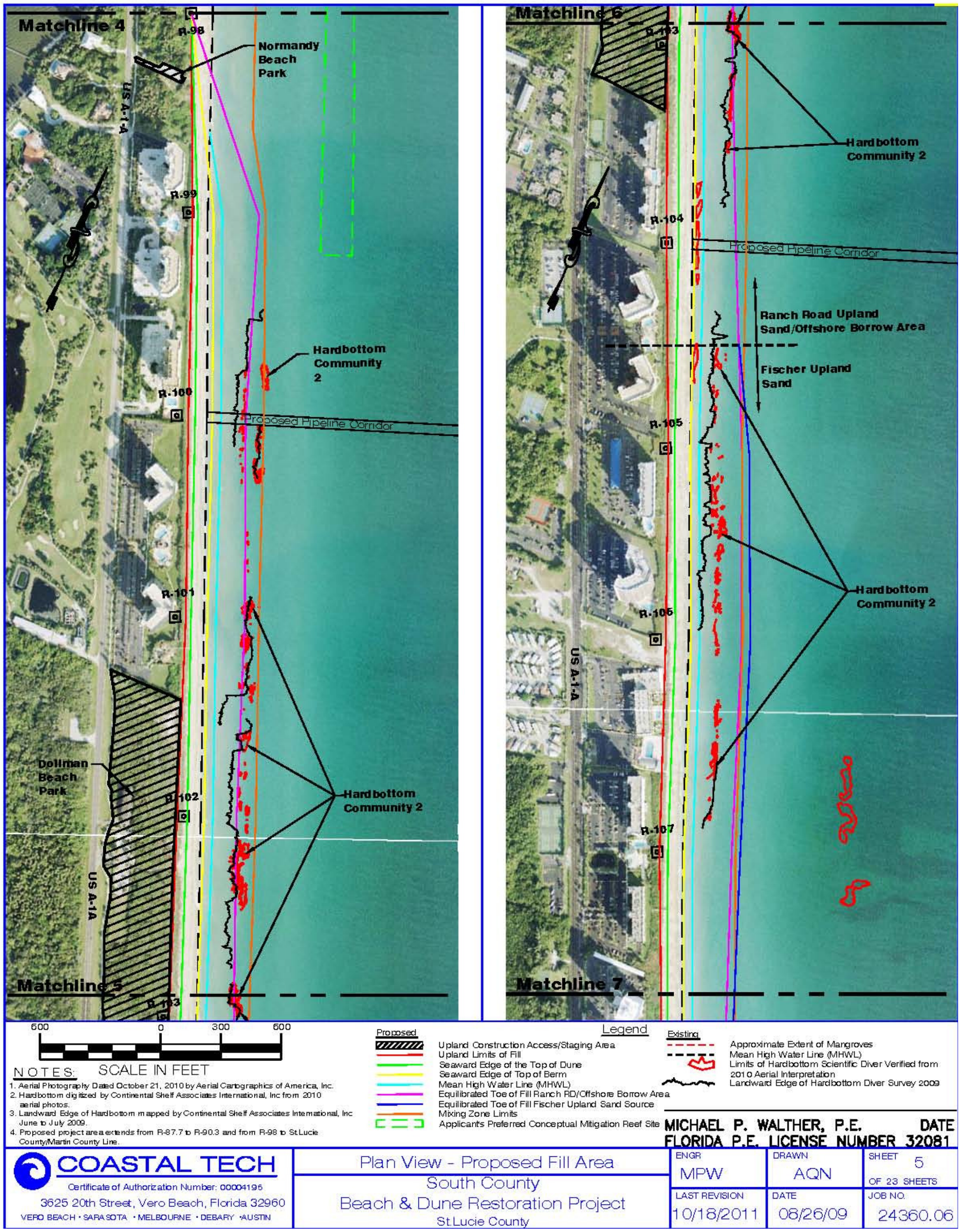

Figure 2. Southern project area depicting the estimated equilibrium toe-of-fill and the mapped hardbottom

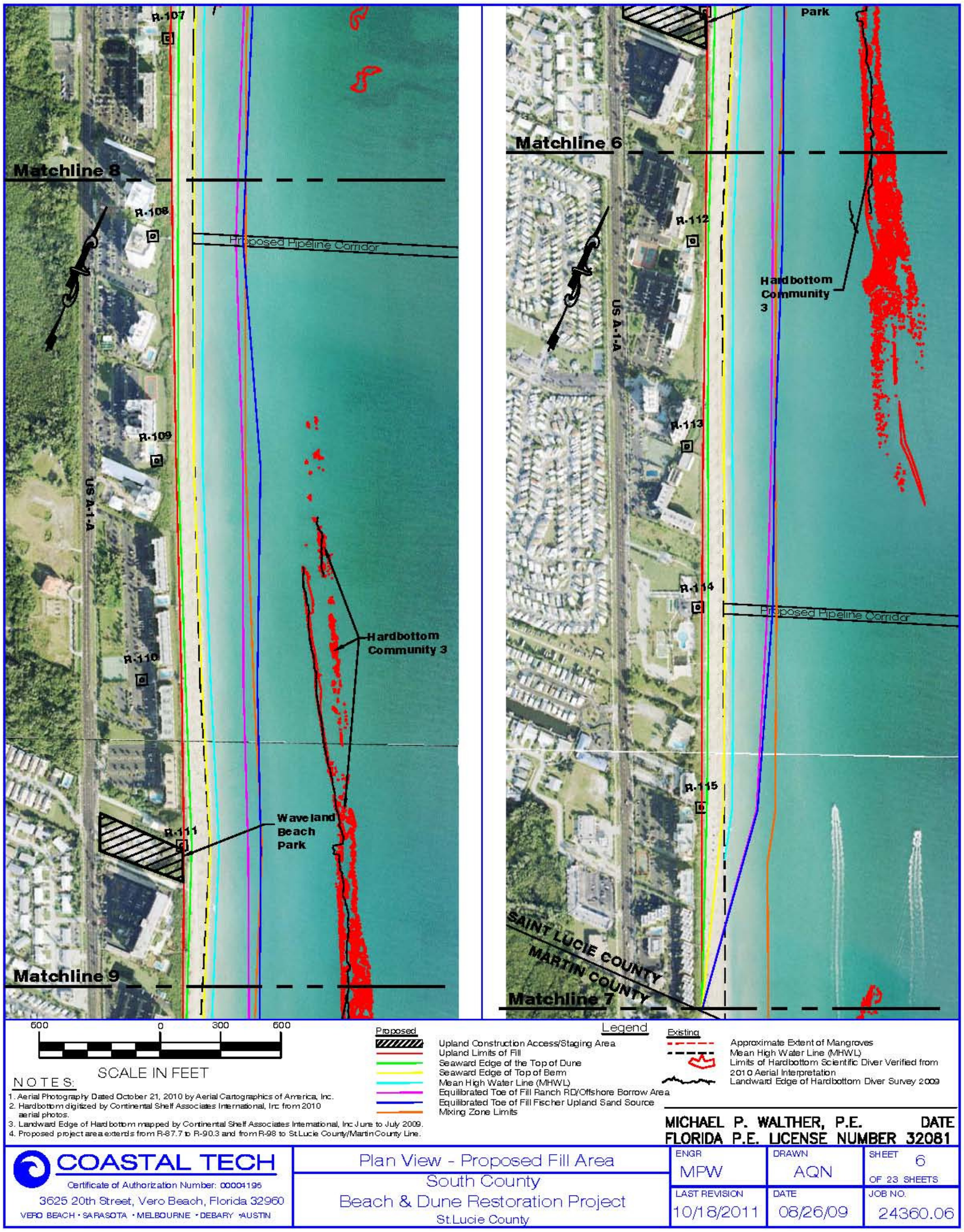

Figure 3. Southern project area depicting the estimated equilibrium toe-of-fill and the mapped hardbottom Community 3

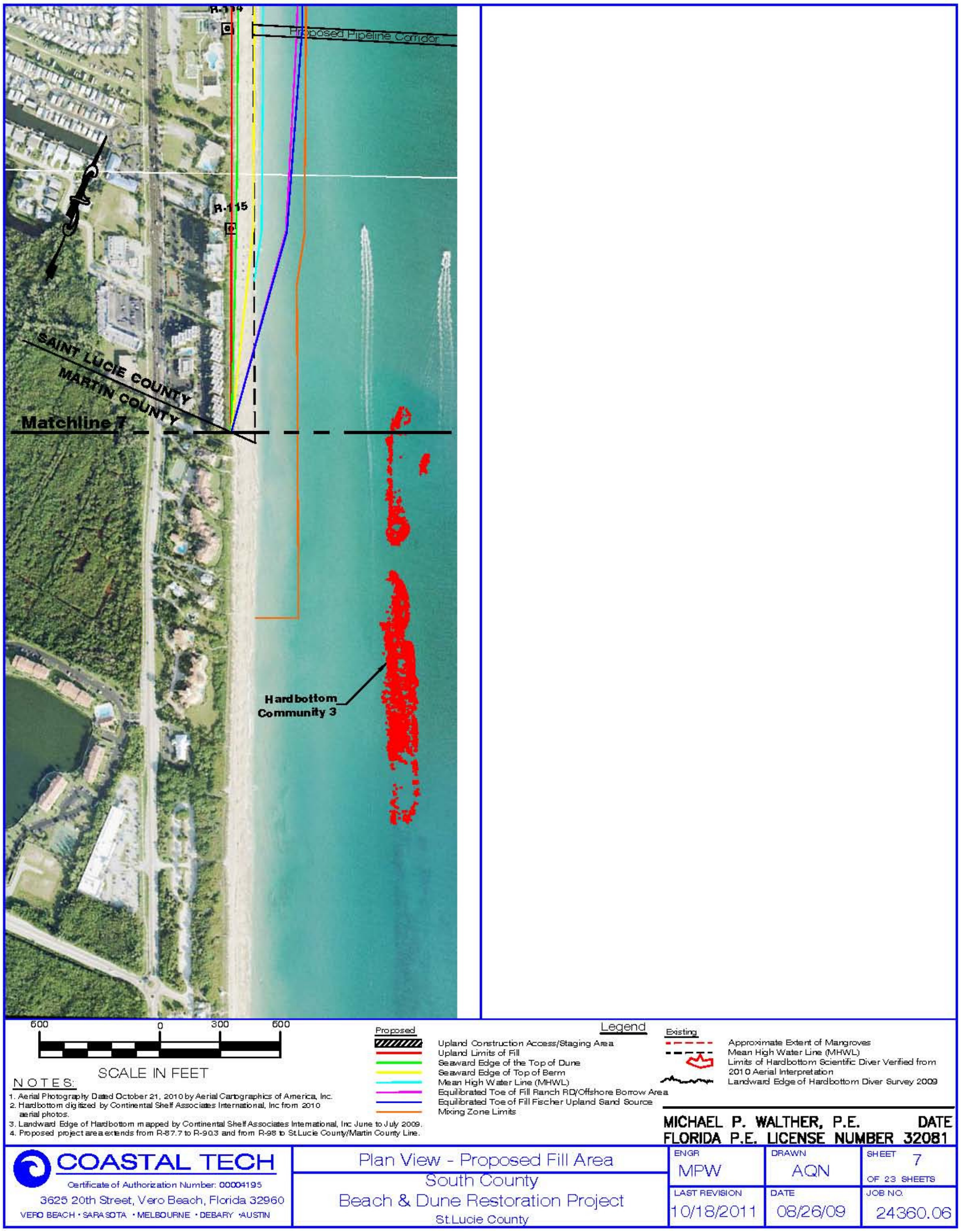

Figure 4. Southern project area depicting the estimated equilibrium toe-of-fill and the mapped hardbottom Community 3

3.1.3. OFFSHORE DREDGING

Routine dredging of soft bottom areas may incur both short- and long-term impacts. Removal of sand will immediately kill or displace sedentary organisms, especially infaunal invertebrates (e.g., annelid worms, gastropods, bivalves, and crustaceans) inhabiting the upper sedimentary layers. This removal would result in the loss of food sources for benthic feeding fishes. However, although Wilber and Stern (1992) found that while borrow sites may remain in an early successional stage for 2 to 3 years, within those years the sites they considered still developed infaunal biomass that provided a food source for fish and macrocrustaceans. Infaunal assemblages in marine soft sediments are distributed in a mosaic of patches containing different numbers and kinds of species (e.g., Hall, 1994). The spatial scale of patchiness is usually related to extent and frequency of disturbances in a particular physical environment (Abele and Walters, 1979; Andrew and Mapstone, 1987; Morrisey et al., 1992; Hall, 1994; Zajac et al., 1998; Thrush et al., 2000; Zajac et al., 2003). Recolonization of newly opened patches is achieved through larval settlement as well as immigration of post-larval, juvenile, and adult individuals. The relative importance of these modes of recolonization will vary with environmental factors at a particular site. Studies have shown that infaunal assemblages recover relatively faster in offshore dredged sites where natural physical disturbance occurs with a higher frequency (Johnson and Nelson, 1985; Jutte et al., 2002; Posey and Alphin, 2002). Because the proposed borrow area is in a physically dynamic region of the inner shelf, it is expected that dredged sections will be recolonized fairly rapidly. Thus, the loss of prey for bottom feeding fishes will not only be spatially limited but will also be temporary.

During dredging, the dredge pipe could entrain some epifaunal invertebrates (e.g., gastropods, decapod crustaceans, and echinoderms) and demersal. On a broader scale, dredging can alter the morphodynamics of shoal features in several ways. Michel et al. (2001) asserted that dredging-related changes in a shoal could trigger complete “deflation” of the entire feature. However, Dibjina and Nairn (2010) studied the morphodynamics effects of dredging shoals. In a study combining field measurements and modeling, they concluded that after dredging, a shoal would likely redevelop (albeit with a smaller total volume, but of similar elevation) and that “there was no indication that there exists a critical threshold for dredging that once crossed, ridge and shoal features may deflate, losing their morphologic integrity.”

Dredging in the form of pits or furrows could cause turbidity to increase if exposed fine sediments are continually re-suspended by wave action. Finally, dredge-related changes in seafloor topography could alter the wave energy striking the adjacent shoreline and potentially affect various coastal processes, including burial of nearshore hardbottom (CSA International, Inc. et al. 2009; Byrnes et al. 2004). However, Byrnes et al (2004) also determined that the infaunal community recovery depends primarily on the depth of excavation and shallow large areas of excavation are better than smaller deep excavations and that the impacts from dredging would not adversely affect EFH on a broad scale.

Kelley et al. 2004, Hammer et al., 2005, and Dibjina and Nairn (2010) (among others) have assessed the potential for offshore dredging to increase shoreline erosion Hammer et al. (2005) recommended revising a St. Lucie Shoal dredging design that those authors evaluated for dredging impacts. The modeled dredging included removal of 14.6 million cubic meters of sand and reduction of the shoal elevation from between -5.4 m and -7.6 m (-17.8 ft and -24.9 ft) to an elevation of -12 m (-39.4 ft - deflation of the shoal to surrounding elevations). The modeled dredging caused unacceptable changes in wave climate along the shoreline. The Hammer et al modeled design removed almost 25 times the amount of sand proposed by the Applicant. The proposed project will dredge only a small fraction of the total shoal area and will not reduce the maximum elevation of the shoal in the project area.

Similarly, Kelley et al. (2004) modeled the removal of an estimated 24 million cubic meters (31.4 million cy) with an excavation depth of 4.6 meters (15 ft - all of St. Lucie Shoal in federal waters). After determining that this dredging would cause unacceptable effects on the wave climate, they determined that the shoal — if reduced in elevation by less than 2.3 meters (7.5 ft) — would yield 12 million cubic meters (15.7 million cy) of sand without causing significant impacts on longshore sediment transport. The proposed project maintains the shoal height and extracts about 5% of the volume Kelley et al. identified as safe to extract considering nearshore wave climate.

St. Lucie County has assessed the potential for increased shoreline sediment transport because of the project (St. Lucie County South Beach and Dune . The analysis (See EIS Appendix Q, St. Lucie County South Beach and Dune Environmental Impact Statement) demonstrated that the proposed offshore dredging alternative would result in insignificant increases in potential longshore current energy and thus erosion potential.

3.2. PROPOSED MITIGATIVE MEASURES

The Applicant has committed to implementing a number of BMPs and mitigation measures during the construction activities. These include implementation of the NMFS smalltooth sawfish and swimming sea turtle construction conditions to avoid adverse effects to smalltooth sawfish and swimming sea turtles. the FWC manatee construction conditions; and water quality monitoring. BMPs associated with dredging the shoal will include but not be limited to the following:

- A dredging profile that includes avoidance of dredging across the shoal
- A refuge patch at the highest shoal elevations to help minimize the impacts to the shoal habitat;
- Excavating the shoal borrow area no deeper than the general elevation of the coastal shelf plain surrounding the shoal.

Managerial BMPs include water quality monitoring during and after construction, biological monitoring before and after construction to assess potential short term and long-term project impacts, and a construction window that avoids potential seasonal impacts (to nesting sea turtles). The applicant has proposed all of these as part of the application for state and federal permits.

During operations at the dredge, manatee signage/observer will avoid impacts to *manatees, and other large seagoing species. Use of turtle deflectors (required on all hopper dredge operations, would avoid and minimize sea turtle mortality by deflecting turtles near or in the dredge head path.*

Operational BMPs that may help reduce turbidity during dredging operations include

- *Elimination or reduction of hopper overflow. Eliminating or reducing hopper overflow reduces the volume of fine material that flows from the hopper in the overflow. Note that this control may significantly reduce hopper dredge production,*
- *Lowering hopper fill level. Lowering the hopper fill level in rough sea conditions can prevent material loss during transport.*
- *Implementing a recirculation system. Recirculating water from the hopper overflow to the draghead can reduce water discharged from the hopper.*

- *Use integrated GPS systems that monitor dredge position, cutterhead location, and allows calculation of dredge production status. Integrated GPS enhances environmental monitoring – provides real-time alarms and archival recording of dredge head position/depth outside of prescribed boundaries/depths*

- *Use of floating tow lines*
- *Pipeline corridor locations that avoid and minimize impacts to hardbottom*
- *Use of pipeline collars in corridors including hardbottom habitat*
- *Establishment of vessel ingress and egress corridors*
    - *Minimizes likelihood of vessel impact to hardbottom due to movement of vessels to and from a site during coastal construction*
    - *Protects the benthic community. Corridor selection considerations include mean tidal range, difference in draft between a fully loaded and empty vessel, width of vessels, and vessel turning radius*

On the beach, the use of sand dikes at the beach dredged material discharge site provides settling time for fine particles to be released from the water column *before* entering the open waters. Shore-parallel dikes must withstand incoming waves and maintain structural integrity during the discharging of sand onto the beach The temporary dike, which moves with the construction, becomes the seaward edge of construction *when* integrated into the final beach; the dike requires no removal.

Some of the BMPs were derived from the recommendations by Diaz et al. (2003) and CSA International, Inc. et al. (2009) to retain undisturbed areas for shoal fauna and minimize adverse ecological impacts (Slacum et al. 2010). This dredging plan should minimize reduction in topographic relief and preserve undisturbed patches that should result in minimal, permanent adverse impacts to the shoal feature. In addition, CSA International, Inc. et al. (2009) indicates that based on physical geological models of shoal formations, there does not appear to be a mechanism for supporting the "deflation" of shoal features from repeated dredging events. Dibjina and Nairn (2010) combined field studies and modeling to assess shoal morphodynamics with dredging. They concluded that after dredging one might expect that a dredged shoal will reform (albeit with less sand) at approximately the same elevation. They could identify no threshold for shoal collapse.

Leaving undisturbed areas (refuge patches) interspersed throughout the borrow site will provide a pool of potential colonists capable of immigrating directly to the dredged areas. This local source of pioneering organisms, along with natural larval settlement from the plankton, will facilitate recolonization of dredged areas by infauna. It is expected that although assemblage composition and relative abundance may differ from surrounding areas, the recolonizing organisms will be available as prey for demersal fishes. This along with the fact that a relatively small area (2.41 x 10^5 $m^{2,}$ $^{(}$59.55 acres) or 2.31%) of St. Lucie shoal will be removed, will lessen the severity of the impacts to benthos and benthic feeding fishes.

St. Lucie County has developed draft Biological and Physical Monitoring Plans (CTC 2010b, 2010c) that ensure the performance of monitoring activities. The Physical Monitoring Plan has five objectives:

- Identify erosion and accretion patterns along the project and adjacent shorelines.
- Provide data to facilitate an engineering analysis of the beach nourishment performance based on pre- and post-construction surveys and subsequent monitoring surveys.
- Identify beach segments that have lost sand in quantities that may require corrective actions.
- Identify location of the ETOF.
- Determine if the borrow area is experiencing infilling under post-construction conditions.

The Draft Biological Monitoring Plan includes nearshore hardbottom monitoring using aerial interpretation of nearshore hardbottom extent; permanent transects and *in-situ* quadrats, nearshore hardbottom edge mapping, and video transect analysis; nearshore fish census and sampling; and in-water sea turtle monitoring. The Plan also includes monitoring of the borrow area, including benthic infaunal monitoring, and beach and dune monitoring comprising beach infaunal monitoring, sea turtle monitoring, shorebird monitoring, and planted dune vegetation monitoring. In addition, a submerged pipeline monitoring plan, provided in the FEIS, calls for regular monitoring of the submerged pipeline for leaks. EIS Appendix P (Pipeline monitoring plan from CTC).

In addition, the draft Mitigation Plan for the project (CTC 2010d) states that low- to medium-relief mitigation structures will mimic the impacted hardbottom habitat. St. Lucie County will submit a detailed Artificial Reef Plan to the lead state and federal permitting agencies at least 30 days before construction. Design of the reef(s) must consider the ecological functions to be restored (CSA International, Inc. et al. 2009). To ensure physical stability of the reef, selection of mitigation reef locations will consider such criteria as sediment overburden, sediment grain size, water depth, and distance from shore. St. Lucie County will develop the ecological and physical details of the mitigation plan with input from appropriate state and federal agencies. The Mitigation Plan also states that standard monitoring techniques will record the ecological development of the reef(s); success criteria will allow evaluation of reef mitigation of ecological functions impacted by the project (CTC 2010d).

Minimization of turbidity effects will include monitoring regularly within a pre-defined mixing zone and comparing ambient turbidity readings with those from adjacent background areas. A post-construction turbidity monitoring plan has been developed (CTC 2010e, EIS Appendix H) to provide a basis for assessing project turbidity effects post-construction and during storms where wave heights exceed 1.3 m.

4. CONCLUSIONS

The proposed dredge and fill project (considered as the Applicant's preferred alternative) could adversely affect EFH for various life stages of several federally managed species or species groups. Effects will result from project-related activities involving burial and excavation of existing habitat and increased turbidity. Broadly defined, habitats of importance include hardbottom, soft bottom, and the water column. EFH in the project fill area most important to managed species and their prey include nearshore hardbottom, nearshore soft bottom (surf zone), and water column habitats. At the proposed offshore borrow site, soft bottom sand shoals and the water column are the most important habitats to managed species and their prey. However, by using a design that maximizes avoidance and minimizes impacts, and includes appropriate mitigation measures (provided in **Section 3.2**) for unavoidable impacts, these adverse effects should not significantly affect EFH.

Fill material spread to form a 35-ft berm will result in permanent impacts to an estimated 0.55 acres of nearshore hardbottom. Use of sublines to transport the fill sand from hopper dredge to the beach will incur another 0.02 acres hardbottom impact, creating a total 0.57 acres of project impacts to HB2 hardbottom habitat. Loss of nearshore hardbottom will affect ecological functions necessary for the growth and survival of reef fishes, coastal pelagic fishes, spiny lobster, and red drum as well as their prey species. The extent and severity of the estimated loss of ecological functions will depend to some extent on the physical and biological nature of the affected hardbottom features. The projected losses (0.57 acres) will occur on hardbottom that is either the landward portion of a larger feature or small isolated patches within the nearshore project template. Estimated hardbottom impacted by the project represents approximately 4% of the total approximate 12.97 acres of total hardbottom in and immediately adjacent to the project area.

Burial of these isolated patches of hardbottom or landward margins of larger hardbottom features will impact fishes variably by species and life stage (CSA International, Inc. 2010b). Excess sedimentation can directly bury or asphyxiate small sedentary species. Most individuals larger than 3 cm will likely swim from the area, albeit with potentially increased vulnerability to predators as they move over open bottom. Small cryptic species such as clingfishes, blennies, gobies, eels, and cardinal fishes are unlikely to survive direct burial episodes. The more mobile grunts, porgies, snappers, and sea basses would have a better chance of survival by fleeing affected areas. Because the project will only impact the landward margin of larger hardbottom features, fleeing individuals can find immediate refuge immediately seaward of the impact areas. This is true to some extent for the smaller, isolated hardbottom patches relatively close to the affected ones. Thus, the loss of smaller segments or patches that are part of a larger hardbottom trend will leave much of the habitat and ecological functions intact.

Appropriate mitigation in the form of replacement low-medium relief habitat deployed in the project vicinity will help replace ecological functions lost due to the project loss.

In addition to direct habitat loss by burial, elevated water column turbidity will adversely affect managed species utilizing nearshore hardbottom. Since the grain size characteristics of the dredged sand used is compatible with the native beach sand, chronic turbidity is not expected, but during construction adverse temporary effects of turbidity will occur wherever the discharge from the construction occurs. These effects are limited in space to each mixing zone where the pipeline is discharging (not the entire project footprint) and in time (during construction).

In the soft bottom of the nearshore surf zone, fill activities will bury and kill or displace both infaunal and epifaunal invertebrate prey for several managed species. Elevated turbidity in the nearshore surf zone may adversely affect feeding and the movement of managed groups such as coastal pelagic species. As stated above, based on available sand grain size data (CTC 2009b), chronically elevated turbidity should not occur since the characteristics of the project sand are similar to those of the native beach sand. Invertebrates will re-colonize the surf zone soft bottom within one or two years (Peterson et al. 2000). However, if grain size parameters of the sand placed on the beach differ greatly from the native beach sands, recovery of pre-existing infaunal community may never occur (Peterson et al. 2000). For this project, CTC (2009a) described the testing used to select the preferred borrow area based on grain size composition and other characteristics.

Physical impacts caused by dredging sand deposits on the continental shelf broadly include changes in circulation, grain size composition, and seafloor topography. All of these physical alterations affect biotic assemblages at a variety of spatial scales. Adverse effects include total removal of sand deposits and associated infauna, changes in seafloor profile, changes in grain size distribution, and alteration of circulation at the dredged site and beyond. Direct effects on EFH include the loss of infauna and epifauna within the dredged area, and indirect, temporary effects would include a temporary loss of a forage base for benthic feeding fishes and invertebrates. Selection of the construction approach may help avoid and minimize the extent and duration of potential adverse impacts. From the perspective of entire shoal features, Michel et al. (2001) suggested that repeated excavation on a shoal could lead to "unraveling" of the entire topographic structure, leading to a major structural alteration or complete loss of a shoal feature. Hayes and Nairn (2004) and Nairn et al. (2004) used the term "deflation" to describe such impacts to the shoals. Loss of entire shoal features or major changes in topography would adversely affect existing invertebrate and fish assemblages.

The dredging plan for the borrow area would require that dredging begin in areas farthest away from the highest shoal elevations. The dredging design follows several BMPs that seek to avoid the highest areas of the shoal to preserve those portions as "refuge patches," as recommended by Diaz et al. (2003) to retain undisturbed areas to contribute colonists for the dredged areas and thus minimize adverse ecological impacts (Slacum et al. 2010). The proposed dredging plan should avoid concerns of shoal deflation, minimize reduction in topographic relief, and preserve undisturbed patches. This plan was designed to reduce potentially adverse impacts to the shoal feature to non-significant. . In addition, based on physical geological models of shoal formations, Dibjina and Nairn (2010) could identify no physical mechanism to support the idea that structural integrity of a shoal feature will deflate or unravel when subject to repeated dredging events. Modeling analysis by Coastal Tech (CTC: 2011; EIS Appendix Q) indicated that the proposed project would not significantly increase the potential for shoreline erosion through alteration of the wave climate along the shore.

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