Appendix D

Stakeholder List

LOCAL RECREATIONAL GROUPS	NAME	CONTACT	ADDRESS	CITY	STATE	ZIP	EMAIL	PHONE #	FAX #
	Palm Beach Hammerheads	Lynora Mae			FL		LynoraMae@aol.com	561-707-0000	
	Starfish Enterprises	Craig Smart	PO Box 3051	Lantana	FL	33465-3041	craig@idivestarfish.com	561-212-2954	
	Wet Pleasures Dive Outfitters		312 West Lantana Road	Lantana	FL	33462	wetpleasures@wetpleasuresfla.com	561-547-4343	561-547-3909
	Perk's Bait & Tackle		307 N 4th Street	Lantana	FL	33462		561-582-3133	
	West Palm Beach Fishing Club	Tom Twyford, President	201 5th Street	West Palm Beach	FL	33401		561-832-6780	
	Eastern Surfing Association Palm Beach County District	Tom Warnke & Brandi Brady	PO BOX 4633	Tequesta	FL	33469	trwarnke@hotmail.com & izzigio@hotmail.com		
	Sportsman Bait & Tackle		312 E Ocean Ave	Lantana	FL	33462		561-275-7467	
ENVIRONMENTAL GROUPS	**NAME**	**CONTACT**	**ADDRESS**	**CITY**	**STATE**	**ZIP**	**EMAIL**	**PHONE #**	**FAX #**
	South Florida Audubon Society	Doug Young	PO Box 9644	Ft. Lauderdale	FL	33310-9644		954 776 5585	
	Cry of the Water	Stephanie & Dan Clark	PO Box 8143	Coral Springs	FL	33075-8143	reefteam2@yahoo.com	954-753-9737	

	NAME	CONTACT	ADDRESS	CITY	STATE	ZIP	EMAIL	PHONE #	FAX #
	Palm Beach County Reef Rescue		PO Box 207	Boynton Beach	FL	33425	etichscuba@aol.com	561-699-8559	
	Sierra Club (Loxahatchee Group)	Ricardo Zambrano, Group Chair	PO Box 6271	Lake Worth	FL	33466-6271	zambrar1@yahoo.com	561-968-8645	
	Surfrider Foundation Palm Beach County Chapter	Todd Remmel, Chair	PO Box 33687	Palm Beach Gardens	FL	33420	tremmel@surfriderpbc.org		
	Sea Turtle Conservancy	David Godfrey, Executive Director	4424 NW 13th St, Suite B-11	Gainesville	FL	32609	stc@conserveturtles.org	352-373-6441	352-375-2449
HOTELS	**NAME**	**CONTACT**	**ADDRESS**	**CITY**	**STATE**	**ZIP**	**EMAIL**	**PHONE #**	**FAX #**
	Palm Beach Oceanfront Inn	General Manager: Jason Mueller	3550 S. Ocean Boulevard	South Palm Beach	FL	33480	gm@palmbeachoceanfrontinn.com	561-855-7575	
		Owner: Palm Beach Holdings LLC	174 West St. (STE 212)	Litchfield	CT	06759-3435			
	Ritz Carlton Hotel	Michael King, General Manager	100 S. Ocean Blvd.	Manalapan	FL	33462	Michael.King@ritzcarlton.com	561-540-4827	
MUNICIPALITIES	**NAME**	**CONTACT**	**ADDRESS**	**CITY**	**STATE**	**ZIP**	**EMAIL**	**PHONE #**	**FAX #**
	Town of Palm Beach	Peter Elwell, TM	360 South County Road (2nd Floor)	Palm Beach	FL	33480	PElwell@TownofPalmBeach.com	561-838-5410	561-838-5411
	Town of South Palm Beach	Rex Taylor, TM	3577 S. Ocean Blvd.	South Palm Beach	FL	33480	rtaylor@southpalmbeach.com	561-588-8889	561-588-6632

	Town of Lantana	Deborah Manzo, TM	500 Greynolds Circle	Lantana	FL	33462	dmanzo@lantana.org	561-540-5004	
	Town of Manalapan	Linda Stumpf, TM	600 South Ocean Boulevard	Manalapan	FL	33462-3321	lstumpf@manalapan.org	561-585-9477	561-585-9498
LOCAL ELECTED OFFICIALS	**NAME**	**CONTACT**	**ADDRESS**	**CITY**	**STATE**	**ZIP**	**EMAIL**	**PHONE #**	**FAX #**
	Bill Hager, FL House of Representatives District 89		301 Yamato Road (Suite 1240)	Boca Raton	FL	33431-4931		561-470-6607	
	Senator Jeff Clemens (District 27)	Palm Beach Office	508 Lake Avenue (Unit C)	Lake Worth	FL	33460		561-540-1140	561-540-1143
	Congresswoman Lois Frankel	Palm Beach Office	2500 N. Military Trail (Suite 490)	Boca Raton	FL	33431		561-253-8433	561-253-8436
CHAMBER OF COMMERCE	**NAME**	**CONTACT**	**ADDRESS**	**CITY**	**STATE**	**ZIP**	**EMAIL**	**PHONE #**	**FAX #**
	Palm Beach Chamber of Commerce	Kevin Lamb, President	400 Royal Palm Way (Suite 106)	Palm Beach	FL	33480		561-655-3282	
MEDIA	**NAME**	**CONTACT**	**ADDRESS**	**CITY**	**STATE**	**ZIP**	**EMAIL**	**PHONE #**	**FAX #**
	Palm Beach Daily News (The Shiney Sheet)	Joyce Reingold, Publisher & Editor	400 Royal Palm Way (Suite 100)	Palm Beach	FL	33480		(561) 820-3800	
	The Coastal Star	Mary Kate Leming, Exec. Editor	5011 N. Ocean Blvd.	Ocean Ridge	FL	33435	editor@thecoastalstar.com	(561) 337-1553	
	Sun-Sentinel		324 Datura	West Palm	FL	33401	pbcnewsroom@sunsent	(561)	(561)

			St., Suite 106	Beach			inel.com	228-5500	833-2742
	The Condo News, Inc.		P.O. Box 109	West Palm Beach	FL	33402	info@condonewsonline.com	(561) 471-0329	
	Lake Worth Herald & Coastal Observer		Lake Worth Herald Press, Inc. 130 South H Street	Lake Worth	FL	33460	editor@lwherald.com	(561) 585-9387	
MAGAZINES	**NAME**	**CONTACT**	**ADDRESS**	**CITY**	**STATE**	**ZIP**	**EMAIL**	**PHONE #**	**FAX #**
	Florida Sportsman	Karl Wickstrom, Founder & Editor-in-Chief	2700 S. Kanner Highway	Stuart	FL	34994		772-219-7400	772-219-6900
	Coastal Angler Magazine	Ben Martin, CEO & Editor in Chief	1924 S Patrick Blvd.	Indian Harbour Beach	FL	32937	bob@coastanglermagazine.com	888-800-9794	
SEA TURTLE PERMIT HOLDERS	**NAME**	**CONTACT**	**ADDRESS**	**CITY**	**STATE**	**ZIP**	**EMAIL**	**PHONE #**	**FAX #**
	Town of Palm Beach Sea Turtle (ST) Permit Holder	Chris Perretta	1012 SW 7th Street	Boca Raton	FL	33486-5492	dbeco@bellsouth.net		
	Town of South Palm Beach ST Permit Holder	Bob Schoenfeld	3610 S. Ocean Blvd. (#101)	Town of South Palm Beach	FL	33480			
	Town of Lantana ST Permit Holder	Chris Redgate, Marine Safety Leiutenant	Marine Safety Headquarters, 100 N. Ocean	Lantana	FL	33462	credgate@lantana.org	561-540-5731	

			Boulevard						
	Town of Manalapan ST Permit Holder	Phil Stone	411 N. Broadway	Lantana	FL	33462	philip.stone@MyFWC.com		
Condominium Presidents	**NAME**	**CONTACT**	**ADDRESS**	**CITY**	**STATE**	**ZIP**	**EMAIL**	**PHONE #**	**FAX #**
	SOUTH PALM RESIDENCE	Dr. Donald Young	3500 S Ocen Blvd., #500	South Palm Beach	FL	33480	don_young@urmc.rochester.edu	588-0196	
	PALM SEA	Pat Paradowski	3520 S Ocean Blvd., #A-306	South Palm Beach	FL	33480	palmsea3520@comcast.net	370-3629	588-9382
	LE CHATEAU ROYAL	Roger Lieberman	3540 S Ocean Blvd., #504	South Palm Beach	FL	33480	condoman57@comcast.net	547-7136	
	THE BARCLAY	Jeff Stein	3546 S Ocean Blvd., #812	South Palm Beach	FL	33480	rentsrj@bellsouth.net	585-2357	588-4246
	CONCORDIA - WEST	Gaylord Palermo	3555 S Ocean Blvd., #614	South Palm Beach	FL	33480	palgifvg@msn.com		586-4804
	CONCORDIA - EAST	Gaylord Palermo	3560 S Ocean Blvd., #614	South Palm Beach	FL	33480	palgifvg@msn.com		586-4804
	TUSCANY	Linda Taft	3570 S Ocean Blvd., #403	South Palm Beach	FL	33480			
	HORIZON EAST	Suzanne Evans (VP)	3580 S Ocean Blvd., #8A	South Palm Beach	FL	33480	ppjgianni@aol.com	541-2348	
	HORIZON	Dr. David Sousa	3581 S	South Palm	FL	33480	davidsnj@aol.com	586-6776	586-

WEST		Ocean Blvd., #PH-E	Beach					6694
MAYFAIR HOUSE - LAKE	Jorge Avellana	3589 S Ocean Blvd., #703L	South Palm Beach	FL	33480	hhreno1@aol.com	582-6653	588-6339
MAYFAIR HOUSE - OCEAN	Jorge Avellana	3589 S Ocean Blvd., #703L	South Palm Beach	FL	33480	hhreno1@aol.com	582-6653	588-6339
SOUTH OCEAN CONDO	Laura Haimes	3600 S Ocean Blvd., #401	South Palm Beach	FL	33480	namzhamz@aol.com	493-4240	493-4240
DUNE DECK	Julia Koniosis	3610 S Ocean Blvd., #917	South Palm Beach	FL	33480	getjuliak@aol.com	547-7607	588-2013
LA PENSEE	John Lawson	4000 S Ocean Blvd., #306	South Palm Beach	FL	33480		547-8850	
PALM BEACH WINDEMERE	Mary Wallace	4200 S Ocean Blvd., #303	South Palm Beach	FL	33480	mwallace@aol.com		
THE IMPERIAL HOUSE	Bonnie Fischer	4500 S Ocean Blvd., #202	South Palm Beach	FL	33480	h2obon@aol.com	588-8795	
La Coquille Club Villas	Steve Russell	100 Evans Lane	Manalapan	FL	33462-3301	steve.lacoquille@comcast.net		
Bellaria Condominium	Stephen Jacobs	3000 S. Ocena Blvd.	Palm Beach	FL	33480			
Palm Beacher Condominium	Cheryl Barnes	3030 S. Ocean	Palm Beach	FL	33480			

		Blvd.						
Palm Beach Hampton	Bernie Kossar	3100 S. Ocean Blvd.	Palm Beach	FL	33480			
Oasis	Joshua Teverow	3120 S. Ocean Blvd.	Palm Beach	FL	33480			
Carlton Place	Bruce Heyman	3140 S. Ocean Blvd.	Palm Beach	FL	33480			
Enclave Palm Beach	Ira Smith	3170 S. Ocean Blvd.	Palm Beach	FL	33480			
3200 Condominium	Bob Mangino	3200 S. Ocean Blvd.	Palm Beach	FL	33480			
La Renaissance	Phillip Karpinsky	3230 S. Ocean Blvd.	Palm Beach	FL	33480			
Dorchester of Palm Beach	Arthur Goldmacher	3250 S. Ocean Blvd.	Palm Beach	FL	33480			
Meridian of Palm Beach	Madeline Shapiro	3300 S. Ocean Blvd.	Palm Beach	FL	33480			
3360 Condominium	Richard Hunegs	3360 S. Ocean Blvd.	Palm Beach	FL	33480			
Emuraude	Herbert Weinstein	3390 S. Ocean Blvd.	Palm Beach	FL	33480			
Atriums of Palm Beach	Rick Mecelli	3400 S. Ocean Blvd.	Palm Beach	FL	33480			

	Halcyon	John Altimari	3440 S. Ocean Blvd.	Palm Beach	FL	33480			
	Patrician	Jack Cohen	3450 S. Ocean Blvd.	Palm Beach	FL	33480			
	Claridges I & II	Richard Flaxman	3456 S. Ocean Blvd.	Palm Beach	FL	33480			
	La Bonne Vie	Ned McAdams	3475 S. Ocean Blvd.	Palm Beach	FL	33462-3301			
Condominium Managers	**NAME**	**CONTACT**	**ADDRESS**	**CITY**	**STATE**	**ZIP**	**EMAIL**	**PHONE #**	**FAX #**
	SOUTH PALM RESIDENCE	Paul Sylvestri	3500 S Ocen Blvd., #500	South Palm Beach	FL	33480	spalm3500@att.net	588-4413	588-0226
	SOUTH PALM RESIDENCE	Ed Rice	3500 S Ocen Blvd., #500	South Palm Beach	FL	33480		582-8394	588-0226
	PALMSEA	Aless Hall	3520 S Ocean Blvd., #A-306	South Palm Beach	FL	33480	palmsea3520@comcast.com	586-6345	588-9382
	LE CHATEAU ROYAL	Cynthia Campfield	3540 S Ocean Blvd., #504	South Palm Beach	FL	33480	lcrcoffice@att.net	585-3940	585-7763
	THE BARCLAY	Andrea Horne	3546 S Ocean Blvd., #812	South Palm Beach	FL	33480	manager@barclaypalmbeach.com	588-1517	588-4246
	CONCORDIA - WEST	Denise Bogner	3555 S Ocean Blvd., #614	South Palm Beach	FL	33480	the3560association@gmail.com	588-2323	588-0977

CONCORDIA - EAST	Denise Bogner	3560 S Ocean Blvd., #614	South Palm Beach	FL	33480	the3560association@gmail.com	588-2323	588-0977
TUSCANY	Josh Debrino	3570 S Ocean Blvd., #403	South Palm Beach	FL	33480	joshuadebrino@tcgmgt.com	585-9404	586-5759
HORIZON EAST	Eric Fink	3580 S Ocean Blvd., #8A	South Palm Beach	FL	33480		561-287-0516	547-5737
HORIZON WEST	David Sousa	3581 S Ocean Blvd., #PH-E	South Palm Beach	FL	33480	davidsnj@aol.com	586-6776	588-1724
HORIZON WEST	Ann Molloy	3581 S Ocean Blvd., #PH-E	South Palm Beach	FL	33480		582-0342	
MAYFAIR - LAKE	Steve Pepin	3589 S Ocean Blvd., #703L	South Palm Beach	FL	33480	mayfairh@comcast.net	588-6305	588-6339
MAYFAIR - OCEAN	Steve Pepin	3589 S Ocean Blvd., #703L	South Palm Beach	FL	33480	mayfairh@comcast.net	588-6305	588-6339
SOUTH OCEAN CONDO ASSOC	Angelo Conte	3600 S Ocean Blvd., #401	South Palm Beach	FL	33480		533-8060	533-8060
DUNE DECK	Elaine Romaine	3610 S Ocean Blvd., #917	South Palm Beach	FL	33480	dunedeckfl@gmail.com	588-4747	588-2013
LA PENSEE	John Jahn	4000 S Ocean	South Palm Beach	FL	33480	jcjahn@bellsouth.net	585-3084	585-3084

		Blvd., #306						
PALM BEACH WINDEMERE	John Boot	4200 S Ocean Blvd., #303	South Palm Beach	FL	33480	jb4299@aol.com	588-4871	588-1601
PALM BEACH WINDEMERE	Irene De Matteo	4200 S Ocean Blvd., #303	South Palm Beach	FL	33480		585-2632 (Home)	
THE IMPERIAL HOUSE	Chris Wurster	4500 S Ocean Blvd., #202	South Palm Beach	FL	33480		602-4031	
Bellaria Condominium	Heath D. Chute	3000 S. Ocena Blvd.	Palm Beach	FL	33480		540-2505	
Palm Beacher Condominium	Jaqueline Wustman	3030 S. Ocean Blvd.	Palm Beach	FL	33480		588-3844	
Palm Beach Hampton	George Cunniff	3100 S. Ocean Blvd.	Palm Beach	FL	33480		588-1233	
Oasis	Julian Butler	3120 S. Ocean Blvd.	Palm Beach	FL	33480		586-0775	
Carlton Place	Charles Linder	3140 S. Ocean Blvd.	Palm Beach	FL	33480		582-7117	
Enclave Palm Beach	Billy Parker	3170 S. Ocean Blvd.	Palm Beach	FL	33480		582-1100	
3200 Condominium	Walter Allan	3200 S. Ocean Blvd.	Palm Beach	FL	33480		588-8769	
La Renaissance	Sibyl Hockman	3230 S. Ocean Blvd.	Palm Beach	FL	33480		588-4203	

	Dorchester of Palm Beach	Ned Flemming	3250 S. Ocean Blvd.	Palm Beach	FL	33480		586-3304	
	Meridian of Palm Beach	Arturo Ramirez	3300 S. Ocean Blvd.	Palm Beach	FL	33480		582-9830	
	3360 Condominium	Jimmy Aroney	3360 S. Ocean Blvd.	Palm Beach	FL	33480		585-4504	
	Emuraude	Tammy Breaux	3390 S. Ocean Blvd.	Palm Beach	FL	33480		585-3656	
	Atriums of Palm Beach	Marc Richter	3400 S. Ocean Blvd.	Palm Beach	FL	33480		586-0154	
	Halcyon	Scott Rutan	3440 S. Ocean Blvd.	Palm Beach	FL	33480		582-9004	
	Patrician	Al Gallo	3450 S. Ocean Blvd.	Palm Beach	FL	33480		588-4313	
	Claridges I & II	Robert McCulloch	3456 S. Ocean Blvd.	Palm Beach	FL	33480		585-4245	
	La Bonne Vie	Ed Waldman	3475 S. Ocean Blvd.	Palm Beach	FL	33462-3301		582-9017	
Community Groups	**NAME**	**CONTACT**	**ADDRESS**	**CITY**	**STATE**	**ZIP**	**EMAIL**	**PHONE #**	**FAX #**
	Palm Beach Civic Association	Ned Barnes	139 N. County Road, Suite 33	Palm Beach	FL	33480			

	Citizens' Association of Palm Beach	Lew Crampton	BankUnited Building, 2875 S. Ocean Blvd., Suite 200	Palm Beach	FL	33480		561-655-5466	561-578-8660
	Neighborhood Alliance of Palm Beach	Jeffrey Cloniger & Rachel Lorentzen	P.O. Box 2174	Palm Beach	FL	33480			
	The Coalition to Save our Shoreline, Inc.	Carla Herwitz	2275 S. Ocean Blvd.	Palm Beach	FL	33480-5356			
MISC	**NAME**	**CONTACT**	**ADDRESS**	**CITY**	**STATE**	**ZIP**	**EMAIL**	**PHONE #**	**FAX #**
	Thomas Warnke		2780 Worcester Road	Lantana	FL	33462	twarnke@surfriderpbc.org		
	The Citizen's Association of Palm Beach		Bank United Building 2875 S. Ocean Boulevard (Suite 200)	Palm Beach	FL	33480	Directors@CitizensAssociationofPalmBeach.org	561-655-5466	561-655-5233
	Private property between 3200 S. Ocean Blvd. and La Renaissance condominiums	Judi Hilderbrandt and Gail Klewicki	941 S. Atlantic Dr.	Lake Worth	FL	33462-4730			

Appendix E

Scoping Comments

Written Comments Received During the August 12, 2013 Public Scoping Meeting

Robert Diffenderfer –
Please provide me notices and drafts of comments and NEPA documents. Please provide me with copies of each of Palm Beach County's and Town of Palm Beach's applications. Please provide a copy of the Karen Erickson report/proposal or links to where these documents may be found.

Pat Cooper –
Will structures be considered? Will a study be made as to the impact of the Lake Worth Pier to downdrift beach be done?

Victoria Piroso –
I am the owner/broker of Victoria's Luxury Estates, a local real estate brokerage in the area. I am interested to see how my clients will be affected (future homeowners).

Florence Elion-Mascott –
Spoke to Resident from Newport Beach, CA – Could not build until groins built – now Estates – furthermore – Surfriders – Heartly approved and no disturbance to reefs or fish.

Larry Goldberg –
As you start the process of evaluating the scope of work to be performed in order to allow the study area to have protection from a predetermined level of storm and at the same time balance environmental concerns, I hope you have the ability to consider and act on the following comments.

First, I would like to take the liberty of providing some background information. I received a Civil Engineering degree from MIT (among other degrees and professional designations) and shortly after that served as an officer in the famous 20th Engineer Combat Battalion. I did not serve in wartime but this unit did and was the first to set foot on Normandy beach where they suffered significant casualties as they cleared the path for others. They were aggressive in responding to one of the many important tasks charged to the USACE (Corps).

The scope of the Corps responsibilities has expanded and now includes the job of ensuring that our environment is protected. This means that a new path needs to be cleared which also requires aggressive and creative action to make sure that our shoreline as well as other resources are protected and maintained on a long term basis. To do this I hope the Corps makes sure their vision is broad enough to help restore and sustain our beach/dune system to provide protection and a habitat to support wildlife, turtles, etc. Projects proposed to do this should be supported and hopefully recommendations could be made to enhance performance. Environmental impacts that are negative but short lived (and controllable) should not prevent implementing project features which provide anticipated long term overall beneficial expectations. Short term disruptions should not deter a positive end result.

As part of this overall vision I hope the Corps can bring objective and courteous thinking regarding the intent of protection and other related project impacts.

To do this I would suggest you consider the thinking and guidelines that were employed by the FDEP in developing the Beach Management Agreement that should encompass this project. As an example, in their deliberations about resolving issues related to beach management the FDEP reviewed shoreline changes in Palm Beach since 1940 and found substantial erosion evident in many areas. They are still evaluating how this information can be incorporated into project guidelines. The thinking was to allow beach berm nourishment back to these old positions to allow a greater degree of storm protection. They would grant a permit to a project whose scope was within these guidelines as long as any necessary mitigation was provided. It would be a significant step forward if the Corps could support this thinking. I think the mitigation requirement could also be reviewed since I know of no scientific evidence stating that covering this newly exposed hardbottom and returning the shoreline to its previous status would reduce fish population by impairing "spawning, breeding, feeding, or growth to maturity." I think this current application of the Magnuson-Stevens Act as it relates to essential fish habitat and hardbottom in the context of shore protection activities is an unintended consequence of the Act that needs examination.

The scope of objectives described by the Corps seven EOP does not clearly discuss the need for providing and maintaining adequate shoreline protection for humans while also providing suitable habitat for wildlife and marine life but they certainly cover this subject on an overall basis.

Perhaps the Corps can step outside the box, take a new look at restrictions and initiate a more balanced approach in reviewing shoreline protection projects. Making sure that in your judgement the erosion control plans that are submitted actually provide the protection that is needed would be a welcome proactive step.

Madelyn Greenberg –
On behalf of The Coalition To Save Our Shoreline, Inc. (SOS) and the thousands it represents, I wish to make a public statement in regard to the EIS for Reach 8. My name is Madelyn Greenberg. I live at 3360 S. Ocean Blvd. and I am a member of the board of directors of the SOS.

While we realize that the Environmental Impact Study will be an arduous and complex process, we, too, have devoted a great deal of time and money to create the "right plan" for our area by balancing the interests of environmentalists, property owners, the public, governmental entities and other interested parties. Karyn Erickson, PE, DCE is the highly qualified coastal engineer who designed "the Coalition To Save Our Shoreline, Inc. (SOS) Beach Nourishment Plan & Design for Reach 8". This plan has been submitted as required to the Army Corps of Engineers for review and study as an alternative for Reach 8. This is in accordance with federal legislation for the Environmental Impact Statement to be conducted for Reach 8 in the Town of Palm Beach and also to be included in Southern Palm Beach Island Comprehensive Shoreline Stabilization Project in Palm Beach County for

Reaches 8, 9 and 10.

We respectfully submit that the SOS Beach Nourishment Plan & Design for Reach 8 meets the standards and criteria that are necessary to prevail. It is feasible, responsible, affordable, balanced and effective for the long term benefits for all. No other submitted proposals or plans can be said to accomplish this nor do they constitute the interests of everyone.

The SOS firmly believes and we hope that the Army Corps of Engineers, the State of Florida Department of Environmental Protection, Beach Management and Palm Beach County will agree that the results of this EIS process should result in a joint project that will serve the needs of the public and will be an all encompassing project that is not just for now, but also for the future.

With that criteria and goal in mind, the SOS has taken into account the historical mistakes made over the years on shore protection matters, particularly inadequate plans for the southern areas of our town. For example, the failure to recognize the inadequate amount of sand that flows to south-end beaches because of the numerous armoring structures such as sea walls and with many improperly placed and incorrectly designed groins, beginning at the north-end through, and including, the revetment in Reach 6, with little regard to erosion downdrift, has resulted in starved and critically eroded beaches to the south. Reach 8, the southernmost beach in the Town of Palm Beach is now in dire need of appropriate beach nourishment and dunes.

While we recognize that groins are generally successful in building up a beach in one place but, it also causes sand deficit and erosion downdrift. It is logical that the erosion downdrift must be compensated for by beach replenishment. Groins must be designed to allow sand to flow with sufficient lateral movement in order to offset erosion downdrift. Beach replenishment and groins are mutually beneficial, complementary, and necessary in these future plans. The SOS plan for Reach 8 provides for specially designed groins that not only trap sand but also allow sufficient lateral movement of sand downdrift.

The FDEP at their BMA Stakeholders Meeting presented "Historical Shoreline Data" which compared the erosion or accretion of our shoreline dating back to 1940. A startling fact is that, Reach 8 has lost from 100 to 200 feet of shoreline depth. We have all witnessed the endangered sea turtles that come to nest on our beaches and, because of the scarps and cliffs and the continually diminishing beach, they lay their eggs and the tide comes up and washes the eggs away or they lay under the water and are destroyed. These sea turtles will continue to be lost to us if man does not restore the wide beaches that sea turtles seek to lay their eggs, nest, hatch their young and return to the sea.

It is now time for a Beach Nourishment Plan to be implemented to correct the neglect, errors and omissions that produced this dangerous situation which places thousands of property owners at risk. The SOS is confident that the Army Corps of Engineers will fmd the Beach Nourishment Plan, which was designed by Ms. Erickson, to be thoroughly researched, environmentally suitable and, most importantly, permittable. This plan will stand on its own merit.

It is significant, that the SOS Beach Nourishment Plan strongly recommends that Ortona sand be used to increase the longevity of the project. It will be cost effective because of its durability and will result in the need for minimal mitigation. Again, the positive aspects of the Coalition To Save Our Shoreline (SOS) Beach Nourishment Plan & Design for Reach 8 will be to fulfill the need to correct severe erosion, satisfy environmental concerns and be a prototype for other successful beach nourishment and erosion control projects in the future.

To: Mr. Garrett Lips; Lt. Col. Thomas M. Greco

August 12, 2013

Re: (SAJ-2005-7908) and (SAJ-2008-04086)

As you start the process of evaluating the scope of work to be performed in order to allow the study area to have protection from a predetermined level of storm and at the same time balance environmental concerns, I hope you have the ability to consider and act on the following comments.

First, I would like to take the liberty of providing some background information. I received a Civil Engineering degree from MIT (among other degrees and professional designations) and shortly after that served as an officer in the famous 20th Engineer Combat Battalion. I did not serve in wartime but this unit did and was the first to set foot on Normandy beach where they suffered significant casualties as they cleared the path for others. They were aggressive in responding to one of the many important tasks charged to the USACE (Corps).

The scope of the Corps responsibilities has expanded and now includes the job of ensuring that our environment is protected. This means that a new path needs to be cleared which also requires aggressive and creative action to make sure that our shoreline as well as other resources are protected and maintained on a long term basis. To do this I hope the Corps makes sure their vision is broad enough to help restore and sustain our beach/dune system to provide protection and a habitat to support wildlife, turtles, etc. Projects proposed to do this should be supported and hopefully recommendations could be made to enhance performance. Environmental impacts that are negative but short lived (and controllable) should not prevent implementing project features which provide anticipated long term overall beneficial expectations. Short term disruptions should not deter a positive end result.

As part of this overall vision I hope the Corps can bring objective and courageous thinking regarding the intent of protection and other related project impacts.
To do this I would suggest you consider the thinking and guidelines that were employed by the FDEP in developing the Beach Management Agreement that should encompass this project. As an example, in their deliberations about resolving issues related to beach management the FDEP reviewed shoreline changes in Palm Beach since 1940 and found substantial erosion evident in many areas. They are still evaluating how this information can be incorporated into project guidelines. The thinking was to allow beach berm nourishment back to these old positions to allow a greater degree of storm protection. They would grant a permit to a project whose scope was within these guidelines as long as any necessary mitigation was provided. It would be a significant step forward if the Corps could support this thinking. I think the mitigation requirement could also be reviewed since I know of no scientific evidence stating that covering this newly exposed hardbottom and returning the shoreline to its previous status would reduce fish population by impairing "spawning, breeding, feeding, or growth to maturity." I think this current application of the Magnuson-Stevens Act as it relates to essential fish habitat and hardbottom in the context of shore protection activities is an unintended consequence of the Act that needs examination.

The scope of objectives described by the Corps seven EOP does not clearly discuss the need for providing and maintaining adequate shoreline protection for humans while also providing suitable habitat for wildlife and marine life but they certainly cover this subject on an overall basis.

Perhaps the Corps can step outside the box, take a new look at restrictions and initiate a more balanced approach in reviewing shoreline protection projects. Making sure that in your judgement the erosion control plans that are submitted actually provide the protection that is needed would be a welcome proactive step.

Larry Goldberg
Larry Goldberg
3360 S. Ocean Blvd. 5CS
Palm Beach, FL 33480
larryccim@aol.com

Send .ppt via email

The Coalition To Save Our Shoreline, Inc.
(SOS)
STATEMENT AT THE PUBLIC SCOPING EIS MEETING ON AUGUST 12, 2013

On behalf of The Coalition To Save Our Shoreline, Inc. (SOS) and the thousands it represents, I wish to make a public statement in regard to the EIS for Reach 8. My name is Madelyn Greenberg. I live at 3360 S. Ocean Blvd. and I am a member of the board of directors of the SOS.

While we realize that the Environmental Impact Study will be an arduous and complex process, we, too, have devoted a great deal of time and money to create the "right plan" for our area by balancing the interests of environmentalists, property owners, the public, governmental entities and other interested parties. Karyn Erickson, PE, DCE is the highly qualified coastal engineer who designed "the Coalition To Save Our Shoreline, Inc. (SOS) Beach Nourishment Plan & Design for Reach 8". This plan has been submitted as required to the Army Corps of Engineers for review and study as an alternative for Reach 8. This is in accordance with federal legislation for the Environmental Impact Statement to be conducted for Reach 8 in the Town of Palm Beach and also to be included in Southern Palm Beach Island Comprehensive Shoreline Stabilization Project in Palm Beach County for Reaches 8, 9 and 10.

We respectfully submit that the SOS Beach Nourishment Plan & Design for Reach 8 meets the standards and criteria that are necessary to prevail. It is feasible, responsible, affordable, balanced and effective for the long term benefits for all. No other submitted proposals or plans can be said to accomplish this nor do they constitute the interests of everyone.

The SOS firmly believes and we hope that the Army Corps of Engineers, the State of Florida Department of Environmental Protection, Beach Management and Palm Beach County will agree that the results of this EIS process should result in a joint project that will serve the needs of the public and will be an all encompassing project that is not just for now, but also for the future.

With that criteria and goal in mind, the SOS has taken into account the historical mistakes made over the years on shore protection matters, particularly inadequate plans for the southern areas of our town. For example, the failure to recognize the inadequate amount of sand that flows to south-end beaches because of the numerous armoring structures such as sea walls and with many improperly placed and incorrectly designed groins, beginning at the north-end through, and including, the revetment in Reach 6, with little regard to erosion downdrift, has resulted in starved and critically eroded beaches to the south. Reach 8, the southernmost beach in the Town of Palm Beach is now in dire need of appropriate beach nourishment and dunes.

While we recognize that groins are generally successful in building up a beach in one place but, it also causes sand deficit and erosion downdrift. It is logical that the erosion downdrift must be compensated for by beach replenishment. Groins must be designed to allow sand to flow with sufficient lateral movement in order to offset erosion downdrift. Beach replenishment and groins are mutually beneficial, complementary, and necessary in these future plans. The SOS plan for Reach 8 provides for specially designed groins that not only trap sand but also allow sufficient lateral movement of sand downdrift.

The FDEP at their BMA Stakeholders Meeting presented "Historical Shoreline Data" which compared the erosion or accretion of our shoreline dating back to 1940. A startling fact is that, Reach 8 has lost from 100 to 200 feet of shoreline depth. We have all witnessed the endangered sea turtles that come to nest on our beaches and, because of the scarps and cliffs and the continually diminishing beach, they lay their eggs and the tide comes up and washes the eggs away or they lay under the water and are destroyed. These sea turtles will continue to be lost to us if man does not restore the wide beaches that sea turtles seek to lay their eggs, nest, hatch their young and return to the sea.

It is now time for a Beach Nourishment Plan to be implemented to correct the neglect, errors and omissions that produced this dangerous situation which places thousands of property owners at risk. The SOS is confident that the Army Corps of Engineers will find the Beach Nourishment Plan, which was designed by Ms. Erickson, to be thoroughly researched, environmentally suitable and, most importantly, permittable. This plan will stand on its own merit.

It is significant, that the SOS Beach Nourishment Plan strongly recommends that Ortona sand be used to increase the longevity of the project. It will be cost effective because of its durability and will result in the need for minimal mitigation. Again, the positive aspects of the Coalition To Save Our Shoreline (SOS) Beach Nourishment Plan & Design for Reach 8 will be to fulfill the need to correct severe erosion, satisfy environmental concerns and be a prototype for other successful beach nourishment and erosion control projects in the future.

Scoping Comments

Conference Call with National Marine Fisheries Service (NMFS) – Habitat Conservation Division (HCD)

September 3, 2013

Attendees: Jocelyn Karazsia (NMFS – HCD)
Garett Lips (USACE)
Lauren Floyd (CBI)

Jocelyn Karazsia (NMFS – HCD) requested this call to discuss the proposed biological characterization methods for collection of benthic resource data for the Town of Palm Beach EIS. This data will provide information on ESA listed (and proposed) species and hardbottom (EFH) in the project area. The following items were discussed during this meeting:

1. J. Karazsia said that no one from NMFS Protected Resources Division (PRD) was able to participate in this call, but encouraged the Corps to continue to seek comments from them on proposed survey methodologies.
2. J. Karazsia said that based on the lengthy consultation history associated with this project area, NMFS considers this a high priority project.
3. G. Lips and J. Karazsia agree to discuss (at a later date) whether the Corps should invite NMFS to participate as a cooperating agency on this EIS.
4. J. Karazsia, G. Lips and L. Floyd reviewed the Draft "Biological Characterization Methodologies for the Southern Palm Beach Island Comprehensive Shoreline Stabilization Project", which includes J. Karzsia's comments and Stacy Prekel's (CBI) responses.
5. Overall, J. Karazsia believes the methods seem appropriate for the survey, but would like to see additional details (e.g., how will location of transects be determined, how will historical aerials be included, would a hardbottom edge delineation be appropriate). She reiterated that NMFS – PRD will need to review and comment on the proposed coral survey methods.
6. G. Lips asked if NMFS would like to be invited to participate in the characterization survey. J. Karazsia said that is not necessary, but that once the survey is complete it might be good to conduct a joint field investigation to look at different hardbottom types identified in the project area.
7. CBI will update the Draft "Biological Characterization Methodologies for the Southern Palm Beach Island Comprehensive Shoreline Stabilization Project" to include additional details requested by J. Karazsia, the Corps will forward to J. Karazsia and to NMFS-PRD for comments before the surveys are conducted.

Rosov, Brad

From: Pierro, Thomas
Sent: Wednesday, September 04, 2013 6:23 PM
To: Lips, Garett G SAJ (Garett.G.Lips@usace.army.mil); Danchuk, Samantha; Rosov, Brad; Prekel, Stacy
Cc: TPB EIS Sharepoint (TPB-EIS@xnetmail.shawgrp.com)
Subject: 20130903 Tom Warnke Comment Follow-up

FYI:

Tom Warnke called me back yesterday following my request to him for additional information on the comments he made at the Scoping Meeting. Below is a summary of his opinions as expressed to me during our discussion:

1. Beach "building" with naturally occurring shell material – Mr. Warnke described his experience as a life-time shell collector growing up Palm Beach County and spending time in Captiva Island, Florida. He explained how he has observed sea shells migrating with wave action and how shells from bivalves and gastropods breakdown into polished particles that collect along the beach face, thus becoming "sand" and building the beach. His opinion is that these particles settle out of suspension quickly and contribute to water clarity. Example areas he cited are Highland Beach and north of the Boynton Inlet. He also stated his opinion that beach nourishment can change the character of the beach though the use of "offshore" sand. He has observed that the shells commonly found along the beaches typically range from tan to white in color, whereas material from offshore borrow areas may include darker olive colored shells that could be from different species. He does not know of any research that exists on this topic but suggested that research should be done.

2. Sand durability – Mr. Warnke suggested that the work of Hal Wanless be reviewed and considered as it relates to the durability of sand particles. He also stated that Wanless has done studies on Bahamian sand (aragonite), which Wanless indicated may be acceptable for use on Florida beaches depending on source location and political factors. He indicated that Wanless had referred him to a source on the east side of Andros Island as a location with "durable" aragonite.

3. Sand standards - Mr. Warnke indicated that Palm Beach County has a sand standard for upland sources that includes 1% silt, as opposed to 5% silt in the state sand rule. He did not have a copy the County's sand specification but recalled seeing a few years ago. He motioned that the Orton source consistency produces beach quality sand that is washed and inspected before being delivered to the beach. He also indicated that inspection of each load of trucked sand at the beach fill site is important for quality control purposes.

Thanks,

Thomas P. Pierro, P.E., D.CE
Vice President
Coastal Planning & Engineering, Inc.
(561) 391-8102 office
(561) 361-3150 direct
(561) 756-2535 cell
(561) 391-9116 fax
Thomas.Pierro@CBI.com

CB&I
2481 NW Boca Raton Blvd.
Boca Raton, FL. 33431

USA
www.CBI.com

APPENDIX B

TECHNICAL SPECIFICATIONS FOR PALM BEACH COUNTY

ANNUAL DUNE AND WETLANDS RESTORATION PROJECT NO. 2013ERM01

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TECHNICAL SPECIFICATIONS FOR

PALM BEACH COUNTY

ANNUAL DUNE AND WETLANDS RESTORATION

PROJECT NO. 2013ERM01

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1.1 **Scope of Work:** The objective of this *Invitation for Bid* and associated prospective construction Contract Documents is to identify and secure a contract necessary for the restoration of beach dunes and wetland/submerged aquatic habitats in Palm Beach County.

The work entails providing and/or excavating, transporting, placement and grading of material within project areas designated by the COUNTY under specific Work Orders to be issued by the COUNTY – consistent with the lump sum and unit costs cited in the Bid Schedule. Bidders shall furnish all labor, materials, equipment, and services necessary to complete the scope of work outlined in these specifications.

Anticipated Work Order(s) under the initial one-year Contract includes the Coral Cove Dune Restoration (Figure 1), the Grassy Flats Estuarine Habitat Restoration Project (Figure 2) and the Bryant Park Living Shoreline Project (Figure 3) as depicted on the Schedule of Estimated Quantities (Table 1). The timing of these Work Order approvals is contingent on site conditions, grant funding and agency permitting. The estimated expenditure under the remaining two-year Contract period, if renewed, would be an amount not to exceed the amount of the first year's contract for each subsequent year.

GOVERNING SPECIFICATIONS: Under this Contract the CONTRACTOR shall have the capacity (necessary equipment and operators available) to: provide and/or excavate, transport, deliver, place, and grade no less than a total of 300,000 tons (250,000 yd^3) of material at a daily rate of no less than 3,000 tons (2,500 yds^3) of sand per 10 hour day of work. The CONTRACTOR shall begin to supply or excavate, transport and deliver material within 48 hours of faxed or emailed receipt of a Work Order and shall be at full operating capacity within 5 calendar days of receipt of a Work Order.

Material Placement: It is expected that the CONTRACTOR shall employ bulldozers, front-end loaders, off-road dump trucks, excavators, conveyors and other equipment as necessary to move the material from the staging area to the project area for excavation/placement. Grading and other construction equipment will not be permitted outside the designated work areas except when specifically defined in the associated Work Order. The site conditions are subject to change; grade elevations may vary from the elevations shown on the plans. The County reserves the right to vary the grade from the grades shown on the plans. The fill cross sections shown on the drawings are for the purpose of permitting and estimating the amount of fill needed and will be used by the COUNTY in making any change in the grades. The CONTRACTOR shall monitor the excavation and fill operations and shall notify the COUNTY if and when the quantity to be placed may exceed the Contract quantities. The quantity of material specified on a Work Order is the maximum quantity the CONTRACTOR will be paid for, unless otherwise authorized by the COUNTY.

Grade Tolerance: Final dressing shall not take place until all filling activity is completed at which time the fill shall be graded and dressed so as to eliminate any abrupt humps and depressions in the fill surfaces. Final grades and elevations shall be as indicated on the plans unless otherwise instructed by the County. Any grade stakes used in the placement of the fill shall be removed intact, without breaking.

Misplaced or Non-compliant Materials: Materials deposited above the maximum tolerance elevation or outside designated project area shall be classified as misplaced material and shall result in a suspension of operations. Sand deposited which does not meet the specifications outlined in Section 2.1 shall be classified as non-compliant material and shall result in a suspension of operations. The CONTRACTOR shall provide immediate notice to the COUNTY including a description of the incident and specific location of either misplaced or non-compliant material. The CONTRACTOR shall remove and redeposit such materials at no added cost to the COUNTY and with no project time extensions. The CONTRACTOR shall not resume operations until approved by the COUNTY.

Measurement of Fill Quantity: Measurement of fill quantity must be approved in advance by the COUNTY. If the CONTRACTOR opts to use front-end loaders with an integrated weighing system, the system shall be capable of printing weight slips and maintaining a daily cumulative total. The CONTRACTOR shall provide documentation demonstrating that the integrated weighing system has been calibrated within 48 hours of commencing work and shall zero the weighing system at the beginning of each work day. Payment shall be based on the cumulative weight as documented by the integrated weighing system.

Weight to Volume Conversion: The weight to volume conversion for measurement and payment shall be 1.2 Ton = 1 yd^3 for well drained sand and fill material with a moisture content less than ten percent (10%).

The following describes the work and associated Bid Items:

2.0 BASE BID (DUNE RESTORATION)

2.1 **Provide Sand (Bid Item 1):** Under Bid Item 1, the CONTRACTOR shall provide COUNTY approved sand meeting the following technical specifications and load the sand into trucks. Said trucks may be the COUNTY's trucks or the CONTRACTOR's trucks; the transport of sand is addressed under Bid Items 2 and 3.

2.1.1 All sand shall meet the following *Technical Standards*:

a) be obtained from a source further than 800ft landward of the coastal construction control line

b) be similar in color to the native beach material [The predominant Munsell Color Value in Palm Beach County for moist (5% - 10%) native beach material is 10YR 7/2 (light gray). An acceptable range of Munsell Color Values for sand is from 10YR 8/1 (white) to 10YR 7/3 (very pale brown), excluding Munsell Color Values with a chroma greater than 3, 2.5Y 8/1 (white) to 2.5 Y 8/3 (pale yellow) or 5Y 8/1(white), 5y 8/2 (pale yellow)]

c) be free of construction debris, rocks, clay, or other foreign matter
d) have less than 1% organic material (TOC)
e) be free of coarse gravel or cobbles, defined by Unified Soils as anything greater than 19mm in diameter
f) have a particle size distribution ranging predominantly between 0.074mm (3.75φ) and 4.76mm (-2.25φ) – and shall **not** contain:

- greater than 1 percent, by weight, silt, clay or colloids passing the #200 sieve and greater than 0.6 percent, by weight, silt, clay or colloids passing the #230 sieve (4.0φ) as determined by wet sieve analysis ASTM method D1140;
- greater than 5 percent, by weight, fine gravel retained on the #4 sieve (-2.25φ)

The acceptable range of the mean grain size of sand shall be from 0.30mm to 0.70mm with a sorting coefficient/standard deviation no greater than 0.9φ.

g) be well-drained and free of excess water, and have a moisture content of less than ten percent (10%). Immediately upon request of the COUNTY representative, the CONTRACTOR shall collect a representative sample from the loading site, seal the sample in an air tight container and deliver the sample on the same day to a COUNTY approved testing laboratory for analysis of the moisture content using ASTM method D2216. Verbal results of the moisture content shall be made available to the COUNTY within 72 hours after the sample is delivered to the laboratory. Deliverables shall include a hard copy and electronic files in a format acceptable to the COUNTY. All costs associated with the sampling and analysis shall be the sole responsibility of the CONTRACTOR.

Quality Assurance Protocols:

a) the CONTRACTOR shall provide daily geotechnical analysis of core samples taken from the stockpile at the source. The core samples shall be a composite of four (4) samples taken around the stockpile using a 6’ tube that is 1.5” in diameter. The four samples shall be combined and quartered per ASTM D75-03, AAHSTO T2-91. The analysis shall consist of a wet sieve method using ASTM C-117 procedures.
b) the COUNTY may collect random sand samples of delivered sand to assess grain size, Munsell color and silt content using ASTM D422-63, AAHSTO T-27 procedures. Each sample shall be archived with the date, time load number of the sample and beach placement location. A record of these sand evaluations will be provided within the COUNTY’S inspection reports.
c) in addition to the field samples, the CONTRACTOR shall visually compare each load to the acceptable sand criteria to ensure compliance with the quality requirements. If determined necessary by the COUNTY, additional assessments of the sand shall be conducted for grain size, Munsell color and silt content for any load sample that does not pass the visual inspection. All costs associated with the additional assessments shall be the sole responsibility of the CONTRACTOR.

APPENDIX C

SOUTHERN PALM BEACH ISLAND COMPREHENSIVE

SHORELINE STABILIZATION PROJECT

2013 ACROPORA SURVEY REPORT

(PBC-ERM, 2013)

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SOUTHERN PALM BEACH ISLAND COMPREHENSIVE SHORELINE STABILIZATION PROJECT
ACROPORA SURVEY – October 22, 2013

Reconnaissance surveys were completed on October 22, 2013, on the nearshore reefs located between R monument 127 and 141 to determine the distribution and abundance of the federally listed coral (*Acropora* spp). The survey also included the seven coral species proposed for listing (*Dendrogyra cylindrus, Montastrea annularis, Montastrea faveolata, Montastrea franksi, Mycetophyllia ferox, Agaricia lamarcki,* and *Dichocoenia stokesi*) under the Endangered Species Act (ESA) since it is anticipated that these species may be listed prior to commencement of the proposed project. The purpose of this survey was to perform the preliminary visual reconnaissance for locating listed species colonies per the NOAA protocol outlined in the "*Recommended Survey Protocol for Acropora spp. in Support of Section 7 Consultation*" document.

The survey encompassed the area from approximately 2000 ft north of the proposed project area (R-127) to approximately 3500 ft south of the proposed project area (R-141). Benthic habitat maps of the nearshore hardbottom in the survey area show highly ephemeral hardbottom habitat located mostly landward of the 10 ft (3 m) depth contour and generally within 500 ft (150 m) from shore. The survey area included all hardbottom habitat located seaward of the 6 ft depth contour and omitted areas that consistently contained unconsolidated sediment based on available aerial analyses; however, these areas were visually verified as unconsolidated sediment during the survey to ensure no potential habitat was omitted. The project is proposed as a truck-haul and therefore the offshore reef resources were not surveyed as they are well outside the proposed project area.

METHODS

Four ERM staff conducted the inspections. Dr. Janet Phipps, ERM's Coral Reef Ecologist, oversaw and participated in the surveys. Prior to the surveys, surveyors reviewed the protocol and visual identification of the coral species. As depths were less than 15 ft (5 m), surveyors were able to snorkel and thus cover the entire linear distance during the survey. The four surveyors were spread in an east-west orientation and swam north visually covering the majority of the exposed hardbottom areas.

RESULTS

Exposed hardbottom, where present, averaged 175-200 ft (53-61 m) in width with maximum width of 265-275 ft. (81-84 m) The survey area was slightly less than 3 miles (4.8 km) in length; however, exposed hardbottom was present in the southern 1.8 miles (2.9 km) (see figure). Depths ranged from 8 to 15 ft (2-5 m). Seas were 1 ft (0.3 m) with a moderate southeast wind. As the day progressed, the winds increased in strength increasing the seas, but visibilities remained the same.

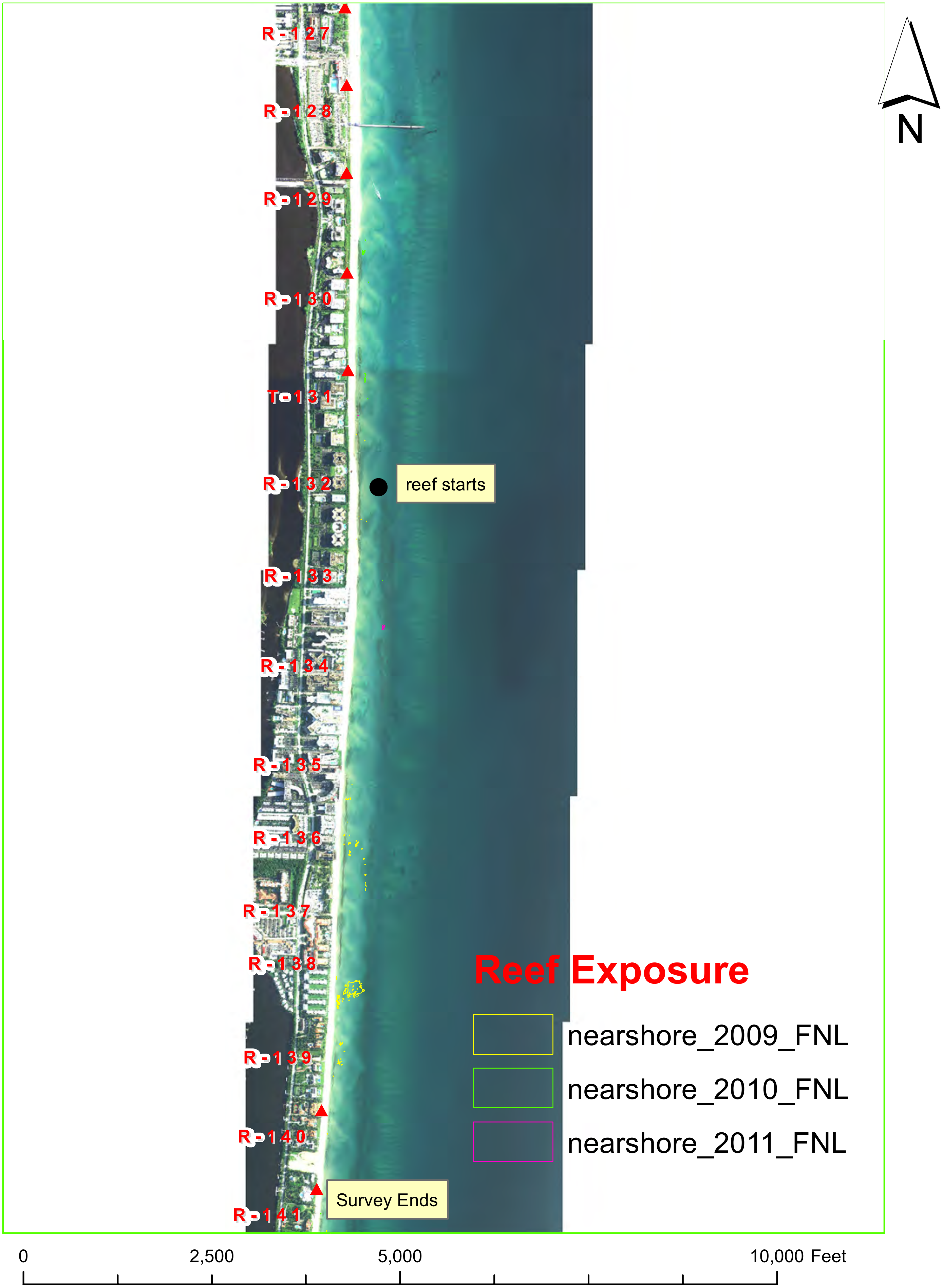
The exposed hardbottom was present between 26^{o} 35.98 / 80^{o} 02.14 (R-132) and 26^{o} 34.44 / 80^{o} 02.23 (R-141). Between R-127 and 132, unconsolidated sediment was present and verified.

No target coral species were observed during this reconnaissance survey of the nearshore hardbottom reefs.

The reef appeared to have been uncovered relatively recently, and much of the area had a sand veneer present. Aerials surveys show that the last time this hardbottom was exposed was in 2006. The attached figure shows reef exposures for 2009-2011.

Average sizes of gorgonians (*Eunicea* sp., *Pseudopterogorgia* sp., *Pterogorgia citrina*, *P. anceps*, and *Leptogorgia miniata*) and fire coral (Millepora alcicornis) were 1-3 in (2.5-7.6 cm) and *Sidestrea siderea* corals were less than 1 inch (2.5 cm) in diameter. Several *S. siderea* colonies greater than one inch (2.5 cm) were present, but they were bleached/dead, indicating prior burials. Algae hydroid (*Thyroscyphus ramosus*) colonies were maximum 4-5 inches (10-12.7 cm) and in one location a bed of *Padina* was present, but each colony was less than one inch (2.5 cm) in size. Thirty-eight species of fish representing 16 families were noted. All fish species were typical of the depth zone, but one unusual sighting was a juvenile blue-spotted cornetfish (*Fistuaria tabecaria*) that was approximately 12 in. (0.3 m) in size.

SOUTHERN PALM BEACH ISLAND



APPENDIX D

SOUTHERN PALM BEACH ISLAND COMPREHENSIVE

SHORELINE STABILIZATION PROJECT

2013 HABITAT CHARACTERIZATION REPORT

(CB&I, 2014)

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SOUTHERN PALM BEACH ISLAND
COMPREHENSIVE SHORELINE STABILIZATION PROJECT
2013 HABITAT CHARACTERIZATION REPORT

Prepared for:

Town of Palm Beach and Palm Beach County

Prepared by:

CB&I Coastal Planning & Engineering, Inc.

Recommended citation for main report:

CB&I Coastal Planning & Engineering, Inc. (CB&I) 2014. Southern Palm Beach Island Comprehensive Shoreline Stabilization Project, 2013 Characterization Report. Boca Raton, Florida: CB&I Coastal Planning & Engineering, Inc. (CB&I) 55 pp.

July 2014

SOUTHERN PALM BEACH ISLAND
COMPREHENSIVE SHORELINE STABILIZATION PROJECT
2013 HABITAT CHARACTERIZATION REPORT

EXECUTIVE SUMMARY

Palm Beach County is located on Florida's east coast approximately 60 miles north of Miami. There are 38 incorporated municipalities within Palm Beach County including four (4) located within the Study Area. These include the Towns of Palm Beach, South Palm Beach, Lantana and Manalapan. The Project Area for the Southern Palm Beach Island Comprehensive Shoreline Stabilization Project comprises approximately 3.3 km (2.1 mi) of shoreline and nearshore environment extending from R-129-210 (south of Lake Worth Municipal Beach located within the Town of Palm Beach) southward to R-138+551 (the Eau Palm Beach Resort & Spa in Manalapan).

The purpose of this report was to assess the existing conditions of the beach and nearshore hardbottom resources within and adjacent to the Project Area (including areas immediately to the north and south). The assessment included the nearshore resources between R-127 and R-141 for a total length of approximately 4.8 km (3.0 mi), herein referred to as the Study Area. The most recent aerial images were provided by Palm Beach County's Department of Environmental Resources Management (PBC-ERM) and delineated in GIS by CB&I Coastal Planning & Engineering, Inc. (CB&I). This resulted in a total area of 14.96 ha (36.96 ac) of nearshore hardbottom adjacent to the Study Area at the time the aerials were flown (March 2013). Originally, fifteen (15) transects were planned for benthic characterization. However, no hardbottom resources were located north and immediately south of the Lake Worth pier; therefore, only twelve (12) shore-perpendicular transects were sampled between R-130 and R-141 on October 21 and 23, 2013. Previous surveys within this area were conducted in May and July 2006. In this report, the 2006 dataset was analyzed for comparison to the current hardbottom habitat conditions. Additionally, a survey was conducted in April 2009 and April 2010 to collect hardbottom relief data in support of the South Palm Beach/Lantana Segmented Breakwater Project. Overall, the benthic hardbottom habitat adjacent to the Study Area is very dynamic and ephemeral in nature. The constant burial and re-exposure of hardbottom in this area facilitates the development of an opportunistic community dominated by turf and macroalgae species that recruit quickly when substrate is available.

In order to ensure that the two federally listed threatened *Acropora* coral species (*A. cervicornis* and *A. palmata*) were not present on the hardbottom resources adjacent to the project area, PBC-ERM conducted an *Acropora* spp. survey on October 22, 2013. No colonies of *Acropora* or any of the seven (7) coral species proposed for listing under the Endangered Species Act (ESA) were observed.

A dune vegetation assessment was also conducted within the Study Area on November 15, 2013 to document the species present. The Study Area was first analyzed using aerial images to determine areas of extensive vegetation for ground-truthing. The areas characterized by seawalls were not investigated *in situ.* Seagrape was the dominant dune vegetation recorded throughout the surveyed area. The endangered dune plant beach jacquemontia (*Jacquemontia reclinata*) was not observed.

SOUTHERN PALM BEACH ISLAND
COMPREHENSIVE SHORELINE STABILIZATION PROJECT
2013 HABITAT CHARACTERIZATION REPORT

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1.0. INTRODUCTION

1.1. PROJECT LOCATION

Palm Beach County is located on Florida's east coast approximately 60 miles north of Miami. Palm Beach County and the Town of Palm Beach have both proposed shoreline stabilization projects that are adjacent to one another. The two projects, combined, include four Palm Beach County municipalities - the Towns of Palm Beach, South Palm Beach, Lantana and Manalapan (Figure 1). The U.S. Army Corps of Engineers (USACE) determined that the proposed projects are connected actions, and is therefore evaluating the environmental effects of these projects together. The comprehensive project includes beach and dune restoration, as well as construction of seven (7) low-profile groins, and has been named the Southern Palm Beach Island Comprehensive Shoreline Stabilization Project (the Project). The Project comprises approximately 3.33 km (2.07 mi) of shoreline and nearshore environment from Florida Department of Environmental Protection (FDEP) monuments R-129-210 (south of Lake Worth Municipal Beach located within the Town of Palm Beach) to R-138+551 (the Eau Palm Beach Resort & Spa in Manalapan). The USACE is preparing an Environmental Impact Statement (EIS) in compliance with the National Environmental Policy Act (NEPA) to identify and assess the environmental effects of the Project and its alternatives. Since a biological investigation of the Project Area had not been conducted since 2006 in the southern portion of the Project Area and since 2008 in the northern portion of the Project Area, an updated characterization of the beach and nearshore habitat was conducted in October 2013 to supplement the EIS.

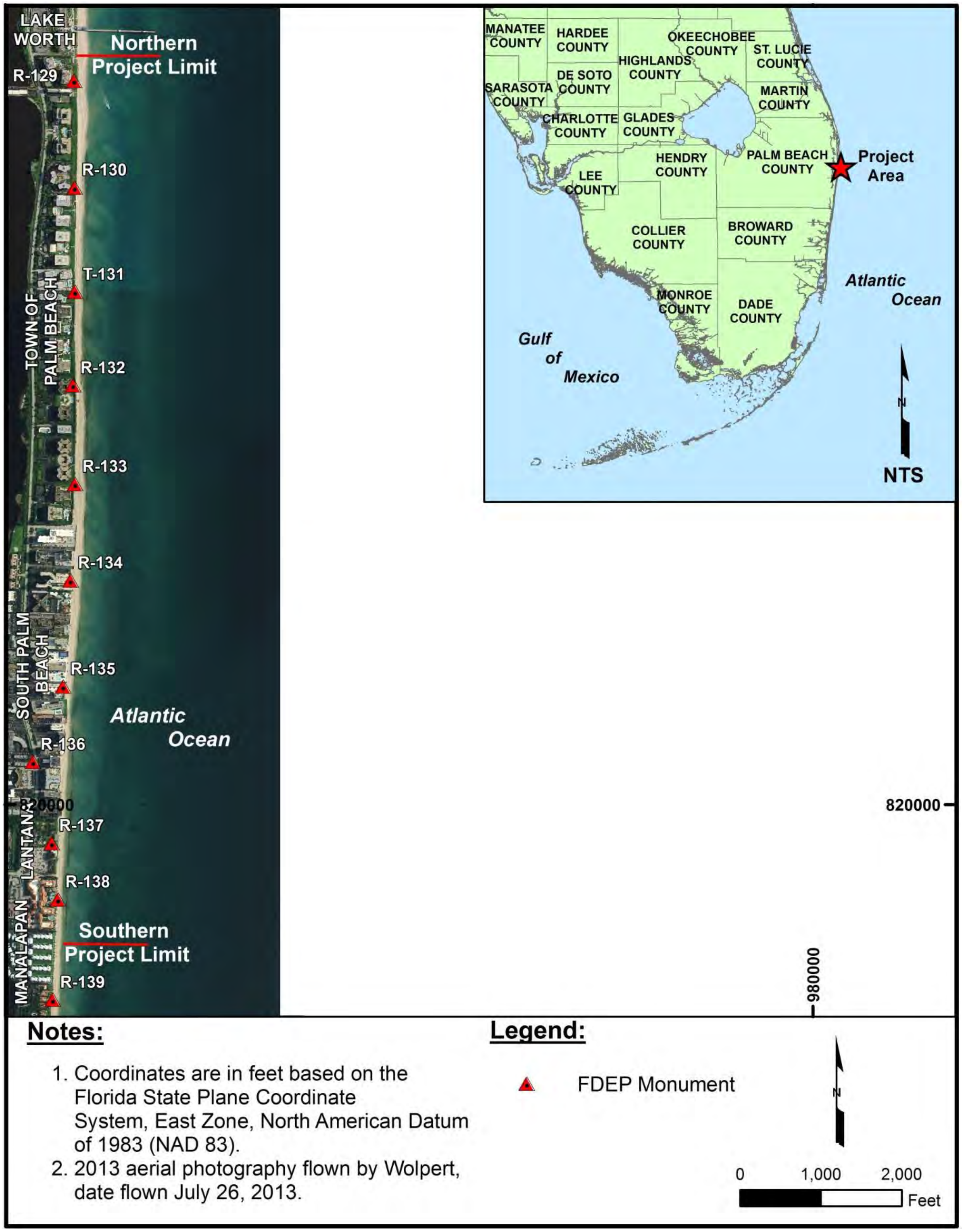

Figure 1. Location map of the Southern Palm Beach Island Comprehensive Shoreline Stabilization Project.

1.2. PROJECT HISTORY

Biological assessments have been conducted in the nearshore marine habitat adjacent to the proposed Project Area within the past several years. Within the Town of Palm Beach, the FDEP Hurricane Recovery Dune Restoration Project was constructed in April and May of 2006 in response to erosion caused by the hurricanes during 2004 and 2005. The project spanned Reaches 7 and 8 in the Town of Palm Beach and was constructed using offshore sand truck-hauled from the Reach 7 Phipps Ocean Park Beach Restoration Project. The biological monitoring program for the 2006 project included shore-perpendicular transects that spanned the width of the nearshore hardbottom resources between R-128 and R-134 (conducted in May 2006). South of the dune project, quantitative assessments were conducted in July 2006 along shore-perpendicular transects between R-134 and R-142 in association with the South Palm Beach/Lantana Erosion Control Study. Within the same project area (R-134 to R-142) and timeframe (September 2006) a dune vegetation survey was conducted to map species coverage and document species location. The data from these surveys will be referenced and used for comparison to the data generated from the 2013 surveys reported herein. The October 2013 biological characterization provides an updated and comprehensive assessment of the Study Area, which includes dune and nearshore resources within and adjacent to the Project Area.

1.3. PROPOSED PROJECT

The Project proposes to use beach fill placement and coastal protection structures to enhance the existing beach and dune system for storm protection to upland property and to improve recreation and enhance the habitat. The Project would place approximately 150,000 cubic yards (cy) of fill along the shorelines of the Town of Palm Beach, South Palm Beach, Lantana and Manalapan from R-129-210 to R-138+551. This project also includes the construction of seven (7) low-profile groins placed perpendicular to the shoreline extending from the existing seawalls to the post-construction (beach fill) waterline in South Palm Beach, Lantana and Manalapan (R-134+113 to R-138+551). Construction of these structures will help stabilize the shoreline by disrupting a portion of the sand flowing south along the beach and encouraging sediment deposition on the updrift (northern) side of the structures. From north to south, the project would place dune fill only from R-129-210 to R-129+150, dune and beach fill from R-129+150 to R-131, dune fill only from R-131 to R-134+113 (Town of Palm Beach southern limit), and beach fill with low-profile groins from R-134+113 to R-138+551. It is anticipated that the mechanism for fill placement would involve use of a truck-haul approach. The sand source would be a combination of stockpiled dredge material from the Reach 7 Phipps Ocean Park Beach Restoration Project (Phipps) or the Mid-Town Beach Restoration Project (Mid-Town) for placement within the Town of Palm Beach project limits (R-129-210 to R-134+113) and upland sand for placement within the project limits in South Palm Beach, Lantana and Manalapan (R-134+113 to R-138+551) (Figure 2).

Notes:

1. Coordinates are in feet based on the Florida State Plane Coordinate System, East Zone, North American Datum of 1983 (NAD 83).
2. Aerial photography flown by Woolpert, Inc. on July 25-26, 2013.
3. 2013 hardbottom delineated by CB&I. 2006 digitized hardbottom provided by FAU.

Legend:

2013 Hardbottom
2006 Hardbottom

Dominant Dune Vegetation
Coccoloba uvifera
Panicum amarum
Uniola paniculata

Buried Seawall
Seawall
Applicants' Preferred Project Design
Proposed Groin
Transects
FDEP Monuments

N

Feet
0 100 200

TITLE:
Southern Palm Beach Island Comprehensive Shoreline Stabilization Project Nearshore Hardbottom and Dune Resources

CB&I
Coastal Planning & Engineering, Inc.
2481 N. W. Boca Raton Boulevard
Boca Raton, FL 33431
Ph. (561) 391-8102
Fax (561) 391-9116

Date: 06/05/14	By: ALS	Comm No. : 150814	Figure No. 2a

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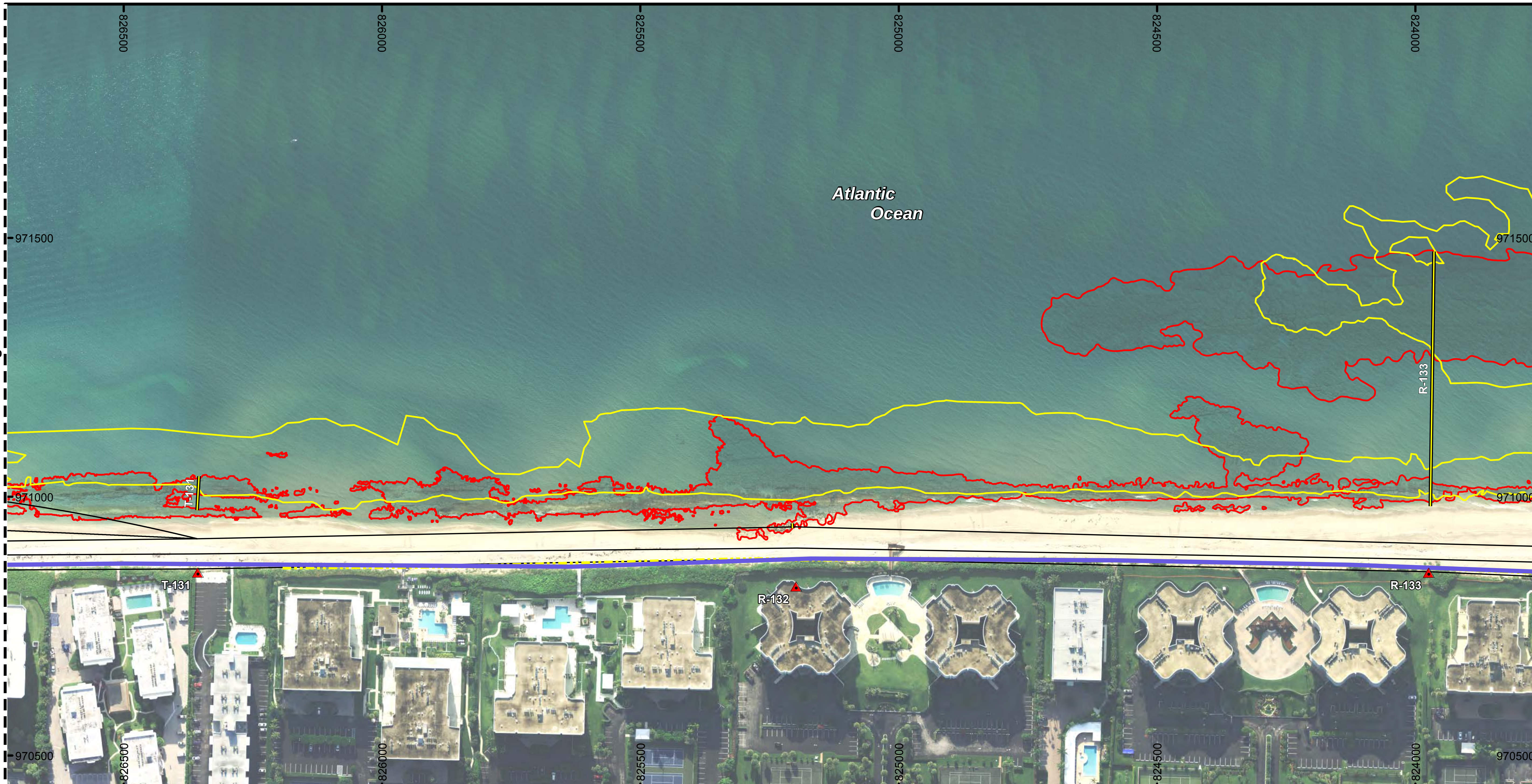

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Notes:

1. Coordinates are in feet based on the Florida State Plane Coordinate System, East Zone, North American Datum of 1983 (NAD 83).
2. Aerial photography flown by Woolpert, Inc. on July 25-26, 2013.
3. 2013 hardbottom delineated by CB&I. 2006 digitized hardbottom provided by FAU.

Legend:

- 2013 Hardbottom
- 2006 Hardbottom

Dominant Dune Vegetation

- *Coccoloba uvifera*

- Buried Seawall
- Seawall
- Applicants' Preferred Project Design
- Proposed Groin
- Transects
- FDEP Monuments

N

Feet
0 100 200

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Date: 06/05/14	By: ALS	Comm No. : 150814	**Figure No. 2b**

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Notes:

1. Coordinates are in feet based on the Florida State Plane Coordinate System, East Zone, North American Datum of 1983 (NAD 83).
2. Aerial photography flown by Woolpert, Inc. on July 25-26, 2013.
3. 2013 hardbottom delineated by CB&I. 2006 digitized hardbottom provided by FAU.

Legend:

2013 Hardbottom
2006 Hardbottom

Dominant Dune Vegetation
Coccoloba uvifera

Buried Seawall
Seawall
Applicants' Preferred Project Design
Proposed Groin
Transects
FDEP Monuments

N

0 100 200 Feet

TITLE:

Southern Palm Beach Island Comprehensive Shoreline Stabilization Project Nearshore Hardbottom and Dune Resources

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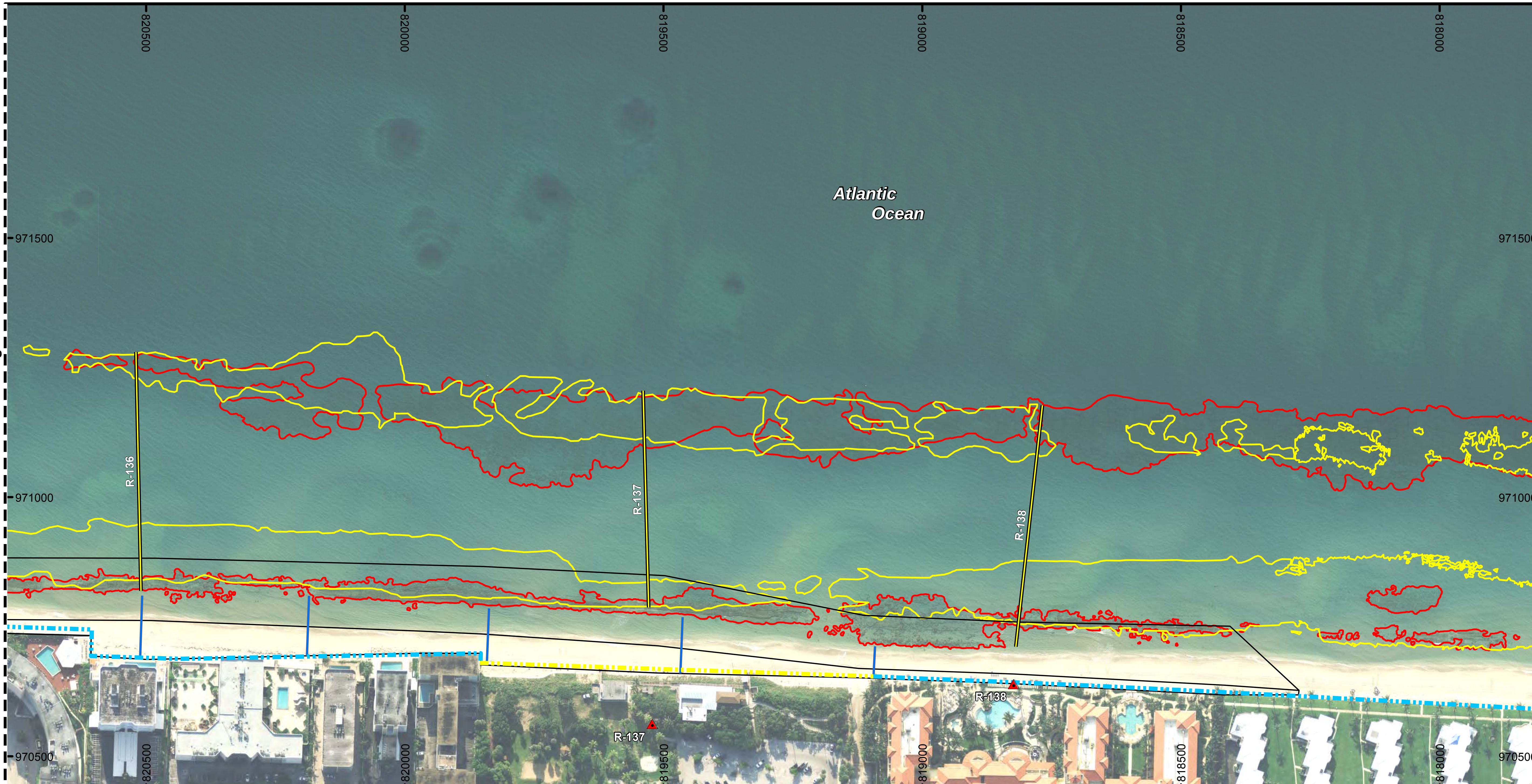
Ph. (561) 391-8102
Fax (561) 391-9116

Date: 06/05/14	By: ALS	Comm No. : 150814	Figure No. 2c

Matchline Figure 2c



Matchline Figure 2e

Notes:

1. Coordinates are in feet based on the Florida State Plane Coordinate System, East Zone, North American Datum of 1983 (NAD 83).
2. Aerial photography flown by Woolpert, Inc. on July 25-26, 2013.
3. 2013 hardbottom delineated by CB&I. 2006 digitized hardbottom provided by FAU.

Legend:

- 2013 Hardbottom
- 2006 Hardbottom
- Buried Seawall
- Seawall
- Applicants' Preferred Project Design
- Proposed Groin
- Transects
- FDEP Monuments

N

Feet
0 100 200

TITLE:

Southern Palm Beach Island
Comprehensive Shoreline
Stabilization Project
Nearshore Hardbottom and Dune Resources

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Boca Raton, FL 33431
Ph. (561) 391-8102
Fax (561) 391-9116

Date: 06/05/14	By: ALS	Comm No. : 150814	Figure No. 2d

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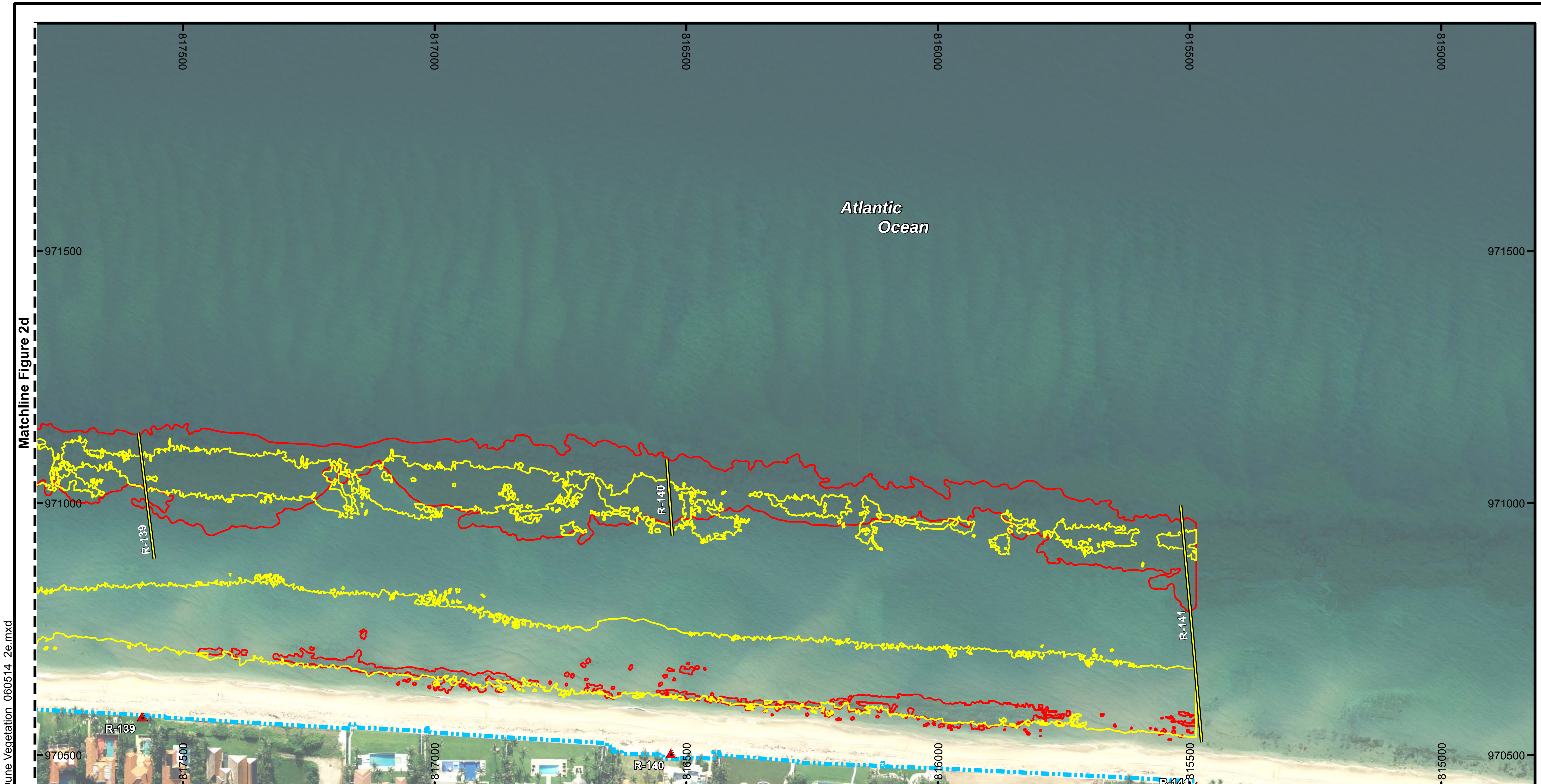

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Notes:

1. Coordinates are in feet based on the Florida State Plane Coordinate System, East Zone, North American Datum of 1983 (NAD 83).
2. Aerial photography flown by Woolpert, Inc. on July 25-26, 2013.
3. 2013 hardbottom delineated by CB&I. 2006 digitized hardbottom provided by FAU.

Legend:

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- 2006 Hardbottom
- Buried Seawall
- Seawall
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N

Feet
0 100 200

TITLE:

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Date: 06/05/14	By: ALS	Comm No. : 150814	Figure No. 2e

2.0. METHODS

A biological characterization of the dune and nearshore hardbottom habitat was conducted to provide an updated dataset of the environmental conditions within and adjacent to the Project Area (including areas immediately to the north and south). The dune and nearshore hardbottom assessment area included the shoreline between R-127 and R-141 for a total length of approximately 4.8 km (3.0 mi), herein referred to as the Study Area.

2.1. AERIAL DELINEATION OF NEARSHORE HARDBOTTOM RESOURCES

The 2013 rectified aerials were provided by Palm Beach County's Department of Environmental Resources Management. The clear and shallow waters of the Study Area allowed the hardbottom resources to be easily delineated. A marine biologist and GIS specialist delineated the hardbottom resources (Figure 2). A shapefile of the 2013 nearshore hardbottom delineation is also provided on the enclosed CD.

2.2. *IN SITU* ASSESSMENT OF NEARSHORE HARDBOTTOM RESOURCES

Originally, fifteen (15) transects were planned for benthic characterization in the Study Area. However, no hardbottom resources were observed between R-127 and R-129; therefore, twelve (12) shore-perpendicular transects were surveyed between R-130 and R-141. Each transect extended from the landward (western) edge of the hardbottom to the seaward (eastern) extent of the hardbottom or 150 m (whichever was less). The seaward limit of 150 m was determined based on current monitoring requirements regulated by FDEP that are commonly applied in south Florida and supported by examination of 2013 aerial images of the Study Area, which showed that a width of 150 m encompassed the majority of nearshore hardbottom resources in the area. Transect details including the start (west) and end (east) locations, transect length and the number of quadrats sampled in the Study Area are provided in Table 1. The 150-m threshold captured all hardbottom resources along each transect (Figure 2).

Table 1. Study Area transect start (west) and end (east) locations, transect length (m) and the number of quadrats sampled per transect during the October 2013 hardbottom characterization. Transect length and number of quadrats sampled were based on hardbottom resources exposed at the time of the survey.

Transect	Start		End		Transect Length (m)	No. of Quadrats
	Latitude	Longitude	Latitude	Longitude		
R-130	26.607331	-80.036497	26.607304	-80.036347	15.2	13
R-131	26.603851	-80.036585	26.603839	-80.036385	20.3	12
R-132	26.600682	-80.036719	26.600683	-80.036691	2.8	5
R-133	26.597285	-80.036617	26.597255	-80.035112	149.8	12
R-134	26.593934	-80.036092	26.594019	-80.035166	89.4	16
R-135	26.590368	-80.035784	26.590393	-80.035222	54.9	13
R-136	26.587768	-80.037194	26.587785	-80.035784	140.0	12
R-137	26.585090	-80.036035	26.585069	-80.037314	127.5	13
R-138	26.583119	-80.037562	26.582968	-80.036140	148.1	12
R-139	26.579644	-80.037046	26.579725	-80.036281	78.1	14
R-140	26.576811	-80.036931	26.576838	-80.036468	44.6	12
R-141	26.573969	-80.037610	26.574032	-80.036771	145.5	15

The 2013 transect locations were based on previously sampled transects surveyed in 2006; the same size quadrats (0.25 m^2) were utilized in order to generate an easily comparable dataset. Transect length was determined *in situ* based upon the extent of exposed nearshore hardbottom within 150 m of the nearshore hardbottom edge. Quadrat placement was biased to hardbottom in order to avoid sampling sand patches. A total of 147 quadrats and 12 transects were sampled during the 2013 characterization. Along each transect, the quadrat-based Benthic Ecological Assessment for Marginal Reefs (BEAMR) methodology (Lybolt and Baron, 2006) was utilized, along with video documentation, line-intercept for sediment, and interval sediment depth measurements. Representative photographs were taken along each transect and GPS coordinates were recorded at the start and end of each transect when water depth allowed boat access. When the boat could not access the start (inshore) point of a transect due to shallow water depth, divers recorded the distance from the start point of the transect to the closest GPS coordinate that could be collected in order to determine the transect start point coordinates.

2.2.1. BENTHIC ECOLOGICAL ASSESSMENT

The BEAMR methodology (Lybolt and Baron, 2006) was used for *in situ* sampling to evaluate the benthic cover of the nearshore hardbottom (Photograph 1). It is a quadrat-based methodology that samples three characteristics of the benthos: physical structure, planar percent cover of sessile benthos, and coral/octocoral density. As with all non-consumptive surveys, BEAMR is necessarily constrained to visually conspicuous organisms with well-defined, discriminating characteristics for identification.

> **Physical characteristics** recorded from quadrats include the maximum topographic relief (cm) and the maximum sediment depth (cm). Maximum relief was measured from the lowest to the highest point of attached hard substratum in the quadrat, inclusive of organisms with stony skeletons (i.e., relief measurements do not include octocorals, tunicates, macroalgae, etc.).
>
> Sediment depth measurements were taken within each quadrat and sediment depths greater than 1 cm were recorded. The length of the ruler determined the maximum detectable sediment depth at a given point (e.g., for a 30-cm ruler, the value 30 denotes sediment ≥ 30 cm deep).
>
> **Estimates of the planar percent cover** of all sessile benthos are pooled to 19 major functional groups that include: sediment, macroalgae, turf algae, encrusting red algae, sponge, hydroid, octocoral, scleractinian coral, tunicate, bare hard substrate, anemone, barnacle, bryozoan, bivalve, *Millepora* spp., seagrass, sessile annelid, wormrock and zoanthid. Additionally, the breakdown of macroalgae genera and bioeroding sponge species percent cover that occupied at least 1% cover were recorded.
>
> **Coral density** was estimated by individual colony count. The maximum diameter (cm) and species of each scleractinian (stony) coral, and the maximum height (cm) and genus of each octocoral were recorded. Encrusting octocorals were measured by their maximum diameter (cm), similar to stony corals.

Photograph 1. Divers conducting the Benthic Ecological Assessment for Marginal Reefs (BEAMR) methodology during the 2013 characterization survey.

2.2.2. VIDEO DOCUMENTATION

Video was recorded using a digital video camera in an underwater housing along each shore-perpendicular transect to provide a record of the conditions of each transect at the time of the survey. The speed of the video did not exceed 5 m per minute and the camera was held at a height of 40 cm above the substrate.

2.2.3. SEDIMENT COVER

The line-intercept methodology used to document sediment cover and the location of physical transitions in the nearshore habitat along the shore-perpendicular transects. The location of hardbottom boundaries interrupted by sand patches larger than 0.5 m in length was documented using two substrate designations: nearshore hardbottom and sand. Nearshore hardbottom was clearly exposed consolidated substrate with the potential for recruitment of benthic organisms, and sand was defined as areas of uninterrupted sediment at least 0.5 m in length with a depth greater than 1.0 cm with no emerging biota. Areas where biota emerged through sand were considered hardbottom regardless of sand depth in the line-intercept survey. The line-intercept data provide a ratio of hardbottom to sand for the area along each transect.

2.2.4. SEDIMENT DEPTH

Sediment depth data were collected at 1.0-m intervals along each shore-perpendicular transect. Sediment depth data provide a snapshot of the shore-perpendicular sand distribution across and between the nearshore hardbottom patches at each sampling event.

2.2.4. FISH OBSERVATIONS

Transect-counts were utilized for visually assessing the fish assemblage structure along the hardbottom located in the Study Area during the 2006 survey. While a formal quantitative fish survey was not required for the 2013 protocol, all fish taxa encountered during the 2013 benthic survey were recorded.

2.3. DUNE VEGETATION SURVEY

Following an examination of aerial photography to determine specific areas of interest along the Study Area which may support dune vegetation, CB&I biologists ground-truthed the extent of vegetation using a Differential Global Positioning System (DGPS) on November 15, 2013. Biologists started the survey south of Lake Worth Pier and continued south until the dune habitat ended and extensive seawalls began at approximately R-133+500. Dominant species were identified and photographs were collected throughout the survey area. Particular effort was made to identify and document the presence of the endangered plant species beach jacquemontia (*Jacquemontia reclinata*).

2.4. STATISTICAL ANALYSIS

Benthic data were entered into a Microsoft Access database for data management. Vertical relief data were exported to Microsoft Excel for comparisons and statistical testing while benthic data were exported to PRIMER v6 (Clark and Gorley, 2006; Clark and Warwick, 2001) for statistical testing. Data analyses consisted of non-parametric univariate and multivariate statistical tests. Statistical significance was determined at $\alpha = 0.05$ (95% confidence interval) and all reference to "significance" has been determined through statistical analysis. Variations of each analytical application are specified in the appropriate results section, *i.e.,* standardization, transformation, *etc.*

Univariate Statistics

Hartley's F_{max} test was used to compare variances of the intertidal and subtidal relief for each year, and to compare 2006 data to 2013 data. As these data were homoscedastic but failed to meet the normality assumption, the non-parametric Mann-Whitney U test (which is essentially the Kruskal-Wallis test applied to two samples), was used to determine significant differences in relief.

Multivariate Statistics

Non-parametric multivariate statistical analyses were conducted using PRIMER v6 (Clark and Gorley, 2006; Clark and Warwick, 2001). Below is a brief description of the tools and analyses applied to the dataset.

Data Pre-Treatment. Data transformation was applied to downweight the contributions of quantitatively dominant species to the similarities calculated between samples. It is particularly important for the Bray-Curtis similarity, which does not incorporate any form of scaling of each taxon by its total or maximum across all samples. The more severe the transformation, the more strength is given to the less abundant taxa.

Resemblance. A definition of resemblance between every pair of samples is fundamental to the operation of any multivariate analysis. Within PRIMER, the term ‘resemblance’ covers the three concepts of similarity, dissimilarity and distance. Similarity ranges between 0 (completely different) to 100 (perfect similarity), dissimilarity is the complement of similarity (100-similarity), and distance ranges from 0 to infinity. The most commonly used similarity coefficient for biological community analysis is the Bray-Curtis similarity because it obeys many of the ‘natural’ biological axioms that most other coefficients do not.

Analysis of Similarity (ANOSIM). ANOSIM is an approximate analogue of the standard univariate 1- and 2-way analysis of variance test and results in a test statistic (R-statistic) and a level of significance (*p*-value) under the null hypothesis that no differences exist between samples being compared. The R-value varies between 0 (no differences) and 1 (differences) – R will be near 0 when differences do not exist and closer to 1 when differences do exist. The *p*-value determines significant differences based on the pre-determined alpha ($\alpha = 0.05$).

Similarity Percentages (SIMPER). When differences between groups of samples have been shown to exist (from ANOSIM), the SIMPER routine was applied to determine which taxa (functional group, genus, species, *etc.*) contributed to the average dissimilarity ($\bar{\delta}$) between the groups. A lower dissimilarity does not mean that the two groups being compared have similar communities (as ANOSIM indicates), but merely indicates when the average dissimilarity increases and decreases and which taxa are contributing to that dissimilarity.

Cluster Analysis with Similarity Profile (SIMPROF). PRIMER carries out simple agglomerative, hierarchical clustering from a resemblance matrix. The output is a dendrogram which displays the grouping of samples into successively smaller numbers of clusters. The SIMPROF test is a series of permutation tests which looks for statistically significant evidence of genuine clusters in samples which are *a priori* unstructured. When the SIMPROF analysis is undertaken, tests are performed at every node of the completed dendrogram and significant differences between samples are indicated.

3.0. RESULTS

Electronic copies of Appendices A through F are included on the enclosed CD. The logbook field notes and raw datasheets are included in Appendices A and B, respectively. Appendix C includes an Excel spreadsheet with 2013 BEAMR, line-intercept and sediment depth data, and Appendix D includes the 2013 hardbottom delineation and dune vegetation shapefiles. The South Palm Beach/Lantana Breakwaters Feasibility Study, Hardbottom Relief Observation Report (CPE, 2010) is provided as Appendix E and results of the PBC-ERM 2013 *Acropora* Reconnaissance Survey are provided in Appendix F. Transect videos documenting the shore-perpendicular transects are included on the enclosed DVDs.

3.1. AERIAL DELINEATION OF HARDBOTTOM RESOURCES

The nearshore hardbottom resources in the Study Area are defined by two shore-parallel ridges that are considered ephemeral. When described separately herein, these are referred to as the intertidal and subtidal hardbottom ridges. Aerial delineations conducted between 2003 and 2013 have shown that both, one or neither of these ridges may be exposed at any given time. The 2013 aerial delineation resulted in 36.96 ac of exposed hardbottom between R-127 and R-141, compared to 48.78 ac of hardbottom in 2006 (Figure 2). The location of the hardbottom resources exposed in 2006 and 2013 are similar; however, when several additional years of hardbottom delineation are presented, the ephemeral nature of these hardbottom resources is apparent. Figure 3 shows the changes observed between 2003, 2007, 2011 and 2013. Not only does the actual location of exposed hardbottom change but the total area of exposure has also varied drastically over time (Table 2). The least amount of exposed hardbottom occurred in 2009 (2.71 ac) and the greatest amount was present in 2006 (48.78 ac) (Figure 4).

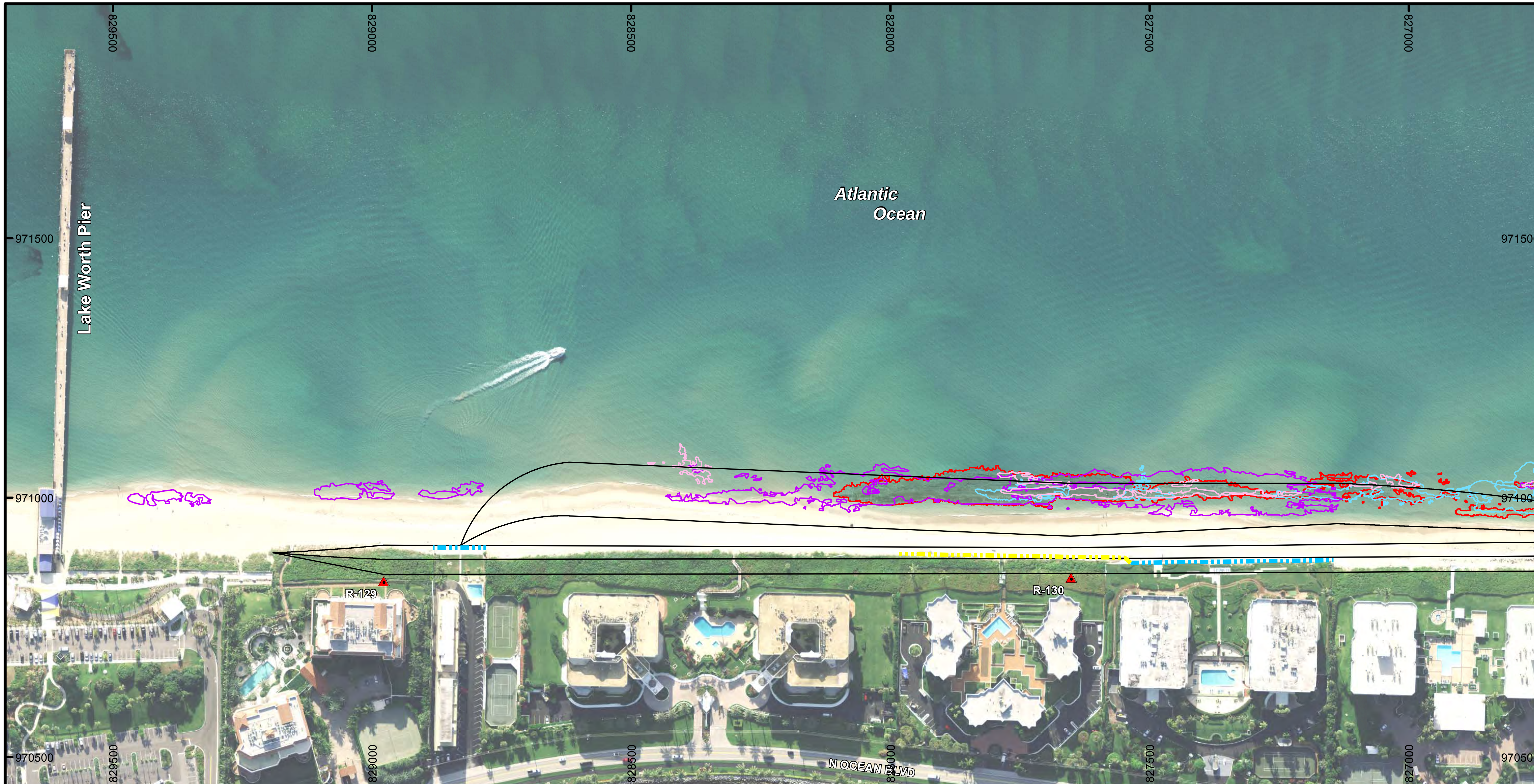
In order to determine the amount of persistent hardbottom exposure, an analysis was conducted in GIS to determine the area and location of hardbottom that was exposed during all aerial delineations between 2003 and 2013. This resulted in a very small area

(0.000392 ac) of hardbottom located on the intertidal hardbottom about 350 ft north of R-133 (Figure 4), supporting the overall designation of hardbottom habitat in the Study Area as ephemeral.

Due to the dynamic nature of sand movement in this area, the hardbottom is constantly exposed to burial and scouring resulting in an opportunistic benthic community dominated by turf and macroalgae and supporting small coral colonies. A survey conducted in 2009 and 2010 to collect hardbottom relief data in support of the South Palm Beach/Lantana Segmented Breakwaters Project (Appendix E) also noted a significant change in exposed hardbottom from year to year. Although quantitative benthic data were not collected for these surveys, various macroalgae species were observed in 2009; however, the hardbottom appeared mostly either buried or well scoured during the 2010 investigation and no macroalgae was noted. Although this habitat is very dynamic, it provides food resources and refuge for benthic and fish species.

Table 2. Exposed hardbottom acreage delineated from aerial imagery between 2003 and 2013 in the Study Area (R-127 to R-141).

Year of Delineation	Area (ac)
2003	4.57
2004	25.03
2005	35.59
2006	48.78
2007	38.94
2008	27.61
2009	2.71
2010 (June)	16.70
2010 (October)	8.02
2011	15.19
2012	16.13
2013	36.96



G:\Enterprise\Palm Beach\150814\Mxd\Dune Vegetation_All_HB_060514_3a.mxd

Notes:

1. Coordinates are in feet based on the Florida State Plane Coordinate System, East Zone, North American Datum of 1983 (NAD 83).
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3. 2013 hardbottom delineated by CB&I.
   2011 hardbottom provided by Tetra Tech.
   2007 digitized hardbottom provided by FAU.
   2003 digitized hardbottom provided by PBC-ERM.

Legend:

- 2013 Hardbottom
- 2011 Hardbottom
- 2007 Hardbottom
- 2003 Hardbottom
- Buried Seawall
- Seawall
- Applicants' Preferred Project Design
- Proposed Groin
- FDEP Monuments

N

Feet
0 100 200

TITLE:
Southern Palm Beach Island Comprehensive Shoreline Stabilization Project Nearshore Hardbottom Resources (2003-2013)

CB&I
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2481 N. W. Boca Raton Boulevard
Boca Raton, FL 33431
Ph. (561) 391-8102
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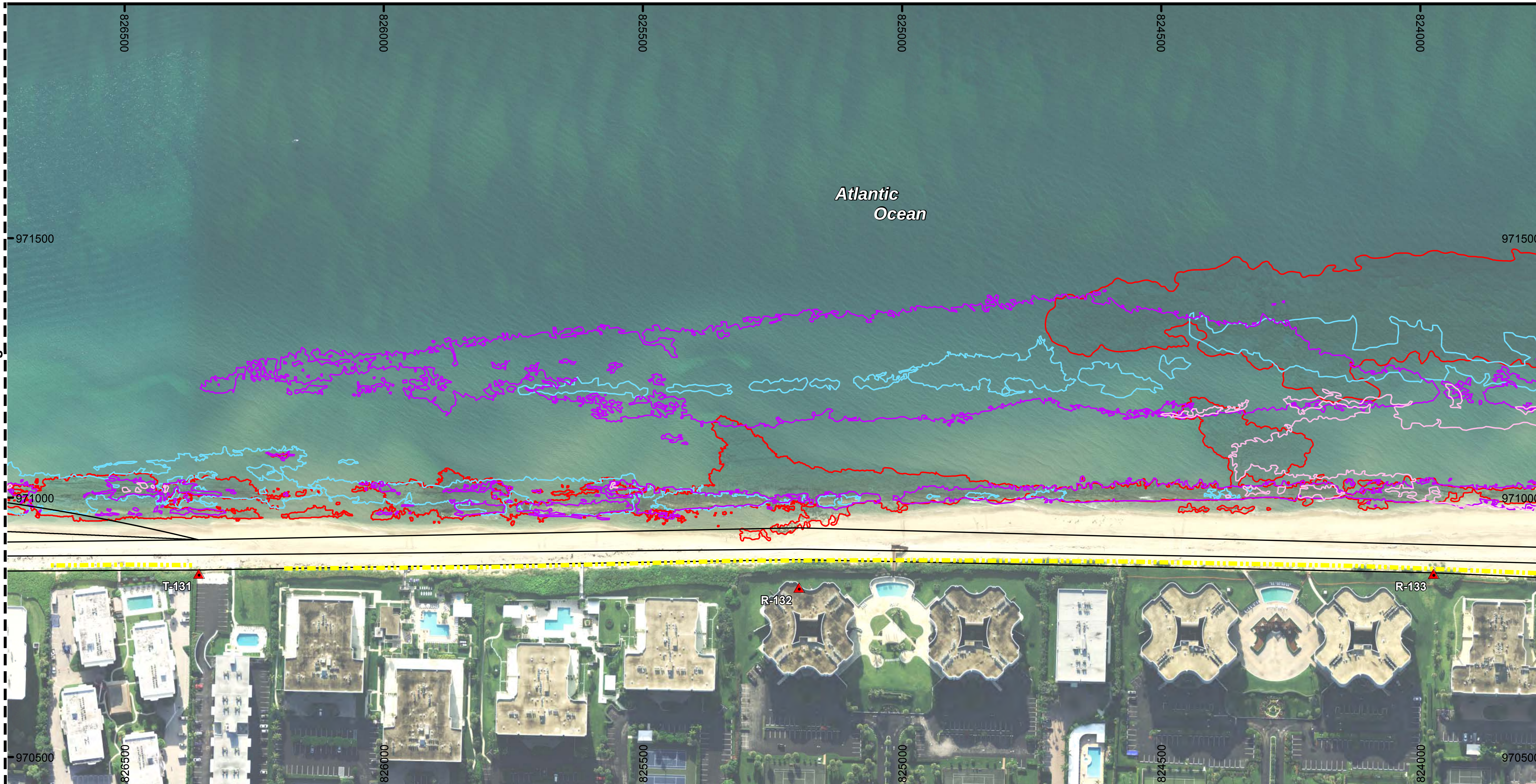
Date: 06/05/14	By: ALS	Comm No. : 150814	Figure No. 3a



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N

0 100 200 Feet

TITLE:

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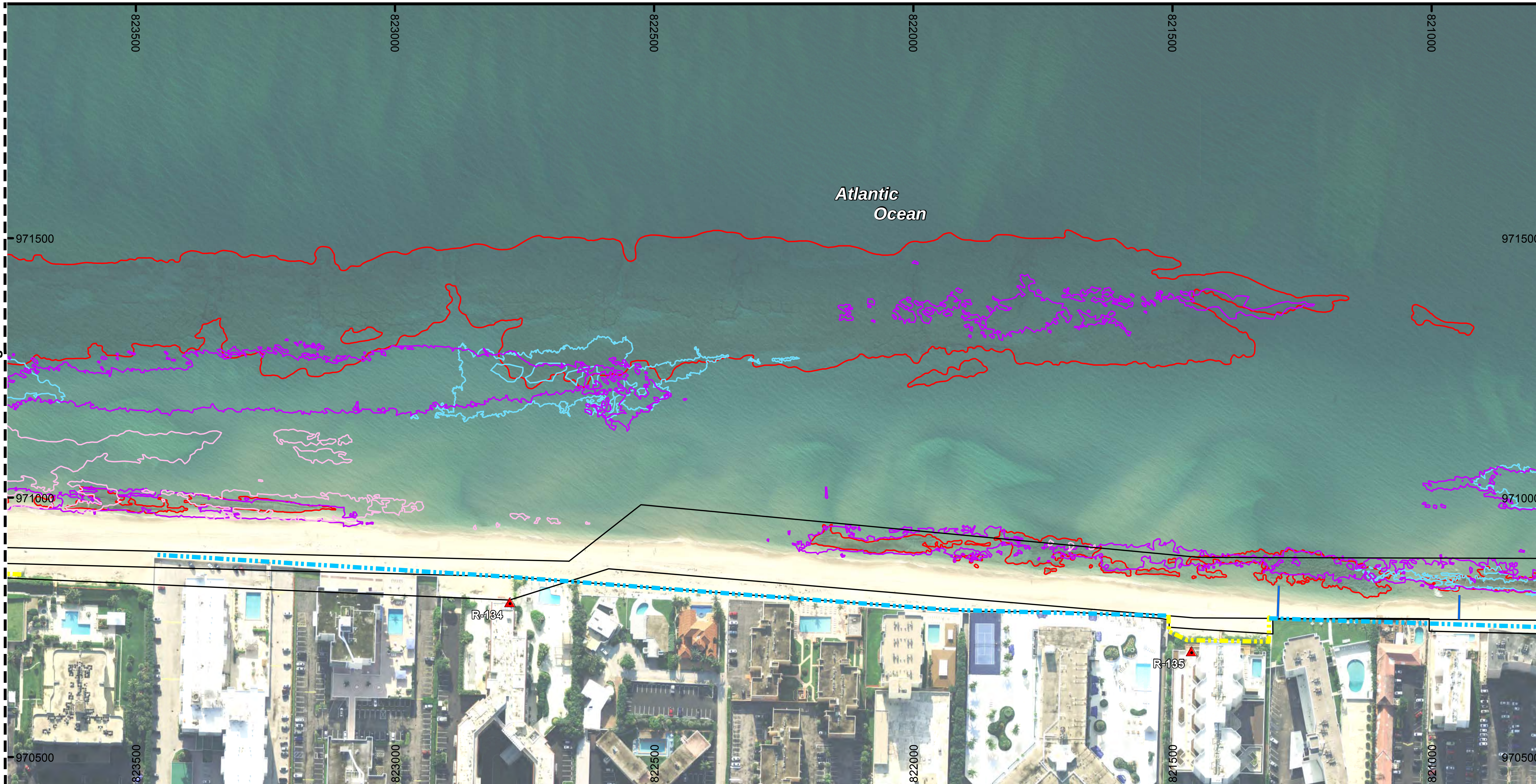
Date: 06/05/14	By: ALS	Comm No. : 150814	Figure No. 3b



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Notes:

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- Buried Seawall
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- Applicants' Preferred Project Design
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N

0 100 200 Feet

TITLE:

Southern Palm Beach Island Comprehensive Shoreline Stabilization Project Nearshore Hardbottom Resources (2003-2013)

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2481 N. W. Boca Raton Boulevard
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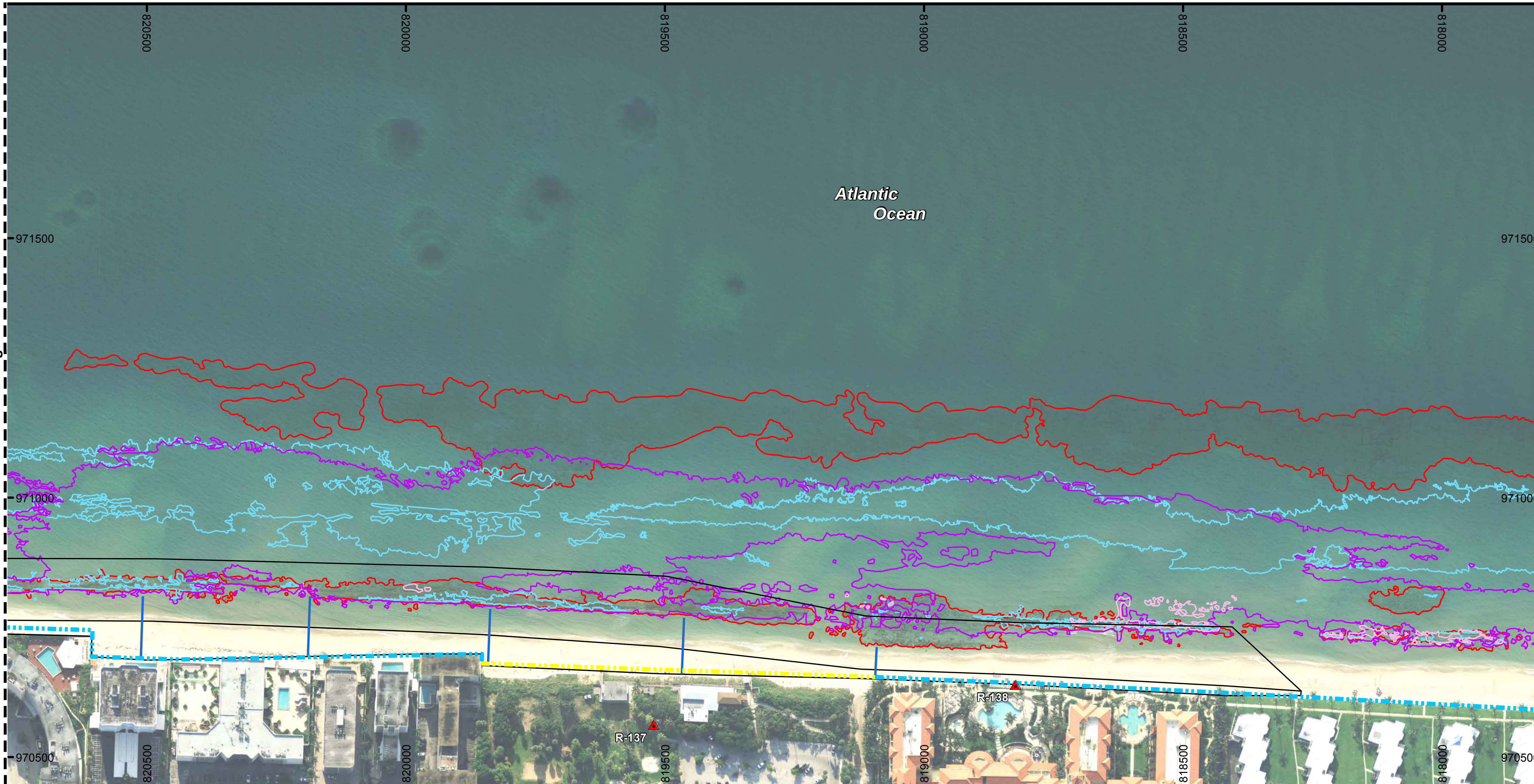
Date: 06/05/14 | By: ALS | Comm No. : 150814 | **Figure No. 3c**



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Notes:

1. Coordinates are in feet based on the Florida State Plane Coordinate System, East Zone, North American Datum of 1983 (NAD 83).
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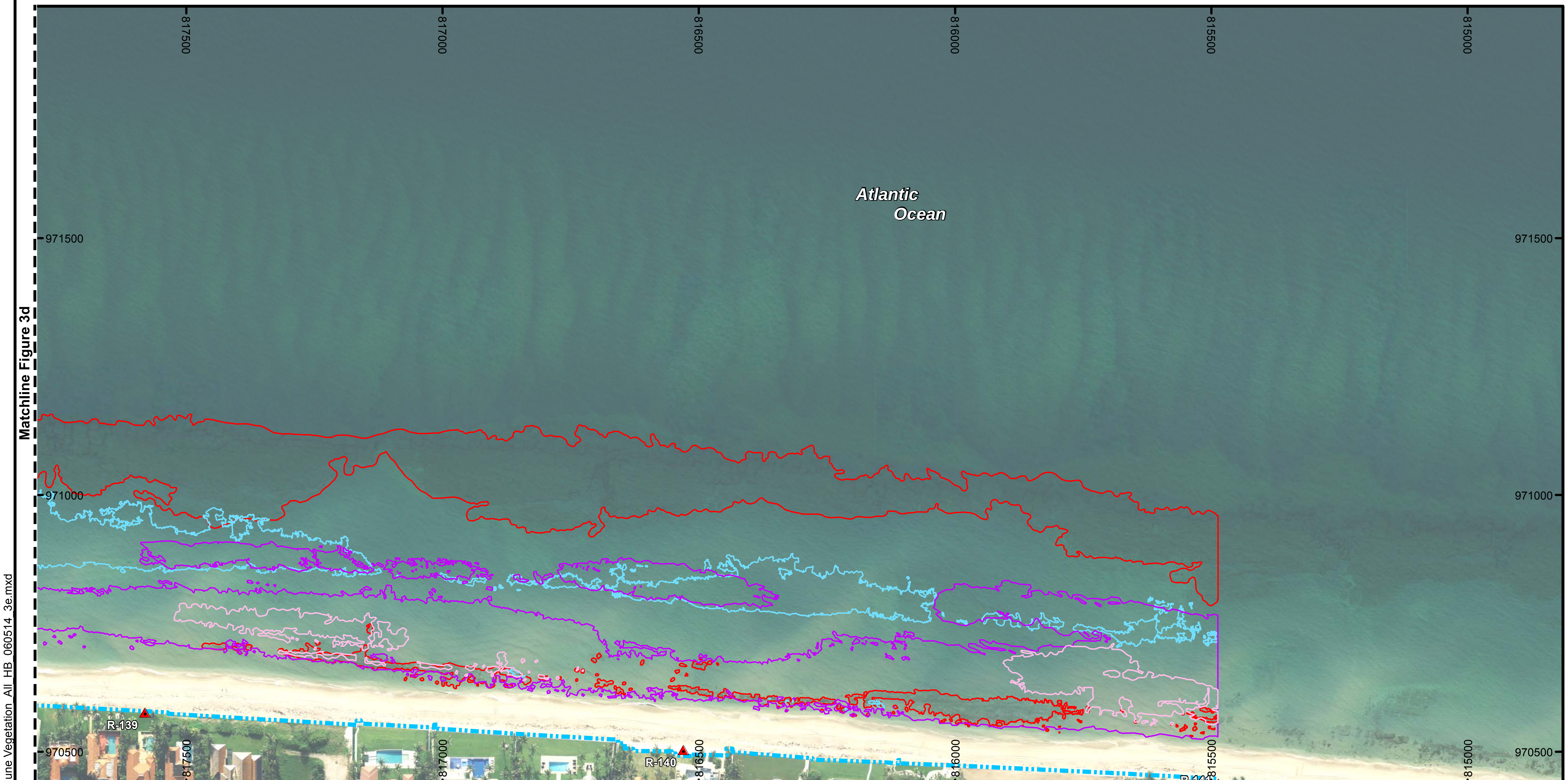
- FDEP Monuments

TITLE:

Southern Palm Beach Island Comprehensive Shoreline Stabilization Project Nearshore Hardbottom Resources (2003-2013)

CB&I
Coastal Planning & Engineering, Inc.
2481 N. W. Boca Raton Boulevard
Boca Raton, FL 33431
Ph. (561) 391-8102
Fax (561) 391-9116

Date: 06/05/14	By: ALS	Comm No. : 150814	Figure No. 3d



Notes:

1. Coordinates are in feet based on the Florida State Plane Coordinate System, East Zone, North American Datum of 1983 (NAD 83).
2. Aerial photography flown by Woolpert, Inc. on July 25-26, 2013.
3. 2013 hardbottom delineated by CB&I. 2011 hardbottom provided by Tetra Tech. 2007 digitized hardbottom provided by FAU. 2003 digitized hardbottom provided by PBC-ERM.

Legend:

- 2013 Hardbottom
- 2011 Hardbottom
- 2007 Hardbottom
- 2003 Hardbottom
- Buried Seawall
- Seawall
- Applicants' Preferred Project Design
- Proposed Groin
- FDEP Monuments

N

0 100 200 Feet

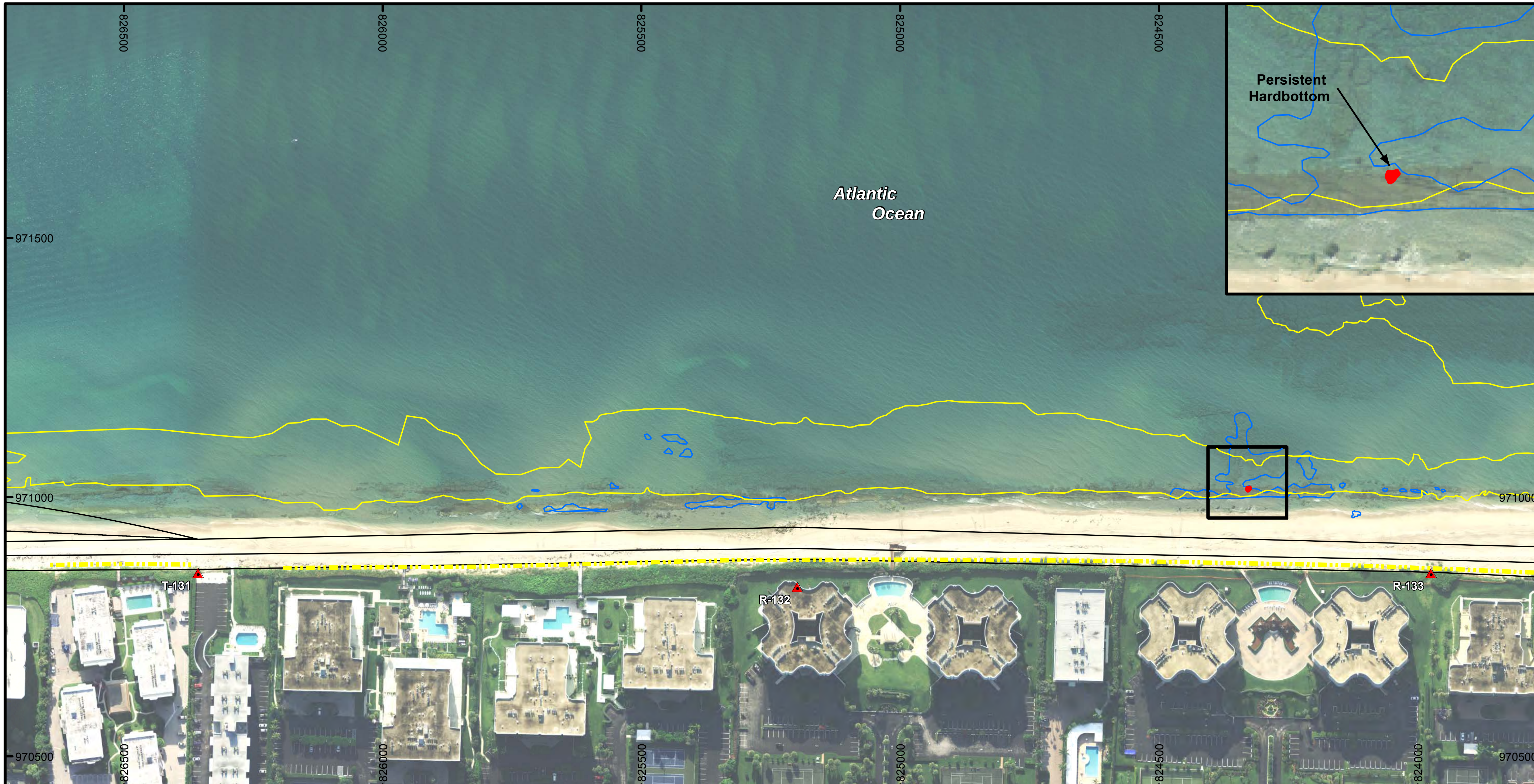
TITLE:

Southern Palm Beach Island Comprehensive Shoreline Stabilization Project Nearshore Hardbottom Resources (2003-2013)

CB&I
Coastal Planning & Engineering, Inc.
2481 N. W. Boca Raton Boulevard
Boca Raton, FL 33431
Ph. (561) 391-8102
Fax (561) 391-9116

Date: 06/05/14	By: ALS	Comm No. : 150814	Figure No. 3e

G:\Enterprise\Palm Beach\150814\Mxd\Dune Vegetation All HB 060514 3e.mxd



G:\Enterprise\Palm Beach\150814\Mxd\Persistent Hardbottom.mxd

Notes:

1. Coordinates are in feet based on the Florida State Plane Coordinate System, East Zone, North American Datum of 1983 (NAD 83).
2. Aerial photography flown by Woolpert, Inc. on July 25-26, 2013.
3. 2006 and 2009 digitized hardbottom provided by FAU.

Legend:

- Persistent Hardbottom (2003 - 2013)
- 2009 Hardbottom
- 2006 Hardbottom
- Buried Seawall
- Applicants' Preferred Project Design
- FDEP Monuments

N

0 100 200 Feet

TITLE:

Southern Palm Beach Island Comprehensive Shoreline Stabilization Project Persistent Hardbottom Resources (2003-2013)

CB&I
Coastal Planning & Engineering, Inc.
2481 N. W. Boca Raton Boulevard
Boca Raton, FL 33431
Ph. (561) 391-8102
Fax (561) 391-9116

Date: 02/04/14	By: HMV	Comm No. : 150814	Figure No. 4

3.2. SEDIMENT DYNAMICS

Line-intercept for sediment and sediment depth measurements were collected along all twelve (12) transects in 2013; however, line-intercept was collected along only eight (8) transects in 2006 (R-134 to R-141) and sediment depth was not collected at all. Available data are presented.

3.2.1. LINE-INTERCEPT FOR SEDIMENT

Each transect measured a different length based on the width of exposed hardbottom at each sampling location. For presentation in Figures 5 and 6, each transect length was standardized to the longest transect length from both surveys (2006 and 2013), which was R-135 in 2006 measuring 187 m in length. Since the sampled transects captured all hardbottom present in the subtidal and intertidal areas, it was safe to include the additional transect length (inshore and/or offshore) as sand cover. Similarly, the average cover for sand and hardbottom was calculated based on a transect length of 187 m. When intertidal hardbottom was not present (2013 transects R-134, R-135, R-139 and R-140), an inshore transect start point (0 m) was determined in GIS by drawing a straight line between the start points of the transects to the north and south that did document intertidal hardbottom. The length of sand from the new start point was then measured eastward to the field-verified start point (westernmost interface) of subtidal hardbottom. This distance is presented in Figures 5 and 6 and accounts for sand cover in Table 3. Transects R-130 to R-133 in 2006 were not extended to a length of 187 m and did not contribute to the calculated average cover because line-intercept was not collected on these transects, i.e., the location and length of sand patches within the hardbottom width was not recorded. The line-intercept data were used to provide a visual presentation of the hardbottom patchiness along each transect during 2006 and 2013, as well as to determine an overall percent cover of hardbottom and sand in the Study Area (Table 3).

2006. Line-intercept data were not collected on transects R-130 to R-133 (for the FDEP Hurricane Recovery Dune Restoration Project), but the maximum width of intertidal hardbottom resources was documented. Based on 2006 aerial imagery, only intertidal hardbottom was exposed along R-130 to R-132. Areas of intertidal and subtidal hardbottom were exposed along transect R-133, although the width of the subtidal hardbottom was not recorded during the May 2006 survey. The intertidal hardbottom width data for transects R-130 to R-133 and the line-intercept data for transects R-134 to R-141 (data collection for the South Palm Beach/Lantana Erosion Control Study) are presented in Figure 5. A distinct sand trough was present between the intertidal and subtidal hardbottom formations in 2006. The intertidal ridge was generally less than 50 m wide and the trough varied in width between 52 m (R-139 and R-140) and 154 m (R-135). Average benthic cover between R-134 and R-141 was 29% hardbottom and 71% sand based on the line-intercept data in 2006.

2013. A distinct sand trough was again present between the intertidal and subtidal hardbottom ridges in 2013 (Figure 2). Similar to 2006, transects R-130 to R-132 revealed only intertidal hardbottom resources; however, unlike 2006, the 2013 survey revealed several areas where only subtidal hardbottom resources were exposed. Average cover from the 2013 line-intercept data was 24% hardbottom and 76% sand using all twelve transects (R-130 to R-141). However, when considering the same eight transects with line-intercept data from 2006 (transects R-134 through R-141), the data revealed an average of 28% hardbottom and 72% sand cover, which was almost the same as in 2006 (Table 3).

Table 3. Mean percent cover of hardbottom and sand based on line-intercept data during the 2006 and 2013 benthic characterization surveys.

Transect	2006		2013	
	% Hardbottom	% Sand	% Hardbottom	% Sand
R-130	--	--	7%	93%
R-131	--	--	5%	95%
R-132	--	--	1%	99%
R-133	--	--	50%	50%
R-134	31%	69%	46%	54%
R-135	18%	82%	19%	81%
R-136	31%	69%	9%	91%
R-137	28%	72%	27%	73%
R-138	25%	75%	25%	75%
R-139	34%	66%	32%	68%
R-140	35%	65%	22%	78%
R-141	29%	71%	42%	58%
Mean	**29%**	**71%**	**24%**	**76%**

Note: Line-intercept was not conducted on R-130 to R-133 during the 2006 survey; the mean for 2006 represents R-134 to R-141 only. Using R-134 through R-141 data only for 2013 resulted in a mean hardbottom cover of 28% and sand cover of 72%.

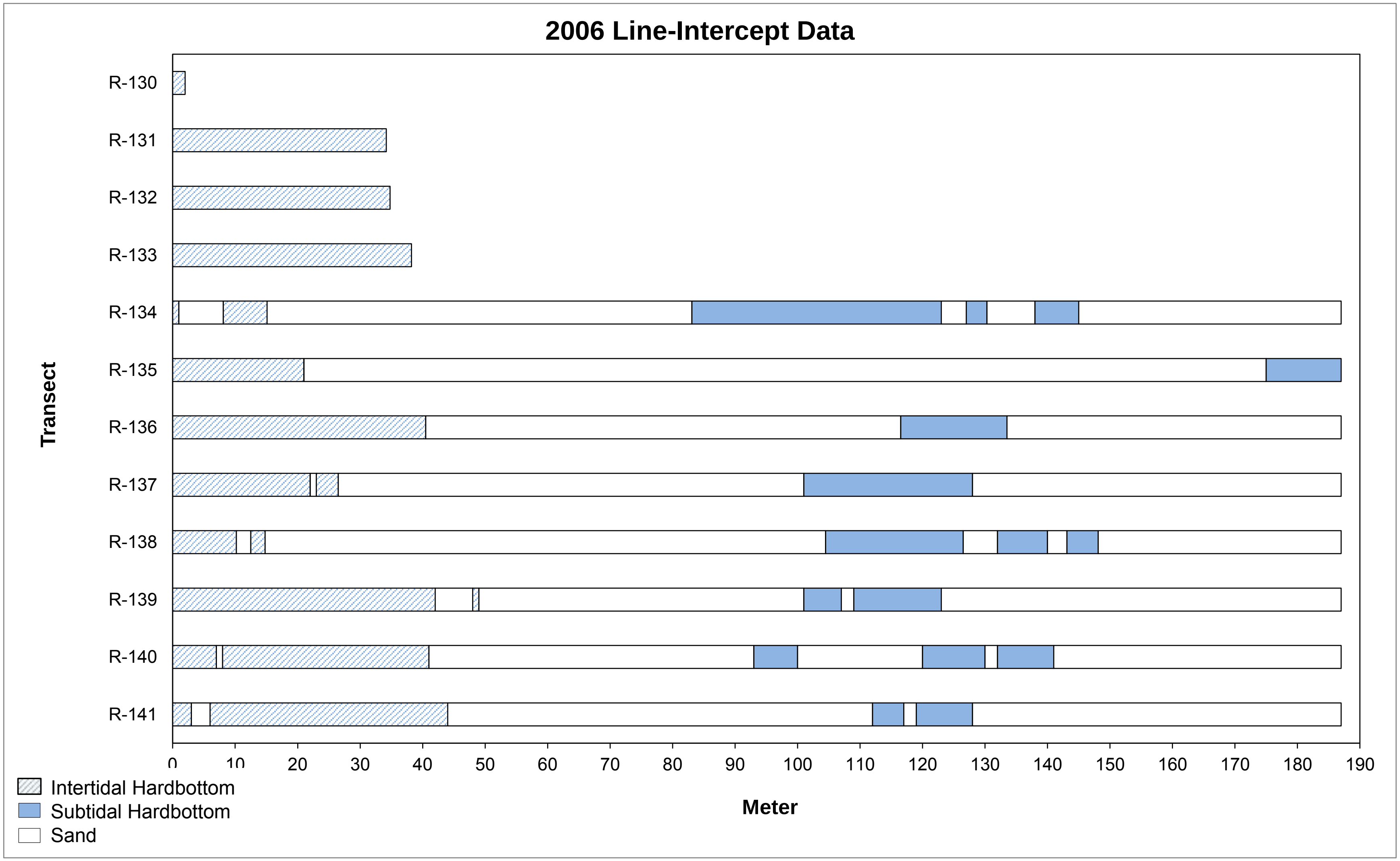


Figure 5. Line-intercept data showing intertidal hardbottom, subtidal hardbottom and sand transitions along transects in the Study Area during the 2006 benthic characterization. Line-intercept data were not collected on Transects R-130 to R-133 (the location and length of sand patches within the hardbottom width was not recorded); therefore, the maximum width of intertidal hardbottom only is presented.

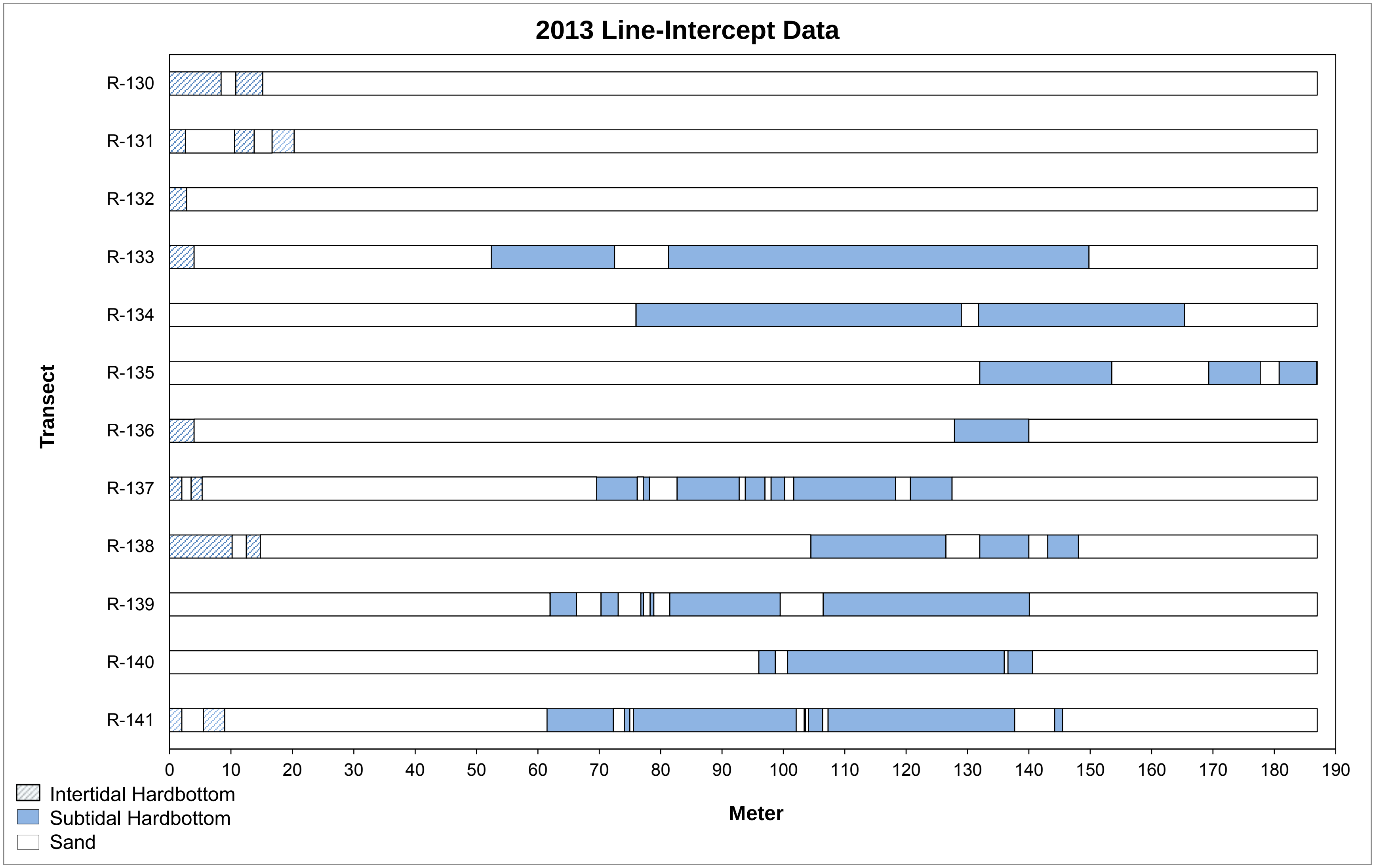


Figure 6. Line-intercept data showing subtidal hardbottom, intertidal hardbottom and sand transitions along transects in the Study Area during the 2013 benthic characterization.

3.2.2. SEDIMENT DEPTH

Sediment depth was measured at every meter along each transect during the 2013 characterization survey but was only collected in the intertidal and subtidal areas when hardbottom was present in both areas, e.g., sediment depth was not collected across the sand trough or subtidal area on transects R-130 to R-132 since subtidal hardbottom was not exposed on these transects. Sediment depths in the intertidal and subtidal zones were dependent on the patchiness of the hardbottom; wider sand patches within the hardbottom boundaries resulted in higher sediment depth as seen in the intertidal on R-131 and the subtidal on R-135 (Table 4). The sediment depth in the sand trough averaged greater than 20 cm on all areas where it was measured.

Table 4. Mean sediment depth measurements (cm) (± Standard Deviation [SD]) along each transect during the 2013 benthic characterization.

Transect	Mean Sediment Depth (cm)		
	Intertidal	Sand Trough	Subtidal
R-130	0.3 ± 1.7	--	--
R-131	8.8 ± 9.6	--	--
R-132	0.3 ± 0.6	--	--
R-133	0.2 ± 0.4	23.7 ± 5.2	0.7 ± 2.1
R-134	--	--	0.5 ± 2.3
R-135	--	--	7.3 ± 10.8
R-136	0.3 ± 0.3	24.2 ± 7.1	1.4 ± 1.8
R-137	2.6 ± 5.4	20.3 ± 5.8	4.1 ± 6.4
R-138	2.0 ± 5.0	26.8 ± 6.3	3.2 ± 5.3
R-139	--	--	3.2 ± 5.8
R-140	--	--	1.9 ± 6.0
R-141	--	--	2.0 ± 4.5

Note: Rough seas prevented complete data collection for the intertidal and sand trough portions of Transect R-141.

3.3. BEAMR QUADRAT SAMPLES

A total of 164 quadrats were sampled during the May and July 2006 characterizations and 147 quadrats were sampled during the October 2013 characterization. As mentioned in the Project History, the 2006 data were collected as part of two separate projects – the FDEP Hurricane Recovery Dune Restoration Project within the Town of Palm Beach (R-130 to R-134) and the South Palm Beach/Lantana Erosion Control Study (R-134 to R-141). The data collected from the South Palm Beach/Lantana

Erosion Control Study was used for Transect R-134 since it was more comprehensive (included line-intercept and division of benthic characterization by intertidal and subtidal hardbottom resources). Table 5 presents the location of hardbottom exposure (intertidal and subtidal) for each transect at the time of sampling in 2006 and 2013.

Overall benthic communities at the functional group, macroalgae and coral levels were compared between the two surveys based on BEAMR quadrat sampling. Additional comparisons were conducted to determine if the benthic communities on the intertidal and subtidal habitats varied significantly over time and space. Both habitats were compared between 2006 and 2013 and then the habitats were compared to each other during each survey.

Table 5. Location of benthic habitat data collected during the characterization surveys of 2006 and 2013 within the Study Area.

Transect	2006		2013	
	Intertidal	Subtidal	Intertidal	Subtidal
R-130	X		X	
R-131	X		X	
R-132	X		X	
R-133	X	X*	X	X
R-134	X	X		X
R-135	X	X		X
R-136	X	X	X	X
R-137	X	X	X	X
R-138	X	X	X	X
R-139	X	X		X
R-140	X	X		X
R-141	X	X	X	X

*Subtidal hardbottom was exposed on R-133 during the 2006 survey but data was not collected beyond the intertidal ridge.

3.3.1. RELIEF

Maximum relief was measured within each quadrat during BEAMR sampling in 2006 and 2013. These data were averaged to determine if any pattern of relief was apparent in a cross-shore or longshore pattern. Hartley's F_{max} test for assessing homoscedasticity was conducted on the maximum vertical relief data to compare variances of the intertidal and subtidal areas for each year, and to compare 2006 data to 2013 data. As the relief data were homoscedastic but non normal, the non-parametric Mann-Whitney

U test (which is essentially the Kruskal-Wallis test applied to two samples), was used to determine any significant differences in relief. Table 6 and Figure 7 summarize the 2006 and 2013 relief data.

2006. In 2006 the mean maximum vertical relief of the intertidal area was 7.8 cm (SD 11.7) and the mean maximum vertical relief for the subtidal area was 11.6 cm (SD 9.2); the difference between intertidal and subtidal relief was significant (H = 12.2, 1 d.f., p = 0.001).

2013. In 2013 the mean maximum vertical relief of the intertidal area was 7.0 cm (SD 10.5) and the mean maximum vertical relief for the subtidal area was 9.3 cm (SD 8.8); again, the difference between intertidal and subtidal relief was significant (H = 9.4, 1 d.f., p = 0.002).

Table 6. Average maximum vertical relief (cm) collected during the characterization surveys of 2006 and 2013 within the Study Area.

Transect	2006			2013		
	Intertidal	Subtidal	Overall	Intertidal	Subtidal	Overall
R-130	10.0	-	10.0	4.0	-	4.0
R-131	12.7	-	12.7	3.8	-	3.8
R-132	5.6	-	5.6	1.0	-	1.0
R-133	8.8	-	8.8	2.5	9.1	8.0
R-134	5.6	14.3	7.6	-	8.3	8.3
R-135	19.2	11.1	14.1	-	9.8	9.8
R-136	3.5	12.2	10.0	17.0	2.8	6.3
R-137	5.6	6.6	6.1	20.0	7.1	8.1
R-138	6.9	10.6	8.9	32.7	5.6	12.3
R-139	6.3	10.8	9.3	-	11.1	11.1
R-140	5.7	14.0	10.3	-	15.9	15.9
R-141	4.6	14.0	10.4	5.0	11.6	11.1
Mean	**7.8**	**11.6**	**9.5**	**7.0**	**9.3**	**8.7**
SD	**11.7**	**9.2**	**10.8**	**10.5**	**8.8**	**9.3**

Intertidal and Subtidal Habitats. No statistically significant differences were observed when comparing overall relief, or subtidal and intertidal relief, between 2006 and 2013. The overall 2006 mean maximum vertical relief was 9.5 cm (SD 10.8) and the 2013 mean maximum vertical relief was 8.7 cm (SD 9.3); there was no statistically significant difference between 2006 and 2013 (H = 1.0, 1 d.f., p = 0.32). The intertidal relief was statistically indistinguishable between 2006 (7.8 cm SD 11.7) and 2013 (7.0 cm SD 10.5) (H = 2.9, 1 d.f., p = 0.09), and subtidal relief was also statistically indistinguishable between 2006 (11.6 cm SD 9.2) and 2013 (9.3 cm SD 8.8) (H = 4.0, 1 d.f., p = 0.05).

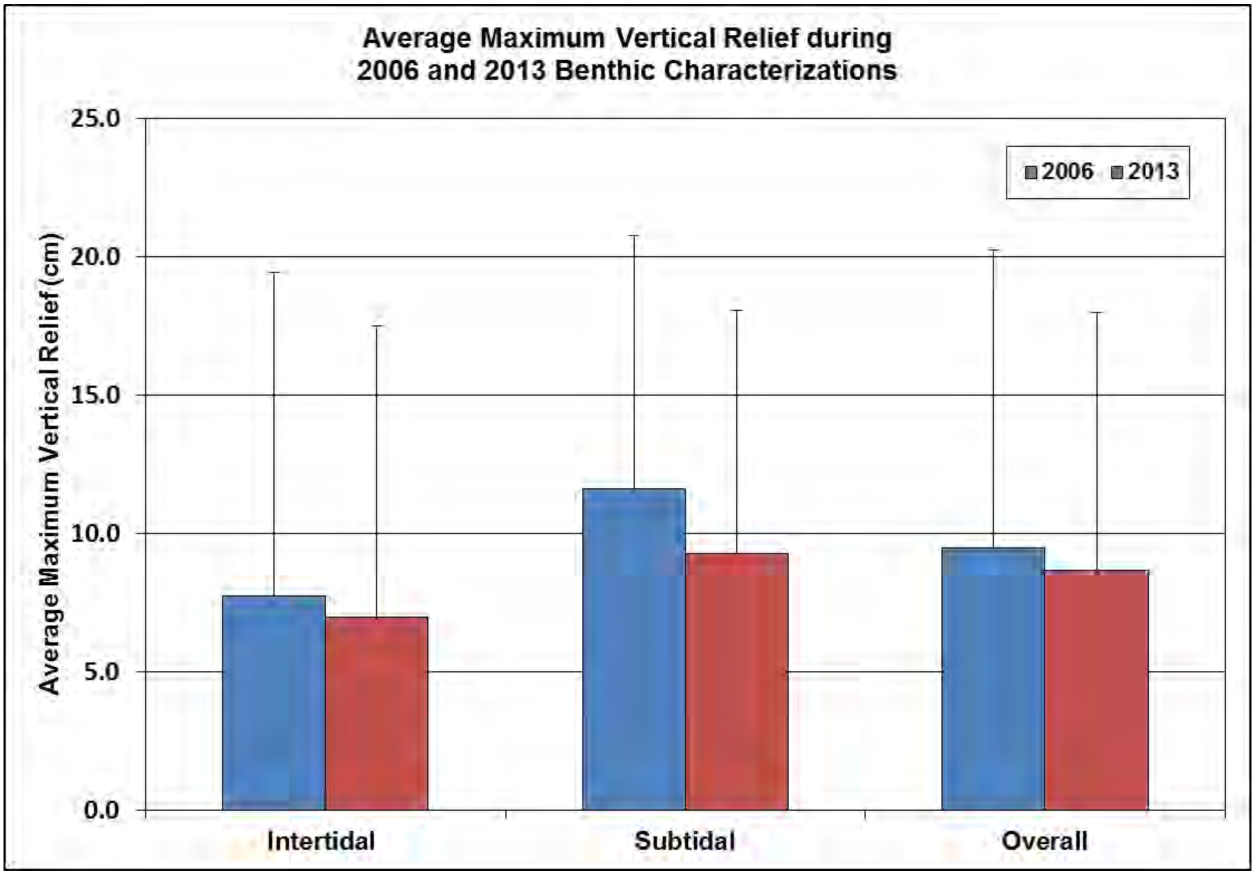


Figure 7. Average maximum vertical relief (+ SD) along the intertidal and subtidal portions, and overall combined area, of the transects during the benthic characterization surveys in 2006 and 2013.

Additionally, hardbottom relief was measured in 2009 and 2010 to provide data in support of the South Palm Beach/Lantana Segmented Breakwaters Project. Relief measurements were taken on the inshore (westernmost interface) and offshore (easternmost interface) hardbottom edges every 50 ft between R-130 and R-141. The average relief measurement was 15.6 cm on the inshore edge and 15.7 cm on the offshore edge. The observation report and maps of these data are provided in Appendix E.

3.3.2. FUNCTIONAL GROUPS

2006. Table 7 presents the mean percent cover of all functional groups recorded on the nearshore hardbottom habitat during the 2006 biological investigations. Turf algae (58.2% SD 30.4) and sediment (22.5% SD 31.8) dominated the cover classes throughout the samples followed by bare hard substrate (8.9% SD 13.4) and macroalgae (7.1% SD 12.5). The high standard deviation indicates that the data are spread out over a large range of values. Therefore, the median is also reported in Table 7 to provide an additional measure of central tendency that is less influenced by outliers. The order of dominant cover remained the same as reported by the median, however, only turf algae remained on the same order of magnitude as reported by the mean. Sediment, macroalgae and bare hard substrate had lower measures of central tendency as reported by the median values.

2013. Table 8 presents the mean percent cover of all functional groups for nearshore hardbottom habitat recorded during the 2013 biological investigations. Turf algae (60.9% SD 2.4) and sediment (21.9% SD 29.5) dominated the cover classes throughout the samples followed by macroalgae (10.4% SD 12.8) and encrusting red algae (2.3% SD 7.2). Similar to the 2006 data, high standard deviations were reported, indicating a large range of values among the quadrats, therefore the median is also reported in Table 8. Based on the median, turf algae remained the dominant cover but sediment and macroalgae had notably lower coverage than reported by the mean.

Table 7. Mean percent cover of all BEAMR functional groups by transect, as well as the overall mean and median cover (with standard deviation) recorded during the 2006 biological investigations. Red, dark pink and light pink indicate the highest, second highest and third highest mean percent cover, respectively, within each transect and overall.

Transect	Date Sampled	Number of Quadrats	Sed	MA	Turf Algae	Coralline Algae	Sponge	Hydroid	Octo	Stony Coral	Tuni	BHS	Anem	Barn	Bivalve	Bryoz	Millepora	Sessile Worm	Wormrock	Zoanthid
R-130	5/18/2006	2	20.5	5.5	31.5	1.5	0.5	0.5	0.0	0.5	1.5	32.5	0.0	0.0	0.0	1.0	0.0	1.0	3.5	0.0
R-131	5/18/2006	10	17.1	11.3	47.4	0.5	1.5	0.0	0.0	0.3	0.0	21.5	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0
R-132	5/18/2006	10	31.0	9.5	30.6	0.3	0.4	0.1	0.0	0.0	0.0	27.9	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
R-133	5/18/2006	10	25.9	7.4	44.2	0.2	0.3	0.0	0.0	0.8	0.1	20.9	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
R-134	7/17/2006	17	27.8	2.0	59.6	1.1	0.5	0.2	0.0	0.2	0.1	6.9	0.0	0.0	0.0	0.4	0.0	0.1	1.2	0.0
R-135	7/17/2006	16	29.6	1.8	59.1	0.4	0.8	0.7	0.0	0.0	0.1	6.2	0.0	0.0	0.0	0.9	0.0	0.2	0.1	0.0
R-136	7/18/2006	16	15.6	12.6	62.9	0.4	0.2	0.6	0.0	0.3	0.1	5.8	0.0	0.0	0.0	0.6	0.0	0.1	1.0	0.0
R-137	7/18/2006	16	15.2	3.1	70.8	0.9	0.4	0.3	0.0	0.0	0.1	8.8	0.0	0.0	0.0	0.4	0.0	0.2	0.0	0.0
R-138	7/18/2006	15	18.1	5.5	66.0	0.8	0.6	0.7	0.0	0.1	0.1	3.3	0.0	0.0	0.0	0.3	0.0	0.1	4.3	0.0
R-139	7/18/2006	18	23.8	18.2	52.7	0.4	0.7	0.5	0.0	0.1	0.1	2.6	0.0	0.0	0.0	0.7	0.0	0.2	0.0	0.0
R-140	7/18/2006	20	21.8	4.6	66.6	0.4	0.4	1.0	0.0	0.2	0.0	4.5	0.0	0.0	0.0	0.5	0.0	0.1	0.2	0.0
R-141	7/19/2006	13	24.2	3.4	64.2	0.4	0.3	0.5	0.0	0.1	0.2	3.2	0.0	0.0	0.0	0.2	0.0	0.3	3.2	0.0
Mean			**22.5**	**7.1**	**58.2**	**0.6**	**0.5**	**0.5**	**0.0**	**0.2**	**0.1**	**8.9**	**0.0**	**0.0**	**0.0**	**0.5**	**0.0**	**0.1**	**1.0**	**0.0**
Median			**5.0**	**2.0**	**64.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**3.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Standard Deviation			31.8	12.5	30.4	0.9	1.0	0.9	0.0	0.5	0.3	13.4	0.0	0.0	0.0	0.8	0.0	0.3	6.1	0.0

Table 8. Mean percent cover of all BEAMR functional groups by transect, as well as the overall mean and median cover (with standard deviation) recorded during the 2013 biological investigations. Red, dark pink and light pink indicate the highest, second highest and third highest mean percent cover, respectively, within each transect and overall.

Transect	Date Sampled	Number of Quadrats	Sed	MA	Turf Algae	Coralline Algae	Sponge	Hydroid	Octo	Stony Coral	Tuni	BHS	Anem	Barn	Bivalve	Bryoz	Millepora	Sessile Worm	Wormrock	Zoanthid
R-130	10/21/2013	13	26.8	6.2	64.1	0.8	0.1	0.1	0.0	0.7	0.0	0.9	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0
R-131	10/23/2013	12	12.0	6.0	74.8	0.6	0.2	0.0	0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0
R-132	10/21/2013	5	5.5	12.3	76.8	0.8	0.0	0.7	0.2	0.1	0.0	2.1	0.0	0.0	0.0	0.9	0.0	0.5	0.0	0.0
R-133	10/23/2013	12	44.2	8.2	43.5	2.2	0.0	1.3	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
R-134	10/21/2013	15	9.1	14.9	70.3	2.4	0.2	0.9	0.7	0.1	0.0	0.6	0.0	0.1	0.0	0.4	0.0	0.2	0.0	0.0
R-135	10/23/2013	13	22.6	18.2	48.4	5.7	0.4	1.4	0.5	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.1	0.0	0.0
R-136	10/23/2013	12	29.5	8.7	45.0	5.2	0.2	0.0	0.0	0.2	7.1	4.2	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
R-137	10/21/2013	13	41.5	7.1	47.6	0.2	0.3	0.5	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.3	0.0	0.0
R-138	10/23/2013	12	21.8	10.6	62.0	1.0	0.1	3.3	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.3	0.0	0.5	0.0	0.0
R-139	10/21/2013	14	29.8	2.2	63.0	1.3	0.3	1.5	0.2	0.2	0.2	0.6	0.0	0.0	0.0	0.3	0.0	0.6	0.0	0.0
R-140	10/23/2013	12	5.8	16.8	64.8	6.2	0.2	1.3	2.0	0.3	0.0	1.2	0.0	0.0	0.0	0.8	0.0	0.6	0.0	0.1
R-141	10/21/2013	14	10.7	8.9	77.3	0.4	0.0	1.7	0.0	0.0	0.0	0.3	0.0	0.0	0.2	0.4	0.0	0.2	0.0	0.1
Mean			**21.9**	**10.4**	**60.9**	**2.3**	**0.2**	**1.1**	**0.5**	**0.1**	**0.6**	**1.1**	**0.0**	**0.0**	**0.0**	**0.6**	**0.0**	**0.3**	**0.1**	**0.0**
Median			**5.0**	**5.0**	**71.0**	**1.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Standard Deviation			29.5	12.8	28.6	7.2	0.5	2.0	1.2	0.4	7.0	3.7	0.0	0.2	0.1	2.2	0.0	0.4	0.7	0.1

Figure 8 provides a graphical representation of the distribution of benthic cover documented during the 2006 and 2013 surveys. These data were input into PRIMER-E v6 to determine if significant differences existed between the two monitoring surveys. A CLUSTER analysis did not detect significant differences; however, it is obvious that the benthic community at functional group-level does display some distinction between the 2006 and 2013 surveys based on the dendrogram output (Figure 9).

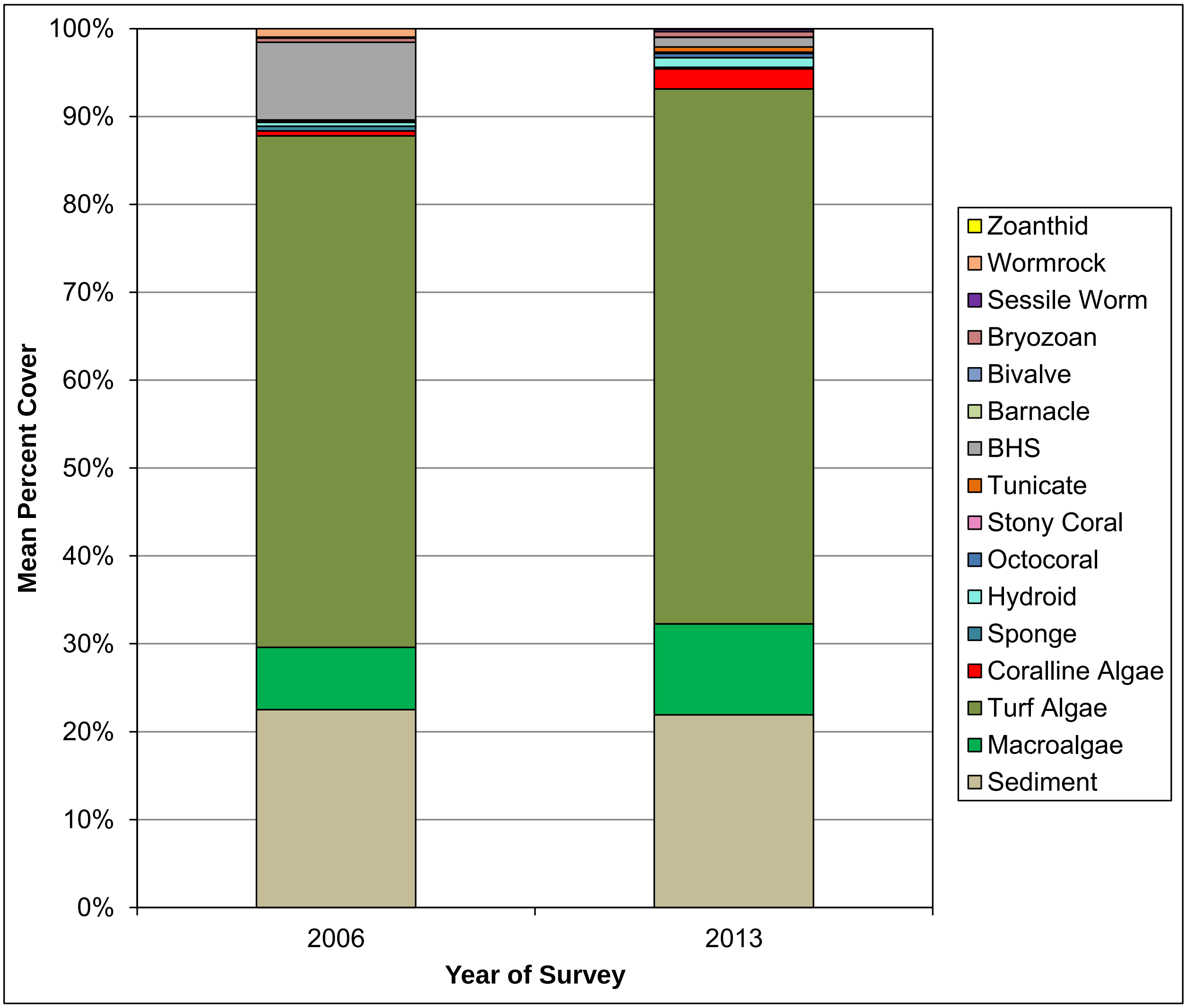


Figure 8. Mean percent cover of functional groups in the Study Area documented during the 2006 and 2013 benthic surveys.

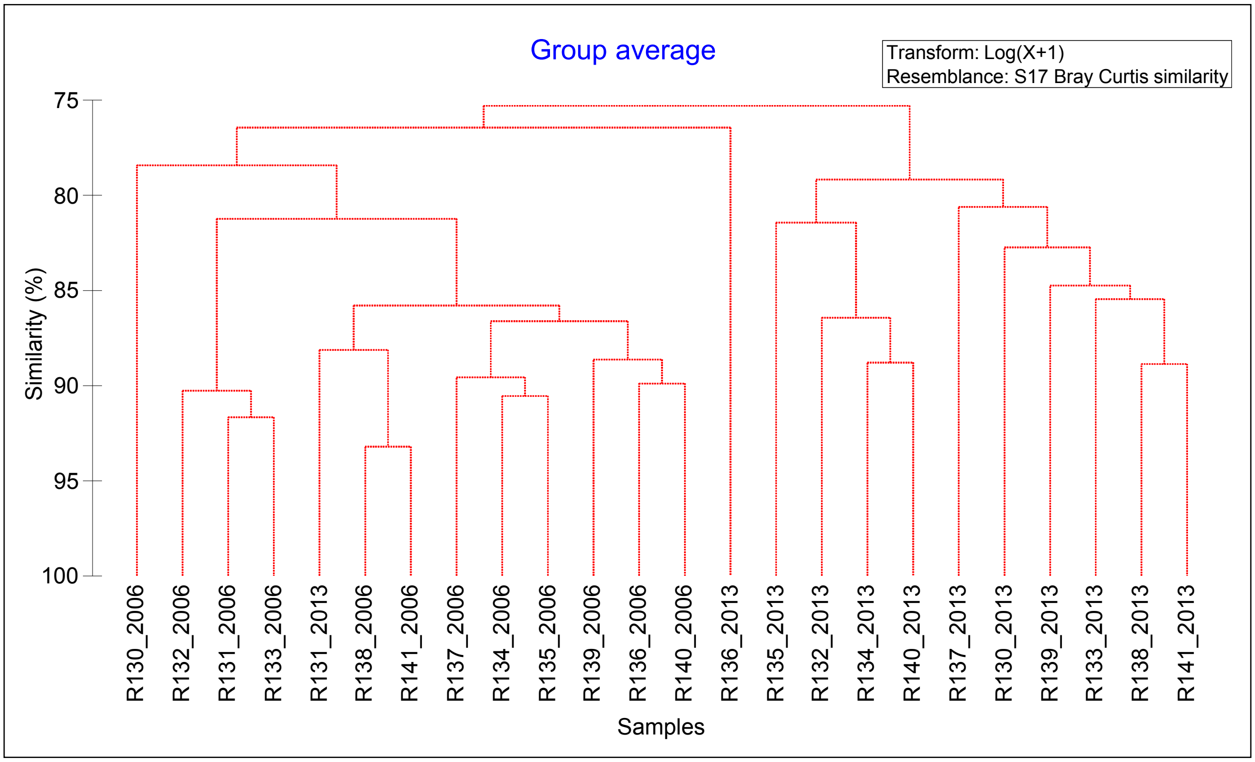


Figure 9. Dendrogram presenting the similarity clusters between transects sampled in 2006 and 2013 based on benthic community functional group percent cover. Red bars indicate no significant differences between samples.

Intertidal and Subtidal Habitats. Additional comparisons were conducted to determine if the intertidal and subtidal habitats varied significantly over time and space at the functional group level. Both habitats were compared between 2006 and 2013 and then the habitats were compared to each other during each survey. All comparisons revealed no significant differences, with one exception. In the intertidal area, the 2013 transects R-133 and R-141 clustered significantly away from all other intertidal transects regardless of year sampled based on a CLUSTER analysis (p = 0.001). Further examination revealed that the intertidal hardbottom along these two transects was defined by a thin ridge with low diversity of functional groups – both transects were characterized by high turf algae cover with low macroalgae and minimal sediment cover. The intertidal habitat on other transects was characterized by several additional functional groups such as sponges, encrusting red algae and tunicates. The ephemeral nature of the nearshore hardbottom habitat and the thin width of exposed hardbottom adjacent to these transects (R-133 and R-141) indicates that substrate may have been exposed for less time than the other samples, thus resulting in a less complex benthic habitat. If the hardbottom in these locations remains exposed, it will likely come to closely resemble the intertidal hardbottom throughout the Study Area.

3.3.3. MACROALGAE

Particular attention was paid to macroalgae genera that were known to be preferred food for juvenile green sea turtles (*Chelonia mydas*). Makowski et al. (2006) identified 11 genera of macroalgae as common food for juvenile green sea turtles (*C. mydas*) in the nearshore waters of Palm Beach, Florida by examining lavage samples. These included: *Gracilaria, Acanthophora, Dictyota, Dictyopteris, Siphonocladus, Jania, Dasycladus, Cladophora, Bryothamnion, Rhizoclonium,* and *Enteromorpha* (now *Ulva* (Hayden et al., 2003))*. Hypnea, Bryothamnion,* and *Gracilaria* were also noted by Wershoven and Wershoven (1988; 1992) to be preferred food items of *C. mydas* at John U. Lloyd Beach State Park in Broward County, Florida, bringing the total preferred macroalgae genera to 12. The genera that dominated macroalgae cover during the 2006 and 2013 benthic characterization surveys (the five most abundant genera in each year) are presented in Figure 10. Macroalgae mean and median percent cover (with standard deviation), as well as frequency of occurrence are presented in Table 9. The mean percent cover represents all quadrats sampled whereas the median percent cover represents only those quads with macroalgae cover greater than 1%; the median value using all quads sampled was 0% for both years.

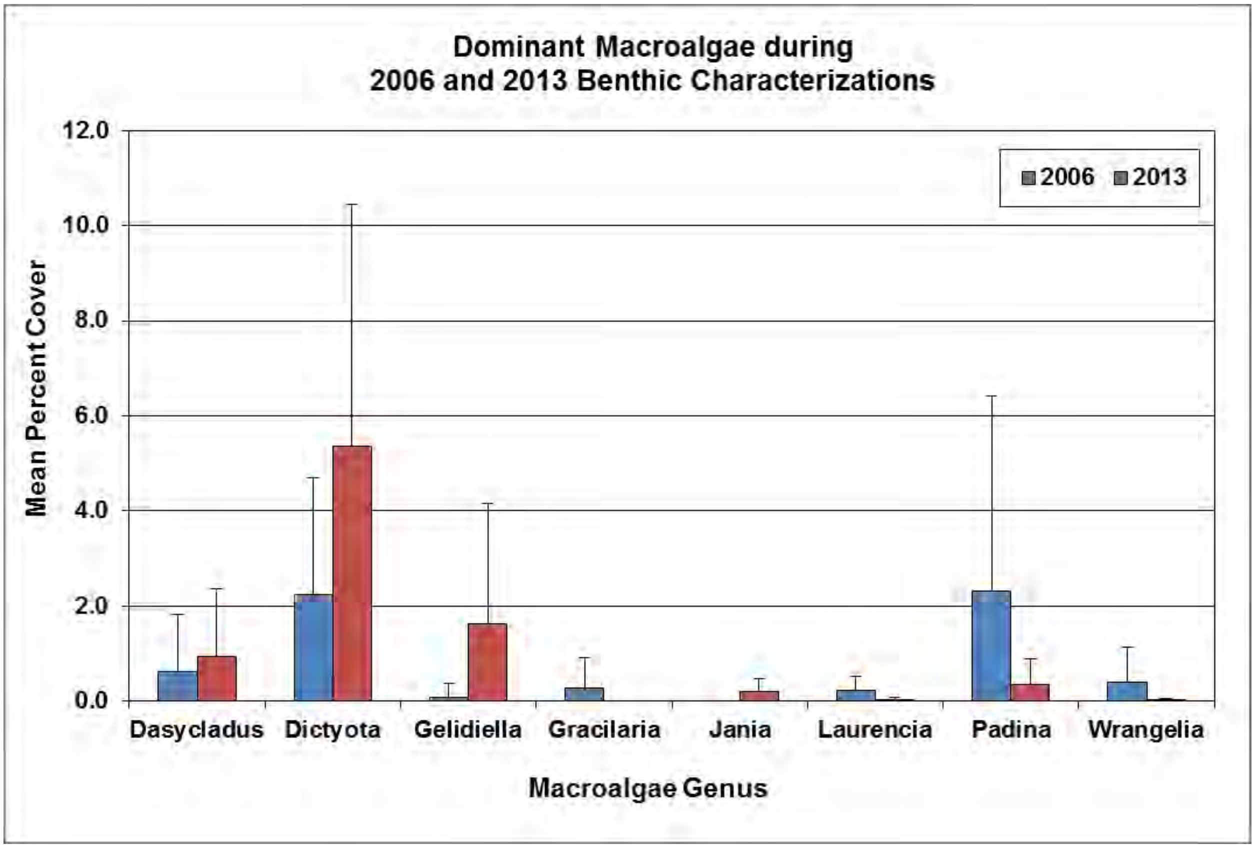


Figure 10. Average percent cover (+ SD) of the dominant macroalgae genera during the benthic characterization surveys in 2006 and 2013.

2006. A total of 13 macroalgae genera were identified during the 2006 characterization survey. Of the 12 genera known to be preferred food items of *C. mydas*, four were identified during the 2006 characterization survey on the nearshore hardbottom habitat, including: *Dasycladus, Dictyota, Gracilaria,* and *Hypnea.* Of all macroalgae genera recorded during the 2006 survey, *Padina* (2.31% SD 4.11), *Dictyota* (2.25% SD 2.44) and *Dasycladus* (0.62% SD 1.20) were the dominant macroalgae cover and the most frequently occurring genera.

2013. A total of 14 macroalgae genera were identified during the 2013 characterization survey, five of which are known to be preferred food items of *C. mydas*. These included *Dictyota, Dictyopteris, Bryothamnion, Dasycladus,* and *Jania.* Of all macroalgae genera recorded, *Dictyota* (5.36% SD 5.08), *Gelidiella* (1.62% SD 2.54) and *Dasycladus* (0.93% SD 1.43) dominated the macroalgae cover in the Study Area and were also the most frequently occurring genera.

Table 9. Macroalgae genera with greater than 1% documented in Study Area during the 2006 and 2013 characterization surveys. Genera with the highest, second highest and third highest mean percent cover are highlighted in red, dark pink and light pink, respectively for each survey event.

Year	Transect	Bryotham*	Caulerpa	Cymopolia	Dasya	Dasycladus*	Dictyopteris*	Dictyota*	Gelidiella	Gelidium	Gracilaria*	Halimeda	Hypnea*	Jania*	Laurencia	Liagora	Padina	Wrangelia
2006	R-130		1.50						1.00		1.00	2.00						
	R-131		0.10					7.50									0.90	2.30
	R-132		0.20			0.30		6.10			2.10					0.10	0.10	0.30
	R-133		0.30					4.30			0.20	0.10	0.20			0.10	0.10	1.50
	R-134					0.94		0.18				0.12			0.06			0.18
	R-135							1.13							0.25			0.25
	R-136				0.13			1.88				0.06			0.25		9.69	
	R-137		0.13			0.13		1.88							0.06		0.38	
	R-138		0.07					2.20							0.13		2.47	0.07
	R-139		0.06	0.44	0.17	3.78		0.56				0.17			0.44		12.11	
	R-140			0.2		2.30		0.45				0.10			0.35		0.85	
	R-141							0.85							1.08		1.08	0.08
2013	R-130					0.08		0.38	2.15	1.69				0.38			0.08	
	R-131		0.17						7.67	0.50								
	R-132								5.40									
	R-133					0.25		5.83						0.33			1.83	
	R-134	0.20				0.67		8.80				0.27		0.07			0.87	
	R-135							5.38						0.92	0.08			
	R-136		0.08	0.17	0.83	0.08		7.58	0.5					0.25				
	R-137		0.23	0.08		1.69	0.38	0.31	3.08								0.62	
	R-138					0		0.17	0.67						0.17			0.17
	R-139					1.79		11.14						0.14			0.21	
	R-140					1.83		12.92						0.08			0.42	
	R-141		0.86			4.79		11.79						0.14				
2006	**Mean**		0.20	0.05	0.02	0.62		2.25	0.08		0.28	0.21	0.02		0.22	0.02	2.31	0.39
	Median		1	4	2	1.5		1	2		1.5	1	2		1	1	3	1
	Mean SD		0.42	0.14	0.06	1.20		2.44	0.29		0.64	0.57	0.06		0.31	0.04	4.11	0.73
	Frequency		0.06	0.02	0.02	0.11		0.32	0.01		0.04	0.06	0.01		0.13	0.01	0.24	0.10
2013	**Mean**	0.02	0.11	0.02	0.07	0.93	0.03	5.36	1.62	0.18		0.02		0.19	0.02		0.34	0.01
	Median	3	2.5	1.5	2	3	5	10	5	4.5		1		1.5	1.5		2	2
	Mean SD	0.06	0.25	0.05	0.24	1.43	0.11	5.08	2.54	0.50		0.08		0.27	0.05		0.55	0.05
	Frequency	0.01	0.03	0.01	0.03	0.18	0.01	0.41	0.16	0.04		0.02		0.10	0.01		0.13	0.01

*Indicates macroalgae genera known to be *C. mydas* preferred food resource.

Intertidal and Subtidal Habitats. The macroalgae communities on the intertidal and subtidal habitats were compared between 2006 and 2013 and the two habitats were also compared to each other within each survey. No significant differences were found when the intertidal habitat was compared between 2006 and 2013; however, significant differences were detected on the subtidal macroalgae habitat over time and between the intertidal and subtidal habitats during each survey event.

Of the 12 transects surveyed in 2006, all had exposed hardbottom in the intertidal zone and nine had exposed hardbottom in the subtidal zone (Figure 5, Table 5). The subtidal macroalgae community clustered together in similarity; however, ANOSIM revealed several of the intertidal transects showed significant differences compared to the subtidal area (intertidal vs. subtidal R = 0.336, p = 0.008). These differences appear to be driven by the presence and abundance of *Dictyota* and *Padina,* which occurred in much higher abundance on the subtidal portions of transects. It should be noted that the relatively low R-value of 0.336 indicates that although the macroalgae community between the intertidal and subtidal areas is not exactly the same, it is highly overlapping.

In 2013, eight transects had exposed hardbottom in the intertidal zone and nine had exposed hardbottom in the subtidal zone (Figure 6, Table 5). The macroalgae community was clearly distinct between the two hardbottom ridges (R = 0.698, p = 0.001). The significant differences appear to be driven by presence and abundance of *Dictyota* and *Gelidiella. Dictyota* had a much higher abundance on the subtidal portions of transects, whereas *Gelidiella* dominated the intertidal macroalgae community but was not observed in the subtidal area.

Differences were also detected over time on the subtidal macroalgae community between 2006 and 2013 (R = 0.343, p = 0.002). These differences were attributed to the higher overall coverage of macroalgae as well as higher genus abundance in 2013. *Wrangelia* was the only genus to occur in 2006 that was not observed in 2013. Once again, the relatively low R-value of 0.343 indicates that although the macroalgae community in the subtidal habitat was not exactly the same between surveys, it is highly overlapping.

3.3.4. CORAL

The nearshore hardbottom habitat within the Study Area is not coral-dominated. The habitat supports small corals, primarily *Siderastrea* spp. Every coral and octocoral colony observed in the BEAMR quadrats was documented by species and maximum diameter (cm) or height (cm). These data were used to determine the average size and density of coral species in the nearshore hardbottom habitat adjacent to the proposed Project Area during the 2006 and 2013 surveys. Due to the low abundance of scleractinian and octocoral colonies documented in the Study Area, only descriptive comparisons were made. Tables 10 and 11 present scleractinian and octocoral density and average size, respectively. Each transect where corals were documented is presented with a breakdown based on the intertidal and subtidal areas as well as the coral community along the entire transect.

Table 10. Scleractinian density (colonies m^{-2}) and average size (cm) during the 2006 and 2013 characterization surveys. Only transects with stony coral presence are presented.

Year	Transect	Density (colonies m^{-2})			Average Size (cm)		
		Intertidal	Subtidal	Overall	Intertidal	Subtidal	Overall
2006	R-130	2.0	0	2.0	2.0	--	2.0
	R-131	2.0	0	2.0	2.0	--	2.0
	R-133	7.6	0	7.6	3.0	--	3.0
	R-134	0.6	4.0	0.6	1.0	2.3	1.6
	R-136	1.0	1.0	1.0	1.0	2.3	1.7
	R-138	1.7	0.5	1.7	1.0	1.0	1.0
	R-139	2.7	0	2.7	1.3	--	1.0
	R-140	0.4	0.4	0.4	1.0	1.0	1.0
	R-141	0	1.0	1.0	--	2.0	2.0
	Mean	**1.5**	**0.6**	**1.1**	**1.7**	**1.7**	**1.7**
2013	R-130	1.8	0	1.8	5.3	--	5.3
	R-131	0.7	0	0.7	3.5	--	3.5
	R-134	0	0.3	0.3	--	3.0	3.0
	R-138	0	1.8	1.8	--	3.0	3.0
	R-139	0	0.9	0.9	--	1.5	1.5
	R-140	0	1.3	1.3	--	1.5	1.5
	Mean	**0.8**	**0.7**	**0.5**	**4.4**	**2.1**	**2.6**

Table 11. Octocoral density (colonies m^{-2}) and average size (cm) during the 2006 and 2013 characterization surveys. Only transects with octocoral presence are presented.

Year	Transect	Density (colonies m^{-2})			Average Size (cm)		
		Intertidal	Subtidal	Overall	Intertidal	Subtidal	Overall
2006	**ALL**	**0**	**0**	**0**	**--**	**--**	**--**
2013	R-134	0	1.6	1.6	--	4.5	4.5
	R-135	0	23.1	23.1	--	5.2	5.2
	R-138	0	2.2	1.7	--	6.3	6.3
	R-139	0	8.0	8.0	--	3.5	3.5
	R-140	0	31.3	31.3	--	5.9	5.9
	R-141	0	5.2	4.9	--	6.0	6.0
	Mean	**0**	**8.4**	**6.1**	**--**	**5.3**	**5.3**

2006. During the 2006 survey, a total of 45 scleractinian colonies (1.1 colonies m^{-2}) and zero octocoral colonies were observed on the 12 transects. *Siderastrea* spp. made up 76% of the scleractinian colonies and the only other species observed was *Solenastrea bournoni*, of which 11 colonies were observed on the intertidal hardbottom of R-133. Average size of all observed scleractinian corals was 1.7 cm.

2013. In 2013, 20 scleractinian colonies (0.5 colonies m^{-2}) and 225 octocoral colonies (6.1 colonies m^{-2}) were documented on the same 12 transects. *Oculina diffusa* added to the scleractinian species diversity in 2013; however, only one 1-cm colony of this species was observed on R-139. The octocoral community was made up of four genera (*Eunicea, Muricea, Pseudopterogorgia* and *Pterogorgia*), all of which occurred in the subtidal portion of the sampling area (Photograph 2). Average size was 2.6 cm for all observed scleractinian corals and 5.3 cm for all observed octocoral corals.

Intertidal and Subtidal Habitats. The main difference between the intertidal and subtidal coral communities was the lack of octocorals on the intertidal habitat during both surveys. In 2006, stony corals had a higher density on the intertidal habitat but the same average size compared to the subtidal habitat. In 2013, however, the density was nearly the same in both areas but the average size was twice as large in the intertidal area.

Photograph 2. Benthic community dominated by octocorals observed on Transect R-135 during the 2013 characterization survey.

3.3.5. FISH OBSERVATIONS

2006. Transect-counts were utilized for visually assessing the fish assemblage structure along the hardbottom located in the Study Area during the 2006 survey. The natural nearshore hardbottom transect-counts yielded a total of 608 individual fishes representing 31 species. Fish surveys documented that 40.6% of the total number of fish were juveniles (<5.0 cm). Mean abundance was 122 fish per transect, with the mean number of species calculated at 16 species per transect. Of the 18 families observed, five families contributed to the majority of individuals recorded and included Labridae (Wrasses) 32.7%, Pomacentridae (Damselfishes) 32.7%, Haemulidae (Grunts) 15.1%, Lutjanidae (Snappers) 4.9%, and Gerreidae (Mojarras) 4.8%. The remaining 13 families contributed less than 2.0% each to the overall abundance.

2013. While a formal quantitative fish survey was not required for the 2013 protocol, all fish taxa encountered during the 2013 benthic survey were recorded to compile a general taxonomic list for the Study Area (Table 12). A total of 56 taxa from 29 families were recorded along the natural hardbottom during this survey (Photographs 3 and 4). The natural hardbottom yielded 18 predatory species and 11 species of the snapper/grouper management complex.

Table 12. Fish taxa recorded during the 2013 characterization survey.

Common Name	Scientific Name	Common Name	Scientific Name
Sergeant Major	*Abudefduf saxatilis*	Slippery Dick	*Halichoeres bivittatus*
Ocean Surgeonfish	*Acanthurus bahianus*	Pudding Wife	*Halichoeres radiatus*
Doctorfish	*Acanthurus chirurgus*	Rock Beauty	*Holacanthus tricolor*
Blue Tang	*Acanthurus coeruleus*	Chub	*Kyphosus sectatrix*
Porkfish	*Anisotremus virginicus*	Hairy Blenny	*Labrisomus nuchipinnis*
Gray Triggerfish	*Balistes capriscus*	Mutton Snapper	*Lutjanus analis*
Spanish Hogfish	*Bodianus rufus*	Mahogony Snapper	*Lutjanus mahogoni*
Saucereye Porgy	*Calamus calamus*	Lane Snapper	*Lutjanus synagris*
Sheepshead Porgy	*Calamus penna*	Banded Jawfish	*Opistognathus macrognathus*
Orange-spotted Filefish	*Cantherhines pullus*	Seaweed Blenny	*Parablennius marmoreus*
Sharpnose Puffer	*Canthigaster rostrata*	Highhat	*Pareques acuminatus*
Yellow Jack	*Carangoides bartholomaei*	French Angelfish	*Pomacanthus paru*
Blue Runner	*Caranx crysos*	Spotted Goatfish	*Pseudupeneus maculatus*
Bar Jack	*Caranx ruber*	Blue Goby	*Ptereleotris calliurus*
Black Seabass	*Centropristis striata*	Lionfish	*Pterois volitans*
Foureye Butterflyfish	*Chaetodon capistratus*	Bandtail Puffer	*Sphoeroides spengleri*
Spotfin Butterflyfish	*Chaetodon ocellatus*	Dusky Damselfish	*Stegastes adustus*
Atlantic Bumper	*Chloroscombrus chrysurus*	Longfin Damselfish	*Stegastes diencaeus*
Sand Perch	*Diplectrum formosum*	Beaugregory	*Stegastes leucostictus*
Spottail Pinfish	*Diplodus holbrookii*	Bicolor Damselfish	*Stegastes partitus*
Neon Goby	*Elacatinus oceanops*	Cocoa Damsel	*Stegastes variabilis*
Silver Jenny	*Eucinostomus gula*	Needlefish	*Strongylura marina*
Nurse Shark	*Ginglymostoma cirratum*	Channel Flounder	*Syacium micrurum*
Green Moray	*Gymnothorax funebris*	Sand Diver	*Synodus intermedius*
Tomtate	*Haemulon aurolineatum*	Bluehead Wrasse	*Thalassoma bifasciatum*
French Grunt	*Haemulon flavolineatum*	Great Pompano	*Trachinotus goodei*
Cottonwick Grunt	*Haemulon melanurum*	Yellow Stingray	*Urobatis jamaicensis*
Sailor's Choice	*Haemulon parra*	Green Razorfish	*Xyrichtys splendens*

Photograph 3. Porkfish observed on Transect R-133 during the 2013 characterization survey.

Photograph 4. Yellow stingray observed on Transect R-139 during the 2013 characterization survey.

3.4. ACROPORA SPP. SURVEY

In order to ensure that the two federally listed threatened *Acropora* coral species (*A. cervicornis* and *A. palmata*) were not present on the hardbottom resources adjacent to the project area, PBC-ERM conducted an *Acropora* spp. survey on October 22, 2013. The survey was conducted using the 2008 NMFS recommended protocol. No colonies of *Acropora* spp. or any of the seven coral species proposed for listing under the Endangered Species Act (ESA) were observed. The survey results and map are provided in Appendix F. It was also noted that no colonies of *Acropora* spp. were observed during the 2009 and 2010 surveys conducted to collect hardbottom relief measurements (Appendix E) or the benthic characterization survey.

3.5. DUNE VEGETATION SURVEY

On November 15, 2013 CB&I biologists ground-truthed the extent of dune vegetation using DGPS (Figure 2). Prior to field verification, aerial images were analyzed to determine specific areas of interest (i.e. areas void of seawalls with vegetation present) for investigation. The dune survey took place between the Lake Worth Pier and R-133+500, at which point seawalls continued to the south and dunes were absent. The dune located immediately south of Lake Worth Pier (R-128+700) was dominated by sea oats (*Uniola paniculata*) (Photograph 5) while the dune located immediately north of the seawall at R-129 was dominated by bitter panic grass (*Panicum amarum*) (Photograph 6). Seagrapes (*Coccoloba uvifera*) with dense cover were the dominant dune vegetation identified throughout the remainder of the survey area (Photographs 7 and 8), which ended near R-133+500 where dune habitat ended and upland properties were bordered by seawalls. One exception, near R-133, was observed where dune vegetation was sparse (Photograph 9). The endangered plant species beach jacquemontia (*Jacquemontia reclinata*) was not observed within the Study Area.

Photograph 5. Dense sea oats (*Uniola paniculata*) were the dominant dune vegetation in the area immediately south of Lake Worth Pier.

Photograph 6. Dense bitter panic grass (*Panicum amarum*) was the dominant dune vegetation in the area immediately north of the seawall at R-129.

Photograph 7. Seagrapes (*Coccoloba uvifera*) were the dominant dune vegetation throughout the survey area.

Photograph 8. Seagrapes (*Coccoloba uvifera*) were the dominant dune vegetation throughout the survey area.

Photograph 9. Steeply scarped dune with sparse vegetation near R-133.

4.0. CONCLUSIONS

The following observations highlight the results from the 2006 and 2013 characterization surveys for the Southern Palm Beach Island Comprehensive Shoreline Stabilization Project 2013.

Aerial Delineation and Sediment Dynamics

Not all transects included both intertidal and subtidal hardbottom formations, but those that did generally crossed a substantial sand patch between the two formations. As a result, the transects that extended between the two formations generally had higher sand cover and longer segments of continuous sand compared to the transects located exclusively in the intertidal or subtidal areas. The area of exposed hardbottom in the Study Area was 48.78 ac in 2006 and 36.96 ac in 2013. Based on line-intercept data, percent cover of exposed hardbottom also decreased slightly from 2006 to 2013.

Sediment depth measurements were not collected during the 2006 survey, so a comparison could not be made over time.

Benthic Characterization

Turf algae and sediment dominated the overall benthic cover classes during both the 2006 and 2013 characterization surveys. Bare hard substrate and macroalgae also had higher cover compared to other functional groups. Overall, the benthic community at the functional group level was similar over time and space.

The macroalgae community was significantly different between the intertidal and subtidal habitats during both surveys of the hardbottom. These differences were driven by the presence and abundance of *Gelidiella* in the intertidal and *Dictyota* and *Padina* in the subtidal. The macroalgae community on the intertidal habitat remained similar between surveys, which is likely due to the highly dynamic nature of this habitat. Constant sand scour and burial facilitates an opportunistic macroalgae community that remains at the pioneer stage of development. The subtidal habitat exhibited significant changes in the macroalgae assemblage between surveys where the 2013 survey had a higher mean coverage and genus abundance. This area is also exposed to fluctuating sand dynamics, but provides a slightly more stable environment for the macroalgae community to develop compared to the intertidal habitat. Differences over time are likely associated with the length of time the hardbottom has been exposed. The 2013 macroalgae cover and genus abundance was higher, indicating a more established community.

Siderastrea spp. dominated the scleractinian coral community in the intertidal and subtidal habitat. This genus is often found in highly disturbed locations and not only has high resistance to stressful environments but exhibits a remarkable resilience to stress (Lirman et al., 2002). These characteristics enable this genus to occupy this habitat and thrive in such a dynamic habitat.

Octocorals were not present on the hardbottom in the 2006 survey but were documented on the subtidal hardbottom in 2013. Based on a study by Yoshioka and

Yoshioka (1991) which found octocoral growth rates in Puerto Rico ranging from 1.36 cm yr^{-1} (SD 1.86) for *Eunicea succinea* and up to 4.48 cm yr^{-1} (SD 2.82) for *Pseudopterogorgia americana*, the average octocoral colony size of 5.3 cm documented during the 2013 benthic characterization indicates an octocoral community that has not been established for very long (2-4 years). This corresponds with the nature of such an ephemeral system as indicated by the aerial analysis of the Study Area.

No colonies of the threatened coral species *Acropora* spp. or any of the seven coral species proposed for listing under the ESA were observed in the Study Area during the benthic characterization or the *Acropora* survey.

Fish

A total of 56 fish taxa from 29 families were recorded along the natural hardbottom during 2013 survey. The natural hardbottom yielded 18 predatory fish species and 11 species of the snapper/grouper management complex.

Dune Survey

The dune vegetation survey indicated a habitat dominated by seagrapes. The endangered plant species beach jacquemontia (*Jacquemontia reclinata*) was not observed within the survey area.

Summary

The benthic hardbottom habitat adjacent to the Study Area is very dynamic and ephemeral in nature. The constant burial and exposure of hardbottom in this area facilitates an opportunistic community dominated by turf and macroalgae species that recruit quickly when substrate is available. Stony corals and octocorals can be observed when hardbottom remains exposed long enough to support their recruitment and growth. Although the hardbottom adjacent to the proposed project area remains low in benthic complexity due to relatively short exposure time, studies have shown that nearshore hardbottom habitat has nursery value for juvenile fish species (Baron et al., 2004; Lindeman and Snyder, 1999), and provides a source of food and refuge for both benthic and fish species.

The dune habitat in the Study Area, established where seawalls are not present, is dominated by common native dune species such as seagrape and sea oats, with no beach jacquemontia present.

5.0. LITERATURE CITED

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SOUTHERN PALM BEACH ISLAND COMPREHENSIVE SHORELINE STABILIZATION PROJECT

Biological Assessment

U.S. Army Corps of Engineers
Jacksonville District

June 2016

SOUTHERN PALM BEACH ISLAND COMPREHENSIVE SHORELINE STABILIZATION PROJECT BIOLOGICAL ASSESSMENT

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1.0. INTRODUCTION

1.1. PURPOSE OF BIOLOGICAL ASSESSMENT

This Biological Assessment (BA) has been prepared to fulfill the U.S. Army Corps of Engineers (USACE) requirements as outlined under Section 7(c) of the Endangered Species Act of 1973 (ESA), as amended. This BA evaluates the potential impacts that the proposed Southern Palm Beach Island Comprehensive Shoreline Stabilization Project may have on federally listed species (threatened and endangered), species proposed for listing, and critical habitat that may occur in the Action Area, and describes proposed avoidance, minimization, and conservation measures. This BA has been developed to assist the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) in completing ESA Section 7 consultation for the proposed Project.

The Southern Palm Beach Island Comprehensive Shoreline Stabilization Project (the Project) includes two projects which will be constructed by two separate Applicants: the Town of Palm Beach and Palm Beach County (County). The USACE has determined that these are similiar actions and is therefore evaluating the environmental effects of these actions together. However, USACE will complete ESA Section 7 consultation for the Town of Palm Beach and County projects separately in association with their respective permit applications. This BA is intended to assist USFWS and NMFS with consultation for both permit applications for actions including the construction of dune restoration and beach nourishment projects, construction of seven (7) low-profile groins (as part of the County project), and artificial reef construction which will likely be required to offset hardbottom impacts.

1.2. PROJECT LOCATION

Palm Beach County is located on Florida’s southeast coast approximately 97 km (60 mi) north of Miami (Figure 1-1). There are 38 municipalities within Palm Beach County, four of which are adjacent to the Project Area and located on Palm Beach Island, a 25.3 km (15.7 mi) long barrier island. These four municipalities include, from north to south, the

Towns of Palm Beach, South Palm Beach, Lantana and Manalapan. The Town of Palm Beach prepared comprehensive coastal management plans in 1986 and 1998 which segmented the Town of Palm Beach's shoreline into "reaches" in order to examine erosion problems and develop engineering plans for areas with similar coastal processes. These reaches have remained more or less consistent for the past 25 years, with slight revisions. The 1998 revision expanded the reach concept from the southern limits of the Town of Palm Beach to the southern limits of Palm Beach Island. More recently, the Town of Palm Beach extended Reach 7 into what had been the northern section of Reach 8, so it now includes the Lake Worth Pier; this revision was proposed to reflect the Town of Palm Beach's evolving management strategies. Table 1-1 summarizes the current reach designations on Palm Beach Island (FDEP, 2013). Reaches 1–8 are located within the Town of Palm Beach and City of Lake Worth, while Reaches 9–11 are associated with the Towns of South Palm Beach, Lantana and Manalapan. The Florida Department of Environmental Protection (FDEP) also utilizes range monuments (R-monuments), a statewide network of survey monuments, to more precisely identify specific locations on the state's shoreline. Palm Beach Island reaches are described by R-monuments, street names and municipalities in Table 1-1.

Table 1-1. Palm Beach Island shoreline reach designation (FDEP, 2013).

Reach	R-Monuments	Location	Municipality
1	R-76 to R-78+500	Lake Worth Inlet to Onondaga Avenue	Town of Palm Beach
2	R-78+500 to R-90+400	Onondaga Avenue to El Mirasol	Town of Palm Beach
3	R-90+400 to R-95	El Mirasol to Via Bethesda	Town of Palm Beach
4	R-95 to R-102+300	Via Bethesda to Banyan Road	Town of Palm Beach
5	R-102+300 to R-110+100	Banyan Road to Widener's Curve	Town of Palm Beach
6	R-110+100 to R-116+500	Widener's Curve to Sloan's Curve	Town of Palm Beach
7	R-116+500 to R-128+530	Sloan's Curve to Lake Worth Pier	Town of Palm Beach*
8	R-128+530 to R-134+135	Lake Worth Pier to Town of Palm Beach southern limit	Town of Palm Beach*
9	R-134+135 to R-137+400	Town of Palm Beach southern limit to Lantana Avenue	Town of South Palm Beach/ Town of Lantana
10	R-137+400 to R-145+740	Lantana Avenue to Chillingsworth Curve	Town of Lantana/ Town of Manalapan
11	R-145+740 to R-151+300	Chillingsworth Curve to South Lake Worth Inlet	Town of Manalapan

***The City of Lake Worth has jurisdiction over a small shorefront in this reach.**

The Project Area extends from R-129-210 to R-138+551 for a length of 2.07 miles. As of June 2014, the FDEP has classified this entire Project shoreline as "critically eroded", which is a designation applied to areas where erosion has been determined to threaten development interests (FDEP, 2014). The Project Area beaches, which provide storm protection to residential and public infrastructure and serve as nesting areas for marine turtles, have experienced erosion from hurricanes, tropical storms, and other weather phenomena, such as strong high pressure systems (Nor'easters) and swell events. The annual shoreline change along the Project Area from June 2004 to winter 2011/2012 averaged a loss of 2.25 ft/yr (CPE, 2013). The Project Area and site conditions are strongly influenced by natural coastal processes due to its location within the littoral cell and the amount of sand entrained in the littoral sand transport system. The erosion rates for this area are driven by many factors, including recent storm events, upland retaining walls, lack of dune habitat, disruptions in littoral sand transport, geographic location on the coast and/or in a littoral cell, proximity to a tidal inlet, sea level rise, nearshore beach morphology, and adjacent coastal structures. These factors, combined with the dynamic nature of coastlines, typically have resulted in characteristics such as a narrow, low-profile beach providing minimal storm protection.

Generally, the Project is in a densely populated urbanized residential setting on a coastal island separated from the main Florida peninsula by the Lake Worth Lagoon (LWL). Bridges spanning the LWL provide access to the coastal island and Project Area. Approximately 1.3 million people live within Palm Beach County and 8,348 people live on Palm Beach Island (U.S. Census Bureau, 2010). The shoreline along the upland development is comprised of hotels, condominiums, homes, and public parks.

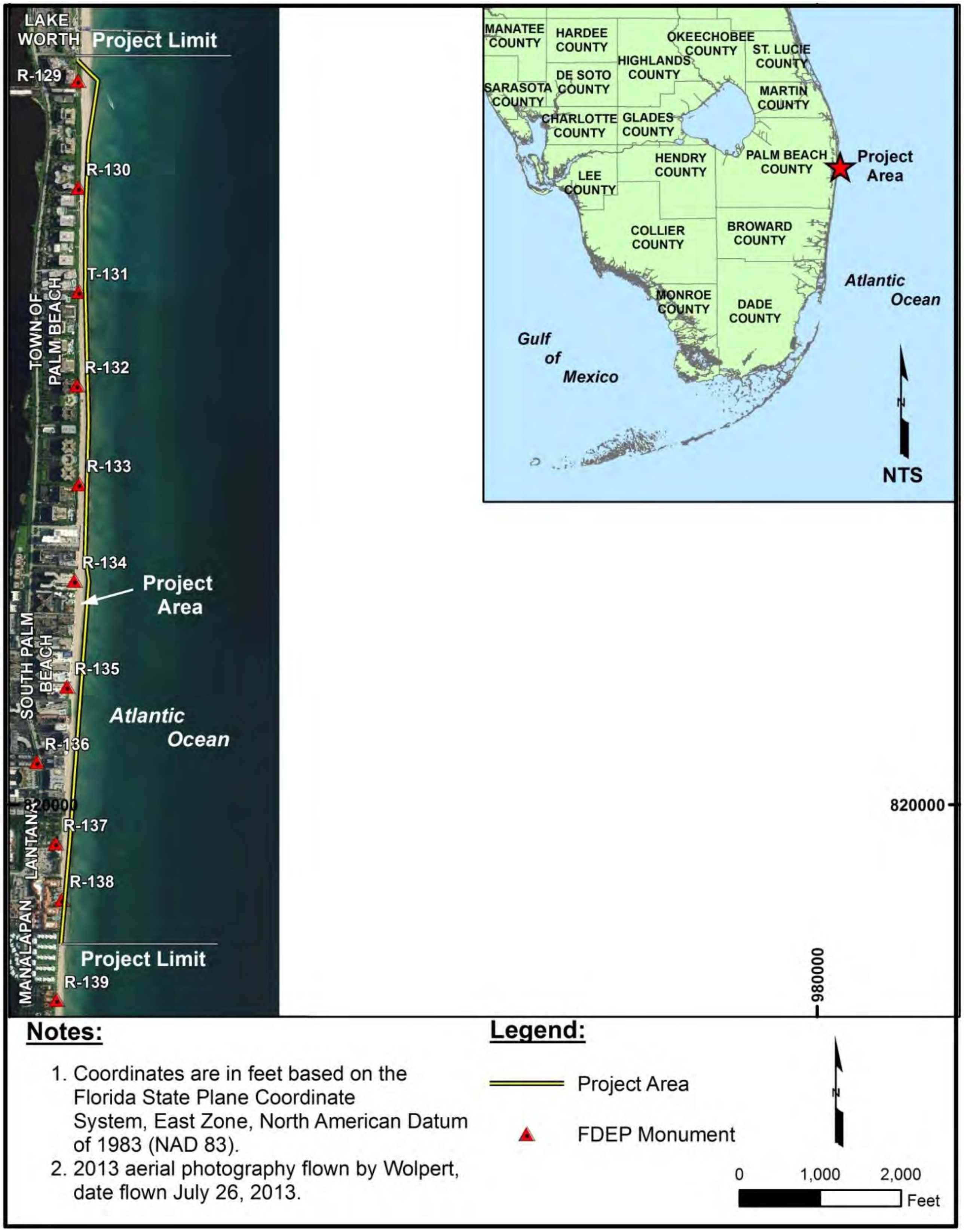


Figure 1-1. Southern Palm Beach Island Comprehensive Shoreline Stabilization Project location map.

1.3. PROPOSED ACTION

The Proposed Action (designated as the Applicants' Preferred Project Alternative, "Project") would use a combination of beach nourishment, dune reconstruction and coastal structures (Figure 1-2). The Applicants' goals and objectives for both nourishment projects are to provide more sand to the littoral system, create a stable beach and dune profile that will buffer the effects of storm surge and wave action, provide wildlife habitat, allow for recreational use, and protect upland infrastructure. The total volume of sand needed will be dependent on the results from surveys conducted immediately prior to construction. However, based on 2014 conditions, approximately 142,800 cubic yards (cy) of fill will be placed along the shoreline within the Project Area from R-129-210 to R-138+551 (approximately 3.33 km (2.07 mi)). The fill volume will be split between the two Applicants' separate project areas – 65,200 cy of sand in the Town of Palm Beach and 77,600 cy in the County project area within South Palm Beach, Lantana and Manalapan. From north to south, the Project would place dune nourishment only from R-129-210 to R-129+150, dune and beach nourishment from R-129+150 to T-131, dune nourishment only from T-131 to R-134+135 (Town of Palm Beach southern limit), and beach nourishment with seven low-profile groins from R-134+135 to R-138+551 (Figure 1-2). The proposed projects may be authorized under a 10-year permit and would allow for initial project construction and maintenance (renourishment) for up to three renourishments.

It is anticipated that the delivery mechanism for the nourishment will be a truck-haul operation. The sand source would be a combination of stockpiled dredge material from the Reach 7 Phipps Ocean Park Beach Restoration Project (Phipps) or the Mid-Town Beach Restoration Project (Mid-Town) for placement within the Town of Palm Beach project limits (R-129-210 to R-134+135) and upland sand for placement within the County project limits in South Palm Beach, Lantana and Manalapan (R-134+135 to R-138+551) (Figure 1-2). For the initial construction of the proposed Project, the Town of Palm Beach proposes to utilize stockpiled dredged sand which will be located within the permitted Phipps template, as authorized by USACE Permit No. SAJ-2000-00380 and authorized by FDEP under the Palm Beach Island Beach Management Agreement (BMA) (FDEP, 2013). For subsequent maintenance of the Project, the Town of Palm Beach plans to alternate between utilizing the Phipps stockpile and an offshore sand stockpile within the permitted Mid-Town template as authorized by USACE under Permit No. SAJ-1995-03779 and authorized by FDEP under the BMA (FDEP, 2013). The Phipps and Mid-Town projects would utilize either a hopper or cutterhead dredge to obtain beach quality sand from an offshore borrow area. If the project schedules do not coincide, the Town of Palm Beach may truck in sand from upland mines. The County only proposes upland sand for construction of its portion of the Project. This BA considers impacts from transport of sand from both dredge stockpiles and upland mines.

As stated in Section 1.1, the Project includes two projects which will be constructed by two separate Applicants: the Town of Palm Beach project area extends from R-129-210 to R-134+135, and the County project area extends from R-134+135 to R-138+551. The total Project Area extends from R-129-210 to R-138+551. This BA considers the larger Action Area, from R-127 to R-141+586, which includes all areas to be affected directly or indirectly by the action, and not merely the immediate area involved in the action (50 CFR 402.02). The Action Area is described in Section 1.4.

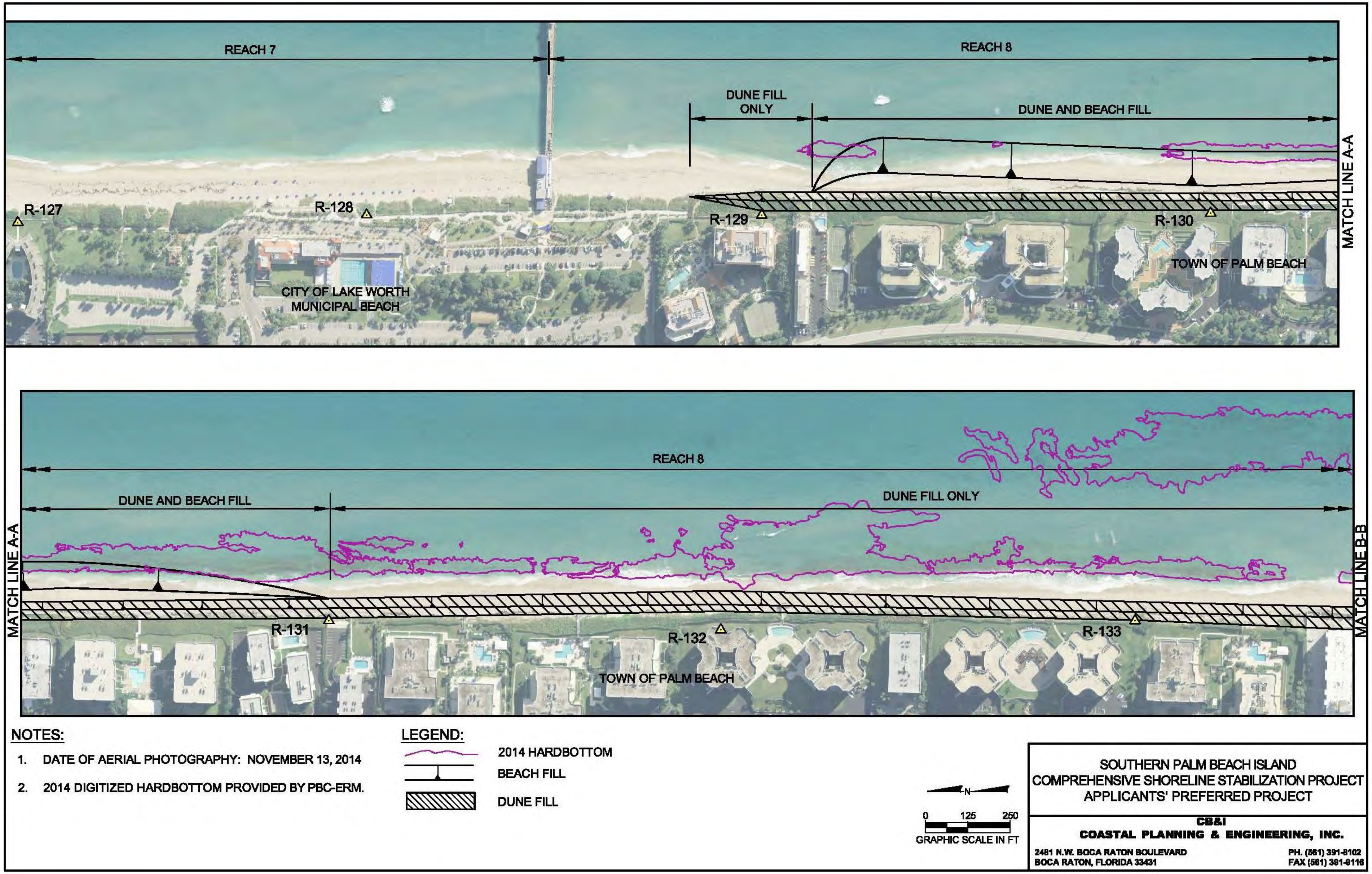


Figure 1-2. The Applicants' Preferred Project.

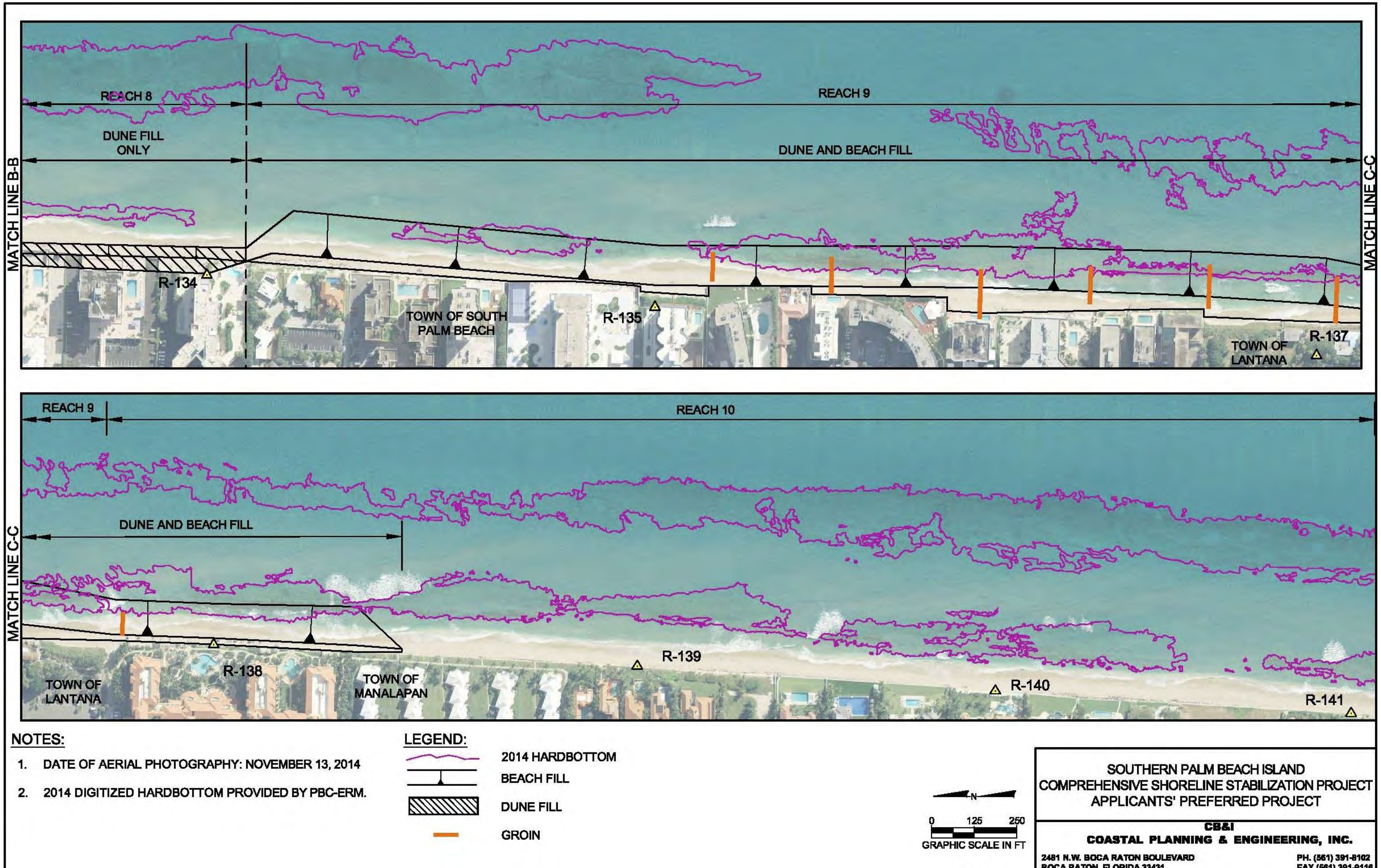


Figure 1-2 (cont.). The Applicants' Preferred Project.

1.3.1. Truck-Haul Operations

For any alternative including beach and dune fill, potential sand sources include stockpiled offshore dredged material and upland mines, all delivered to the Project Area via truck haul. Utilizing a truck-haul approach for a beach fill project involves several stages of transport: loading of material at the mine site or stockpile, road transport via dump trucks, beachside delivery and stockpiling, transfer from stockpile to off-road vehicles, beach transport, placement, and grading. The only need for in-water work during the truck haul fill process will be if vessels are required during turbidity monitoring.

For the proposed Project, the truck-hauled sand source would be a combination of stockpiled dredge material from the Phipps template or the Mid-Town template for placement within the Town of Palm Beach project limits (R-129-210 to R-134+135) and upland sand for placement within the project limits in South Palm Beach, Lantana and Manalapan (R-134+135 to R-138+551) (Figure 1-2). The Phipps Project (alternating with use of a stockpile from the Mid-Town Project) is planned to occur at the same time as the Project discussed herein, but if the project schedules do not coincide, the Town of Palm Beach may truck in sand from upland mines. The remaining sand fill along the County shoreline in the Towns of South Palm Beach, Lantana and Manalapan would utilize sand from one or more upland mines.

Sand from either source must meet FDEP requirements for beach sand compatibility as per Florida Administrative Code, Rule 62B-41.007(2)(j). These criteria apply to all beaches in Florida so that the sand closely resembles the “native” sand for biological, physical and aesthetic purposes. For the specific Project Area, any sand source must be consistent with the BMA cell-wide sediment quality specifications (Table 1-2) (FDEP, 2013). The sand source used for the County project must also meet the County's technical sand specifications (provided as Appendix B to the EIS). According to the County’s technical standards, sand must be obtained from a source further than 800 ft landward of the coastal construction control line, must be similar in color to the native beach material, must be free of construction debris, rocks, clay, or other foreign matter, must have less than 1% organic material, must be free of coarse gravel or cobbles, must have a particle size distribution ranging predominantly between 0.074 mm and 4.76 mm, and must be well-drained and free of excess water and have a moisture content of less than 10%. By adhering to the above standards and regulations, no foreign matter or unacceptable material as a component of the fill material is anticipated.

Table 1-2. FDEP sediment quality compliance specifications as per the BMA (FDEP, 2013).

Sediment Parameter	Parameter Definition	Compliance Value
Mean Grain Size	Min and max values (using moment method calculation)	0.25 mm to 0.60 mm
Maximum Silt Content	Passing #230 sieve	2%
Maximum Fine Gravel Content*	Retained on #4 sieve	5%
Munsell Color Value	Moist value (chroma = 1)	6 or lighter

Note: The beach material shall not contain construction debris, toxic material, other foreign matter, coarse gravel or rocks.
***Shell content is used as the indicator of fine gravel content for the implementation of quality control/quality assurance procedures.**

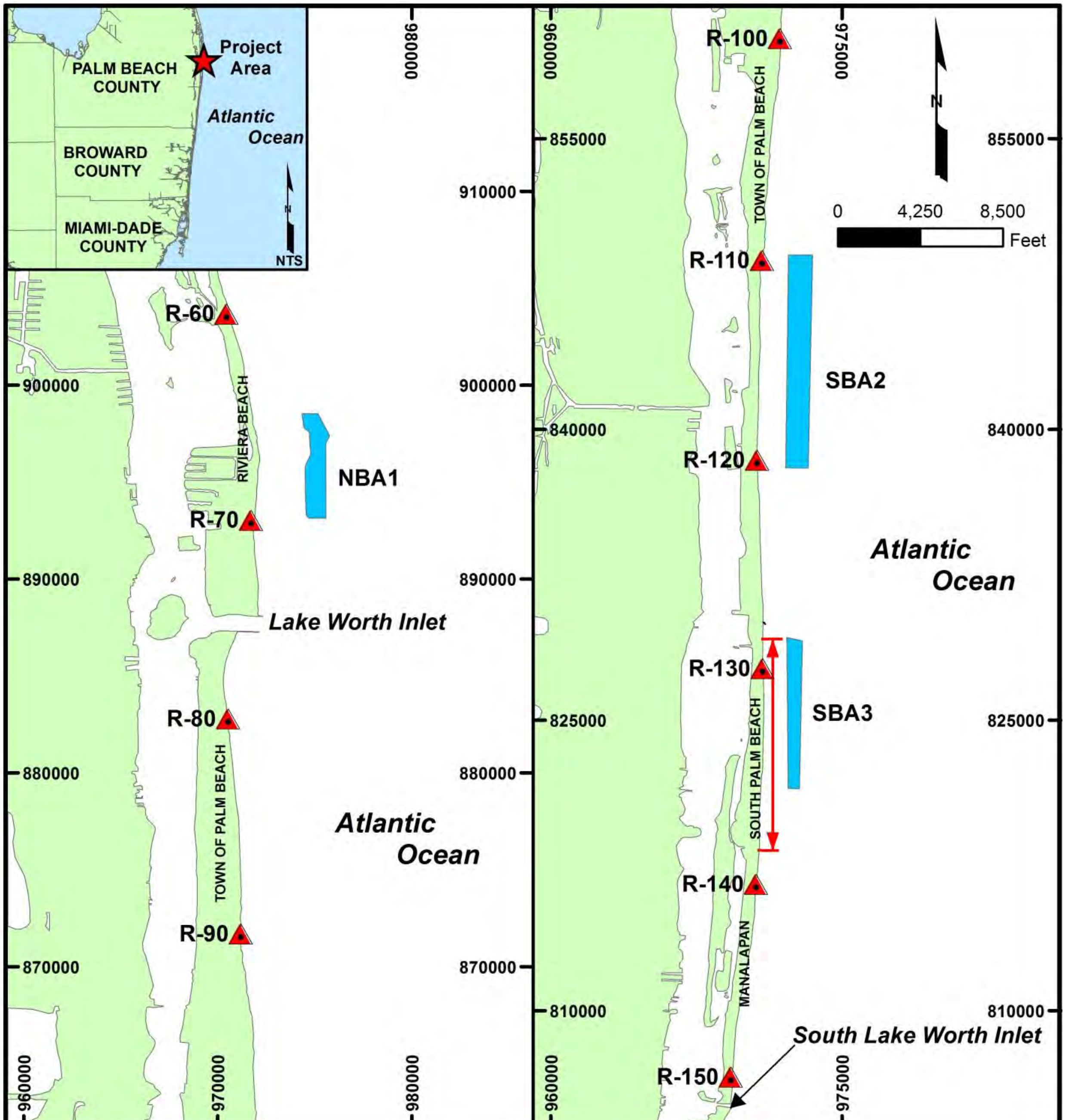
Delivery of sand via truck haul would require beach access points along State Road (S.R.) A1A large enough to allow passage of dump trucks and heavy machinery. If space at the access area is too limited to allow efficient transfer from long-haul road truck to off-road truck, a conveyor system may be used. Access points are needed to remove sand from the stockpile and to deliver sand to the Project Area. If stockpiled sand is utilized from the Phipps Project, it will be accessed at the 3360 Condominium property (3360 S. Ocean Blvd.). If sand stockpiled from the Mid-Town Project is used, the stockpile will be accessed at the intersection of Peruvian Avenue and S.R. A1A. For placement of truck-hauled sand, two potential access points were identified as suitable along the Project Area shoreline, including one within the Town of Palm Beach project area and one within the County project area. Since 2005, the Town of Palm Beach has truck-hauled sand and placed equipment on the beach in Reach 8 from the 3200 Condominium property (3200 S. Ocean Blvd.). The Lantana Public Beach will act as a staging area for the County project, with access via Dorothy Rissler Road.

For transport to the Project Area, the Applicants will likely employ a ‘mixed fleet’ of long-haul road trucks including two-axle and six-axle dump trucks. Long-haul road trucks are capable of transporting 15-20 cy of material and, when fully loaded, have a gross weight of approximately 20-27 tons, respectively. If more distant sand sources are used, such as mines in northern Florida, it is possible that material would be transported from the mine via railway. Material can be transported as a single railcar, a group of cars, or a unit train of 80-100 cars each. A single railcar can carry 100 tons of material, or about 74 cy. A unit train could transport between 80,000-100,000 tons of sand and would be the most cost-effective rail method. Once delivered to a nearby stockpile area, material may be offloaded from the rail and then re-loaded onto trucks. Another option for delivery of material from domestic upland sand sources is to do so by barge. Although possible, this approach would require many steps to transfer sand to and from the barge as well as truck delivery to the beach - it is unlikely that this method would be used.

In contrast to hydraulically placed beach nourishment, a truck haul operation is complicated by the bulking of the sand. Sand placed hydraulically or reworked by waves is near its maximum density. Sand placed and transported in the dry may not be at the maximum density. Depending on its loading, transporting, and placement processes, the density of the sand may be approximately 10% less than hydraulically placed sand. As the sand is reworked by waves and tides, consolidation will occur. Therefore, an additional volume may be placed to compensate for the expected consolidation.

For a truck haul operation there are several limitations to the construction progress. These include the following: constructing during only daylight work hours, truck availability, traffic congestion on the roads, traffic congestion at the beach access points, and the time associated with re-handling and movement of sand along the beach.

Offshore sand source. A stockpile of dredged material from the Phipps Project (alternating with use of a stockpile from the Mid-Town Project) is the preferred sand source for the Project Area within the Town of Palm Beach limits. The Palm Beach Island Beach Management Agreement (BMA) (FDEP, 2013) authorizes the dredging and stockpiles for the Phipps and Mid-Town projects, and federal authorizations will be provided under USACE Permit Nos. SAJ-2000-00380 and SAJ-1995-03779 for the Phipps and Mid-Town projects, respectively. Phipps and Mid-Town projects may dredge sand from North Borrow Area 1 (NBA1), South Borrow Area 2 (SBA2), South Borrow Area 3 (SBA3) (Figure 1-3), or any offshore sand source that is consistent with the BMA cell-wide sediment quality specifications (Table 1-2) (FDEP, 2013). The stockpiled sand will be located within the permitted Phipps and Mid-Town templates (alternating between the two projects) and will be considered an active stockpile so that sand is removed for transport to the Project Area soon after it is piled. The total proposed volume for placement within the Town of Palm Beach is approximately 65,200 cy, 3,400 cy of which will be placed below mean high water (MHW). If timing of the Phipps and Mid-Town projects does not allow for use of dredged sand, the Town of Palm Beach would consider using sand from an upland source.



Notes:

1. Coordinates are in feet based on the Florida State Plane Coordinate System, East Zone, North American Datum of 1983 (NAD 83).

Legend:

Southern Palm Beach Island Comprehensive Shoreline Stabilization Project

Project Limits

Borrow Area

FDEP Monuments

Figure 1-3. Potential borrow areas to be used during Phipps and Mid-Town projects that may supply the sand for the proposed Project within the Town of Palm Beach limits (R-129-210 to R-134+135).

Upland sand source. Use of upland sand allows the greatest flexibility in project planning. Upland sand sources have provided sand for beach and dune restoration projects in Florida for over a decade. Upland sand has historically been used for small projects (less than 50,000 cy) (USACE, 2001), but upland sand has recently been utilized for larger projects in Indian River County, Broward County, and Brevard County, and is currently being utilized for a separate 5-mile long project in Broward County. Within Palm Beach County, upland sand has been used for restoration efforts in Coral Cove Park in Tequesta, Singer Island, Town of Palm Beach, South Palm Beach, Lantana, and Delray Beach. Specifically within the Project Area, the Towns of Palm Beach, South Palm Beach, and Lantana have utilized upland sand to maintain dune habitat and protect upland infrastructure.

The sand source for the County project area within the limits of the Towns of South Palm Beach, Lantana, and Manalapan (R-134+135 to R-138+551) is sand from domestic upland sand quarries within the state of Florida. The sand would be placed on the beach mechanically, rather than hydraulically. There are known sand mines within 161 km (100 mi) of the Project shoreline that have provided clean, quality material for past nourishment projects in southeast Florida. A study conducted in Broward County found that due to a larger mean grain size and smaller fines content, upland sand is expected to be more stable and produce less turbidity in the nearshore environment than sand obtained from offshore borrow areas (OAI and CPE, 2013).

The County has proposed to utilize sand from E.R. Jahna Industries, Inc. Ortona Sand Mine (Ortona) and/or Stewart Mining Industries in Ft. Pierce (Figure 1-4). The Town of Palm Beach's preferred upland sand mine is Ortona, which has been previously utilized within the Town of Palm Beach, as well as Stewart Mining Industries. Each mine will be evaluated based on compliance with the F.A.C., Rule 62B-41.007(2)(j), the BMA cell-wide sediment quality specifications (Table 1-2), the County's technical sand specifications outlined in the County's Annual Dune and Wetlands Restoration contract (Appendix B to the EIS), sediment characteristics, location relative to the Project Area, compliance with state and federal laws and method of transport available.

Table 1-3. Potential upland sand sources.

Company	Mine Name	Distance from Project Area (km)*	Distance from Project Area (mi)*
E.R. Jahna Industries, Inc.	Ortona	154	96
Stewart Mining Industries	Ft. Pierce	127	79

*Distance is the shortest driving distance (miles) between each mine and Lantana Municipal Beach Park; actual distance will depend on routes selected by contractor.

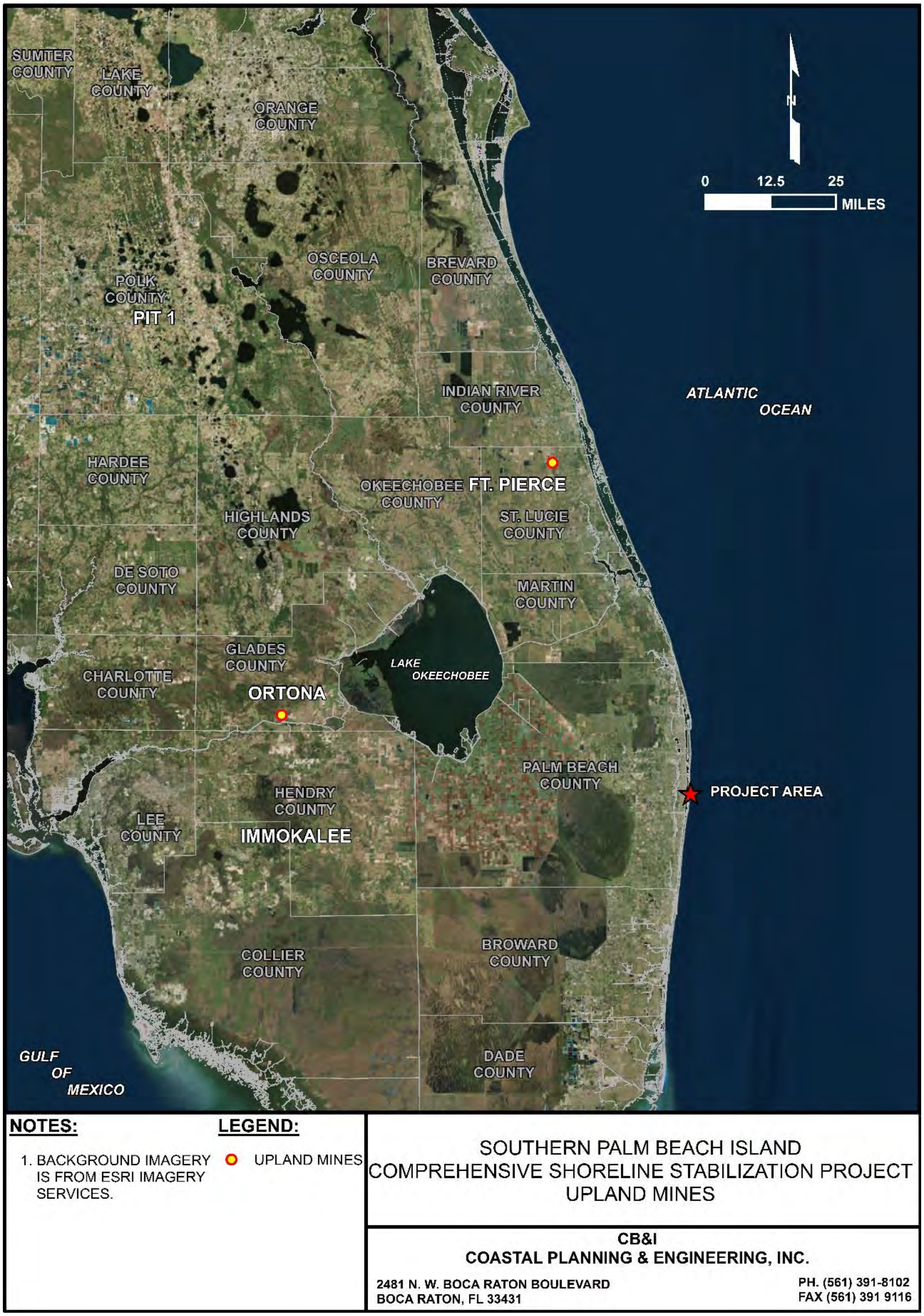


Figure 1-4. Upland sand mines with potentially feasible sources of material that could be considered for a truck-haul project for placement in the proposed Project Area.

One consideration involved with selecting upland sand sources is the availability of material within the mines, as this can affect overall construction rate of the project. The mine(s) selected must have sufficient total and daily production capacity to meet the project needs. Sand mines can stockpile some of the material to ensure that they can keep pace with required delivery rates. Other considerations that affect project efficiency include the distance from the mine to the project, the number of trucks and other machinery at the staging and beach nourishment areas, as well as the number of active access points. In the event that delivery rate exceeds handling time on the beach, it may be useful to employ offsite truck waiting areas to avoid congestion at the access points. Those mines determined to be most suitable based on the state and County sediment guidelines, as well as having sufficient production capacity and a reasonable trucking distance from the Project Area, will be considered.

1.3.2. GROIN CONSTRUCTION

The County portion of this Project also includes the construction of seven (7) groins placed perpendicular to the shoreline extending from the existing seawalls to the post-construction (beach fill) shoreline in South Palm Beach, Lantana and Manalapan (R-134+135 to R-138+551) (Figure 1-2). The groins will be low-profile, meaning that they are designed to be level with the berm and are intended to blend in with the beach. They will be concrete king pile and panel groins with 18 inch (+/-) wide H-piles spaced every 8 to 10 ft. Exact location and length of the groins will depend on the presence of nearshore hardbottom resources at the time of construction, but it is currently estimated that they will be approximately 90 ft long and spaced approximately 300 ft apart. As the sand naturally erodes from the beach, the groins would gradually become partially exposed until the next nourishment. The groins will be a disruption of the natural littoral sand transport system along the beach in this area, with sand accretion/sediment deposition occurring on the updrift side and erosion on the downdrift side of the groin field. The construction of the groins may occur from either land-based operations or using in-water construction, or a combination of the two methods.

1.3.3 MEASURES TO MINIMIZE/MITIGATE ENVIRONMENTAL IMPACTS

The Project will utilize beach compatible sand and will be constructed during daylight hours between November 1 and April 30 in order to avoid peak sea turtle nesting season, thereby minimizing impacts to sea turtles.

The proposed Project has also been designed to maximize coastal protection while minimizing impacts to nearshore hardbottom. The Project includes some sections of dune-only construction, including placement of dune fill only between T-131 to R-134+135, which is adjacent to extensive nearshore hardbottom. Based on 2014 conditions, the total sand volume proposed for the Project would be approximately 142,800 cy, of which only 30,000 cy will be placed below MHW. Although measures have been incorporated into the project design to minimize hardbottom impacts, placement and equilibration of beach sand will impact nearshore hardbottom resources. Hardbottom closest to shore will be directly buried by placement of beach sand immediately following construction, while equilibration (spreading) will impact additional hardbottom (Figure 3-1). Based on the engineering and Delft3D modeling results (Appendix G to the EIS), it is anticipated that the Applicants' Preferred Alternative may result in permanent impacts to between 3.86 and 3.99 acres of hardbottom, and temporary impacts to between 9.53 and 9.93 acres of hardbottom due to direct sand placement and subsequent spreading (equilibration) of sand (Figures 3-2 through 3-4). Impacts to hardbottom were based on a time-average of exposed hardbottom delineated from aerial images between 2003 and 2014 (this method is described below in Section 3.3.). Using the engineering and Delft3D modeling results, historic exposed hardbottom acreage, and recent benthic characterization data, a preliminary Uniform Mitigation Assessment Method (UMAM) evaluation was conducted (provided as Appendix H to the EIS). This draft UMAM analysis determined that between 6.55 and 6.66 acres of mitigation may be required to offset these impacts to intertidal and subtidal hardbottom. The Project, which includes the Town of Palm Beach and theCounty projects, has been evaluated in this BA and in the EIS as a comprehensive project; however, these projects will be permitted separately. In order to facilitate the permitting of these projects, engineering and Delft 3D modeling analyses were also performed to quantify hardbottom impacts resulting from each separate project. These impacts are presented in Section 5.1.1.2.1 of the EIS.

Appendix I to the EIS provides the Applicants' draft mitigation plans, including potential locations of the artificial reef sites. The artificial reefs will likely be constructed of limestone boulders or boulder pods placed over sand substrate of 1-2 ft thickness. The reefs will be placed at a similar depth as the impacted hardbottom resources and will be constructed with a protective buffer between the artificial and natural reefs.

A dune planting plan for the Town of Palm Beach South End Restoration (Reach 8) Project (CSI, 2011b) was established in December 2011 and may be adopted to evaluate the installation of plants and ensure that planting will be conducted in accordance with the plans and specifications for the proposed Project. Post-construction monitoring will also occur to determine plant survivorship and success.

A complete description of Conservation Measures is provided in Section 7.0.

1.4. ACTION AREA

The Action Area is defined as all areas to be affected directly or indirectly by the action and not merely the immediate area involved in the action (50 CFR 402.02). For the proposed Project, the Action Area to be assessed in this BA includes approximately 5 km (3 mi) of dune and beach habitat and nearshore marine environment from R-127 south to R-141+586 within the southern extent of Reach 8, throughout all of Reach 9, and the northern extent of Reach 10. The Action Area includes the 3.33 km (2.07 mi) of shoreline and nearshore habitat within the Project construction area (direct impact), in addition to adjacent areas to the north and south of the Project where construction equipment may operate on the beach and where impacts to the nearshore environment could occur as a result of sand equilibration (indirect impact). The eastern limit of the Action Area extends out to a maximum of approximately 360 meters (1,181 ft) offshore in order to assess potential impacts to all nearshore hardbottom resources (Figure 1-2). The Action Area also includes the truck routes from the upland mine(s) and from the Phipps and Mid-Town stockpiles, as well as the offshore sites where mitigative artificial reefs will be constructed to offset Project impacts to hardbottom.

The Action Area evaluated in this BA does not include the offshore borrow areas which will be the sand source for stockpiles which will be utilized for the Project Area within the Town of Palm Beach, between R-129-210 to R-134+135. These borrow areas will be dredged for the Phipps and Mid-Town projects under authorization of the BMA (FDEP, 2013), and federal authorizations will be provided under USACE Permit Nos. SAJ-2000-00380 and SAJ-1995-03779 for the Phipps and Mid-Town projects, respectively. The Action Area also does not include the upland mine (or mines) which will be the sand source for the Project Area between R-134+135 and R-138+551, as these mines are authorized independent of the Project. The County has proposed to utilize sand from E.R. Jahna Industries, Inc. Ortona Sand Mine (Ortona) and/or Stewart Mining Industries, Inc. in Ft. Pierce. Also, the Town of Palm Beach's preferred upland sand mine is Ortona, which has been previously utilized within the Town of Palm Beach, as well as Stewart Mining Industries, Inc. in Ft. Pierce.

The effects associated with utilizing a truck haul methodology from upland mines or stockpiles of offshore sand include the following:

Truck transport from the mine or stockpile area. Truck haul through urban and residential areas potentially creates noise, pollution, traffic congestion, road damage, spilled sand along roadways, and numerous other safety and aesthetic concerns (USACE, 2001).

Traffic. Effects of the associated increase in vehicular traffic may include: air quality degradation, increased petroleum products in stormwater runoff from the roads, increased noise, greater potential for collision with upland wildlife, increased traffic congestion, and reduced vehicular and pedestrian safety as a result of increased truck traffic.

Staging areas. Staging areas provide space to transfer fill material from road-trucks to off-road-trucks and for short-term storage of materials. Off-road-dump trucks would move the fill material from the staging areas to the beach and dump the sand within the construction template for grading by mechanized machinery to appropriate template elevations. The staging areas off the beach may provide temporary storage of equipment during construction. All equipment maintenance would occur off the beach and dune environment at an appropriate off-site location. Timing and sequencing of the Project would include considerations of minimizing traffic disruptions, public park access control, and adjacent property owners.

Noise. The main sources for noise production along the shoreline of the proposed Project Area include breaking surf, boat activity, and the typical noises associated with adjacent residential areas. Noise levels during construction will increase above the background levels due to the presence of construction equipment and personnel.

Heavy trucks, including all log-haul tractor-trailers (semi-trucks), large tow trucks, dump trucks, cement mixers, large transit buses, motor homes with exhaust located at top of vehicle, and other vehicles with the exhaust located above the vehicle (typical exhaust height of 12 to 15 feet) create noise levels of 84 to 86 dBA at 55 mph at 50 feet (Traffic Noise, 2014).

Air pollution. Air pollutants are classified as either primary or secondary depending on how they are formed. Primary pollutants are generated daily and emitted directly from a source into the atmosphere. Primary pollutants include carbon monoxide (CO), nitrogen dioxide (NO_2), nitric oxide (NO), sulfur dioxide (SO_2), particulates (PM-10 and PM-2.5), and hydrocarbons (HC). Hydrocarbons are also known as volatile organic compounds (VOC).

Secondary pollutants are created over time as a result of chemical and photochemical reactions in the atmosphere. Ozone (O_3) is a secondary pollutant, formed when NO_2 reacts with HC in the presence of sunlight.

The U.S. Environmental Protection Agency (EPA) has established national ambient air quality standards for six “criteria air pollutants”. The State of Florida has adopted the same six criteria pollutants and related standards. The ambient air quality standards for criteria pollutants are shown in Table 1-4. The Southeast Florida Intrastate Air Quality Control Region, which includes the County, is classified as a Federal attainment area (an area designated by EPA as having attained the relevant national ambient air quality standard for a given pollutant).

Table 1-4. Ambient air quality standards.

Air Pollutant	National Standard	
	Primary	**Secondary**
Ozone (O_3)	0.12 ppm, 1-hr. average	0.12 ppm, 1-hr average
Monoxide (CO)	9.0 ppm, 8-hr. average	
	35 ppm, 1-hr. average	
Nitrogen Dioxide (NO2)	0.053 ppm, AAM	0.053 ppm, AAM
Sulfur Dioxide (SO_2)	0.03 ppm, AAM	0.50 ppm, 3-hr. average
	0.14 ppm, 24-hr. average	
Suspended Particulate Matter (PM10)	150 μg/m^3, 24-hr. average	150 μg/m^3, 24-hr.
	50 μg/m^3 AAM	50 μg/m^3 AAM
Lead (Pb)	1.5 μg/m^3, calendar quarter	1.5 μg/m^3

Source: EPA Office of Air Quality Planning and Standards, 2013
Notes: ppm = parts per million by volume, AAM = annual arithmetic mean, μg/m^3 = micrograms per cubic meter

The Project is exempt from the Clean Air Act (CAA) conformity requirements because it is located in a Federal attainment area (EPA, 1973). On July 1, 2000, the State of Florida eliminated the auto emissions test requirement for all vehicles throughout the state (FL DMV, 2013). The typical sea breezes along the Palm Beach coastline readily disperse airborne pollutants. This Project, regardless of the alternative implemented, would not require air quality permits.

1.5. ALTERNATIVES CONSIDERED

The Proposed Action described in Section 1.3 is designated by the Town of Palm Beach and the County as the Applicants' Preferred Project Alternative. Alternatives to the Preferred Project which are also being considered are presented below. These alternatives include scenarios in which only some (or none) of the elements of the Preferred Project are constructed and/or modified. This BA evaluates potential impacts from the Applicants' Preferred Project Alternative (Alternative 2 below), which includes all potential project components: dune only, dune and beach nourishment, and beach nourishment with groins (Figure 1-2). All seven project alternatives are described in detail in the Southern Palm Beach Island Comprehensive Shoreline Stabilization Project EIS:

1. No Action Alternative (Status Quo)
2. The Applicants' Preferred Alternative: Beach and Dune Fill with Shoreline Protection Structures Project
3. The Applicants' Preferred Project without Shoreline Protection Structures
4. The Town of Palm Beach Preferred Project and County Increased Sand Volume Project without Shoreline Protection Structures
5. The Town Of Palm Beach Increased Sand Volume Project and County Preferred Project
6. The Town of Palm Beach Increased Sand Volume Project and County Increased Sand Volume Project without Shoreline Protection Structures

7b. The Town of Palm Beach Increased Sand Volume with Two Shoreline Protection Structures (The Coalition to Save Our Shoreline, Inc. (SOS) Alternative) and County Preferred Project

A brief summary of the seven alternatives is provided below. The volumes of sand presented in this BA and the EIS are based on the 2014 conditions. Table 1-5 presents the volumes required to implement each alternative based on physical surveys conducted in 2008/2009, 2011/2012 and 2014. All three of these conditions are presented for the following reasons: 1) the original project was developed based on 2008 conditions; 2) the modeling conducted during the initial analysis for this EIS in 2013 was based on the most recent conditions at the time (2011/2012); and 3) based on public comments, even more recent data was analyzed (2014), which was included in the Storm Induced Beach Change (SBEACH) analysis. The actual volume of sand needed to construct the project will be dependent on the project template and the condition of the beach (based on results of a physical survey) immediately prior to construction.

During evaluation of each build alternative, a numerical modeling study was conducted to assess potential impacts to the nearshore hardbottom. In the Town of Palm Beach, a range of grain sizes (0.25 mm, 0.36 mm and 0.60 mm) were modeled for each alternative to bracket the FDEP sand quality compliance specifications as per the BMA (FDEP, 2013) and provide flexibility in sand source. Sand will be selected so that it meets FDEP requirements for beach sand compatibility in accordance with Section 62B-41.007(2)(j), F.A.C. The sand source selected for the Town of Palm Beach must also be consistent with FDEP’s sand quality compliance specifications as per the Beach Management Agreement (FDEP, 2013). The County plans to utilize upland sand and only a grain size of 0.36 mm was modeled for their portion of the Project Area. The sand source for the County must also meet the County's technical sand specifications outlined in Section 2.1.1 of the County’s Annual Dune and Wetlands Restoration contract, which is provided as Appendix B to the EIS. Details on how the different impact types were developed can be found in the UMAM Analysis (Appendix H).

Table 1-5. Construction template fill volumes (cy) based on surveys between 2008-2014.

Construction Template Fill Volumes (CY)				
Alternative	**Survey Area**	**2008/2009 Survey**	**2011/2012 Survey**	**2014 Survey**
Alternative 2	TOPB	75,000	53,800	65,200
	PB County	75,000	63,500	77,600
	Total	**150,000**	**117,300**	**142,800**
Alternative 3	TOPB	75,000	53,800	65,200
	PB County	75,000	63,500	77,600
	Total	**150,000**	**117,300**	**142,800**
Alternative 4	TOPB	75,000	53,800	65,200
	PB County	160,000	172,100	187,800
	Total	**235,000**	**225,900**	**253,000**
Alternative 5	TOPB	96,000	100,900	121,700
	PB County	75,000	63,500	77,600
	Total	**171,000**	**164,400**	**199,300**
Alternative 6	TOPB	96,000	100,900	121,700
	PB County	160,000	172,100	187,800
	Total	**256,000**	**273,000**	**309,500**
Alternative 7b	TOPB	n/a	166,500	175,500
	PB County	n/a	63,500	77,600
	Total	**--**	**230,000**	**253,100**

1.5.1. ALTERNATIVE 1 – NO ACTION (STATUS QUO)

The No Action alternative must be considered under CEQ Regulations Sec. 1502.14(d). For the proposed Project Area, the No Action alternative does not provide a solution to the existing erosion and shore protection problems. The recreational capacity of the beach, the nesting sea turtle habitat and the nesting and roosting shorebird habitat would be subject to the natural fluctuations in the volumetric quantity of sand within the existing beach profile. Under the No Action alternative, the Applicants would not place sand or construct groins below the MHW and seasonal high tide line; however, the dunes may continue to be enhanced periodically through placement of small volumes of sand in portions of the Project Area. Efforts to protect the dune and upland infrastructure would be limited to construction activities located wholly in uplands and could include dune restoration, upland retaining walls, shoreline armoring, or other structures or work in uplands.

Stockpiled sand from dredge projects authorized under separate state and federal permits, as well as upland sand, would likely provide the sand sources for continued dune maintenance. The No Action alternative would not include any work, sand, or structures within waters of the U.S., and therefore would not require Department of the Army (DA) authorization. This alternative may stabilize the dune area and provide limited storm protection to upland infrastructure; however, based on current and historical shoreline conditions, this approach is insufficient to address the purpose and need of the Project, which are defined in Chapter 1 of the EIS.

1.5.2. ALTERNATIVE 2 – APPLICANTS' PREFERRED PROJECT ALTERNATIVE

The Applicants' Preferred Project alternative proposes to use beach fill placement and coastal protection structures to enhance the existing beach and dune system, provide storm protection to upland property, and contribute to the sustainability of the existing seawalls. This alternative is described above in Section 1.3 – Proposed Action. This alternative is evaluated within this BA. It is estimated that the life expectancy of the Town of Palm Beach's proposed project will be between 2 and 4 years. The estimated life expectancy of the County project will be between 2 and 3 years within the Towns of South Palm Beach, Lantana and Manalapan.

1.5.3. ALTERNATIVE 3 – APPLICANTS' PREFERRED PROJECT WITHOUT SHORELINE PROTECTION STRUCTURES

This alternative provides the same fill volumes and template configurations as Alternative 2 - the Applicants' Preferred Alternative, but would not include construction of the seven low-profile groins between R-134+135 and R-138+551. Without the structures, the project would not provide the level of shoreline stabilization necessary to achieve the purpose and need, effectively diminishing the success of the project as it is currently designed to perform. It is estimated that the life expectancy of this project will be between 2 to 4 years within the Town of Palm Beach and 1 year within the County project area in the Towns of South Palm Beach, Lantana and Manalapan.

1.5.4. ALTERNATIVE 4 – TOWN OF PALM BEACH PREFERRED PROJECT AND COUNTY INCREASED SAND VOLUME PROJECT WITHOUT SHORELINE PROTECTION STRUCTURES

This alternative includes the Preferred Alternative along the Town of Palm Beach shoreline and a larger fill only (no shoreline protection structures) project along the County shoreline within the Towns of South Palm Beach, Lantana and Manalapan. The fill volume along the Town of Palm Beach would remain the same, 65,200 cy. The fill volume from R-134+135 to R-138+551 would increase from 77,600cy to 187,800 cy and advance the beach berm on average 15 m (50 ft) seaward. Placing a larger fill volume would achieve the purpose and need for this section of the project by extending the nourishment interval compared to Alternative 3. Within the Town of Palm Beach, the life expectancy would be between 2 to 4 years. The life expectancy of the sand placed within the County project area in the Towns of South Palm Beach, Lantana and Manalapan would be between 2 and 3 years.

1.5.5. ALTERNATIVE 5 – TOWN OF PALM BEACH INCREASED SAND VOLUME PROJECT AND COUNTY PREFERRED PROJECT

This alternative includes a larger fill project along the Town of Palm Beach shoreline and the County's Preferred Alternative project along the Towns of South Palm Beach, Lantana and Manalapan. The fill volume along the Town of Palm Beach would slightly increase from 65,200 cy to 121,700 cy but the distribution would vary from the preferred alternative design. The volume was increased by advancing the dune and beach berm on average 3 m (10 ft) seaward from R-129-210 to T-131 and the dune on average 15 m (50 ft) seaward from T-131 to R-134+135 (Town of Palm Beach southern limit). This would also result in additional needs to dredge, stage, and truck haul a greater volume of sand. Placing a larger fill volume addresses comments received during the scoping period and lengthens the nourishment interval. Within the Town of Palm Beach, the life expectancy would be between 3 to 4 years. The life expectancy of the County's project within the Towns of South Palm Beach, Lantana and Manalapan would be between 2 and 3 years.

1.5.6. ALTERNATIVE 6 – TOWN OF PALM BEACH INCREASED SAND VOLUME PROJECT AND COUNTY INCREASED SAND VOLUME PROJECT WITHOUT SHORELINE PROTECTION STRUCTURES

This alternative includes a larger fill project along both project shorelines. The fill volume along the Town of Palm Beach would increase from 65,200cy to 121,700 cy and the fill volume along the County shoreline within the Towns of South Palm Beach, Lantana and Manalapan would increase from 77,600 cy to 187,800 cy. The volume for Alternative 6 was increased by advancing the dune and beach berm on average 3 m (10 ft) seaward from R-129-210 to T-131, the dune on average 15 m (50 ft) seaward from T-131 to R-134+135 (Town of Palm Beach southern limit), and the beach berm on average 15 m (50 ft) seaward from R-134+135 to R-138+551. Placing a larger fill volume addresses comments received during the scoping period and lengthens the nourishment interval. Within the Town of Palm Beach, the life expectancy would be between 3 to 4 years. The life expectancy of the sand placed within the County project area in the Towns of South Palm Beach, Lantana and Manalapan would be between 2 and 3 years.

1.5.7. ALTERNATIVE 7b – THE TOWN OF PALM BEACH INCREASED SAND VOLUME WITH TWO SHORELINE PROTECTION STRUCTURES (THE COALITION TO SAVE OUR SHORELINE, INC. ALTERNATIVE) AND THE COUNTY PREFERRED PROJECT

This alternative includes a larger fill project along the Town of Palm Beach shoreline with two T-head groins and the County's Preferred Alternative project along the Towns of South Palm Beach, Lantana and Manalapan. Based on the 2014 conditions, the sand volume along the Town of Palm Beach shoreline would increase from 65,200 cy to 175,000 cy and the County's Preferred Alternative would require a sand volume of approximately 77,600 cy. Placing a larger fill volume addresses comments received during the scoping and comment periods and lengthens the nourishment interval. Within the Town of Palm Beach, the life expectancy would be between 3 to 4 years. The life expectancy of the County's project within the Towns of South Palm Beach, Lantana and Manalapan would be between 2 and 3 years.

2.0. PREVIOUS COORDINATION

2.1. BRIEF OVERVIEW OF BEACH NOURISHMENT AND COASTAL STRUCTURES ON PALM BEACH ISLAND

The Palm Beach Island shoreline has a long history of chronic beach erosion. The Lake Worth Inlet was cut at the northern end of the island in 1917 and the South Lake Worth Inlet was cut in 1927 at the southern end of the island. Jetties were constructed at each inlet in order to slow the rate at which the inlets refilled with sand. In addition, beach quality sand was dredged from the Palm Beach Inlet and disposed of offshore for decades. The inlets, jetties and offshore disposal of beach compatible sand, combined with natural forces, have led to the erosion of Palm Beach Island's shoreline. To offset the sand losses caused by both inlets, sand transfer plants were constructed on each inlet's north jetty to bypass some of the detained sand across the inlet to eroded beaches south of the inlets (FDEP, 2013; PBC-ERM, 2003).

Several efforts have been undertaken by the County, municipalities, and private property owners to combat erosion along the Palm Beach Island shoreline. Coastal protection efforts have included construction of structures such as groins and seawalls as well as dune restoration and beach nourishment projects. The USACE periodically dredges the Lake Worth Inlet to improve navigation, periodically placing the beach quality sand from those activities on immediately adjacent eroded beaches or in the nearshore environment (FDEP, 2013).

Historically, beach erosion control and inlet management activities have been regulated by the FDEP and USACE on a project-by-project basis. In an effort to adopt a more holistic approach to ecosystem management that could address the full scope of Palm Beach Island's shoreline erosion problems, in 2012 the Town of Palm Beach and the County requested that FDEP enter into a binding Beach Management Agreement (BMA) for beach nourishment, inlet sand bypassing, and dune restoration projects along the Palm Beach Island shoreline. A primary goal of the BMA is to develop a coordinated, long-term process that facilitates predictable approval of qualifying coastal erosion control and inlet management activities within the Palm Beach Island coastal cell (Lake Worth Inlet to the South Lake Worth Inlet). The final BMA, executed on September 26, 2013, includes authorization from FDEP for maintenance dredging of the Lake Worth Inlet with placement on downdrift beaches, construction of an improved sand transfer plant at Lake Worth Inlet, repair and removal of groins throughout the cell, nourishment of the Mid-Town Project, nourishment of the Phipps Ocean Park Project, and dune restoration (FDEP, 2013).

A summary of recent Palm Beach Island projects which are related to the proposed Project is provided in Section 2.2 of this BA.

2.2. RELATED PALM BEACH ISLAND PROJECTS

Town of Palm Beach (Reaches 7 and 8)

A Joint Coastal Permit (JCP) application was submitted in 2001 to nourish Reach 7 in the Town of Palm Beach. The issued permits (FDEP Permit No. 0165332-001-JC, USACE Permit No. SAJ-2000-00380) and subsequent modifications allowed beach and dune fill in Reach 7 (Phipps Ocean Park Beach Restoration Project) and dune fill only in Reach 8 due to concerns over potential hardbottom impacts. The Phipps Project was constructed in 2006 between R-118-700 and R-126. The Reaches 7 and 8 dune project, known as the FDEP Hurricane Recovery Program Dune Restoration Project, was also constructed in 2006 with offshore sand from the Phipps Project from R-116.5 to R-119-300, R-126 to R-127+100, and R-129+200 to R-133+500. In 2011, another modification was issued to restore the dune in Reach 8 between R-129 and R-133 using an upland sand source (FDEP, 2013). Table 2-1 summarizes recent, beach nourishment projects constructed on Palm Beach Island which are related to the proposed Project.

The Town of Palm Beach submitted a JCP application to place beach fill on Reach 8 in June 2005 (FDEP File No. 0250572-001-JC, USACE File No. SAJ-2005-7908). The project was originally proposed to extend for the entire length of Reach 8 (T-125 to R-134+350) to restore the eroded portions of shoreline within Reach 8 with approximately one million cy of sand dredged from an offshore source. However, in order to avoid or minimize impacts to nearshore hardbottom resources at the south end of the Project Area, the project was redesigned with a southern limit at R-132. In addition, the City of Lake Worth requested that they be removed from the project resulting in a gap or no fill area between R-127+597 and R-128+954. The proposed project failed to receive a 401 water quality certification by the FDEP, and was subsequently withdrawn from further review by the USACE. In 2010, the Town of Palm Beach prepared a conceptual design which addressed the 401 Water Quality Certification concerns and was submitted to the FDEP and the USACE in September 2010 for authorization. On February 4, 2013, the FDEP issued permit for the North Reach 8 Beach Restoration Project (Permit No. 0250572-003-JC) authorizing nourishment of 670 m (2,200 ft) of Town of Palm Beach shoreline from FDEP R-monuments R-125 to R-127+60 ft with approximately 132,700 cy of sand truck hauled from an upland source. The USACE is actively reviewing the project and is coordinating with NMFS (as of July 2014).

Table 2-1. Recent beach nourishment and dune restoration projects on Palm Beach Island.

Date	Project	Project Extents	Volume (cy)	Sand Source
1976	Beach Nourishment	Sloan's to Widener's Curve (R-117)	100,000	Import Fill
1977	Beach Nourishment	Chilean Avenue (R-98)	86,000	Onshore Excavation
1995	Mid-Town Beach Renourishment and Groin Field[1]	R-95 to R-100	880,000	Offshore Borrow Area
1997	Lake Worth Municipal Beach Dune Restoration	0.51 acres of dune restored	Unknown	Unknown
2003	Mid-Town Expanded Beach Renourishment	R-90.5 to R-101	1,273,100	Offshore Borrow Area
2003	SPB/Lantana Dune Restoration[2]	R-135+460 to R-137+410	1,000	Upland
2004	SPB Dune Restoration	0.66 acres of dune restored	Unknown	Unknown
2005	SPB /Lantana Dune Restoration[2]	R-135+460 to R-137+410	3,132	Upland
2005	SPB /Lantana Dune Restoration[2]	R-135+460 to R-137+410	5,814	Upland
2006	Mid-Town Beach Renourishment	R-90 to R-94.2; R-94.5 to R-101	893,000	Offshore Borrow Area
2006	Phipps Ocean Park Beach Restoration[3]	R-118+700 to R-126	1,100,000	Offshore Borrow Area
2006	FDEP Hurricane Recovery Program Dune Restoration Project[2]	R-116.5 to R-119-300; R-126 to R-127+100; R-129+200 to R-133+500	141,458	Offshore Borrow Area
2007	SPB /Lantana Dune Restoration[2]	R-135+460 to R-137+410	6,750	Upland
2008	SPB /Lantana Dune Restoration[2]	R-135+460 to R-137+410	11,000	Upland
2009	SPB /Lantana Dune Restoration[2]	R-135+460 to R-137+410	10,000	Upland
2010	FEMA truck haul partial nourishment event	R-96 to R-100	52,000	Upland
2011	Phipps Ocean Park Beach and Dune Restoration[2]	Dune R-129 to R-133	56,000	Upland
2015	Mid-Town Beach Renourishment	R-90.4 to R-101.4	1,000,000	Offshore Borrow Area
2015	Reach 8 Dune Restoration	R-128+500 to R-134	34,902	Offshore from Mid-Town Project
2016	Phipps Ocean Park Beach and Dune Restoration[2]	R-116 to R-127	1,100,000	Offshore Borrow Area
2016	Reach 8 Dune Restoration	R-128+500 to R-134	10,026	Offshore from Phipps Project
2016	Mid-Town Dune Restoration	R-90 to R-93	15,000	Offshore from Phipps Project

[1] Mid-Town Beach Experimental PEP Reef constructed 1992, was removed in 1995.

[2] Project located within Study Area.

[3] As mitigation, a 3.1 acre artificial reef was constructed in 2004; additional 0.8 ac artificial reef constructed in 2007 as additional mitigation required by USACE.

Town of Palm Beach (Mid-Town, Reaches 3 and 4)

The Town of Palm Beach constructed the first Mid-Town project (non-federal project) in 1995, placing 880,000 cy of sand dredged from an offshore borrow area on the shoreline from R-95 to R-100 (FDEP, 2013). A groin field was also installed during the 1995 project. In 2003, the Mid-Town project (Reaches 3 and 4) was expanded to include placement of 1.2 million cy of sand dredged from an offshore borrow area on the Mid-Town beaches from R-90.5 to R-101 (FDEP, 2013). In 2004 a joint County/Town of Palm Beach dune restoration project took place along Old South Ocean Boulevard between R-96 and R-97 within the Mid-Town section of Palm Beach Island. The project involved exotic tree removal, placement of over 200 cy of sand from the Juno Dunes Natural Area, and placement of native vegetation (PBC-ERM, 2011). In response to hurricanes Frances, Jeanne, and Wilma in 2004-2005, the Town of Palm Beach constructed an emergency berm and dune repair project in 2006 which included placement of 893,000 cy of sand dredged from an offshore borrow area on the Mid-Town beaches from R-90 to R-94.2 and R-94.5 to R-101 (Table 2-1) (FDEP, 2013). The Town of Palm Beach plans to construct the next Mid-Town project winter 2014/15.

Towns of South Palm Beach and Lantana

There have been six dune restoration projects completed in the Towns of South Palm Beach and Lantana since 2003 (Table 2-1). The project area for the six County projects ran from R-135+460 to R-137+410; however, the first restoration completed in 2003 did not include sand placement at Lantana Public Beach (exotic vegetation removal only), while all subsequent projects included placement of sand here. In addition, the Mayfair House Condominium, which is located within this Project Area, never participated in any of the restorations. Therefore, this property was bypassed during each event (Miranda, pers. comm., 2013).

Palm Beach Island Beach Management Agreement (BMA)

The BMA includes FDEP, the Town of Palm Beach and the County, and implements a programmatic pilot program approach to managing the erosion that allows the local and county municipalities to protect their beaches by adding sand. FDEP will authorize periodic beach nourishment to maintain the beach restoration project located in the southern portion of Reach 7 in the Town of Palm Beach between R-119 and R-125 and periodic placement of sand to maintain the restored dune in the northern portion of Reach 7, from R-116 to R-119. In addition, FDEP will authorize beach restoration and periodic beach nourishment between R-125 and the northern boundary of the Lake Worth Municipal Park at R-127 (northern segment of Reach 8). Approval for construction and maintenance of these three contiguous segments has been granted by the FDEP through the BMA. The projects may be conducted separately or together and material may be stockpiled on the berm between R-119 and R-126 to replenish the restored dune (FDEP, 2013). Authorization to obtain beach-compatible sand for the stockpile has been provided for offshore borrow areas NBA1, SBA2, SBA3, or any offshore source consistent with the BMA cell-wide sand specifications.

2.3. CURRENT CONSULTATION FOR THE SOUTHERN PALM BEACH ISLAND COMPREHENSIVE SHORELINE STABILIZATION PROJECT

The Town of Palm Beach submitted a permit application to nourish two portions of Reach 8 in 2010 (SAJ-2005-07908). The northern portion included R-125 to R-127+60 and the southern portion included R-129+150 to R-135+350. The final permit authorized the northern portion only. The Town of Palm Beach is now seeking authorization to construct the southern portion of Reach 8 from R-129-210 to R-134+135, which is adjacent to the County's proposed project (SAJ-2008-04086). Under this file number, the County proposed to construct breakwaters between R-132 and R-138+551 in 2008. This project was withdrawn and a revised application for construction of beach nourishment with low profile groins between R-134+135 and R-138+551 was submitted in September 2014.

The USACE is responsible for reviewing these projects because they involve filling, dredging, and/or construction of coastal structures within waters of the United States, and as proposed, constitute a “major federal action”. The USACE determined that these two projects are “similar actions” and therefore the environmental effects and alternatives of these projects should be evaluated together. The comprehensive project comprises approximately 2.07 miles of shoreline and nearshore environment from FDEP R-monuments R-129-210 to R-138+551. The Town of Palm Beach and the County (the Applicants) are seeking federal authorization to construct the project, which is known as the Southern Palm Beach Island Comprehensive Shoreline Stabilization Project (the Project).

The Town of Palm Beach's and the County's projects are each standalone projects, but because they are adjacent to one another they have been deemed similar actions in terms of the National Environmental Policy Act (NEPA). Therefore, the USACE is evaluating the anticipated combined direct and indirect effects of both projects together through the preparation of a single comprehensive study. The USACE determined the proposed beach stabilization project, including the anticipated scope of the project and the resulting scope of effects (including cumulative, direct, and indirect effects), could significantly affect the quality of the human environment and determined an Environmental Impact Statement (EIS) was necessary to identify, evaluate, and disclose the array of anticipated environmental effects associated with the proposals.

On July 3, 2013, the USACE published a Notice of Intent (NOI) (78 FR 40128) to prepare a Draft Final Environmental Impact Statement (DFEIS) for the Project. The DFEIS will be prepared in compliance with NEPA requirements to identify and assess the effects of the Proposed Action and its alternatives in order to provide a basis for rendering an informed decision on the proposed Project. The USACE's decision will be to either issue, issue with modifications or deny DA permits for the Proposed Action. The DFEIS is intended to be sufficient in scope to address federal, state and local environmental requirements concerning the Proposed Action.

The NOI announced the initiation of a 45-day scoping and commenting period and included a notification to stakeholders and all interested parties that a public scoping meeting would be held on August 12, 2013. The USACE invited Federal agencies, American Indian Tribal Nations, state and local governments, and other interested private organizations and parties to attend the public scoping meeting and provide comments in order to ensure that all significant issues are identified and the full range of issues related to the permit request are addressed. Pursuant to NEPA requirements, this scoping meeting was held on August 12, 2013 at the Town of Palm Beach Town Hall. It provided an opportunity to the public to submit comments on the scope of the EIS, the alternatives to be considered and the environmental and socioeconomic issues to be addressed. Following the scoping meeting, the scoping comment period continued through September 3, 2013. A scoping report summarizing comments received during the scoping period (July 3–September 3, 2013) was submitted to USACE on October 4, 2013 (CB&I, 2013).

On August 7, 2013, the USACE emailed NMFS requesting review of and concurrence with a draft list of species to be included in the BA. NMFS responded on August 9, 2013, by sending a list of endangered and threatened species and critical habitats under NMFS jurisdiction in the Florida-Atlantic region (Mincey, pers. comm., 2013).

On August 7, 2013, the USACE emailed USFWS requesting review of and concurrence with a draft list of species to be included in the BA. USACE received a response from USFWS on August 15, 2013, concurring with the species list for the proposed Project (Howe, pers. comm., 2013).

Pursuant to Section 7 of the Endangered Species Act, the USACE initiated consultation with USFWS and NMFS on February 3, 2016, under separate letters for the Town of Palm Beach (SAJ-2005-07908) and Palm Beach County (SAJ-2008-04086) projects. A biological opinion will be obtained from USFWS before USACE issues the record of decision (ROD) and makes a permit decision on the Section 10/404 permit application. The USACE's decision will comply with the ESA.

3.0. DESCRIPTION OF AFFECTED ENVIRONMENT

This section provides a description of the existing environmental resources located within the Project Action Area, with emphasis on those natural resources that are capable of supporting listed and proposed threatened and endangered species and critical habitat. This section focuses on the dune, beach and nearshore marine environments between R-127 and R-141+586 (Figure 1-2), which may be impacted by construction of the Project.

The Action Area also includes the truck routes from the upland mines and stockpiles to the Project Area. The Action Area does not include borrow areas or upland mines; therefore environmental impacts associated with the offshore borrow areas and upland mines will not be evaluated in this BA. The borrow areas which will be the sand source for the Project Area between (R-129-210 to R-134+135) will be dredged for the Phipps (USACE Permit No. SAJ-2000-00380) and Mid-Town (USACE Permit No. SAJ-1995-03779) projects under authorization of the BMA (FDEP, 2013).The upland mine (or mines) which will be the sand source for the Project Area between R-134+135 and R-138+551 are commercial mines which are authorized independent of the Project.

3.1. DUNE ENVIRONMENT

Barrier islands are dynamic environments, with topographic and vegetation profiles dictated by the interaction of plant growth and physical processes such as wind-driven sand movement and salt spray, and wave-driven erosion and accretion. The dunes in a barrier island system are the vegetated mounds of unconsolidated sediments that lie landward of the active beach. Dune formation occurs when winds carrying beach sediments encounter resistance from vegetation, thereby causing the wind to deposit this material. Dunes are comprised of finer sand, while sand in the berm and beach face is coarser. Dunes are dynamic geologic features that continually accrete and erode from factors such as seasonal and episodic fluctuations in wave height and storm activity (Rogers and Nash, 2003).

Beach and dune vegetation are known to provide habitat for a variety of mammals including the raccoon (*Prycon lotor*) and house mouse (*Mus musculus*), as well as many bird species. Dune habitat is present within sections of the Action Area (Photographs 3-1a and 3-1b).

Photographs 3-1a and 3-1b. Select dune habitats located within Action Area.

Much of the native dune system within the Action Area has been lost to beach erosion and upland development. Severe erosion of the frontal dune community was observed during a 2005 dune survey within Reach 8 (T-125 to R-134). Dune vegetation documented during the survey included primarily seagrape (*Coccoloba uvifera*), as well as sea oats (*Uniola paniculata*), inkberry (*Scaevola plumieri* L.), bitter panicum grass (*Panicum amarum*), bay cedar (*Suriana maritima*) and seashore elder (*Iva imbricata*). A restored dune area adjacent to the Lake Worth Pier parking lot (R- 128 to R-128+800) was also vegetated with bitter panicum and sea oats. Seagrape and inkberry were most prevalent and typically found above eroded and undercut embankments. No vegetation was documented seaward of exposed seawalls in the study area (CPE and CSI, 2011). A dune vegetation survey was also conducted in South Palm Beach (R-134 to R-141) in 2006 (CPE, 2007). That survey showed that 78% of the study area contained hardened structures (seawalls and revetments) and the remaining 22% of the area included vegetated dune faces; only minimal, scattered vegetation was observed waterward of the structures. The vegetation observed during the 2006 survey included a combination of native species typical to South Florida beach dunes and several invasive species; half flower (*Scaveola plumieri*) was the most significant invasive species observed (CPE, 2007). Table 3-1 lists the dune and plant species observed during the 2005 Town of Palm Beach Reach 8 and 2006 South Palm Beach surveys (CPE and CSI, 2011; CPE, 2007). No threatened or endangered plants were identified during the dune surveys.

In 2007, several species of dune vegetation were planted in both Reach 7 and Reach 8 as part of the Phipps Ocean Park Beach Restoration Project and FDEP Emergency Dune Restoration Project. Approximately 80% of the plants were sea oats, and the remaining 20% consisted of 14 other species (CPE, 2009). A list of the planted species is also provided in Table 3-1. No threatened or endangered plants were identified during the dune surveys.

Most recently, in November 2013, a dune vegetation investigation was performed within the Action Area. During this survey, areas of interest where vegetation was identified in aerial photography were ground-truthed by biologists. The 2013 Habitat Characterization Report (CB&I, 2014) is provided as Appendix D to the EIS. Exposed and buried seawalls are intermittently spaced along the shoreline from R-129 to just south of R-133. Dune vegetation exists on the seaward side of buried seawalls in this area. The shoreline includes exposed seawalls south of R-133 to R-141. The dune located immediately south of Lake Worth Pier was determined to be dominated by sea oats while the dune located immediately north of the seawall at R-129 was dominated by bitter panicum grass. Seagrapes were the dominant dune vegetation identified throughout the remainder of the survey area, which terminated at R-133+500 where dune habitat ended and upland properties bordered by sea walls began (and continued south to the end of the Action Area at R-141+586). One exception, near R-133, was observed where dune vegetation was sparse. Overall, just less than half of the Project Area is fronted by dunes.

The endangered plant species beach jacquemontia (*Jacquemontia reclinata*) was not present within the surveyed area (CB&I, 2014). Table 3-1 lists the dune and plant species observed during the 2005, 2006 and 2013 dune surveys as well as the species planted in 2007 (CPE and CSI, 2011; CB&I, 2014). Figure 3-1 shows the location of all existing dune vegetation and seawalls within the Action Area (CB&I, 2014). The two truck haul access points for the Town of Palm Beach are located on condominium properties that have dune habitat dominated by sea grapes. Sand placement activities and land-based groin construction operations have the potential to impact the upland habitat at these access points. The access point for the County is located at the Lantana Public Beach where only a buried seawall is present' therefore, there is no potential impact to dune habitat at this location.

Table 3-1. Dune vegetation within the Action Area (CPE, 2007, 2009; CPE and CSI, 2011; CB&I, 2014).

Observed Species (2005, 2006, 2013)		Planted Species (2007)	
Common Name	**Scientific Name**	**Common Name**	**Scientific Name**
2005		Bay bean	*Canavalia rosea*
Bay cedar	*Suriana maritime*	Beach cordgrass	*Spartina patens*
Bitter panicum	*Panicum amarum*	Beach elder	*Iva imbricata*
Inkberry	*Scaevola plumieri L.*	Beach morning glory	*Ipomoea imperati*
Sea oats	*Uniola paniculata*	Beach verbena	*Verbena maritime*
Seagrape	*Coccoloba uvifera*	Bitter panicum	*Panicum amarum*
2006		Blanket flower	*Gaillardia pulchella*
Australian Pine	*Casuarina equisetifolia*	Dune sunflower	*Helianthus debilis*
Bay bean	*Canavalia rosea*	Railroad vine	*Ipomoea pes-caprae*
Beach croton	*Croton punctatus*	Sea lavender	*Limonium carolinianum*
Beach Peanut	*Okenia hypogeaea*	Sea oats	*Uniola paniculata*
Beach spurge	*Chamaesyce mesembryanthemifolia*	Sea purslane	*Sesuvium portulacastrum*
Crowfoot grass	*Dactyloctenium aegyptium*	Shore paspalum	*Pasplam distichum*
Half flower	*Scaveola sericea*	Virginia dropseed	*Sporobolus virginicus*
Purslane	*Portulaca oleracea*		
Railroad vine	*Ipomoea pes-caprae*		
Salt grass	*Distichlis spicata*		
Sea oats	*Uniola paniculata*		
Sea pickle	*Sesuvium portulacastrum*		
Seagrape	*Coccoloba uvifera*		
Seashore elder	*Iva imbricata*		
Silver buttonwood	*Conocarpus erectus*		
Spanish bayonet	*Yucca aloifolia*		
Spider lily	*Hymenocallis latifolia*		
2013			
Bitter panicum	*Panicum amarum*		
Sea oats	*Uniola paniculata*		
Seagrape	*Coccoloba uvifera*		

3.2. BEACH ENVIRONMENT

Beaches are formed by the deposition and accumulation of sand by way of coastal currents and wave transport. A beach is a dynamic environment that is intermittently eroded during winter in periods of rough seas and strong winds and accreted during the calmer spring and summer months. Biological abundance varies seasonally and is generally highest in summer and lowest in winter (Matta, 1977; Reilly and Bellis, 1983).

The intertidal zone, or wet beach, of oceanfront barrier island beaches is the area periodically exposed and submerged by waves, varying frequently and with lunar tide cycles. These areas are comprised mainly of sandy bottoms that serve as habitat to many benthic and infaunal organisms, as well as foraging grounds for birds and finfish. The benthic and infaunal organisms found within the intertidal/swash zone are adapted to the harsh conditions of a wave-swept environment such as heavy sediment loading and movement. Organisms common to this environment include polychaetes, amphipods, isopods and interstitial organisms that feed on bacteria and unicellular algae. In addition, mole crabs (*Emerita talpoida*), coquina clams (*Donax spp*.) and ghost crabs (*Ocypode quadrata*) can be found in this community (Gorzelany and Nelson, 1987; Irlandi and Arnold, 2008). These macroinvertebrates provide important ecological services such as cycling of organic matter and trophic transfer of production to surf zone fishes and shorebirds (Leber, 1982).

The dry (upper) beach begins at the berm (MHW) and slopes gently upwards to the foot of the dune. Burrowing organisms such as sand fleas, isopods, ghost crabs and other transient organisms dominate the fauna in this zone. The dry beach area provides recreational areas for humans and nesting grounds for sea turtles (Photograph 3-2a). A variety of seabirds and shorebirds also depend on the beach and dune environment for nesting and foraging purposes. Florida seabirds, such as the least tern (*Sternula antillarum*), black skimmer (*Rynchops nige*r), royal tern (*Thalasseus maxima*) and sandwich tern (*Thalasseus sandvicensis*) nest on open beach areas. Florida shorebirds, such as the American oystercatcher (*Haematopus palliatus*), snowy plover (*Charadrius alexandrines*), Wilson's plover (*Charadrius wilsonia*) and willet (*Trina semipalmata*) nest within the wrack line (Photograph 3-2b), on open beach, within dune vegetation or even in marsh grasses (FWC, 2010; 2013a). While many resident and migratory shorebird species seasonally utilize beach habitats for feeding and roosting, beach nesting of shorebirds in the Action Area has not been reported by the Audubon Society Christmas Bird Count, Florida Fish and Wildlife Conservation Commission (FWC) Breeding Bird Atlas, the Shorebirds and Seabird Monitoring/Reporting website, or the Florida Natural Areas Inventory. Shorebird surveys were conducted in September 2006 by CZR, Inc.

along the shoreline between R-134 and R-141 in support of the Town of South Palm Beach and Town of Lantana Erosion Control Study (CPE, 2007). Results of these surveys are presented in Table 3-2. No shorebird nesting was observed during the 2006 surveys.

Photographs 3-2a and 3-2b. A recently-laid sea turtle nest (a) and wrack line (b) on the beach within the Action Area.

Table 3-2. Results of 2006 shorebird surveys, R-134 through R-141 (CPE, 2007).

Common Name	Scientific Name
Barn swallow	*Hirundo rustica*
Boat-tailed grackle	*Quiscalus major*
Bonaparte's gull	*Larus philadelphia*
Brown pelican	*Pelecanus occidentalis*
Common tern	*Sterna hirundo*
Fish crow	*Corvus ossifragus*
Foster's tern	*Sterna forsteri*
Gull-billed tern	*Gelochelidon nilotica*
Herring gull	*Larus argentatus*
Osprey	*Pandion haliaetus*
Purple martin	*Progne subis*
Ring-billed gull	*Larus delawarensis*
Royal tern	*Sterna maxima*
Ruddy turnstone	*Arenaria interpres*
Sanderling	*Calidris alba*
Sandwich tern	*Sterna sandvicensis*
Yellow-crowned night heron	*Nyctanassa violacea*
Unidentified terns	*Sterna spp.*

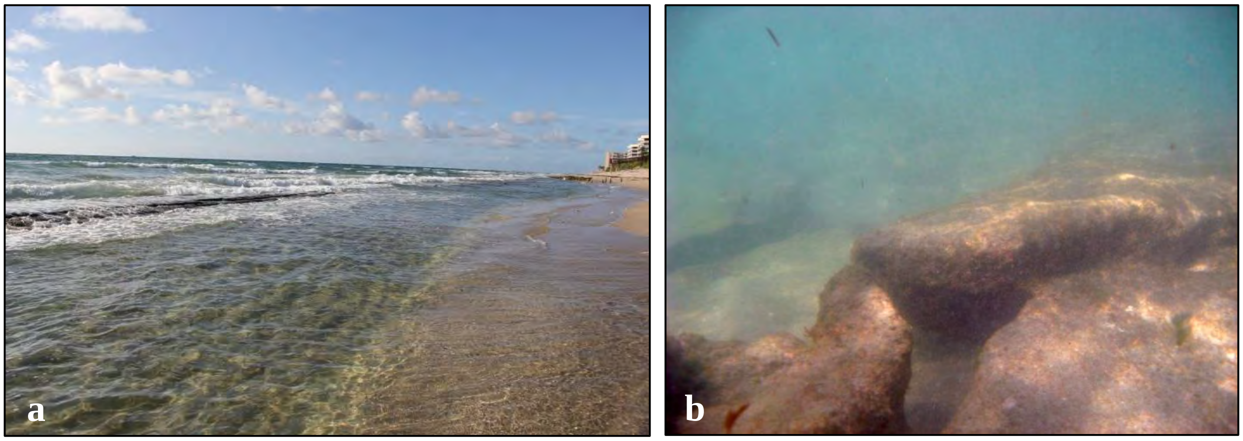
3.3. INTERTIDAL AND SUBTIDAL HARDBOTTOM HABITAT

The term "hardbottom" refers to areas of solid substratum in the marine environment which provide habitat utilized by sea turtles, fish, and a wide range of marine organisms.

Hardbottom is widely distributed in Florida, found from intertidal and subtidal areas to the continental shelf edge; the presence or absence is dictated by the underlying geology of the area. Nearshore hardbottom habitat is classified by FDEP to include the "200-400 meter-wide strip from the shoreline, ranging from the supralittoral zone to the depth of -4 meters", intermediate hardbottom exists "from the depth of -4 meters to the depth of closure (approximately -8 meters)", and offshore hardbottom is located in "water depths deeper than -8 meters, beyond the depth of closure to -12 meters" (FDEP, 2013). Nearshore, hardbottom is found in much of southeast and central Florida, including portions of Broward, Palm Beach, Martin, St. Lucie, Indian River and Brevard Counties. Along most of the East Coast of Florida, the Pleistocene Anastasia Formation forms the main coastal bedrock outcrop (Finkl 1993; Esteves and Finkl, 1999). Anastasia limestone is comprised of sediments and mollusk shells (primarily the coquina clam *Donax)* that accumulated on shorelines 80,000-120,000 years ago (CSA, 2009). Formations that are exposed in the surf zone tend to have smooth surfaces that are abraded by wave and current action. In Palm Beach County, shoreline occurrences of the Anastasia Formation can be found between the Lake Worth Inlet and the South Lake Worth Inlet (also called Boynton Inlet) and occur in a range of morphological expressions of coquina, including inshore and offshore rock reefs (Finkl and Warner, 2005). These rock exposures are quite often ephemeral, exhibiting periodic burial and exposure. The dynamics are largely storm driven with periodicities related to occurrences of high-energy events such as northeasters, tropical storms, and hurricanes (CPE and CSI, 2011).

The nearshore hardbottom within Palm Beach County includes areas of wormrock, formed by tube building sabellariid tubeworms (*Phragmatopoma*) (USACE, 2012). Epibenthic communities associated with hardbottom and associated wormrock often include macroalgae, sponges, octocorals, stony corals, bryozoans and tunicates. These communities do not actively accrete reefs, but can add rugosity to an environment through destructive processes such as bioerosion (Hutchings, 1986). Intertidal and very shallow subtidal areas in east Florida sometimes host the scleractinian coral species *Siderastrea* spp., two species of zoanthids (*Palythoa caribaeorum* and *Zoanthus pulchellus*) and several species of anemones; these species have a higher tolerance for the fluctuation in salinity and temperature that occur in the these habitats (CSA, 2009).

Areas of intertidal and subtidal hardbottom habitat, including associated wormrock, are present within the Action Area of the proposed Project (Figure 3-1; Photographs 3-3a and 3-3b). The hardbottom resources delineated through aerials, and most recently characterized in 2013, are all located within 400 m (1,312 ft) from the shoreline in depths generally less than -4 m; these resources are considered “nearshore hardbottom” (FDEP, 2013). These resources are highly ephemeral, fluctuating seasonally and during storm events. Between 2003 and 2014, the amount of exposed hardbottom in the Project Area varied widely ranging between 1.5 ac (2009) to 36.6 ac (2006). Because of the variability observed from year to year, the USACE determined that a time-average analysis of the amount of hardbottom exposed over 10 years would best represent the habitat since it smooths out short-term fluctuations and provides longer-term trends by averaging a function over iterations of time. The 2014 dataset was added during updates to the EIS extending the time-average analysis over 11 years. In this case, the average amount of exposed hardbottom (ac) between two surveys is multiplied by the number of days between those two surveys (ac-days). The sum of ac-days is divided by the total number of days between the first survey and the last survey. This provides the time-averaged amount of hardbottom in an area. Based on delineation of aerials, there has been a time-averaged 28.43 acres of exposed hardbottom within the Action Area (R-127 to R-141+586) between July 2003 and November 2014 (Figure 3-1). Within this area, less than a tenth of an acre (0.000392 ac) has remained persistently exposed through all aerial delineations, further demonstrating the ephemeral nature of the nearshore hardbottom.



Photographs 3-3a and 3-3b. Intertidal (a) and subtidal (b) hardbottom habitat within the Action Area.

In addition to aerial delineation of hardbottom resources, *in situ* hardbottom biological monitoring has been conducted in association with several beach nourishment projects on Palm Beach Island, and a recent survey was conducted in October 2013 in order to provide updated data for planning and permitting of the proposed project (CB&I, 2014). In general, observations show that nearshore hardbottom relief is low, averaging 15 cm or less (CPE, 2007; 2010; 2014). Surveys of the benthic community have shown high cover of turf algae and sediment along transects, followed by bare hard substrate, wormrock (*Phragmatopoma caudata*), and macroalgae. Common macroalgae genera include *Padina, Dictyota, Hypnea, Dasycladus*, *Laurencia* and *Halimeda.* Also observed on the nearshore hardbottom, but typically with less than 1% cover, were tunicates, sponges, zoanthids, bryozoans, scleractinian (stony) corals and octocorals. The scleractinian species most frequently observed on the intertidal and subtidal hardbottom are *Siderastrea siderea* and *S. radians* and *Solenastrea bournoni*. The most common genus of octocorals observed is *Pseudopterogorgia,* with colonies of *Pterogorgia, Muricea* and *Eunicea* sometimes documented, as well (CPE, 2005, 2006, 2007; CB&I, 2014; CPE and CSI, 2011).

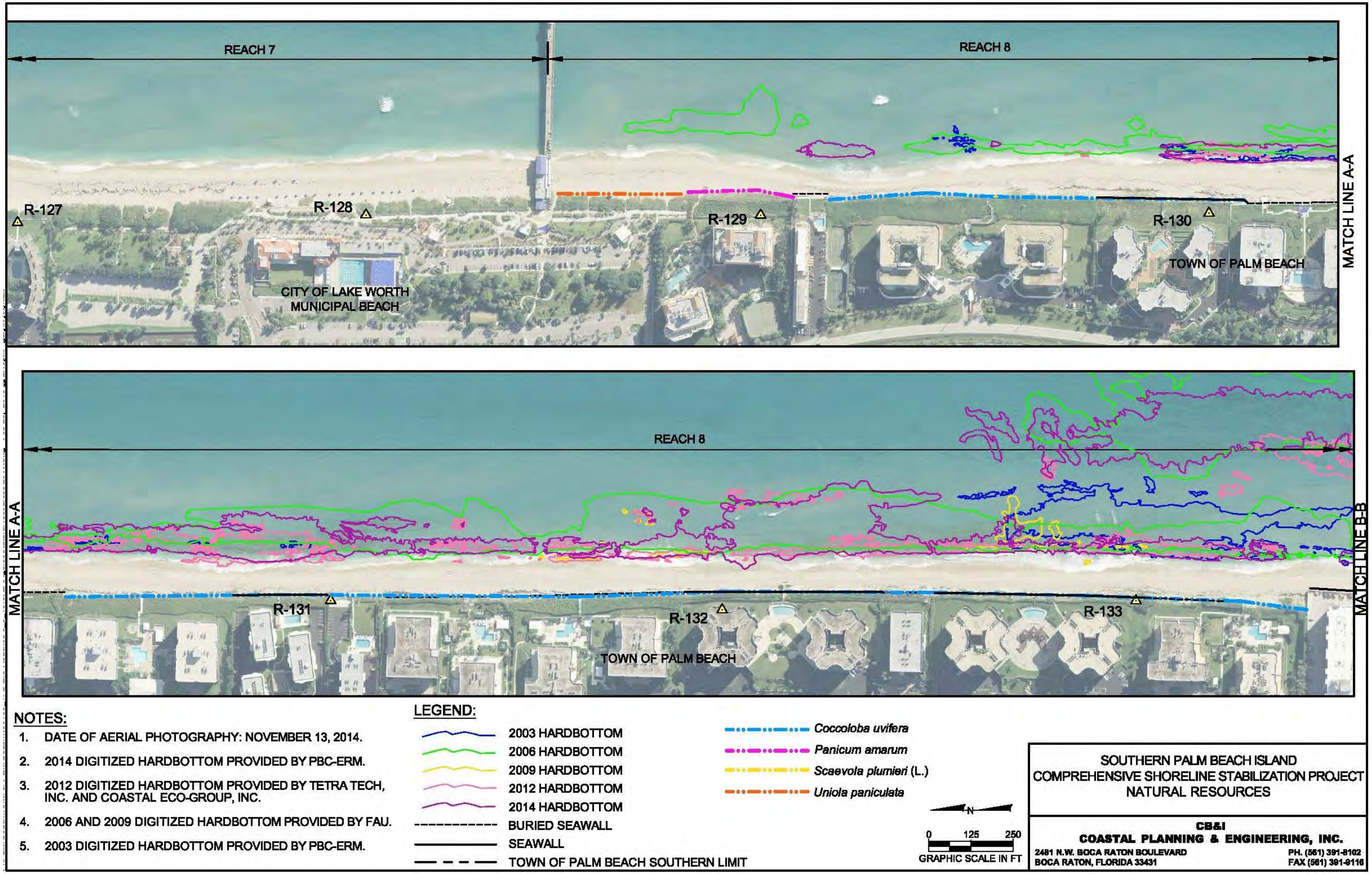


Figure 3-1. Nearshore hardbottom and dune resources.

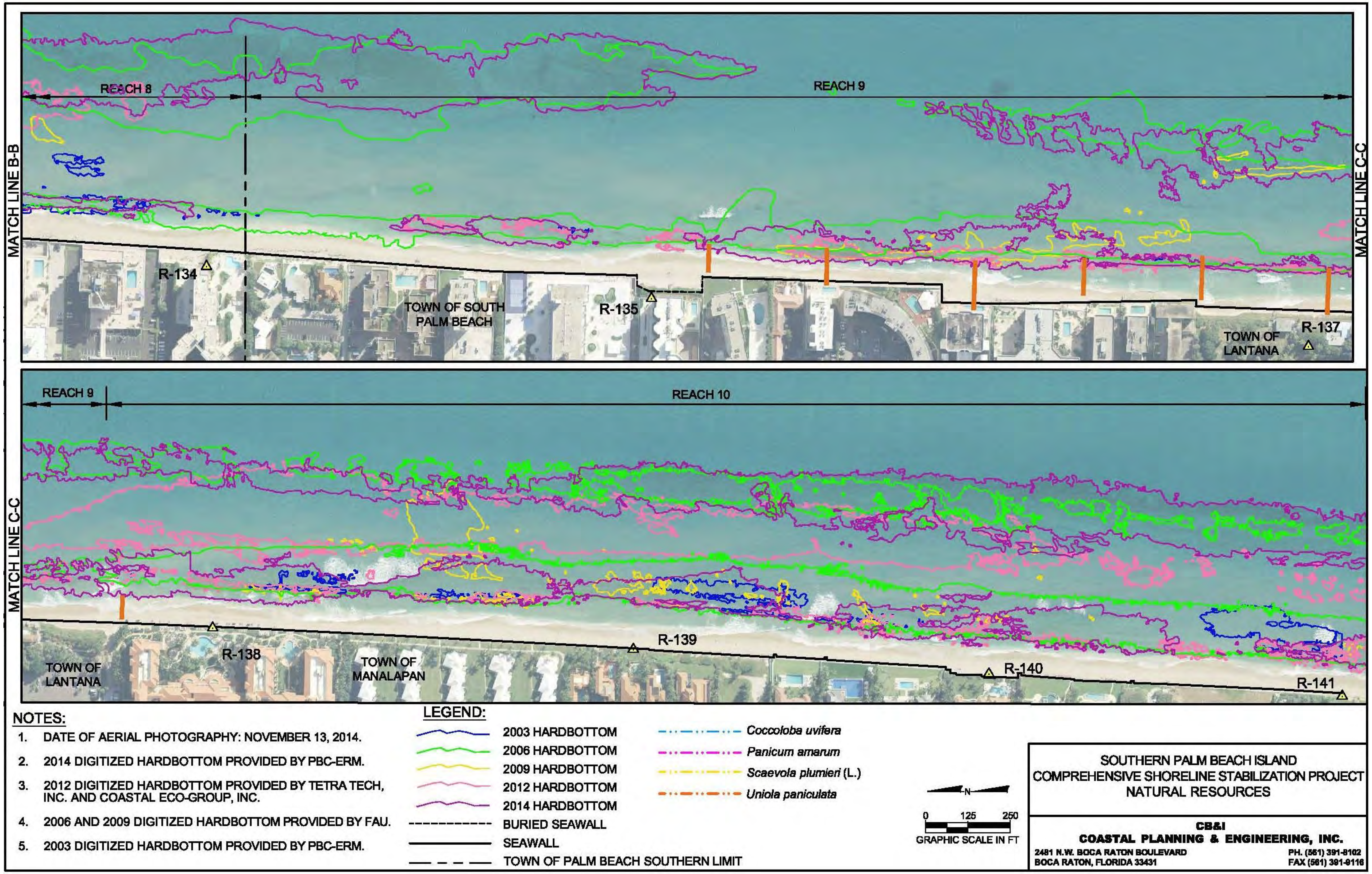


Figure 3-1 (cont.). Nearshore hardbottom and dune resources.

Placement and equilibration of beach sand will impact nearshore hardbottom resources. Hardbottom closest to shore will be directly buried by placement of beach sand immediately following construction, while equilibration will impact additional hardbottom (Figures 3-2 through 3-4). The results of the engineering and Delft3D modeling study (Appendix G to the EIS) provided polygons that represented sand accumulation in the nearshore habitat over three years due to project implementation for each alternative and for each grain size modeled. These polygons were overlaid onto aerial delineations of exposed hardbottom digitized in GIS from 2003 through 2014 to determine potential impacts to this resource. From these polygons, seven levels of potential impact to hardbottom were developed based on temporal and spatial factors. These impact types are described in greater detail in the Draft Uniform Mitigation Assessment (UMAM) provided as Appendix H to the EIS and include the following categories:

1. Permanent impacts
2. Direct Temporary impacts for less than 1 year
3. Direct Temporary impacts for more than 1 year
4. Direct Temporary impacts for more than 2 years
5. Indirect Temporary impacts for 1 year
6. Indirect Temporary impacts for 2 years
7. Indirect Temporary ETOF impacts

In order to determine the area of potential impact due to project construction, the amount of exposed hardbottom from each hardbottom delineation (2003 – 2014) that fell within the impact polygons generated by the Delft3D modeling was determined in GIS and these areas were input into the time-average calculation (described above). For each alternative (and each grain size modeled), these impact areas were input into UMAM to determine potential mitigation requirements.

Based on the engineering and Delft 3D modeling results, it is anticipated that Applicants' Preferred Alternative may result in permanent impacts to between 3.86 and 3.99 acres of hardbottom, and temporary impacts to between 9.53 and 9.93 acres of hardbottom due to direct sand placement and subsequent spreading (equilibration) of sand (Figures 3-2 through 3-4). As mentioned above, impacts to hardbottom were based on a time-average of exposed hardbottom delineated from aerial images between 2003 and 2014. Using the engineering and Delft 3D modeling results, historic exposed hardbottom acreage, and recent benthic characterization data, a preliminary UMAM evaluation was conducted (provided as Appendix H to the EIS). This draft UMAM analysis determined that between 6.55 and 6.66 acres of mitigation may be required to offset these impacts to intertidal and subtidal hardbottom.

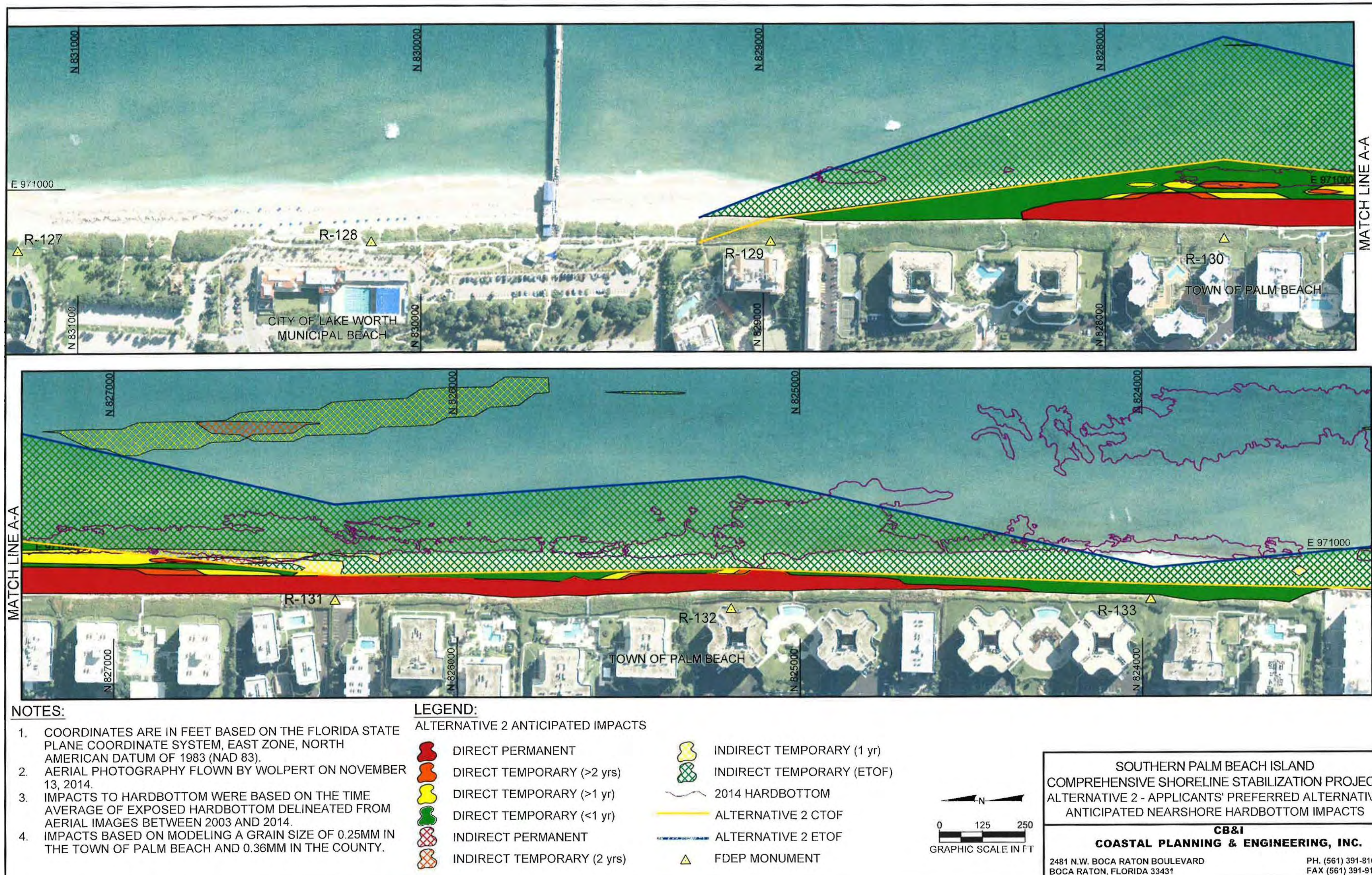


Figure 3-2. Anticipated impacts to nearshore hardbottom resources from Alternative 2 – Applicants' Preferred Alternative. Impacts based on modeling a grain size of 0.25 mm in the Town of Palm Beach and 0.36 mm in the County.

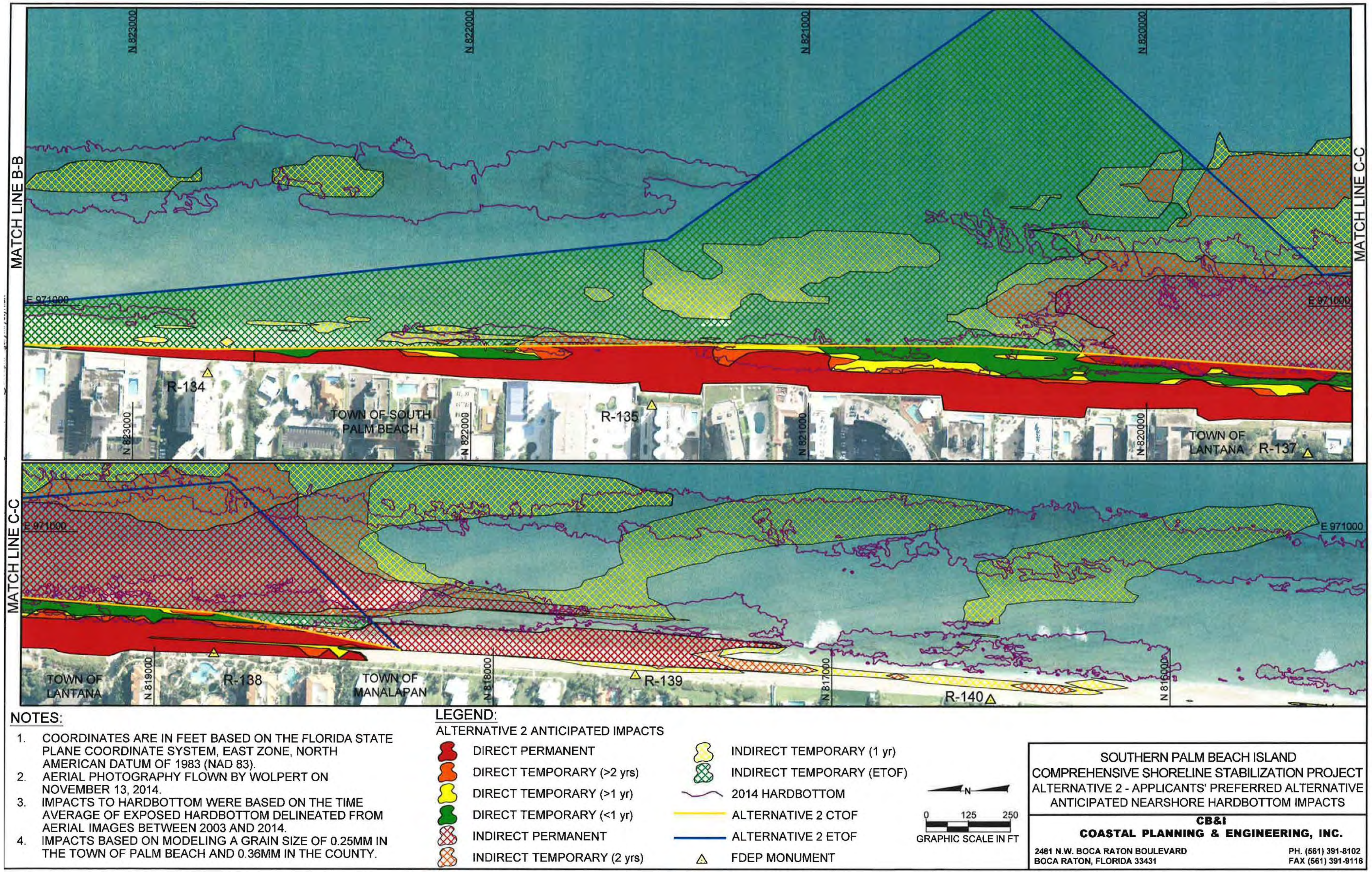


Figure 3-2 (cont.). Anticipated impacts to nearshore hardbottom resources from Alternative 2 – Applicants' Preferred Alternative. Impacts based on modeling a grain size of 0.25 mm in the Town of Palm Beach and 0.36 mm in the County.

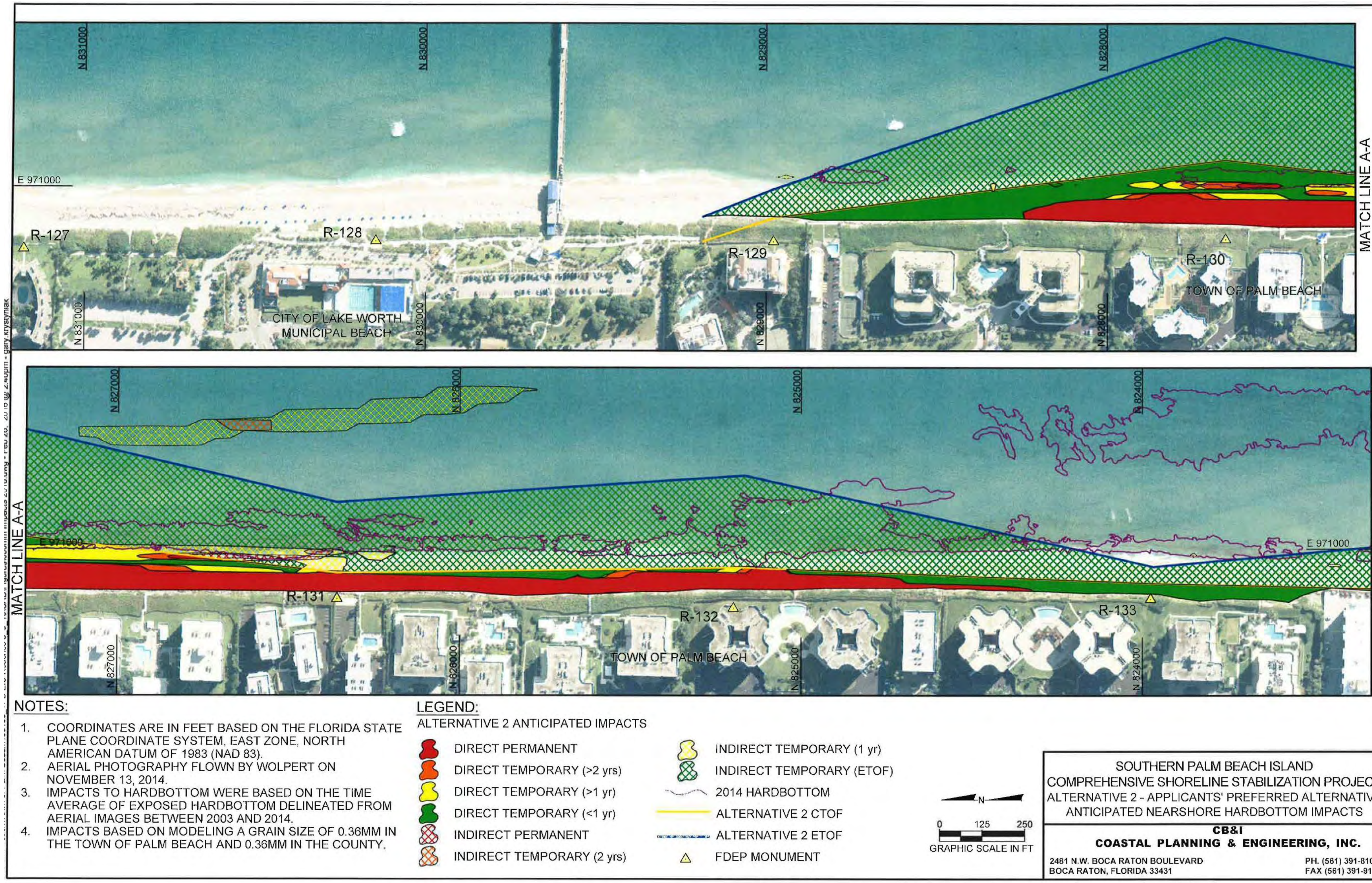


Figure 3-3. Anticipated impacts to nearshore hardbottom resources from Alternative 2 – Applicants' Preferred Alternative. Impacts based on modeling a grain size of 0.36 mm in the Town of Palm Beach and 0.36 mm in the County.

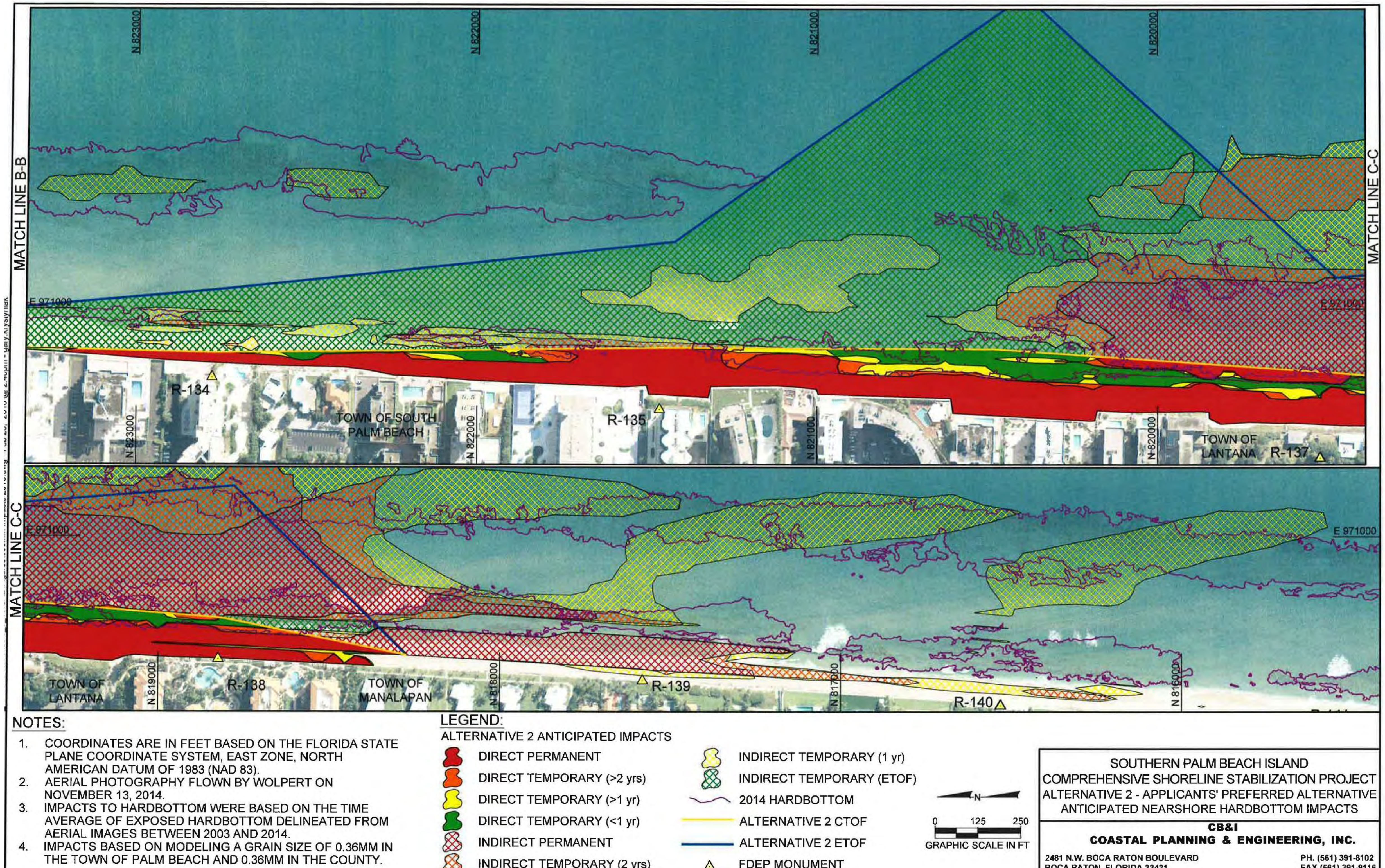


Figure 3-3 (cont.). Anticipated impacts to nearshore hardbottom resources from Alternative 2 – Applicants' Preferred Alternative. Impacts based on modeling a grain size of 0.36 mm in the Town of Palm Beach and 0.36 mm in the County.

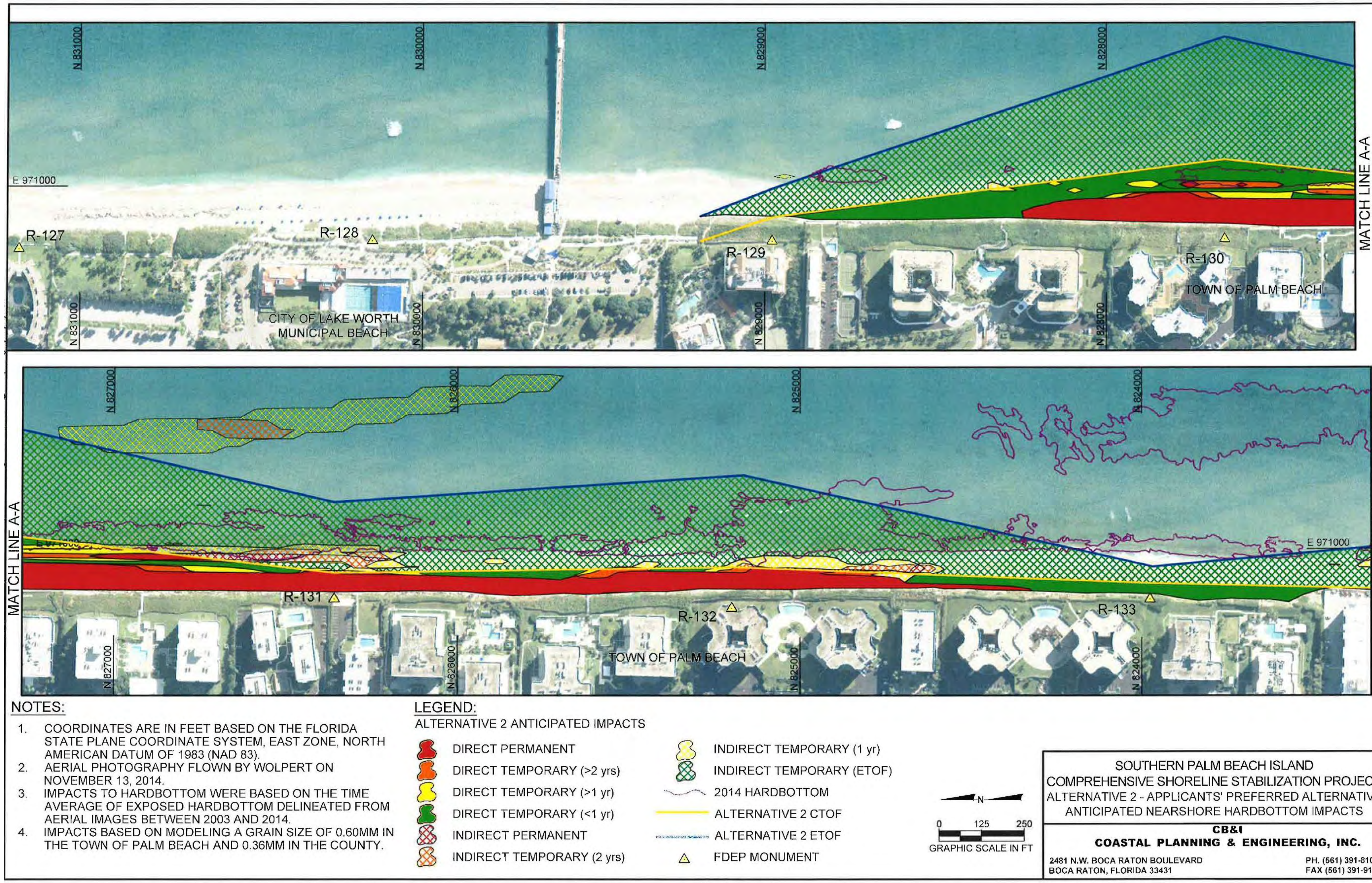


Figure 3-4. Anticipated impacts to nearshore hardbottom resources from Alternative 2 – Applicants' Preferred Alternative. Impacts based on modeling a grain size of 0.60 mm in the Town of Palm Beach and 0.36 mm in the County.

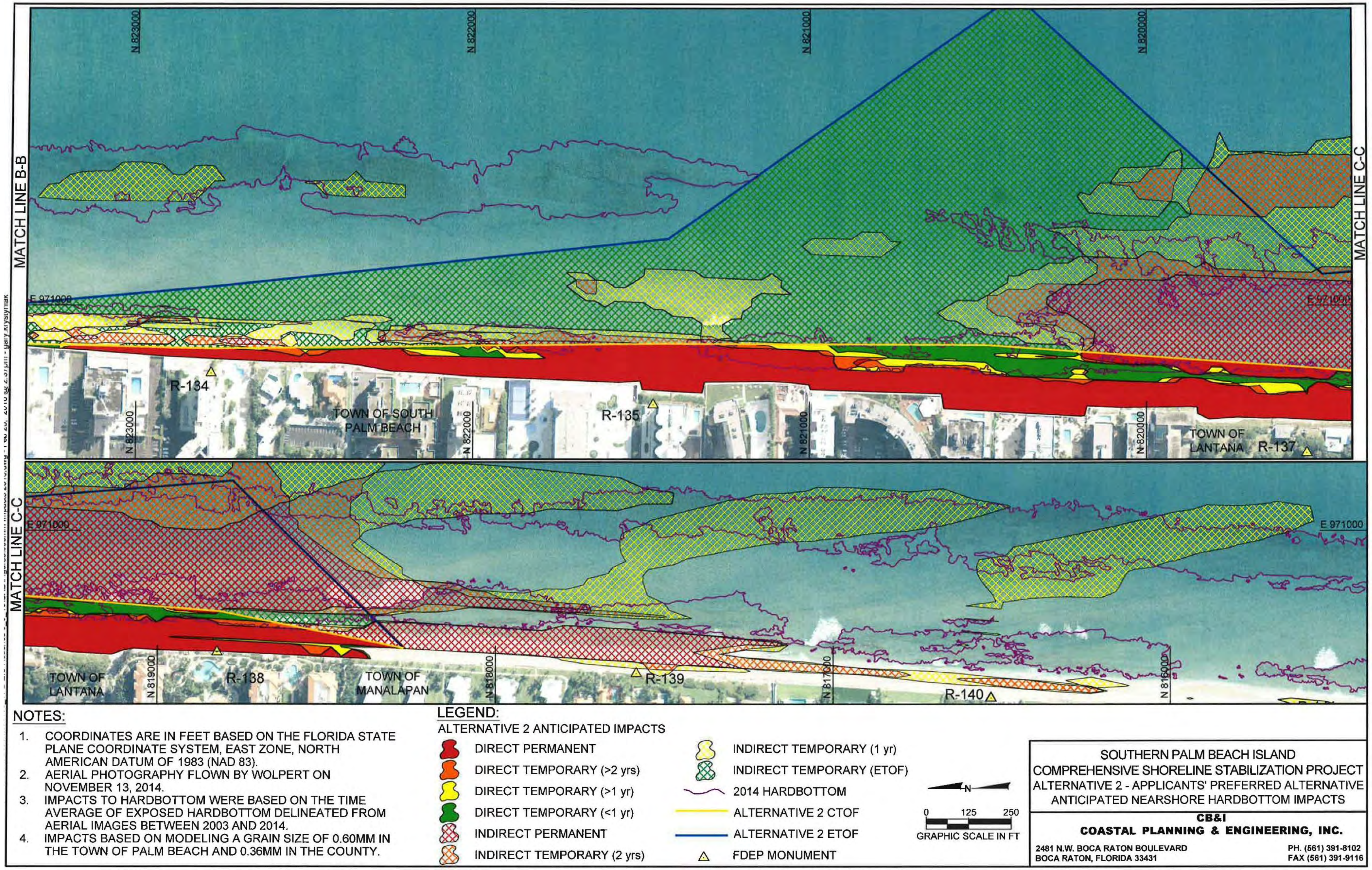


Figure 3-4 (cont.). Anticipated impacts to nearshore hardbottom resources from Alternative 2 – Applicants' Preferred Alternative. Impacts based on modeling a grain size of 0.60 mm in the Town of Palm Beach and 0.36 mm in the County.

3.4. UN-VEGETATED BOTTOM

A large portion of the nearshore marine habitat within the Action Area is composed of unconsolidated softbottom habitat. Unvegetated softbottom intertidal and subtidal areas are important habitats for benthic organisms living on (epibenthos) or within (infauna) the sediment. This faunal community is an important element in the food web, providing prey for wading birds, shorebirds and fish. Shallow subtidal softbottom environments are strongly impacted by water turbulence, suspended sediments and unstable substrate, causing low species diversity and faunal abundance. Shallow subtidal softbottom habitat is dominated by a mix of polychaetes (primarily spionids), gastropods (*Oliva* sp., *Terebra* sp.), portunid crabs (*Arenus* sp., *Callinectes* sp. and *Ovalipes* sp.) and burrowing shrimp (*Callianassa* sp.). In slightly deeper water (1-3 m (3-10 ft) depth), the dominant fauna are polychaetes, haustoriid and other amphipod groups, and the bivalves *Donax* sp. and *Tellina* sp. (Marsh et al., 1980; Goldberg et al., 1985; Gorzelany and Nelson, 1987; Nelson, 1985).

A review of infaunal studies revealed that invertebrate recovery following placement of dredged material in relatively stable, unstressed marine environments generally takes between one and four years, while recovery in more naturally stressed areas is faster, often achieved within nine months (Bolam and Rees, 2003; Kotta el al., 2009). However, more recent studies have shown a maintained decrease of infaunal and epifaunal macroinvertebrates after sand displacement activities (Wanless and Maier, 2007; Manning et al., 2014).

4.0. DESCRIPTION OF LISTED SPECIES AND CRITICAL HABITAT

This section describes federally listed and proposed threatened and endangered species and designated and proposed critical habitat within the vicinity of the Action Area for the Project. Table 4-1 summarizes the species which were determined by USACE, NMFS and USFWS as potentially occurring in the Action Area (Mincey, pers. comm., 2013; Howe, pers. comm., 2013). Species and critical habitat which may occur in southeast Florida but are not likely to occur in the Action Area are not included in Table 4-1, and are discussed in Section 4.1. Current species conditions and results of surveys within the Action Area are presented in Section 5.0.

Table 4-1. Federally listed and proposed species, and critical habitat (CH) potentially occurring in the Action Area.

Common Name	Scientific Name	Federal Listing Status
SEA TURTLES		
Green	*Chelonia mydas*	T
Hawksbill	*Eretmochelys imbricata*	E
Kemp's Ridley	*Lepidochelys kempii*	E
Leatherback	*Dermochelys coriacea*	E
Loggerhead	*Caretta caretta*	T[1]/CH[2,3]
Eastern indigo snake	*Drymarchon corais couperi*	T
FISH		
Smalltooth sawfish	*Pristis pectinata*	E
MAMMALS		
Florida manatee	*Trichechus manatus latirostris*	E
Florida panther	*Puma concolor coryi*	E
CORALS		
Boulder star coral	*Orbicella annularis*	T
Elkhorn coral	*Acropora palmata*	T[4]
Mountainous star coral	*Orbicella faveolata*	T
Pillar coral	*Dendrogyra cylindrus*	T
Rough cactus coral	*Mycetophyllia ferox*	T
Staghorn coral	*Acropora cervicornis*	T[4]
Star coral complex	*Orbicella franksi*	T
BIRDS		
Piping plover	*Charadrius melodus*	T/E[5]
Rufa red knot	*Calidris canutus rufa*	Proposed T
PLANTS		
Beach jacquemontia	*Jacquemontia reclinata*	E

[1] Northwest Atlantic Ocean (NWA) distinct population segment (DPS). On September 22, 2011, NMFS and USFWS issued a final rule changing the listing of loggerhead sea turtles from a single threatened species to nine distinct population segments (DPSs) listed as either threatened or endangered (FR 76 58868). The NWA DPS was listed as threatened.

[2] On July 10, 2014, USFWS designated critical habitat (nesting beach) for NWA loggerhead sea turtle DPS (79 FR 39755). The Action Area is located with unit LOGG-T-FL-12.

[3] On July 10, 2014 NMFS designated critical habitat (nearshore marine) for the NWA loggerhead sea turtle DPS within the Atlantic Ocean and the Gulf of Mexico (79 FR 39855). The Action Area falls within the LOGG-N-19 unit.

[4] The northern limit of Acropora critical habitat is South Lake Worth Inlet, south of the Action Area for the proposed Project.

[5] Piping plovers are listed as threatened, except for the Great Lakes population which is listed as endangered; Florida provides overwintering habitat for both threatened and endangered populations.

4.1. SPECIES AND CRITICAL HABITAT ELIMINATED FROM FURTHER CONSIDERATION

Species and critical habitat which may occur in southeast Florida or the Atlantic waters off the Florida coast but are not likely to occur in the Action Area were eliminated from further consideration and therefore were not included in Table 4-1. The Applicants' Preferred Project alternative described in Section 1.3 utilizes both stockpiled sand from an offshore borrow area and an upland sand source for the proposed truck haul nourishment project. Due to the unlikelihood of potential impacts to whales from this construction method, listed whale species are not discussed in further detail in this analysis. In addition, Johnson's seagrass (*Halophila johnsonii*) has not historically been documented within the vicinity of the Action Area. The current range of Gulf sturgeon (*Acipenser oxyrinchus desoto*) is in the Gulf of Mexico, extending from Lake Pontchartrain and the Pearl River system in Louisiana and Mississippi respectively, east to the Suwannee River in Florida (NMFS and USFWS, 2009). The geographic range of the shortnose sturgeon (*Acipenser brevirostrum)* is from the Saint John River, New Brunswick, Canada to the St. Johns River, Florida (NMFS, 1998). In addition, the gopher tortoise (*Gopherus polyphemus)*, whooping crane (*Grus americana)*, and southeastern beach mouse (*Peromyscus polionotus niveiventris*) are unlikely to occur in the vicinity of the Project Area and so will also be eliminated from further discussion. The gopher tortoise prefers a xeric upland habitat, especially sandhills, which do not occur in the vicinity of the Project Area or along the truck-haul route (FWC, 2007). The whooping crane population in Florida is found primarily on the Kissimmee Prairie and surrounding areas. The southeastern beach mouse is not found in Palm Beach County and according to FWC the southern limit of the species range is Martin County. Due to the fact that these species are unlikely to be found in the vicinity of the Action Area, it has been determined that the Proposed Action will have "no effect" on whales, Johnson's seagrass, Gulf sturgeon, shortnose sturgeon, the gopher tortoise, or the whooping crane. Therefore, these species will not be evaluated further in this document.

4.2. SEA TURTLES

Five species of sea turtles can be found in Florida waters: loggerhead (*Caretta caretta*), green, *(Chelonia mydas)*, leatherback *(Dermochelys coriacea)*, hawksbill *(Eretmochelys imbricata)* and Kemp's ridley *(Lepidochelys kempii)*. The USFWS has listed green (Florida breeding populations), leatherback, hawksbill and Kemp's Ridley sea turtles as Endangered, and the Northwest Atlantic (NWA) population of loggerheads as Threatened. The sea turtle nesting season in Palm Beach County is from March 1 to October 31st. Leatherbacks typically nest early in the season followed by loggerheads and greens. Loggerheads arrive in substantial numbers in May. Nesting continues through the summer months and tapers off in early September (PBC-ERM, 2014). Each sea turtle species is discussed further in the following sections.

4.2.1. LOGGERHEAD SEA TURTLES

The loggerhead sea turtle (*Caretta caretta*) was listed on July 28, 1978 as a threatened species under the ESA (43 FR 32800). On September 22, 2011, NMFS and USFWS established a Final Rule to list nine Distinct Population Segments (DPS) of loggerhead sea turtles that qualify as ''species'' for listing as endangered or threatened under the ESA (76 FR 58868). Under this rule, four DPSs were listed Threatened (Northwest Atlantic Ocean (NWA), South Atlantic Ocean, Southeast Indo-Pacific Ocean, and the Southwest Indian Ocean) and five were listed as Endangered (Northeast Atlantic Ocean, Mediterranean Sea, North Indian Ocean, North Pacific Ocean and South Pacific Ocean). The population of loggerheads found in the Action Area is the NWA DPS.

Adults and sub-adults have a large, reddish-brown carapace. Scales on the top and sides of the head and on top of the flippers are also reddish-brown, but have yellow borders. The neck, shoulders, and limb bases are dull brown on top and medium yellow on the sides and bottom. The plastron is also medium yellow. Adult average size of loggerhead adults in the southeast U.S. is approximately 1 m (3.3 ft) straight carapace length; average weight is 116 kg (256 lbs). The relative size of a loggerhead's head, when compared to the rest of its body, is substantially larger than other sea turtle species (NMFS and

USFWS, 2007a, 2008). Adults reach sexual maturity at about 35 years old, and nesting occurs between April and September.

The loggerhead is found throughout the temperate and tropical regions of the Atlantic, Pacific and Indian Oceans and is the most abundant sea turtle occurring in U.S. waters. Recent data suggest that there are only two locations with greater than 10,000 nesting females: south Florida and Masirah Island in Oman. In the southeast U.S., nesting is estimated at approximately 68,000 to 90,000 nests per year (NMFS, 2013a), with the majority occurring on over 2,400 km (1,491 mi) of beaches: North Carolina (531 km (330 mi)), South Carolina (303 km (188 mi)), Georgia (164 km (102 mi)), Florida (1,327 km (825 mi)), and Alabama (78 km (49 mi)). Approximately 80% of loggerhead nesting in the southeast U.S. occurs in six Florida counties (Brevard, Indian River, St. Lucie, Martin, Palm Beach and Broward). Loggerheads lay the vast majority of nests in Florida, accounting for nearly 90% of the statewide total in 2012, with green and leatherback turtles accounting for the remainder of nests. Females lay between three to five clutches per season, and incubation ranges from about 42 to 75 days (NMFS and USFWS, 2008; NMFS, 2013a). During non-nesting years, adult females from U.S. beaches are distributed in waters off the eastern U.S., the Bahamas, Greater Antilles, and Yucatán, and throughout the Gulf of Mexico (NMFS and USFWS, 2008).

The primary threats to loggerhead sea turtle recovery include: bottom trawl, pelagic longline, demersal longline, and demersal large mesh gillnet fisheries; legal and illegal harvest; vessel strikes; beach armoring; beach erosion; marine debris ingestion; oil pollution; light pollution; and predation by native and exotic species (NMFS and USFWS, 2008).

Loggerhead Designated Critical Habitat

USFWS-Designated Terrestrial Habitat. USFWS proposed critical habitat for the NWA DPS of the loggerhead sea turtle under the ESA on March 25, 2013, (78 FR 17999) and published the final critical habitat designation on July 10, 2014 (79 FR 39755). The USFWS-designated terrestrial critical habitat includes 88 nesting beaches in coastal counties located in North Carolina, South Carolina, Georgia, Florida, Alabama and

Mississippi. These beaches account for 48% of an estimated 1,531 miles of coastal beach shoreline used by loggerheads, and about 84% of the documented numbers of nests, within these six states.

Five designated critical habitat areas (LOGG-T-FL units 10-14) include nesting beaches within Palm Beach County (Figure 4-1). Unit LOGG-T-FL-12 includes the nesting beach between Lake Worth Inlet and South Lake Worth Inlet (Boynton Inlet) from the MHW line to the tow of the secondary dune or developed structures. USFWS Unit LOGG-T-FL-12 includes the Action Area for this Project.

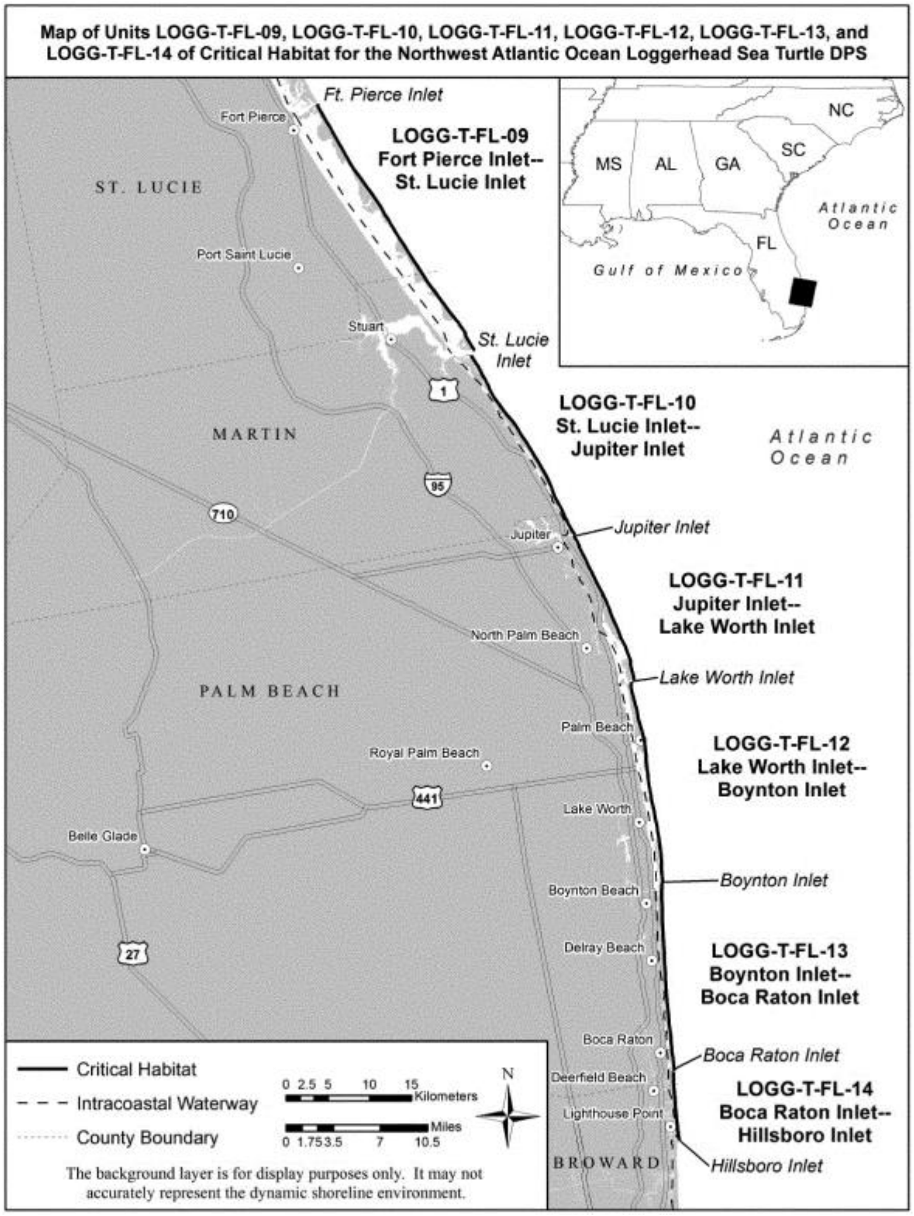


Figure 4-1. USFWS-designated critical habitat units for the loggerhead sea turtle NWA DPS including Palm Beach County units (79 FR 39755).

As part of the critical habitat designation process the physical and biological features of terrestrial environments are identified in areas occupied at the time of listing that are essential to the conservation of the loggerhead sea turtle. Specifically, the focus is on the primary constituent elements (PCE) of those features. PCEs are defined as the specific elements that are essential to the conservation of the species and provide for a species' life-history processes (79 FR 39755). The USFWS has determined four terrestrial PCEs for NWA DPS of the loggerhead sea turtle:

(1) PCE 1 - Suitable nesting beach habitat that has (a) relatively unimpeded nearshore access from the ocean to the beach for nesting females and from the beach to the ocean for both post-nesting females and hatchlings and (b) is located above MHW to avoid being inundated frequently by high tides.
(2) PCE 2 - Sand that (a) allows for suitable nest construction, (b) is suitable for facilitating gas diffusion conducive to embryo development, and (c) is able to develop and maintain temperatures and a moisture content conducive to embryo development.
(3) PCE 3 - Suitable nesting beach habitat with sufficient darkness to ensure nesting turtles are not deterred from emerging onto the beach and hatchlings and post-nesting females orient to the sea.
(4) PCE 4 – Natural coastal processes or artificially created or maintained habitat mimicking natural conditions.

USFWS also determined that protection and special management considerations are required within critical habitat areas to address threats to the essential features of loggerhead sea turtle terrestrial habitat. The primary threats that may impact the habitat are grouped into 12 categories. Nine of these categories apply to the LOGG-T-FL-12 unit: recreational beach use; predation; beach and sand placement activities; in-water and shoreline alterations; coastal development; artificial lighting; beach erosion; climate change; and human-caused disasters and response to natural and human-caused disasters (79 FR 39755).

NMFS-Designated Marine Habitat. NMFS proposed critical habitat for the NWA DPS of the loggerhead sea turtle NWA DPS within the Atlantic Ocean and the Gulf of Mexico under the ESA on July 18, 2013, (78 FR 43005) and published the final critical habitat designation on July 10, 2014 (79 FR 39855). The NMFS-designated marine critical habitat includes some nearshore reproductive areas directly off of nesting beaches from North Carolina through Mississippi, winter habitat in North Carolina, breeding habitat in Florida, constricted migratory corridors in North Carolina and Florida, and Sargassum habitat, which is home to the majority of juvenile turtles, in the western Gulf of Mexico and in U.S. waters within the Gulf Stream in the Atlantic Ocean. Unit LOGG-N-19 includes the nearshore reproductive habitat, constricted migratory habitat and breeding habitat from the Martin County/Palm Beach County line south to Hillsboro Inlet. This unit includes the Action Area of the proposed Project.

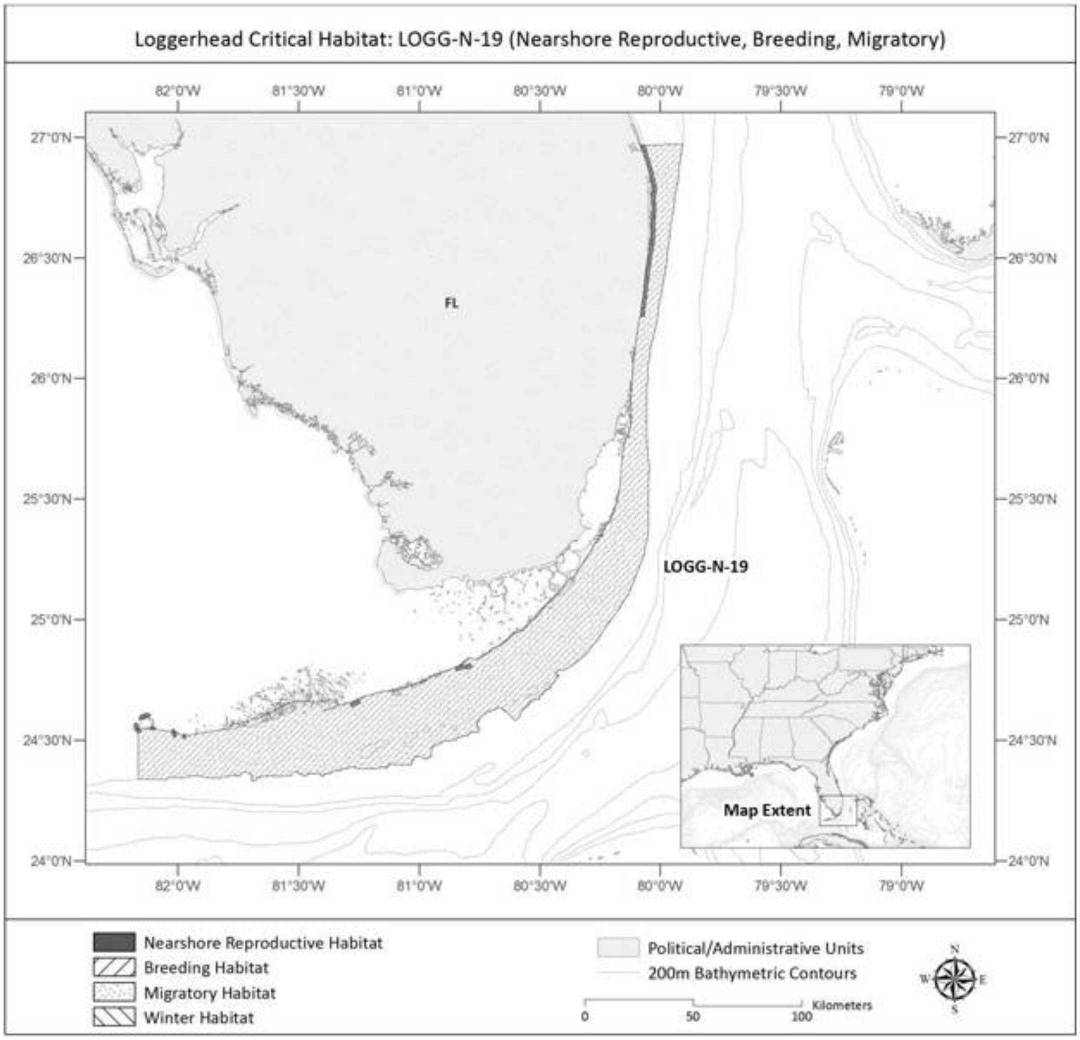


Figure 4-2. NMFS-designated critical habitat unit LOGG-N-19 for the loggerhead sea turtle NWA DPS (79 FR 39855).

NMFS determined PCEs for the Nertic (nearshore reproductive, foraging, winter, breeding and migratory) and *Sargassum* Habitats of the NWA DPS of the loggerhead sea turtle (79 FR 39855):

Nearshore Reproductive Habitat

(1) PCE 1 - Nearshore waters directly off the highest density nesting beaches and their adjacent beaches as identified in 50 CFR 17.95(c) to 1.6 km (1 mile) offshore.
(2) PCE 2 - Waters sufficiently free of obstructions or artificial lighting to allow transit through the surf zone and outward to open water.
(3) PCE 3 – Waters with minimal manmade structures that could promote predators (*i.e.*, nearshore predator concentration caused by submerged and emergent offshore structures), disrupt wave patterns necessary for orientation and/or create excessive longshore currents.

Foraging Habitat

(1) PCE 1 – Sufficient prey availability and quality, such as benthic invertebrates, including crabs (spider, rock, lady, hermit, blue, horeshoe), mollusks, echinoderms and sea pens).
(2) PCE 2 – Water temperatures to support loggerhead inhabitance, generally above 10°C.

Winter Habitat

(1) PCE 1 – Water temperatures above 10°C from November through April.
(2) PCE 2 – Continental shelf waters in proximity to the western boundary of the Gulf Stream.
(3) PCE 3 – Water depths between 20 and 100 m.

Breeding Habitat

(1) PCE 1 – High densities of reproductive male and female loggerheads.
(2) PCE 2 – Proximity to primary Florida migratory corridor.
(3) PCE 3 – Proximity to Florida nesting grounds.

Constricted Migratory Habitat

(1) PCE 1 – Constricted continental shelf area relative to nearby continental shelf waters that concentrate migratory pathways.
(2) PCE 2 – Passage conditions to allow for migration and from nesting, breeding, and/or foraging areas.

Sargassum Habitat

(1) PCE 1 – Convergence zones, surface-water downwelling areas, the margins of major boundary currents (Gulf Stream), and other locations where there are concentrated components of the *Sargassum* community in water temparatures suitable for the optimal growth of *Sargassum* and inhabitance of loggerheads.
(2) PCE 2 – *Sargassum* in concentrations that support adequate prey abundance and cover.
(3) PCE 3 – Available prey and other material associated with *Sargassum* habitat including, but not limited to, plants and cyanobacteria and animals native to the *Sargassum* community such as hydroids and copepods.
(4) PCE 4 – Sufficient water depth and proximity to available currents to ensure offshore transport (out of the surf zone), and foraging and cover requirements by *Sargassum* for post-hatchling loggerheads, i.e., >10 m. depth.

NMFS also determined that protection and special management considerations are required within critical habitat areas to address threats to the essential features of loggerhead sea turtle marine habitats. The primary threats that may impact the reproductive, breeding and migratory marine habitats within LOGG-N-19 include: offshore structures; lights on land or in the water; oil spills and response activities; fishing; dredge and disposal activities; and climate change (79 FR 39855).

4.2.2. GREEN SEA TURTLES

The green sea turtle (*Chelonia mydas*) was federally listed as a protected species on July 28, 1978 (43 FR 32800) under the ESA. In this initial listing, breeding populations of the green turtle in Florida and along the Pacific Coast of Mexico were listed as endangered;

all other populations were listed as threatened. On April 6, 2016 NMFS and USFWS issued a final rule to list 11 DPSs based on the best available scientific and commercial data (81 FR 20058). Under this rule, three DPSs are endangered species (Mediterranean, Central West Pacific, and Central South Pacific) and eight DPSs are threatened species (North Atlantic, South Atlantic, Southwest Indian, North Indian, East Indian-West Pacific, Southwest Pacific, Central North Pacific, and East Pacific). The threatened North Atlantic DPS is located in the Project Area. Green turtles are the largest of all the hard-shelled sea turtles, but have a comparatively small head. While hatchlings are just 50 mm (2 in) long, adults can grow to more than 0.9 m (3 ft) long and weigh 136-159 kg (300-350 lbs) (NMFS, 2013b). Characteristics that distinguish the green turtle from other marine turtle species are a smooth carapace with four pairs of lateral (or costal) scutes and a single pair of elongated prefrontal scales between the eyes (NMFS and USFWS, 1991). A green turtle's carapace is smooth and can be shades of black, gray, green, brown and yellow. Their plastron is yellowish white. Hatchlings are distinctively black on the dorsal carapace and white on the ventral plastron. Adult green turtles differ from other sea turtles in that they are herbivorous, feeding primarily on seagrass and algae. This diet is thought to give them greenish colored fat, from which they take their name (NMFS and USFWS, 1991; NMFS, 2013b).

The green turtle has a worldwide distribution in tropical and subtropical waters. Green turtles are thought to inhabit coastal areas of more than 140 countries. In U.S. Atlantic and Gulf of Mexico waters, green turtles are found in inshore and nearshore waters from Texas to Massachusetts, the U.S. Virgin Islands, and Puerto Rico. Nesting occurs in over 80 countries. The two largest nesting populations are found at Tortuguero, on the Caribbean coast of Costa Rica, and Raine Island, on the Great Barrier Reef in Australia (NMFS, 2013b). Major green turtle nesting colonies in the western Atlantic/Caribbean occur on the Yucatan Peninsula (Mexico), Tortuguero (Costa Rica), Aves Island (Venezuela), Galibi Reserve (Suriname) and Isla Trinidade (Brazil) (NMFS and USFWS, 2007b). In the U.S., green turtles nest primarily along the central and southeast coast of Florida; present estimates range from 200-1,100 females nesting annually (NMFS, 2013b). Scientists estimate green turtles reach sexual maturity anywhere between 20 and 50 years, at which time females begin returning to their natal beaches every 2-4 years to lay eggs. In the southeastern U.S., females generally nest between June and September, while peak nesting occurs in June and July. During the nesting season, females nest at approximately two week intervals, laying an average of five clutches. In Florida, green turtle nests contain an average of 135 eggs, which will incubate for approximately 2 months before hatching (NMFS, 2013b).

Green sea turtles are threatened by impacts to the nesting and marine environment. Threats include: loss or degradation of nesting habitat from coastal development; beach nourishment and beach armoring; disorientation of hatchlings by beachfront lighting; excessive nest predation by native and non-native predators; degradation of foraging habitat; marine pollution and debris; watercraft strikes; and incidental take from channel dredging and commercial fishing operations. Fibropapillomatosis, a disease of sea turtles characterized by the development of multiple tumors on the skin and internal organs, is also a mortality factor and has seriously impacted green turtle populations in Florida, Hawaii, and other parts of the world. The tumors interfere with swimming, eating, breathing, vision and reproduction, and turtles with heavy tumor burdens may die (NMFS and USFWS, 1991; 2007b).

In 1998, NMFS designated critical habitat for the green sea turtle to include the coastal waters around Culebra Island, Puerto Rico (63 FR 46693). There is no green sea turtle critical habitat in the vicinity of the Action Area for the proposed Project.

4.2.3. LEATHERBACK SEA TURTLES

The leatherback sea turtle (*Dermochelys coriacea*) was listed as endangered throughout its range on June 2, 1970 (35 FR 8491). Adult leatherbacks are highly migratory and are believed to be the most pelagic of all sea turtles (NMFS and USFWS, 1992). The leatherback turtle is distributed worldwide in tropical and temperate waters of the Atlantic, Pacific and Indian Oceans. It is also found in small numbers as far north as British Columbia, Newfoundland and the British Isles, and as far south as Australia, Cape of Good Hope and Argentina (USFWS, 2013a). The leatherback is the largest turtle and the largest living reptile in the world. Mature adults can be as long as 2 m (6.5 ft) and weigh almost 900 kg (2,000 lbs). The leatherback is the only sea turtle that lacks a hard, bony shell; its carapace consists of leathery, oil saturated connective tissue overlaying loosely interlocking dermal bones. The carapace has seven longitudinal ridges and tapers to a blunt point. Adult leatherbacks are primarily black with a pinkish white mottled ventral surface and pale white and pink spotting on the top of the head. The front flippers lack claws and scales and are proportionally longer than in other sea turtles, and the back flippers are paddle-shaped. The ridged carapace and large flippers are characteristics that make the leatherback uniquely equipped for long distance foraging migrations (NMFS, 2013c).

Nesting grounds are distributed worldwide. The largest nesting populations in the Atlantic are located in Suriname and French Guiana (5,000-20,000 females nesting/year) and Gabon (15,730-41,373 females nesting/year). In the Pacific the largest nesting populations are located in Papua, Solomon Islands, Papua New Guinea, Vanuatu, and Indonesia (2,700-4,500 females nesting/year). In the United States, small nesting populations occur in Florida (63-754 nests/year), Sandy Point, U.S. Virgin Islands (143-1,008 nests/year), and Puerto Rico, including Culebra (32-395 nests/year) and mainland (131-1,291 nests/year) (NMFS, 2013d) . The U.S. Caribbean, primarily Puerto Rico and the U.S. Virgin Islands, and southeast Florida support minor nesting colonies, but represent the most significant nesting activity within the U.S. Adult leatherbacks are capable of tolerating a wide range of water temperatures and have been sighted along the entire continental coast of the United States as far north as the Gulf of Maine and south to Puerto Rico, the U.S. Virgin Islands, and into the Gulf of Mexico (NMFS and USFWS, 2007c; NMFS, 2013c). Females nest several times during a nesting season, laying clutches of approximately 100 eggs on sandy, tropical beaches. The incubation period for leatherback sea turtles ranges from about 55-75 days (NMFS, 2013c).

Leatherback turtles face threats on both nesting beaches and in the marine environment. The crash of the Pacific leatherback population, once the world's largest population, is believed primarily to be the result of exploitation by humans for the eggs and meat, as well as incidental take in numerous commercial fisheries of the Pacific. The primary threats to leatherbacks worldwide continue to be long-term harvest and incidental capture in fishing gear. Harvest of eggs and adults occurs on nesting beaches while juveniles and adults are harvested on feeding grounds. Incidental capture primarily occurs in gillnets, but also in trawls, traps and pots, longlines, and dredges. Together these threats are significant ongoing sources of mortality that adversely affect the species' recovery (NMFS, 2013c). Other factors threatening leatherbacks include loss or degradation of nesting habitat from coastal development, disorientation of hatchlings by beachfront lighting, excessive nest predation by native and non-native predators, marine pollution and debris and watercraft strikes (NMFS and USFWS, 1992; 2007c).

In 1978, USFWS initially designated 0.3 km (0.2 mi) of land at Sandy Point Beach on the Western end of St. Croix in the Virgin Islands as critical habitat for the leatherback sea turtle. In 1979, the NMFS extended critical habitat to the coastal waters adjacent to Sandy Point (44 FR 17710). The designation was again revised in 2012 to include approximately 16,910 mi^2 (43,798 km^2) along the California coast, and 25,004 mi^2 (64,760 km^2) of coastline between Washington and Oregon (77 FR 4170). There is no leatherback critical habitat in the vicinity of the Action Area.

4.2.4. HAWKSBILL SEA TURTLES

The hawksbill sea turtle (*Eretmochelys imbricata*) was listed as an endangered species on June 2, 1970 (35 FR 8491). The hawksbill turtle is small to medium-sized compared to other sea turtle species. Adults weigh 45-68 kg (100-150 lbs) on average, but can grow as large as 91 kg (200 lbs). The carapace of an adult ranges from 63-90 cm (25-35 in) in length and has a "tortoiseshell" coloring, ranging from dark to golden brown, with streaks of orange, red, and/or black. The shells of hatchlings are 25-50 mm (1-2 in) long and are mostly brown and somewhat heart-shaped. The plastron is clear yellow. The hawksbill turtle's head is elongated and tapers to a point, with a beak-like mouth that gives the species its name. The shape of the mouth allows the hawksbill turtle to reach into holes and crevices of coral reefs to find sponges, their primary food source as adults, and other invertebrates. Hawksbill turtles are unique among sea turtles in that they have two pairs of prefrontal scales on the top of the head and each of the flippers usually has two claws (NMFS and USFWS, 1993; NMFS, 2013e).

This species is most commonly associated with healthy coral reefs and is found in tropical and subtropical seas of the Atlantic, Pacific and Indian Oceans. Hawksbills are widely distributed throughout the Caribbean Sea and western Atlantic Ocean, regularly occurring in southern Florida and the Gulf of Mexico (especially Texas), in the Greater and Lesser Antilles, and along the Central American mainland south to Brazil (NMFS and USFWS, 1993; NMFS 2013e).

Hawksbills are solitary nesters, thus determining population trends or estimates on nesting beaches is difficult. The largest populations of hawksbills are found in the Caribbean, the Republic of Seychelles, Indonesia and Australia, and the largest nesting population of hawksbills occurs in Australia. The most significant nesting within the U.S. occurs in Puerto Rico and the U.S. Virgin Islands, specifically on Mona Island and Buck Island, respectively. Nesting also occurs on beaches in St. Croix and on St. John, St. Thomas, Culebra Island, Vieques Island and mainland Puerto Rico. Within the continental U.S., nesting is rare and restricted to the southeast coast of Florida and the Florida Keys. No nesting occurs on the west coast of the U.S. mainland. In the U.S. Pacific, hawksbills nest only on main island beaches in Hawaii. Hawksbill nesting has also been documented in American Samoa and Guam. In addition to nesting beaches in the U.S. Caribbean, hawksbills nest at numerous other sites throughout the Caribbean, with the majority of nesting occurring in Mexico and Cuba (NMFS and USFWS, 1993; NMFS, 2013e). Female hawksbills return to their natal beaches every 2-3 years, generally laying 3-5 nests per season, each nest containing an average of 130 eggs. Hawksbill turtles usually nest high up on the beach under or in the beach/dune vegetation on both calm and turbulent beaches. They commonly nest on pocket beaches with little or no sand. Incubation for hawksbill sea turtles lasts for about 60 days (NMFS and USFWS, 1993; NMFS, 2013e).

The decline of the hawksbill species has been primarily due to human exploitation for tortoiseshell. While the legal hawksbill shell trade ended when Japan agreed to stop importing shell in 1993, a significant illegal trade continues. Current threats to hawksbills also include loss or degradation of nesting habitat from coastal development, construction of buildings and pilings, beach armoring and renourishment, and sand extraction. These factors may directly, through loss of beach habitat, or indirectly, through changing thermal profiles and increasing erosion, serve to decrease the amount of nesting area available to nesting females, and may evoke a change in the natural behaviors of adults and hatchlings. Sea-level rise resulting from climate change may increase practices to fortify the coast, further exacerbating the problem (NMFS and USFSW, 2013).

In addition, coastal development is usually accompanied by artificial lighting. The presence of lights on or adjacent to nesting beaches alters the behavior of nesting adults (of all sea turtle species) and is often fatal to emerging hatchlings as they are attracted to light sources and drawn away from the water or may even cause them to change course offshore. In many countries, coastal development and artificial lighting are responsible for substantial hatchling mortality (NMFS and USFWS, 2013). Another major threat to hawksbills is habitat loss of coral reef communities, which provide food resources and habitat. Coral reefs are vulnerable to destruction and degradation caused by human activities (e.g. pollution, vessel groundings, global climate change). While previously thought to be obligate reef dwellers, hawksbills may occupy a range of habitats that include coral reefs or other hard bottom habitats, seagrass, algal beds, mangrove bays and creeks. In the Caribbean, seagrass beds, which are thought to be peripheral habitat for hawksbills, sustain hawksbill foraging aggregations comparable to reef habitat. Although not as common as coral reef or hard-bottom habitat, Bjorndal and Bolten (2010) state that hawksbills historically may have used seagrass habitat but abandoned it as green turtle populations collapsed and the pastures went ungrazed decreasing the value of the habitat for hawksbills. Nonetheless, seagrass pastures may become more important as coral reefs decline (NMFS and USFWS, 2013).

Critical habitat for the hawksbill sea turtle has been designated in coastal waters surrounding Mona and Monito Islands, Puerto Rico (63 FR 46693). There is no hawksbill critical habitat in the vicinity of the Action Area.

4.2.5. KEMP'S RIDLEY SEA TURTLES

The Kemp's ridley sea turtle (*Lepidochelys kempii*) was first listed endangered throughout its range on December 2, 1970 under the Endangered Species Conservation Act of 1970, and subsequently under the ESA(43 FR 32800) (NMFS et al., 2011; NMFS, 2013f). This species was also listed by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) on July 1, 1975, which prohibited all commercial international trade. The International Union for the Conservation of Nature lists the Kemp's ridley as Critically Endangered (NMFS, 2013f). The smallest living sea turtle, the Kemp's ridley has a straight carapace length around 65 cm (26 in), with the adult's shell almost as wide as it is long. The dorsal carapace is round to heart-shaped and distinctly light gray. The range of the Kemp's ridley includes the Gulf coasts of Mexico and the U.S., and the Atlantic coast of North America as far north as Nova Scotia and Newfoundland. The Atlantic waters off the eastern seaboard of the U.S. serve as important foraging grounds for juvenile stages, ranging from New England to Florida. Adults of this species are usually confined to the Gulf of Mexico, although adult-sized individuals sometimes are found on the east coast of the U.S. (NMFS et al., 2011). Male turtles migrate between breeding and foraging grounds that span many different parts of the Gulf of Mexico, while females have been tracked migrating from nesting grounds to foraging grounds ranging from the Yucatan Peninsula to southern Florida (NMFS 2013f).

Nesting aggregations of Kemp's ridley turtles occur at Rancho Nuevo in Tamaulipas, Mexico, where 95% of worldwide nesting occurs for this species. These nesting aggregations (known as "arribadas") are synchronized events unique to the *Lepidochelys* genus. Nesting also occurs in Veracruz, Mexico, and Texas, U.S., but on a much smaller scale. Nesting occurs from May to July, and females lay two to three clutches of approximately 100 eggs, which incubate for 50 to 60 days (NMFS, 2013f). After leaving the nesting beach, hatchlings are believed to become entrained in eddies within the Gulf of Mexico, where they are dispersed within the Gulf and Atlantic by oceanic surface currents until they reach about 20 cm (8 in) in length, at which size they enter coastal shallow water habitats. As juveniles, Kemp's ridley turtles feed primarily on crabs, clams, mussels and shrimp and are most commonly found in productive coastal and estuarine areas. Adults primarily prey on swimming crabs, but may also eat fish, jellyfish, and mollusks (NMFS, 2013f).

Due to mainly anthropogenic causes, this species experienced dramatic declines in numbers from 1948 to the early 2000's. In 1947, video footage of nesting activity captured the arrival of upwards of 40,000 females near Rancho Nuevo (NMFS, 2013f). Collapse of the species was evident twenty years later when only 5,000 nesting females were observed. By the mid 1980's the population declined to record lows, with 702 nests representing only 300 females, recorded in 1985. Today, under strict protection, the population appears to be in the early stages of recovery. Nesting has drastically increased since the 1980's, and over 20,000 nests were recorded at nesting beaches in Tamaulipas, Mexico in 2009. However, only 13,302 nests were recorded in 2010 at this location (NMFS et al., 2011). In Texas, nesting data from 2005 to 2010 indicate approximately 5,500 females are nesting annually, a dramatic increase from the 81 nests recorded from 1948-2001 (Shaver and Caillouet Jr., 1998).

The Kemp's ridley population is exponentially increasing (NMFS et al., 2011), which may be indicative of the success of several fishing regulations designed to reduce impact to sea turtles in the commercial fisheries. The Kemp's ridley has also benefitted from conservation efforts enacted by the Mexican government since the 1960's, including a ban on the take of any sea turtle species and designation of the Rancho Nuevo nesting beach as Natural Protected Area in 2002. If survival rates occur at the present rate, population models predict the population will grow at a rate of 19%.

NMFS and USFWS were jointly petitioned in February of 2010 to designate critical habitat for the Kemp's ridley sea turtles' nesting beaches along the Texas coast and marine habitats in the Gulf of Mexico and Atlantic Ocean. This petition is currently being reviewed (NMFS, 2013f).

4.3. SMALLTOOTH SAWFISH

The smalltooth sawfish (*Pristis pectinata*) is a tropical marine and estuarine elasmobranch fish that inhabits the waters of the eastern United States, the northwestern terminus of their Atlantic range. On April 1, 2003 NMFS published a final rule to list the U.S. DPS as an endangered species under the ESA (68 FR 15674). The smalltooth sawfish commonly reaches 5.5 m (18 ft) in length and may grow to 7 m (25 ft) (NMFS, 2013g). Little is known about the life history of these animals, but they may live up to 25-30 years, maturing after about 10 years. Like many elasmobranchs, smalltooth sawfish are ovoviviparous, meaning the mother holds the eggs inside of her until the young are ready to be born, usually in litters of 15-20 pups.

Sawfish species inhabit shallow coastal waters of tropical seas and estuaries throughout the world. Specifically, they are usually found in shallow waters very close to shore over muddy and sandy bottoms within sheltered bays, on shallow banks, and in estuaries or river mouths (NMFS, 2013g). Juvenile sawfish use shallow, well-vegetated habitats, such as mangrove forests, as important nursery areas. Smalltooth sawfish have been reported in the Pacific and Atlantic Oceans and Gulf of Mexico; however, the U.S. population is found only in the Atlantic Ocean and Gulf of Mexico. Historically, the U.S. population was common throughout the Gulf of Mexico from Texas to Florida, and along the east coast from Florida to Cape Hatteras. Now, however, this species is most commonly found within the Everglades region at the southern tip of the state (NMFS, 2013g). Sawfish encounters have also been recorded within Florida Bay and the Florida Keys, in depths ranging from less than 3 m (10 ft) to greater than 21 m (70 ft), within a variety of habitats including mud, sand, seagrass, limestone hardbottom, rock, coral reef and sponge bottom. Some individuals were also observed near a culvert pipe, seafans, and artificial reefs a freshwater spring, and an oil rig (Poulakis and Seitz, 2004). Although sawfish were once a common sight off Florida’s coastline, they have become less common during the last century because they were unintentionally overfished. Their long “saws”, referred to scientifically as “rostrums” or "rostra", were easily entangled in any kind of fishing gear. Sawfish rostrums have also been popular trophy items. Since these fish produce few young, it has been a challenge for their population to recover after being depleted (FWC, 2013b). Many of the habitats that serve as important nursery areas for juveniles have been modified or lost due to development of the waterfront in Florida and other southeastern states, likely contributing to the decline of this species (NMFS, 2013g). Based on the contraction in range and anecdotal data, it is likely that the population is currently at a level less than 5% of its size at the time of European settlement (NMFS, 2009).

Critical habitat was designated for the smalltooth sawfish on September 2, 2009, and includes two units: the Charlotte Harbor Estuary Unit and the Ten Thousand

Islands/Everglades Unit. These two units are located along the southwestern coast of Florida between Charlotte Harbor and Florida Bay (73 FR 45353) (Figure 4-3). There is no smalltooth sawfish critical habitat in the vicinity of the Action Area for the proposed Project.

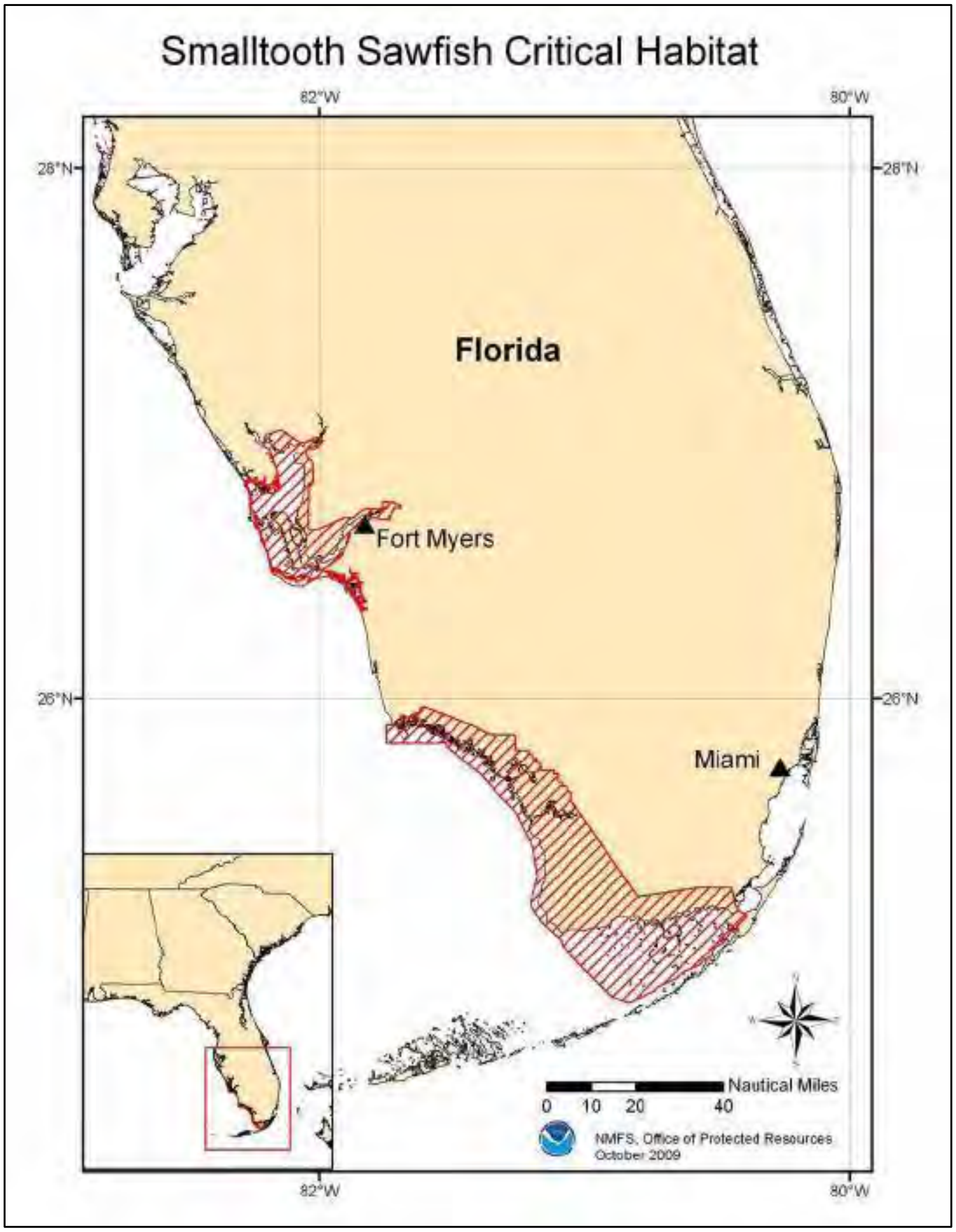


Figure 4-3. Critical habitat for the smalltooth sawfish (73 FR 45353) (NMFS, 2013g).

4.4. MAMMALS

4.4.1. FLORIDA MANATEE

The Florida manatee (*Trichechus manatus*) was first listed as endangered under the Federal Endangered Species Preservation Act of 1966 (32 FR 4001), later superseded by the 1969 Endangered Species Conservation Act. Previously, however, Florida prohibited the killing of manatees in 1893, making it one of the first wildlife species in the U.S. to receive protection. In 1973 manatees were listed under the ESA. They are also protected under the Marine Mammal Protection Act (MMPA) of 1972. The West Indian manatee includes two distinct subspecies, the Florida manatee (*Trichechus manatus latirostris*) and the Antillean manatee (*Trichechus manatus manatus*). The USFWS published a five-year review of the Florida manatee population in 2007, which stated that the best available science shows the overall population of the Florida Manatee has increased and the Antillean manatee levels are stable, and neither subspecies is currently in danger of becoming extinct within all or a significant portion of their range. The USFWS concluded that the West Indian manatee species' status better fits the ESA definition of threatened and as such has recommended reclassification (USFWS, 2007b). On January 8, 2016 the USFWS published (81 FR 1000) a 12-month finding on a petition to downlist the West Indian manatee and a proposed rule to reclassify the West Indian manatee as threatened; however, this species is currently still listed as endangered.

The Florida manatee is found in freshwater, brackish, and marine environments. Typical coastal and inland habitats include coastal tidal rivers and streams, mangrove swamps, salt marshes, freshwater springs, and vegetated bottoms. Manatees' diet includes submerged, emergent, and floating vegetation. Shallow grass beds, with ready access to deep channels, are generally preferred feeding areas in coastal and riverine habitats. In coastal Georgia and northeastern Florida, manatees feed in salt marshes on smooth cordgrass (*Spartina alterniflora*) by timing feeding periods with high tide. Manatees use springs and freshwater runoff sites for drinking water; secluded canals, creeks, embayments, and lagoons for resting, cavorting, mating, calving and nurturing their young; and open waterways and channels as travel corridors (USFWS, 2001; 2007b).

Florida manatees occupy different habitats during various times of the year. During the winter, cold temperatures keep the population concentrated in peninsular Florida and many manatees rely on the warm water from natural springs and power plant outfalls. During the summer they expand their range and, on rare occasions, are seen as far north as Rhode Island on the Atlantic coast and as far west as Texas on the Gulf coast (USFWS, 2001; 2007b). The Florida manatee population appears to be divided into at least two somewhat isolated areas, one on the Atlantic coast and the other on the Gulf coast of Florida; the populations are broken down further into regional groups, with the Northwest and Southwest groups on the Gulf Coast and Atlantic and Upper St. Johns River groups on the Atlantic coast (USFWS, 2001). Each of these “subpopulations” is composed of individual manatees that tend to return to the same warm-water sites each winter and have similar non-winter distribution patterns. Exchange of individuals between these subpopulations is considered to be limited during winter months, based on telemetry data (USFWS, 2007b).

The most significant threat to Florida manatees is death or injury from boat strikes (USFWS, 2001). In the Northwest Region, which includes Alabama waters, adult mortality is almost equally divided between human-related and natural causes, with watercraft collision (direct impact and/or propeller) being the primary cause of human-induced mortality. For non-adults, perinatal mortality is the most common cause of death, with watercraft collisions ranked second (USFWS, 2007b). Other human-related threats include entrapment and/or crushing in water control structures (e.g. gates and, locks), and entanglement in fishing lines and crab pot lines. Natural threats include exposure to cold and red tide, which can result in mortality through cold stress syndrome and brevitoxicosis, respectively (USFWS, 2007b). In Florida, many manatees depend on warm-water refuges; however, the long-term availability of these refuges is uncertain if minimum flows and levels are not established for natural springs and as deregulation of the power industry in Florida occurs (USFWS, 2001).

Critical habitat was designated in 1976 for the Florida manatee (50 CFR Part 17.95(a)). This was one of the first ESA designations of critical habitat for an endangered species and the first for an endangered marine mammal (USFWS, 2001). On March 16, 2012, the

USFWS established a manatee refuge in the waters of Kings Bay, its tributaries and connected waters in Citrus County, Florida (77 FR 15617). The closest critical habitat to the north includes all of Lake Worth in Palm Beach County, from its northernmost point immediately south from the intersection of U.S. Highway 1 and Florida State Highway A1A southward to its southernmost point immediately north of Boynton Beach. The closest critical habitat to the south includes the mainland of Dade County, as well as Biscayne Bay and all adjoining lakes, rivers, canals and waterways from the southern tip of Key Biscayne northward to and including Maule Lake in Dade County (50 CFR Part 17.95(a)). There is no critical habitat for the Florida manatee within the Action Area.

4.4.2. FLORIDA PANTHER

The Florida panther (*Puma concolor coryi)*, federally listed as endangered, is one of the smaller cougar species in the western hemisphere. There are currently only 100-160 Florida panthers left in the wild. Adult males can reach a length of 2.1 m (7 ft) with a shoulder height between 60-70 cm (24-28 in), and an average weight of 52.6 kg (116 lbs). Females are smaller, as they only reach a length of up to 1.8 m (6 ft) and a weight of 34 kg (75 lbs). Adult Florida panthers have a reddish-brown back, dark tan sides, and a pale gray belly. Kittens have a gray colored body, with black or brown spots, and five stripes that go around the tail. Panthers are never black in coloration (USFWS, 2008).

Florida panthers are carnivores and their diet consists primarily of deer, raccoons, wild hogs, armadillos, and rabbits. Florida panther home ranges average 194 and 388 km^2 (75 and 150 mi^2) for females and males, respectively. There is some overlap amongst home ranges, particularly for females, but males are typically intolerant of other males.

Florida panthers are solitary in nature, except for females with kittens, and they do not form pair bonds with mates. The total gestation time is 92-96 days with one to four kittens per litter. Births occur throughout the year, but mainly occur in late spring. Dens are usually created in a palmetto thicket. Females do not breed again until their young are 1.5-2 years old. Females reach sexual maturity at 1.5-2.5 years old, while males reach sexual maturity around 3 years old.

Female panthers have a higher survival rate and therefore tend to live longer than male panthers. Ages at death average 7.5 years for females and just over 5 years for males. The oldest known wild panthers were 20 and 14 years old at death for a female and male panther, respectively.

Habitat loss and hunting have led to the panther's near extinction. Low wild population numbers led to decreased genetic diversity and inbreeding. A plan to restore the genetic health of Florida panthers was implemented in 1995. Genetic restoration involved the release of eight female pumas (*Puma concolor stanleyana*) from Texas in 1995 into available panther habitat in south Florida. The Texas subspecies was selected for this project because they represented the closest puma population to Florida, and historically, the Florida panther subspecies bordered the Texas population and interbreeding occurred naturally between them. Five of the eight Texas females reproduced successfully, resulting in a minimum of 20 kittens. By 2003, the last three surviving Texas females were removed from the wild Florida population; no Texas pumas remain in the wild in Florida today. Habitat loss and fragmentation continue to be major threats to the Florida panther, along with inbreeding, insufficient large prey, disease and environmental contaminants (FWC, 2014 PantherNet, 2014).

4.5. CORALS

Two species of coral, *Acropora cervicornis* and *A. palmata*, have been listed as threatened under the ESA since 2006, and five additional Caribbean corals were recently listed in August 2014 as threatened: *Orbicella annularis, O. faveolata, O. franski, Dendrogyra cylindrus* and *Mycetephyllia ferox* (Table 4-1).

4.5.1. ACROPORID CORALS

In 2006, staghorn coral (*A. cervicornis*) and elkhorn coral (*A. palmata)* were listed as threatened under the ESA (71 FR 26852, May 9, 2006). In 2008, NMFS designated critical habitat for these two species (73 FR 72210, November 26, 2008), which includes the hardbottom and reef resources located approximately 2.5 miles south of the proposed Project Area. On December 7, 2012, NMFS proposed that the two species of *Acropora* already listed under the ESA be reclassified from threatened to endangered (77 FR 73219). However, on August 27, 2014, NMFS determined these species still warrant a threatened listing, and did not reclassify them (50 CFR Part 223).

These species have played crucial roles on Caribbean reefs, currently as habitat providers and historically as reef-building organisms. Staghorn and elkhorn coral were once the most abundant species on Caribbean and Florida Keys coral reefs in terms of accretion and reef structure. Rapid growth rates and reproductive strategies exhibited by both species were essential to enabling reefs to keep pace with environmental changes. Staghorn coral, one of the fastest growing corals in the western Atlantic, may exhibit growth rates from 10-20 cm (4-8 in) per year. The primary method of reproduction is via asexual fragmentation, in which new colonies form when branches are broken off and reattach to the substrate. Elkhorn coral may grow as much as 5-10 cm (2-4 in) per year. Similarly, the primary reproductive mode for this species is asexual fragmentation. In both species, sexual reproduction also occurs once a year via mass broadcast spawning of gametes into the water column between August and September. Colonies are simultaneous hermaphrodites and release millions of gametes during the spawning season (NMFS, 2013h).

Environmental influences have driven the morphological differences between the two species. Staghorn coral occurs in back reef and forereef environments in depths from 0-30 m (0-98 ft), and habitat is limited by wave activity, suspended sediments and light availability. Prior to the mid 1980's, forereef zones at depths of 5-25 m (16-82 ft) were dominated by extensive stands of staghorn coral. This species characteristically grows in antler-like colonies with cylindrical, fragile branches of 1-4 cm (0.4-1.6 in) in diameter. Elkhorn coral, by contrast, typically occurs in reef crest and forereef environments exposed to heavy surf, in depths less than 6 m (20 ft). Colonies grow in robust, antler-like formations with thick, sturdy branches that can reach 2-10 cm (0.8-3.9 in) in thickness (NMFS, 2013h).

In general, the two species have the same geographic range with a few exceptions. Both are found throughout southeast Florida, the Florida Keys, the Bahamas, and the

Caribbean islands, as well as the eastern coasts of Mexico, Belize, Honduras, Nicaragua, Costa Rica, Panama and Venezuela. In southeast Florida, staghorn coral has been documented as far north as Palm Beach County in deeper (17 m (56 ft)) water (CEG, 2009) and is distributed south and west throughout the coral and hardbottom habitats of the Florida Keys, through Tortugas Bank. Elkhorn coral has been reported as far north as Broward County, Florida (Precht and Aronson, 2004), and extending discontinuously southward to Venezuela.

Since the 1980's, population declines have been drastic, and it has been estimated that 90-95% of these corals have been lost (EOL, 2013). Major threats to staghorn and elkhorn coral include disease, coral bleaching, predation, climate change, storm damage and human activity. All of these factors have created a synergistic effect that greatly diminishes the survival and reproductive success of these corals (Precht and Aaronson, 2004). Natural recovery of coral is a slow process and may never occur with these species because there are so many inhibitors to its survival.

The predominance of asexual methods of reproduction in these species combined with limited larval dispersal has led to the development of populations with low genetic diversity and potentially increased susceptibility toward disease (Vollmer and Palumbi, 2007). Diseases that affect elkhorn coral include white pox disease, white band disease, and black band disease. White pox disease only affects elkhorn coral and is caused by a fecal enterobacterium, *Serratia marcescens* (Patterson et al., 2002). The disease is very contagious and commonly moves from one colony to its nearest neighbor. White pox creates white lesions on the coral skeleton and results in an average tissue loss of 2.5 cm^2 (0.39 in^2) per day but can cause as much tissue loss as 10.5 cm^2 (1.63 in^2) per day (Patterson et al., 2002). White band disease and black band disease have also greatly reduced the abundance of elkhorn coral by causing catastrophic losses (Reefball, 2013). A rapidly progressing condition referred to as rapid tissue loss has been observed over large areas in the Florida Keys (Williams and Miller, 2005) and southeast Florida (Smith and Thomas, 2008). This condition is characterized by a sloughing off of tissue that progresses rapidly (on average 4 cm branch length per day) throughout the colony.

Predators of elkhorn and staghorn coral include coral eating snails (*Coralliophila abbreviata*), polychaetes such as the bearded fireworm and damselfish. Predation by these organisms reduces the growth and reproductive abilities of the coral. Predation can eventually lead to the death of the coral colony.

Critical habitat for threatened staghorn and elkhorn coral was designated on November 26, 2008 in four areas: Florida, Puerto Rico, St. John/St. Thomas and St. Croix. In Florida, critical habitat is divided into three sub-areas (71 FR 72210). Sub-Area A ranges from South Lake Worth Inlet in Palm Beach County to Government Cut in Miami-Dade County, from the inshore boundary at the 1.8 m (6 ft) contour out to the seaward boundary at the 30 m (98 ft) contour. The northern limit of critical habitat for these species is South Lake Worth Inlet, located approximately 4 km (2.5 mi) south of the proposed Project Area (Figure 4-4). *Acropora* critical habitat is not located within the Action Area of the proposed Project.

Designation of the critical habitat also requires the identification of the physical or biological features that our essential to the conservation of the species. ThePCE essential for the conservation of staghorn and elkhorn corals is substrate of suitable quality and availability to support larval settlement and recruitment and reattachment and recruitment of asexual fragments. For purposes of this definition, “substrate of suitable quality and availability” is defined as natural consolidated hard substrate or dead coral skeleton that is free from fleshy or turf macroalgae cover and sediment cover (50 CFR 223 and 226).

NMFS published a Draft Recovery Plan for Staghorn and Elkhorn Corals on September 5, 2014 (79 FR 53019), which describes actions beneficial for the conservation and recovery of *Acropora palmata* and *A. cervicornis.*

Figure 4-4. Critical habitat in Florida for staghorn (*Acropora cervicornis*) and elkhorn coral (*A. palmata*) (71 FR 72210) (NMFS, 2013h).

4.5.2. RECENTLY LISTED CARIBBEAN CORAL SPECIES

On October 20, 2009, the Center for Biological Diversity petitioned NMFS to list 83 coral species as threatened or endangered under the ESA. NMFS identified 82 of the corals as candidate species and established a Biological Review Team (BRT) to prepare a Status Review Report to examine those 82 candidate coral species and evaluate extinction risks for each of them. Of those 82 species, NMFS proposed listing for 66 coral species: 59 in the Pacific (7 as endangered, 52 as threatened) and 7 in the Caribbean (5 as endangered, 2 as threatened) (December 2012, 77 FR 73219). On August 27, 2014, NMFS published their Final Rule (50 CFR Part 223) listing 20 of the proposed 66 coral species as threatened under the ESA (in addition to *Acropora palmata* and *A. cervicornis,* which were already listed). These newly listed threateded coral species include 15 in the Indo-Pacific and five in the Caribbean.

The following information on the species biology of the five newly listed Caribbean coral species: *Orbicella annularis, O. faveolata, O. franski, Dendrogyra cylindrus* and *Mycetephyllia ferox*. This information is gathered from the NOAA-NMFS Coral Status Review Report of 82 Candidate Coral Species Petitioned under the ESA (Brainard et al., 2011) unless otherwise cited.

***Orbicella annularis* complex**

Species within the *Orbicella annularis* complex were previously classified under the *Montastrea* genus*;* however*,* a recent study by Budd et al. (2012) reclassified the genus as *Orbicella* based on molecular and morphological data. *Orbicella* has historically been one of the primary reef framework builders of the western Atlantic and Caribbean. Its depth range is from 1 m (3.3 ft) to over 30 m (100 ft) and it has multiple growth forms ranging from columnar to massive to plating. Based on their morphology, depth range, ecology and behavior with subsequent support from reproductive and genetic studies, these growth forms were partitioned into three separate species in the early 1990s: *Orbicella annularis, O. faveolata* and *O. Franksi*.

The *Orbicella annularis* complex characterizes the “buttress zone” and “annularis zone” in the classical descriptions of Caribbean reefs and has been described as very abundant in these zones. Declines became obvious in the 1990s and 2000s and were most often associated with combined disease and bleaching events. They exhibit dramatically low productivity (low growth and extremely low recruitment), which puts them at high extinction risk due to any substantial declines in adult populations.

In Florida, several studies spanning nearly 30 years imply extreme declines in the Florida Keys (80% to 90%) between the late 1970s and 2003. Parameters measured revealed declines in absolute cover, colony shrinkage, and virtually no recruitment. Additionally, further dramatic losses occurred in this region during the cold weather event in January 2010. Similar declines have been documented in the U.S. Virgin Islands, Belize and Colombia as well as on relatively remote Caribbean reefs such as Navassa Island National Wildlife Refuge and offshore islands in Puerto Rico.

All three species are hermaphroditic broadcast spawners. Reproduction is characterized by small eggs and larvae and very slow post-settlement growth rates, which may contribute to extremely low post-settlement survivorship. It is thought that only *O. annularis* is capable of some degree of fragmentation/fission and clonal reproduction.

The *Orbicella annularis* complex has been shown to be highly-to-moderately susceptible to bleaching, which was highlighted during the well-documented mortalities in these species following severe mass-bleaching in 2005 due to thermal stress. Disease outbreaks of white-plague and yellow-band have also resulted in population declines to these species. Degraded water quality (increased nutrients and/or toxins) and increased turbidity and sedimentation associated with land-based sources of pollution has resulted in decreased growth rates and increase susceptibility to bleaching and disease.

Orbicella annularis. Boulder star coral is restricted to the western Atlantic and occurs throughout the Caribbean, including Florida, the Bahamas and Flower Garden Banks but may be absent in Bermuda. It has been reported in water depths ranging from 0.5-20 m (1.6-66 ft) and is generally described with a shallower distribution than the other two species in the complex.

Orbicella annularis colonies grow in columns that exhibit rapid and regular upward growth. Based on the 2011 Status Review, very low productivity (growth and recruitment), dramatic recent declines and its restriction to the highly disturbed/degraded wider Caribbean region and its preference for shallow habitats (yielding greater exposure to surface-based threats) are the main factors that increase the extinction risk for *O. annularis.*

Orbicella faveolata. Mountainous star coral is restricted to the western Atlantic and occurs throughout the Caribbean, including Florida, the Bahamas, Flower Garden Banks and the entire Caribbean coastline. It is documented on most reef habitats ranging in water depths from 0.5-40 m (1.6-131 ft). It has been reported as the most abundant coral in forereef environments between 10-20 m (33-66 ft).

In many life history characteristics, including growth rates, tissue regeneration and egg size, *O. faveolata* is considered to be intermediate between its two sister species. Based on the 2011 Status Review, extremely low productivity (growth and recruitment), dramatic recent declines and its restriction to the highly disturbed/degraded wider Caribbean region are the main factors that increase the extinction risk for *O. faveolata.*

Orbicella franksi. Star coral is restricted to the western Atlantic and found throughout the Caribbean, including Florida, the Bahamas, Bermuda, Flower Garden Banks and the entire Caribbean coastline. It has been reported in water depths from 5-50 m (16-164 ft) and is often a dominant component of Caribbean mesophotic reefs. *Orbicella franksi* tends to have a deeper distribution than its two sister species.

Based on the Status Review, extremely low productivity (growth and recruitment), dramatic recent declines and its restriction to the highly disturbed/degraded wider Caribbean region are the main factors that increase the extinction risk for *O. franksi.*

Dendrogyra cylindrus

Pillar coral (*D. cylindrus*) is restricted to the western Atlantic and is present throughout the greater Caribbean, including Florida, but is one of the Caribbean genera absent from the southwest Gulf of Mexico. A single colony (in poor condition) is known in Bermuda. It is reported in most reef environments but is more common on forereef spur-and-groove habitats in the Florida Keys rather than in nearshore hardbottom and reef habitats. It has been documented in water depths between 2-25 m (7-82 ft).

Dendrogyra cylindrus is reported as uncommon but conspicuous with isolated colonies scattered across a range of habitat types. In Florida, the overall density is estimated at approximately 0.6 colonies per 10 m^2. They are described as having gonochoric spawning but their low density does not support successful reproduction; however, they are effective in propagation through fragmentation. Annual growth rates range from 12-20 mm (0.5-0.8 in) in the Florida Keys up to 0.8 cm yr^{-1} (0.3 in yr^{-1}) elsewhere in the Caribbean.

Conflicting reports and low density make understanding the susceptibility of *D. cylindrus* to elevated temperatures difficult; however, it is known to be sensitive to cold shock. Based on the Status Review, the overall low population density and low population size combined with a gonochoric spawning mode, corresponding lack of observed sexual recruitment, and susceptibility to observed disease mortality are the main factors that increase the extinction risk for *D. cylindrus.*

Mycetophyllia ferox

Rough cactus coral (*M. ferox*) is restricted to the western Atlantic with reports throughout most of the Caribbean, including Florida, although it has not been documented in the Flower Garden Banks or in Bermuda. It has been reported to occur in shallow reef habitats ranging from 5-30 m (16-100 ft) water depths.

The species is described as uncommon or rare contributing less than 0.1% species contribution and occurs at densities less than 0.8 colonies per 10 m^2 in Florida. Studies conducted in the Florida Keys show a dramatic decline since the mid-1990s and it has been suggested that *M. ferox* was much more abundant in the upper Florida Keys in the early mid-1970s compared to current observations, but that it was highly affected by disease.

Mycetophyllia ferox has been reported as susceptible to acute and sub-acute white plague disease, which was positively correlated with water temperature. Based on the 2011 Status Review, disease, rare abundance, and observed declines in abundance are the main factors that increase the extinction risk for *M. ferox.*

Although land-based sources of pollution (nutrients, sediments, toxins, and salinity) may not produce extinction on a global scale, they produce stresses that act in concert and are influenced by other biological and hydrological factors. Collectively, they may pose significant threats at local scales and reduce the resilience of corals to bleaching. While ocean acidification has not been demonstrated to have caused appreciable declines in coral populations so far, the BRT established by NMFS who prepared the Status Review Report considers it to be a significant threat to corals by 2100 (Brainard et al., 2011).

4.6. BIRDS

4.6.1. PIPING PLOVERS

Piping plovers (*Charadrius melodus*) are small, migratory shorebirds that breed in only three geographic regions of North America: on sandy beaches along the Atlantic Ocean, on sandy shorelines throughout the Great Lakes region and on the river-bank systems and prairie wetlands of the Northern Great Plains. Piping plover breeding populations were federally listed as threatened and endangered in 1986. The Northern Great Plains and Atlantic Coast breeding populations are threatened, and the Great Lakes population is endangered. Piping plovers from all three breeding populations winter along South Atlantic, Gulf Coast, and Caribbean beaches and barrier islands, primarily on intertidal beaches with sand and/or mud flats with no or very sparse vegetation. Piping plovers are considered threatened throughout their wintering range (USFWS, 2009). This species is also federally protected under the Migratory Bird Treaty Act (MBTA) 0f 1918, and is State-listed in Florida as threatened.

Piping plovers are approximately seven inches long with pale gray to sandy-brown plumage on their backs and crown, and white plumage on their underparts. Breeding birds have a single black breastband, a black bar across the forehead, bright orange legs and bill, and a black tip on the bill. During winter, the black bands disappear, the legs fade to pale yellow, and the bill becomes mostly black (USFWS, 2013b). Plovers arrive on the breeding grounds during mid-March through mid-May, where they typically remain for 3-4 months per year. They nest above the high tide line on coastal beaches, sandflats at the ends of sandspits and barrier islands, gently sloping foredunes, blowout areas behind primary dunes, sparsely vegetated dunes, and washover areas cut into or between dunes. They lay 3-4 eggs in shallow scraped depressions lined with light colored pebbles and shell fragments; the eggs hatch within 30 days. Plovers depart for the wintering grounds from mid-July through late October. Breeding and wintering plovers feed on exposed wet sand in wash zones, intertidal ocean beach, wrack lines, washover areas, mud-, sand- and algal flats, and shorelines of streams, ephemeral ponds, lagoons, and salt marshes by probing for invertebrates at or just below the surface. They use beaches adjacent to foraging areas for roosting and preening. Small sand dunes, debris, and sparse vegetation within adjacent beaches provide shelter from wind and extreme temperatures (USFWS, 1996, 2013b).

The initial decline of the piping plover population in the nineteenth century was due primarily to hunting for the millinery trade; however, shooting of the piping plover and other migratory birds has been prohibited since passage of the MBTA. Major threats to the species are now loss and degradation of breeding and foraging habitat attributed to development and shoreline stabilization. Disturbance by human activity and pets cause direct and indirect mortality of eggs and chicks, and predation is also a major threat to piping plover reproductive success (USFWS, 2013b, 2009). The listing of all three breeding populations is evidence of the drastic declines observed in piping plovers in recent decades.

Critical habitat was designated for the Great Lakes breeding population in 2001 (66 FR 22938), and for the Northern Great Plains breeding population in 2002 (67 FR 57638). Critical habitat for wintering piping plovers (including individuals from the Great Lakes, Northern Great Plains, and Atlantic Coast breeding populations) was designated along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas in July 2001 (66 FR 36038). The initial critical habitat designations were challenged and subsequently amended in North Carolina in 2008 (73 FR 62816) and Texas in 2009 (74 FR 23476). The closest critical habitat unit to the Action Area is critical habitat Unit FL-33. This unit is located within St. Lucie Inlet in Martin County, more than 35 miles north of the Action Area for the proposed Project (Figure 4-5). There is no piping plover critical habitat in the vicinity of the Action Area.

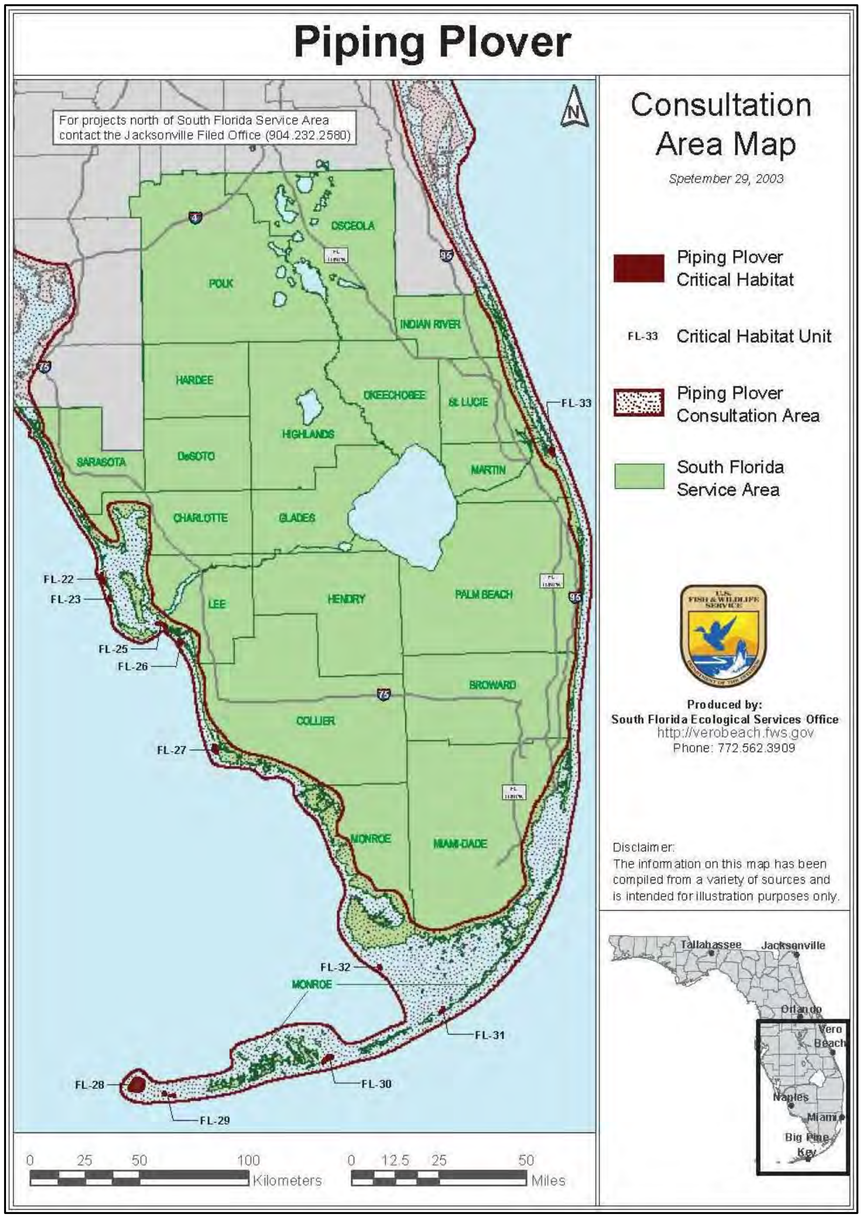


Figure 4-5. Piping plover consultation area including Critical Habitat Unit FL-33 (USFWS, 2003).

4.6.2. RUFA RED KNOT

The red knot (*Calidris canutus*) was added to the list of Federal ESA candidate species in 2006 anda proposed rule to list the rufa supbspecies (*Calidris canutus rufa*) as threatened under the ESA was published on September 30, 2013. The rufa red knot was federally listed as threatened on December 11, 2014 (79 FR 73706). Rufa red knots are also federally protected under the MBTA.

At nine to ten inches long, the rufa red knot is a large, bulky sandpiper with a short, straight, black bill (Audubon, 2013). During the breeding season, the legs are dark brown to black, and the breast and belly are a characteristic russet color that ranges from salmon-red to brick-red. Males are typically brighter shades of red, with a more distinct line through the eye. When not breeding, the two sexes look similar with plain gray above and dirty white below with faint, dark streaking. As with most shorebirds, the long-winged, strong-flying knots fly in groups, occasionally with other species. Rufa red knots feed on invertebrates, especially bivalves, small snails, crustaceans, horseshoe crab eggs and, on breeding grounds, terrestrial invertebrates (USFWS, 2013c).

The primary wintering areas for the rufa red knot include the southern tip of South America, northern Brazil, the Caribbean, and the southeastern and Gulf coasts of the U.S. The rufa red knot breeds in the tundra of the central Canadian Arctic. Some of these shorebirds fly more than 15,000 km (9,300 mi) from south to north every spring and reverse the trip every autumn, making the rufa red knot one of the longest-distance migrating animals. Migrating rufa red knots can complete non-stop flights of 2,400 km (1,500 mi) or more, converging on critical stopover areas to rest and refuel along the way. Large flocks of rufa red knots arrive at stopover areas along the Delaware Bay and New Jersey's Atlantic coast each spring, with many of the birds having flown directly from northern Brazil. The spring migration is timed to coincide with the spawning season for the horseshoe crab (*Limulus polyphemus*). Horseshoe crab eggs provide a rich, easily digestible food source which allows the rufa red knots to lay down fat and protein reserves both to fuel the 3,000 km (1864 mi) flight to the arctic breeding grounds and ensure their survival after they arrive at a time when food availability is often low. Mussel beds on New Jersey's southern Atlantic coast are also an important food source for migrating knots. Birds arrive at stopover areas with depleted energy reserves and must quickly rebuild their body fat to complete their migration to Arctic breeding areas. During their brief 10 to 14-day spring stay in the mid-Atlantic, rufa red knots can nearly double their body weight (Niles et. al, 2008; USFWS, 2013c).

The declining population of the rufa red knot is directly related to the increased harvest of horseshoe crabs as bait for the conch pot and eel fisheries in the mid-Atlantic (Niles et.

al, 2008). Threats to the rufa red knot also include sea level rise; coastal development; shoreline stabilization; dredging; reduced food availability at stopover areas; disturbance by vehicles, people, dogs, aircraft, and boats; and climate change (USFWS, 2013c).

For the proposed Project, the USACE requests a conference opinion from USFWS regarding the rufa red knot. Since the listing may take place before the Project is complete, this process will consider potential impacts to this species now in order to avoid re-initiation of formal consultation at a later date, which could delay or interrupt Project construction.

4.7. BEACH JACQUEMONTIA

There are approximately 100 species of the genus *Jacquemontia*, most of which are found in tropical and subtropical America. *Jacquemontia reclinata* is the only species found along the beaches of southeastern Florida and is endemic to the coastal barrier islands in southeast Florida from Palm Beach to Miami-Dade Counties. It is commonly known as beach jacquemontia or beach clustervine. This species is a perennial vine with a woody base and non-woody, twining stems up to six feet long. Leaves are alternate, estipulate, spirally arranged, and almost always petiolate reaching 1-3 cm (0.4-1.2 in) in length and 0.5-2.5 cm (0.2-1.0 in) in breadth and characterized as fleshy and rounded with blunted or indented tips. The flowers are white or pinkish, approximately 2.5 cm across, and deeply five-lobed with a short tube. *J. reclinata* requires open areas that are typically found on the crest and lee sides of stable dunes but may also invade and restabilize maritime hammock or costal strand communities that have been disturbed by tropical storms, hurricanes and possibly fire.

The range of *J. reclinata* extends from Jupiter Island to Key Biscayne, a distance of approximately 85 miles. Florida's east coast barrier islands in this range are entirely urbanized except for a few small parks and private estates (FTG, 2003). *Jacquemontia reclinata* was listed as federally endangered in 1993 (58 FR 62050), and is also state-listed as endangered (USFWS, 1999). The vast majority of beach coastal strand and maritime hammock vegetation, the primary habitat of this species, has been destroyed by residential and commercial construction, development of recreational areas, and beach erosion. This species is further threatened by invasion of exotic plant species including Australian pine, carrotwood, Brazilian pepper and turf grass. All but one of the wild populations exists on public lands in parks or conservation areas. The most recent surveys indicate that studied populations were declining in total number of individuals, total area occupied and stem density. There has been a 13% decline in total wild populations since 2000 (USFWS, 2007a). Protection and management of this species involves removal of exotics, protecting coastal habitats from development by conservation purchases or easements, and establishing new populations of this species in protected areas. Reintroductions of *J. reclinata* have increased the number of plants in the wild, although survival after transplant is quite variable (2-97%), due to mortality caused by human and natural factors (USFWS, 2007a).

4.8. EASTERN INDIGO SNAKE

The eastern indigo snake (*Drymarchon corais couperi*) is a large, black non-venomous snake. Its color is uniformly lustrous-black, dorsally and ventrally, except for a red or cream-colored suffusion of the chin, throat, and sometimes cheeks. It is the longest snake in the United States, reaching length up to 265 cm. Its scales are large and smooth in 17 scale rows at midbody.

In north Florida breeding occurs between November and April, and females deposit four to 12 eggs during May or June (Moler, 1992). Speake et al. (1987) reported an average clutch size of 9.4 for 20 captive bred females. Eggs are laid from late May through August, and young hatch in approximately three months. Peak hatching activity occurs between August and September, and yearling activity peaks in April and May (Groves, 1960; Smith, 1987). Limited information on the reproductive cycle in south-central Florida suggests that the breeding and egg laying season may be extended. In this region, breeding extends from June to January, laying occurs from April to July, and hatching occurs during mid-summer to early fall (Layne and Steiner, 1996).

The eastern indigo snake is an active terrestrial and fossorial predator that will eat any vertebrate small enough to be overpowered. An adult eastern indigo snake's diet may include fish, frogs, toads, snakes (venomous as well as nonvenomous), lizards, turtles, turtle eggs, juvenile gopher tortoises, small alligators, birds, and small mammals (Keegan, 1944, Babis, 1949, Kochman, 1978, Steiner et al., 1983). Juvenile eastern indigo snakes eat mostly invertebrates (Layne and Steiner, 1996).

Layne and Steiner (1996) determined in south-central Florida, adult male home ranges average about 74 ha (max. 199.2 ha), whereas adult female home ranges average about 19 ha (max. 48.6 ha). Eastern indigo snakes require a sheltered refuge from winter cold and dry conditions. Wherever the eastern indigo snake occurs in xeric habitats (Georgia, Alabama, and the panhandle area of Florida), it is closely associated with the gopher tortoise, the burrows of which provide shelter from winter cold and the desiccating sandhill environment (Bogert and Cowles 1947, Speake et al. 1978). In more mesic habitats that lack gopher tortoises, eastern indigo snakes may take shelter in hollowed root channels, rodent burrows, armadillo burrows, hollow logs, or crab burrows (Lawler 1977, Moler 1985b).

5.0. DESCRIPTION OF CURRENT CONDITIONS FOR LISTED SPECIES

This section describes the current status of those species listed in Table 4-1. The current conditions of each species are described, with data presented when available for any listed or proposed species known to occur in the Action Area for the Project.

5.1. SEA TURTLES

Nesting sea turtles and emergent hatchlings are present annually on the beaches of Palm Beach County during the nesting season (March 1 - October 31). In 2015, Palm Beach County accounted for 26.7% of the nesting in the state (FWC, 2015). In the same year, loggerhead, green and leatherback sea turtles accounted for 70.7%, 27.9% and 1.4%, respectively, of the nesting in the County (FWC, 2015). These three species are known to regularly nest on Palm Beach County beaches. Table 5-1 summarizes the sea turtle monitoring data collected within the Action Area (R-127 to R-141+586) between 2009 and 2015. The data provided by FWC/FWRI encompass the survey areas starting in R.G.

Kreusler Memorial Park (R-127) extending south to South Lake Worth Inlet (also called Boynton Inlet) (R-151). The nesting data are not reported by R-monument during the sea turtle nesting monitoring surveys; rather the total number of nests and false crawls are reported for an area that includes South Palm Beach, Lantana, and all of Manalapan. Therefore, in order to estimate the nesting within the Action Area, the Manalapan survey area (~4.2 km (2.6 mi)) data were scaled to include only the portion of Manalapan south to R-141+586 (~1.3 km (0.8 mi)), rather than reporting the nests for the entire length of the Manalapan shoreline. Based on coordination with FWC, presenting a portion of Manalapan survey area as a fraction of the entire area is an appropriate way to estimate nesting; however, it should be noted that this method assumes even distribution of nesting along the Manalapan survey shoreline, and so would not account for any areas that may experience higher (or lower) nesting densities than other areas (Brost, pers. comm., 2013).

Table 5-1. Sea turtle nests and non-nesting emergences (NNE) by species from 2009 to 2015 within the Action Area (R-127 to R-141+586). Data Source: Brost, pers. comm. (2015; 2016) using FWC/FWRI Statewide Nesting Beach Survey Program Database.

Year	Loggerhead		Green		Leatherback	
	Nests	NNE	Nests	NNE	Nests	NNE
2009	776	1265	44	73	19	12
2010	856	1428	60	82	7	6
2011	1097	1659	127	94	15	3
2012	1269	2026	63	39	18	3
2013	1335	1437	172	108	4	0
2014	1616	1953	78	113	14	1
2015	1829	1970	78	116	15	0

5.1.1. LOGGERHEAD SEA TURTLES

Loggerheads are found in the open ocean offshore of Palm Beach County due to the warm temperatures of south Florida's waters and the availability of foraging grounds provided by predominant sea turtle species in the area. Loggerhead females typically select nesting sites on coastlines adjacent to warm-temperate currents. In South Florida, the demographically independent loggerhead nesting population occurs from 29°N on the east coast to Sarasota County on the west coast (TEWG, 2000). In the 2015 nesting season, loggerhead nesting represented 70.7% of the overall nests surveyed in the County (FWC, 2015). Loggerheads deposited 24,198 nests in the County in 2015, which was the second highest count since 1998, and exceeds the previous 18-year average of 14,936 (± 4,457) by approximately 9,000 nests. Figure 5-1 displays the overall upward trend in the number of loggerhead nests recorded each year since 1998.

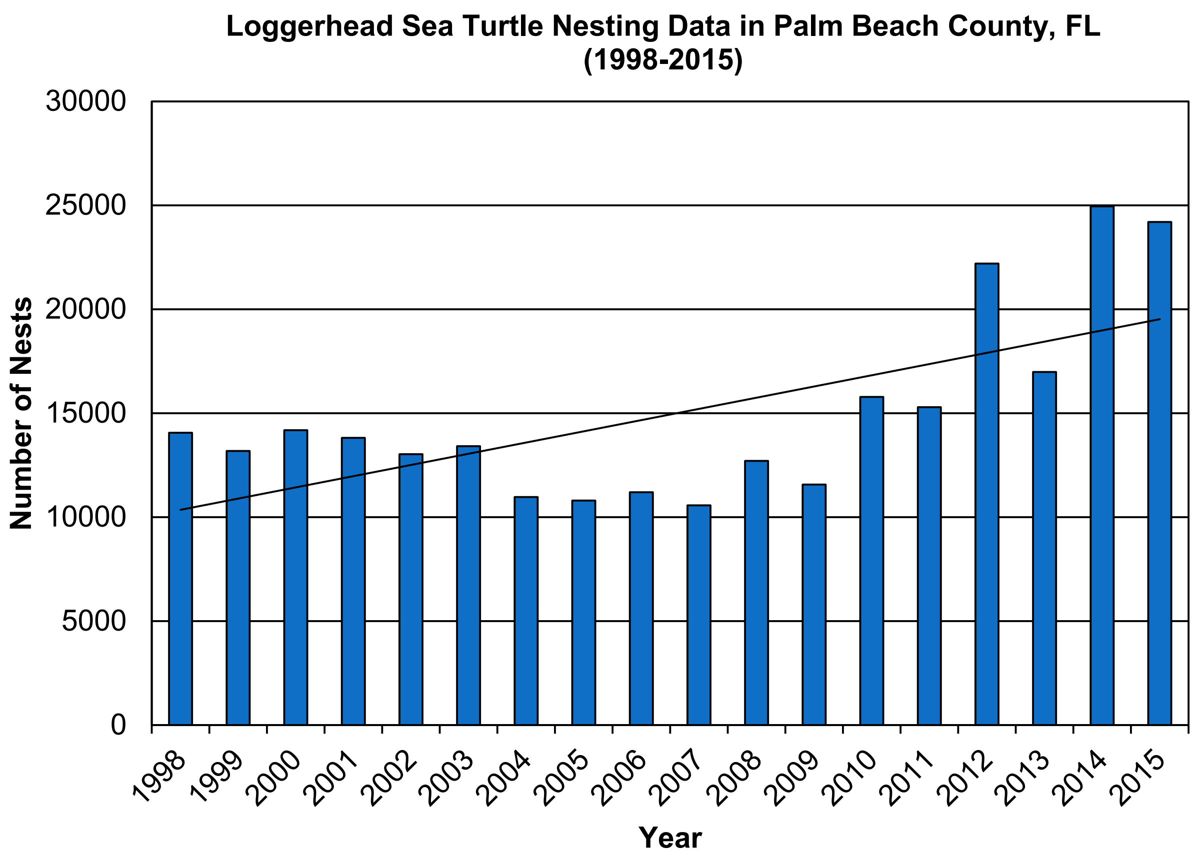


Figure 5-1. Loggerhead sea turtle nesting data for Palm Beach County (1998-2015); the black line represents a slightly increasing linear trend in the number of nests per year (FWC, 2015).

Within the Action Area, loggerhead nesting typically occurs between May and August. Table 5-1 summarizes the loggerhead nesting data within the Action Area (R-127 to R-141+586) between 2009 and 2015. These data show that loggerhead nesting activity has steadily increased within Action Area since 2009.

5.1.2. GREEN SEA TURTLES

Green turtles deposited 9,554 nests in the County in 2015, which is the highest count recorded since 1998. There is an overall upward trend in annual number of green sea turtle nests from 1998-2015 (Figure 5-2). The 2015 nesting data were above the previous 18-year average of 2,639 (± 2,555) by approximately 7,000 nests. According to FWC (2016a), green sea turtle nesting data typically has large year-to-year fluctuations due to their two-year reproductive cycle.Green sea turtle nesting within the Action Area is presented in Table 5-1.

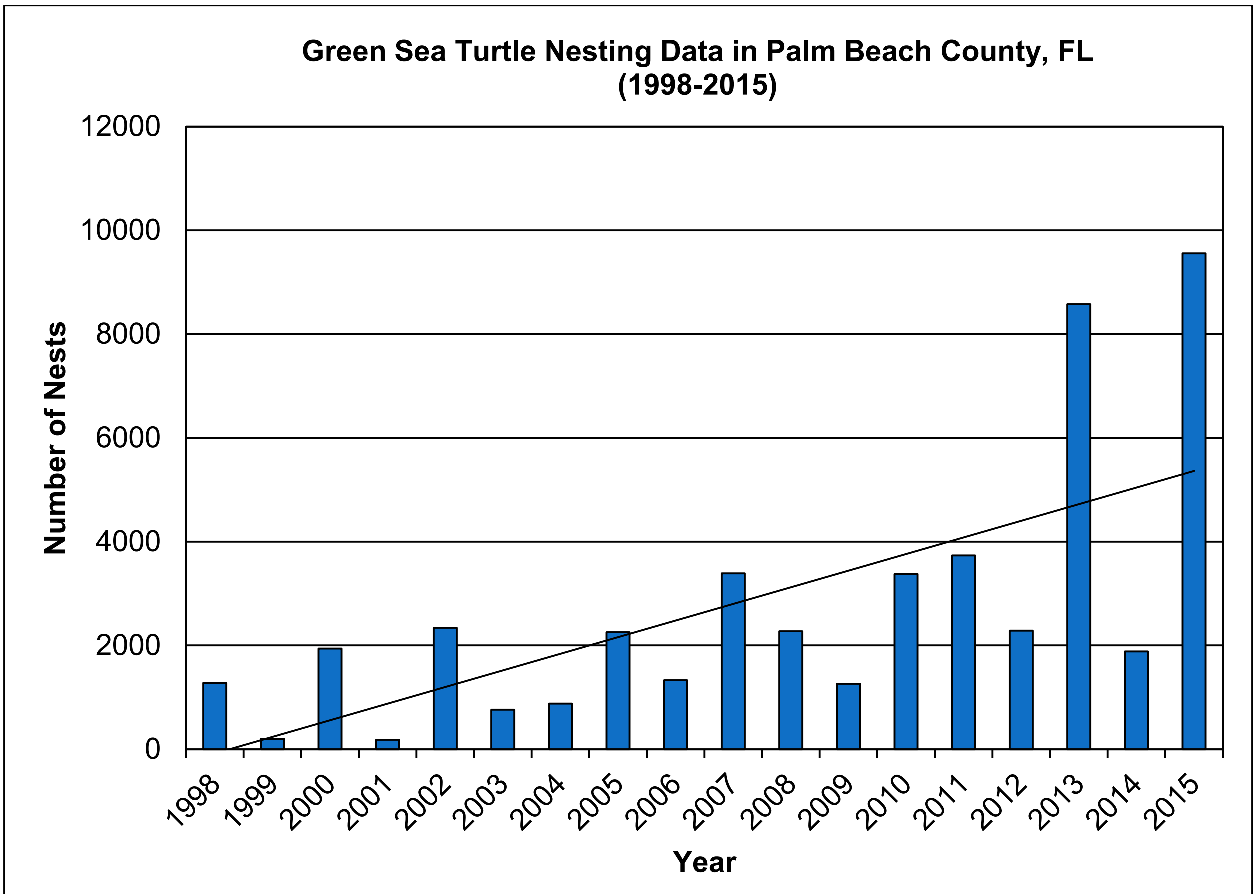


Figure 5-2. Green sea turtle nesting data for Palm Beach County (1998-2015); the black line represents an increasing linear trend in the number of nests per year (FWC, 2015).

5.1.3. LEATHERBACK SEA TURTLES

Leatherbacks deposited 463 nests in Palm Beach County in 2015, which was higher than the previous 18-year average of 342 (± 157) nests by approximately 100 nests. There is an overall upward trend in yearly number of leatherback sea turtle nests from 1998-2015 (Figure 5-3).

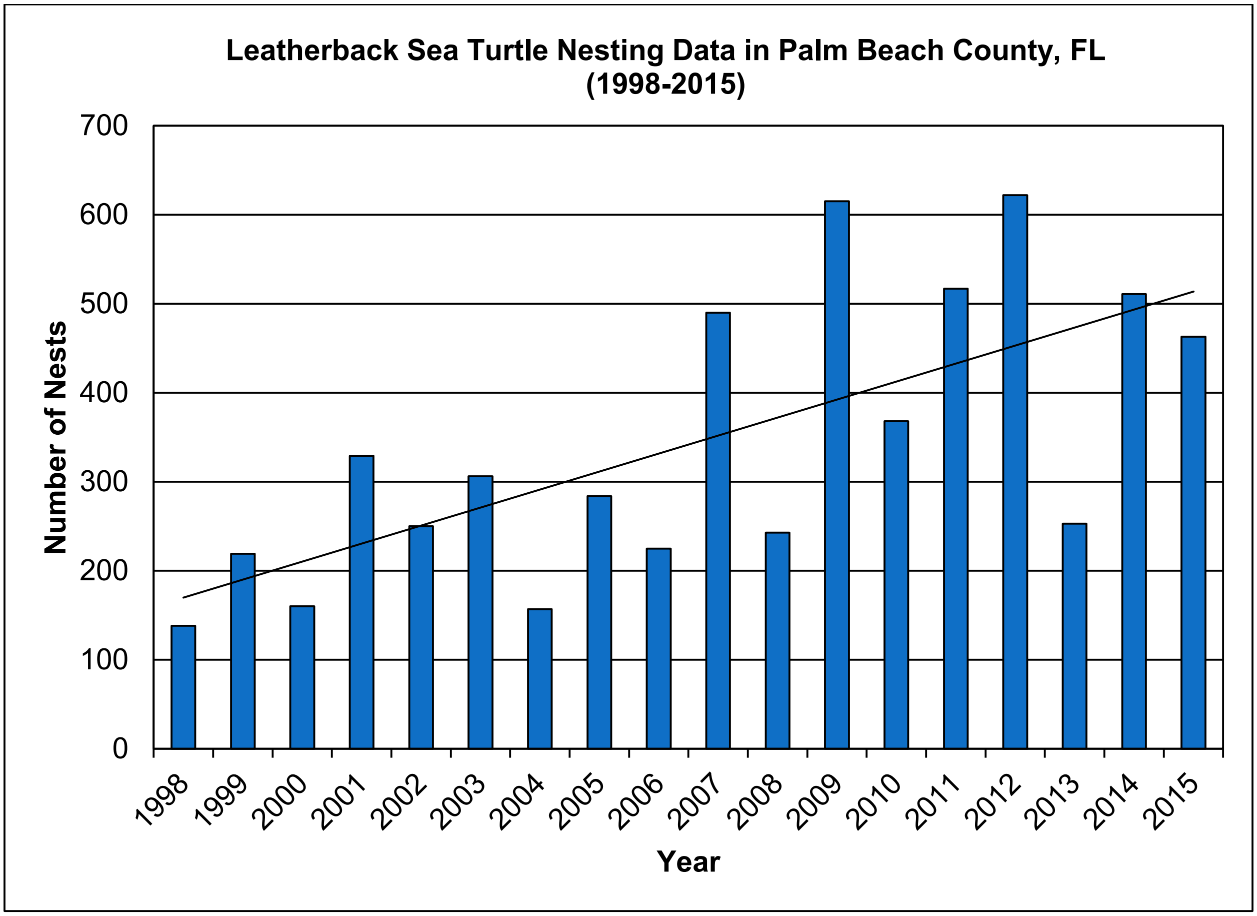


Figure 5-3. Leatherback sea turtle nesting data for Palm Beach County (1998-2015); the black line represents an increasing linear trend in the number of nests per year (FWC, 2015).

Leatherback turtles are a pelagic species remaining in the open ocean until the females move inshore to nest. They are not found foraging in the nearshore areas of the County; however, they have been recorded to nest in the proposed Action Area. Leatherback nesting within the Action Area is summarized in Table 5-1.

5.1.4. HAWKSBILL SEA TURTLES

Although they are common inhabitants of the shallow nearshore waters of southern Florida, hawksbill sea turtles nest infrequently on County shorelines; one hawksbill nest was laid on a Boca Raton beach (south of the Action Area) in 2013 (GLNC, 2013). Hawksbill sea turtles have never been documented nesting in the Action Area and are unlikely to occur there.

5.1.5. KEMP'S RIDLEY SEA TURTLES

Kemp's ridley sea turtles have never been documented as nesting in Palm Beach County, and so are unlikely to occur in the Action Area.

5.2. SMALLTOOTH SAWFISH

Population data are few for this species, therefore reliable estimates of the current population size are not available (NMFS 2009; 2013g). However, historic records, including museum records and anecdotal fishermen observations, indicate that the smalltooth sawfish was once abundant throughout its range; historically, the U.S. population was common throughout the Gulf of Mexico from Texas to Florida, and along the east coast from Florida to Cape Hatteras. Available data suggest that the distribution has been reduced by about 90%, and that the population has declined by 95% or more (NMFS, 2013g). According the International Sawfish Encounter Database, there have been 55 sightings of *P. pectinata* in Palm Beach County between 2003 and 2015 (Figure 3-12). Two sightings were in South Lake Worth Inlet and the remaining 53 were sighted in the Atlantic Ocean. Within the same time frame, five smalltooth sawfish were sighted within roughly 4 km (2.5 mi) of the Town of Palm Beach. Since April 2011, there have been three smalltooth sawfish sightings in the Atlantic Ocean offshore the Town of Palm Beach (Frick, pers. comm., 2013). On May 25, 2014, a smalltooth sawfish was caught with hook and line in the County near the Boynton Beach (Landau, 2014).

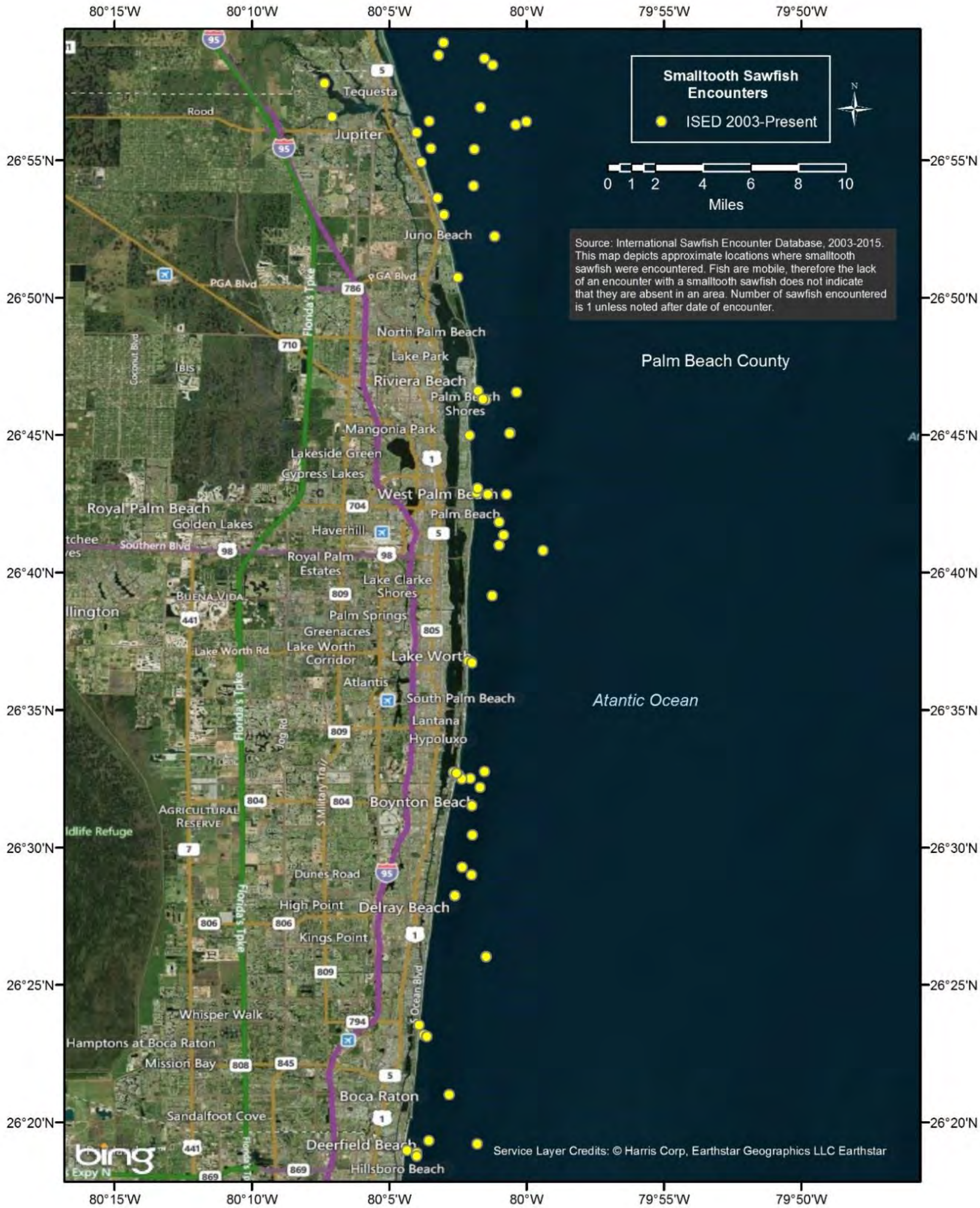


Figure 5-4. Smalltooth sawfish encounters in Palm Beach County, FL from 2003-2015 (Frick, pers. comm., 2015).

5.3. MAMMALS

5.3.1. FLORIDA MANATEE

The current available estimate of the Florida manatee population is 6,250 individuals, based on synoptic aerial surveys of warm-water sites on the east and west coasts of Florida on conducted on February 11, 12, and 13, 2016 (FWC, 2016b). This is the highest count recorded during synoptic surveys since 1991. The annual statewide manatee synoptic surveys were not performed in winter 2012 or 2013 because the warmer than average weather created unfavorable survey conditions that did not meet minimum criteria established by FWC.

In Palm Beach County, manatees are common year-round residents in canals and waterways. Collection of data from past surveys suggests that in the County the most abundant populations occur during the winter season. The north section of Lake Worth Lagoon (LWL) is an area of particular importance for manatee habitat. Extensive seagrass beds occur in this area serving as an attractant to manatee populations (CUESFAU and EAI, 2007). Since 1974, FWC has documented mortality statistics of the Florida manatee including the number of deaths and their cause. Data from 2015 (not yet finalized) show a total of ten manatee mortalities in the County categorized by perinatal, cold stress, undetermined causes, and unrecovered. This represents approximately 2.5% of the total 405 manatee mortalities documented within Florida. Of the 405 total mortalities, 15 were red-tide related deaths in 2015. Preliminary data from 2016 ending on January 31, 2016 show a total of three manatee mortalities in the County, or 7% of the total 43 manatee mortalities documented within Florida to date (FWC, 2016c).

5.3.2. FLORIDA PANTHER

Florida panthers inhabit large forested communities and wetlands (FNAI, 2001). They can be found in south Florida and parts of central Florida, although male panthers have been documented as far north as central Georgia. Collier, Glades, and Lee counties are the stronghold for the Florida panther, but Miami-Dade and Monroe counties are also important. Currently, FWC estimates there are between 100 and 160 adult panthers in south Florida (FWC, 2014). The USFWS panther subteam of Multi-Species/Ecosystem Recovery Implementation Team (MERIT) developed three panther habitat zones to identify important areas for the long-term survival of the species (Figure 5-4). The Primary Zone encompasses “all lands essential for the survival of the Florida panther in the wild.” The Secondary Zone includes “lands contiguous with the Primary Zone, and areas which panthers may currently use, and where expansion of the Florida panther population is likely to occur.” The Dispersal Zone is an “area needed for panthers to disperse north of the Caloosahatchee River.” There are Primary, Secondary, and Dispersal Zones within Collier and Glades County, which are where potential upland mines are located, therefore the Florida panther may potentially occur in the vicinity of truck routes from upland mines (FWC, 2012).

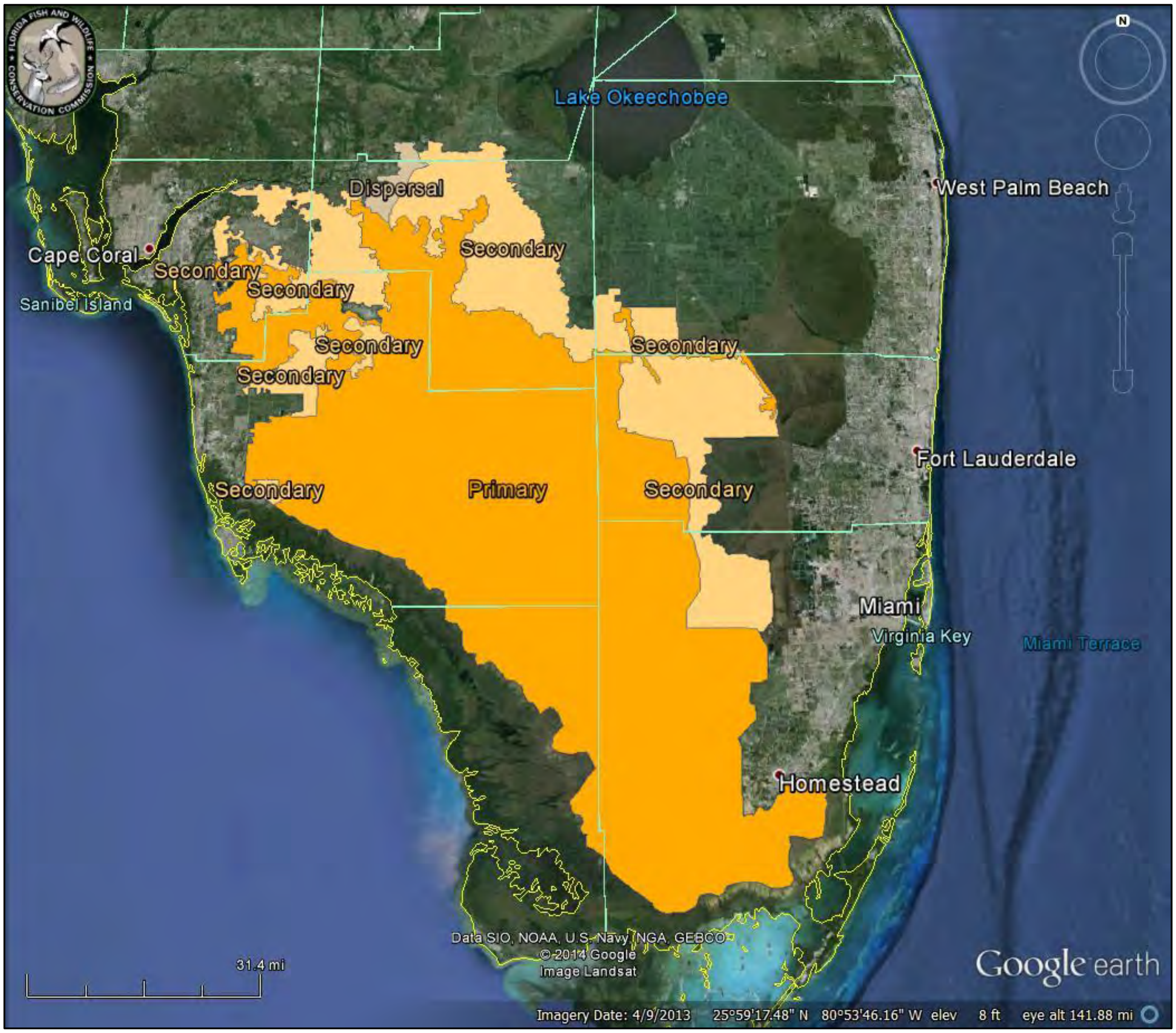


Figure 5-5. Florida panther habitat zones (FWC, 2012). Primary Zone shown in orange and Secondary Zone shown in light orange.

5.4. CORALS

5.4.1. ACROPORID CORALS

On January 6, 2009, NMFS received a petition from Palm Beach County Reef Rescue (PBCRR) to extend the northern boundary of Florida Critical Habitat area for elkhorn and staghorn corals to the Lake Worth Inlet, approximately 24.9 km (15.5 mi) north of the designated boundary at South Lake Worth Inlet. The petition provided information on the location of *A. cervicornis* colonies on an offshore reef locally known as Bath and Tennis Reef, approximately eight miles north of Boynton Beach Inlet and approximately 6.1 km

(3.8 mi) north of the proposed Project Area. In September 2009, PBCRR revisited the site on Bath and Tennis Reef and reported an expansion in the number of *A. cervicornis* colonies. Based upon these reports, the Town of Palm Beach commissioned the verification, mapping and characterization study of the area by Coastal Eco-Group Inc (CEG). Staghorn coral (*A. cervicornis)* mapping and assessment activities were conducted in October 2009. The 2009 study site was located north and seaward of the proposed Project Action Area, approximately 1,710 m (5,609 ft) offshore of R-105, at an average water depth of 17 m (57 ft). During the 2009 investigation, *A. cervicornis* was the dominant coral species within the sample area with 51 colonies, contributing over 32% to the total stony coral assemblage. However, of the 51 total colonies, only 30 colonies were attached to the reef substrate (21 were detached) for a mean density of 0.43 ± 0.11 colonies/m^2 (CEG, 2009). After reviewing the data provided by CEG and PBCRR, NMFS announced their final determination on January 22, 2010 stating they would deny the petition and not extend the northern boundary of the critical habitat area to the Lake Worth Inlet. This conclusion was “based on the adequacy of the existing, recent designation to meet the corals' conservation needs, the relatively low benefit the requested revision would provide, the protections afforded to the species from the recent ESA Section 4(d) regulations, and our need to complete higher priority conservation activities for these and other coral species” (75 FR 3711).

In October 2013 Palm Beach County divers conducted an *Acropora* survey on nearshore hardbottom within the Project Action Area (R-127 and R-141+586). The purpose of this survey was to perform the preliminary visual reconnaissance for locating listed species colonies per the NMFS “Recommended Survey Protocol for *Acropora* spp. in Support of Section 7 Consultation”. No *Acropora* colonies were observed in the investigation area (PBC-ERM, 2013). Nearshore hardbottom investigations were also conducted by CB&I biologists in October 2013. These surveys assessed the benthic communities in the Action Area, from the intertidal zone out to approximately 150 m offshore. No *Acropora* colonies were observed during these investigations (CB&I, 2014). There is no evidence to suggest the presence of *A. cervicornis* in water depths of less than 15 m (50 ft) north of South Lake Worth Inlet in Palm Beach County; therefore *Acropora* spp. are unlikely to be found in the Action Area.

5.4.2. RECENTLY LISTED CARIBBEAN CORAL SPECIES

Nearly all five of the Caribbean coral species recently listed as threatened (August 27, 2014, 50 CFR Part 223) may be found throughout the hardbottom communities in southeast Florida, with the exception of *M. ferox* (Banks et al., 2007). However, shallow nearshore surveys within the Action Area, including two recent nearshore hardbottom investigations (described above) conducted within the Project Action Area in October 2013, have documented none of the five recently listed Caribbean coral species (CPE 2007, 2009; PBC-ERM, 2013; CB&I, 2014).

5.5. BIRDS

5.5.1. PIPING PLOVERS

Data from the USGS 2011 International Piping Plover Census indicated that the total number of wintering Piping Plovers observed along south Florida’s Atlantic coast (58) was higher than the 1991 (46), 1996 (46), and 2006 (44) census results, and lower than the 20014 results (647The 2011 census had the first recorded observations along the Indian River County beaches approximately 90 miles north of the Action Area. Data from the 2006 census reported no piping plover observations within Palm Beach County (Elliott-Smith et al., 2009).

A September 2006 shorebird survey, conducted along the shoreline between R-134 and R-141, did not document any piping plovers (CPE, 2007). However, according to e-Bird, a database launched by the Cornell Lab of Ornithology and National Audubon Society, there have been 207 piping plover sightings in Palm Beach County since 2013. Nine piping plover sightings have occurred within the Action Area between R-127 and R-129, including one near Lake Worth Pier (2010), four on Lake Worth Municipal Beach (2012) and four in Kreusler Memorial Park in 2012 (e-Bird, 2015a). Therefore, it may be expected that overwintering piping plovers may occur within the Action Area.

5.5.2. RUFA RED KNOTS

Florida is known overwintering habitat for the rufa red knot, and wintering rufa red knots are most commonly recorded on the west coast where the population was estimated at around 10,000 in the 1980s (Niles et. al, 2006; Morrison & Harrington 1992). A September 2006 shorebird survey, conducted along the shoreline between R-134 and R-141, did not document any rufa red knots (CPE, 2007). However, according to e-Bird, there have been 60 rufa red knot sightings in Palm Beach County since 2013. Closest to the Action Area for the proposed Project, three rufa red knots were observed in 2005 at Boynton Inlet Park (near R-152), just south of South Lake Worth Inlet and one was observed around Ocean Ridge in 2004 (near R-162) (e-Bird, 2015b). While no rufa red knot observations have been recorded within the Action Area, based on documented sightings along the shoreline elsewhere in Palm Beach County, it may be expected that overwintering rufa red knots may occur within the Action Area.

5.6. BEACH JACQUEMONTIA

Beach jaquemontia is endemic to the coastal barrier islands in southeast Florida from Palm Beach to Miami-Dade Counties. It was once found at several sites on Jupiter Island and Palm Beach Island, but is no longer found north of Jupiter Inlet due to habitat destruction associated with residential construction. To the south, it has been documented at Crandon Park in Miami-Dade County and at Hugh Taylor Birch State Recreational Area in Broward County (USFWS, 1999). A dune restoration project in Delray Beach, Palm Beach County, has successfully reintroduced *J. reclinata* to the site and is testing whether breeding history of plants will influence survival, reproduction and population growth (Barron, 2013). A small population of beach jacquemontia is also present in Loggerhead Park (Juno Beach, FL). Several locations in Juno Beach were identified as acceptable sites at which to plant this endangered species in order to increase the size of the population in Palm Beach County; 64 plants were planted in Juno Beach in 2006-2007. As of July 2011, 32 of the 64 plants (50%) had survived (PBC-ERM, 2011).

CB&I biologists conducted a dune vegetation survey within the Action Area of the Project in November 2013. Following an examination of aerial photography to determine specific areas of interest along the Project Area which may support dune vegetation, CB&I biologists ground-truthed the extent of vegetation using DGPS. Dominant species were identified and photographs were collected throughout the survey area. Particular effort was made to identify and document the presence of the endangered plant species beach jacquemontia. No beach jacquemontia was observed within the survey area (CB&I, 2014).

5.7. EASTERN INDIGO SNAKE

The main threats facing the eastern indigo snake are habitat destruction, fragmentation, and degradation. Habitat destruction is caused mainly by the extension of urban development in their habitat. Eastern indigo snakes lose more than 5% of their habitat each year in Florida (Kendrick and Mengak 2010). Eastern inidigo snakes often occupy gopher tortoise burrows and face being injured by people hunting for rattlesnakes in the burrows. This action usually causes death to other species in the burrow including eastern indigo snakes. Habitat degradation is also a result from this action. Habitat fragmentation is also a threat as increased housing and road development can separate their habitat into smaller individual habitats, which affects the species' capability of supporting a viable population. Other threats include pollutants, vehicle strikes, captures for domestication, and intentional killings (Kendrick and Mengak 2010, Florida Natural Areas Inventory 2001).

6.0. EFFECTS OF PROPOSED ACTION

This section describes how the proposed Project will affect threatened, endangered or proposed species or critical habitat that may occur in the Action Area (Figure 1-2). Components of the Project include trucking sand from stockpiles of dredged sand and from upland mines, placement of beach and dune fill, construction of seven shore-perpendicular groins, and construction of mitigative artificial reefs. The ESA requires that all effects be considered when determining if an action may affect listed species and critical habitat, including direct effects, indirect effects, interrelated or interdependent actions, and cumulative effects:

- **Direct effects** - caused by the action and occur at the same time and place as the action.
- **Indirect effects** - caused by the action at a later time, but are reasonably certain to occur.
- **Interrelated actions** - part of a larger action and depend on the larger action for their justification.
- **Interdependent actions** - have no significant independent utility apart from the action under consideration.
- **Cumulative effects** - effects of future activities which are reasonably certain to occur within the action areas of the federal actions subject to consultation. Cumulative effects are defined by ESA as those effects of future state or private activities, not involving federal activities, that are reasonably certain to occur within the action area of the federal action subject to consultation (50 CFR §402.02). This definition applies only to ESA Section 7 analyses and should not be confused with the broader use of this term in NEPA or other environmental laws.

6.1. SEA TURTLES

6.1.1. NESTING SEA TURTLES AND HATCHLINGS

Although five species of sea turtle are known to occur within Florida, only three species regularly nest on the beaches of Palm Beach County: loggerhead, leatherback and green sea turtles. The proposed Project has the potential to adversely affect nesting females, nests and hatchlings within the Action Area.

Direct and/or Indirect Effects

The Project will utilize beach compatible sand and will be constructed between November 1 and April 30 in order to avoid peak sea turtle nesting season, thereby minimizing the potential for the mechanical destruction and burial of nests and encounters with construction equipment on the beach during nesting activities. The construction will only occur during daylight hours; therefore, no artificial construction-related lighting will be required.

Beach Nourishment

Even when constructed outside of nesting season, beach renourishment projects can have indirect effects on sea turtle nesting in the Action Area, such as changes to the physical and chemical beach environment. If the nourishment sand is dissimilar from the native sand, this can cause changes in sand compaction, beach moisture content, sand color, sand grain size and shape, and sand grain mineral content, all of which may alter sea turtle nesting behavior (Grain et al., 1995). Incompatibility of nourishment material with the nesting habitat can potentially affect female sea turtles' ability to nest and reproduce (Lutcavage et al., 1997). Nest site selection and digging behavior of the female can be altered or deterred, if she finds the beach unsuitable. Beach compaction can lead to reductions in nesting success (i.e., increased false crawls), which may result in increased physiological stress to the nesting females (Nelson and Dickerson, 1989). Clutch viability and hatchling emergence may also be impaired if the beach state is altered (Nelson and Dickerson, 1989; Grain et al., 1995). Steep escarpments may form along nourished beaches as they adjust from an unnatural construction profile to a more natural beach profile (Grain et al., 1995). These escarpments can impair or prevent access to nesting sites, in some cases leading to females selecting marginal or unsuitable nesting sites. Studies suggest that within the first year post-nourishment, turtle nesting decreases. Montague (1993) states that beach profiles of a newly restored beach are not conducive to nesting and hatchling success. Eventually, with local wave, tide, and wind energy, the profiles equilibrate and the beach stabilizes to resemble a natural profile of the area. While the above described impacts can occur, the proposed Project will place only beach compatible sand on the beaches and dunes to minimize indirect effects on sea turtle nesting. Permit conditions will require compaction testing and/or tilling of the beach to prevent compaction and scarp removal prior to each nesting season for three years.

The Ocean Ridge Shore Protection Project was constructed between August 1997 and April 1998 at Ocean Ridge in Palm Beach County, just south of the South Lake Worth Inlet. This project involved the removal of 11 groins, construction of eight T-head groins and beach nourishment. A sea turtle monitoring program was implemented, which allowed for comparison of data between 1997 (pre-construction) and 2001 (four years post-construction). Monitoring showed an initial decrease in nesting, nesting success and reproductive success; however, 4 years post-nourishment data suggested that the negative effects on nesting and emergence success observed during the previous years had returned to pre-construction levels. These results further supported other observations (at Jupiter and Martin County) that the negative effects of beach nourishment persist for approximately 2 years (PBC-ERM, 2001).

It has been suggested that beach nourishment may lead to more development in greater density within shorefront communities that are then left with the possible need for additional future replenishment, or even coastal armoring, in a negative feedback loop (Pilkey and Dixon, 1996). Increased development immediately adjacent to nesting beaches has often led to more coastal construction, sometimes with larger and larger structures being built to accommodate resultant increase in tourism. While the above described impacts may occur in some areas, Palm Beach Island is already highly developed, leaving little room for additional coastal development in the vicinity of the Action Area.

Increasing the elevation of the beach berm may expose sea turtles to onshore lights that were obscured prior to the beach nourishment. This could impact sea turtles by increasing the number of disorientations caused by artificial lighting (USFWS, 2011). In 1987 the County's Board of County Commissioners passed the Palm Beach County Sea Turtle Protection Ordinance and its measures are implemented by Palm Beach County's Department of Environmental Resources Management (PBC-ERM). Beachfront lighting is regulated by the Palm Beach County Unified Land Development Code (ULDC) Article 14.A, Sea Turtle Protection and Sand Ordinance. This ordinance requires that all coastal construction adhere to strict guidelines to eliminate impacts to sea turtles. Within the Project Area, Lantana and Manalapan are within the jurisdiction of the Article 14.A, ULDC and this ordinance can help minimize the effect of artificial lighting by adopting more sea turtle compatible lighting. The Town of Palm Beach and South Palm Beach have opted-out of the ordinance.

Groin Construction

Construction of the groins as part of the proposed Project will avoid peak sea turtle nesting season, thereby minimizing potential direct impacts to nesting sea turtles, nests and hatchlings. However, following construction, groins have the potential to interfere with nesting turtle access to the beach, result in a change in beach profile and width (downdrift erosion, loss of sandy berms, and escarpment formation), trap hatchlings, and concentrate predatory fishes, resulting in higher probabilities of hatchling predation (USFWS, 2011). While there are several cases where individual turtles have interacted with groins, many nesting beaches where groins are present experience little or no decrease and in some cases show an increase, in nesting as a result of the structures (Fox, pers. comm., 2013; PBC-ERM, 2001). The 1998 Ocean Ridge Shore Protection project included the removal of 11 groins and construction of eight rock T-head groins. Sea turtle monitoring indicated that the beach in and around the groin field experienced higher nesting success in 2001 compared to 1997. However, hatchling entrapment in the rock groin structures, exacerbated by local lighting problems, led to labor intensive management options (PBC-ERM, 2001). The design of the groins which are proposed to be constructed in South Palm Beach, Lantana and Manalapan (R-134+135 to R-138+551) will reduce these potential impacts to nesting sea turtles and hatchlings, as described below.

Unlike rock groins, the groins proposed for construction as part of the Project will be low profile concrete king pile and panel groins (similar to structure shown in Photograph 6-1). This type of structure is solid, and does not have spaces where turtles could become entrapped. The groins are designed to be level with the beach berm in order to blend with the beach, which will also reduce potential obstacles to nesting or hatchling sea turtles.

Photograph 6-1. Shoreward view of a concrete king pile and panel groin.

Structures such as groins can impact hatchling sea turtles by impeding swimming behavior. It has been shown that during the first 24-36 hours after leaving the nest, hatchlings engage in a continuous swimming “frenzy” to reach less risky offshore waters (Whelan and Wyneken, 2007). Surface wave refraction is an initial cue critical to the process of normal offshore orientation of sea turtle hatchlings (Glenn, 1996). Hard structures, such as the groins, may interfere with this process causing hatchling sea turtles to temporarily be impeded on their way to the water, or during the swimming frenzy. The concrete king pile and panel groins are installed perpendicular to shore with no T-head end, thus minimizing the impact to sea turtle hatchlings.

Sharks and fin-fishes, including snappers (Lutjanidae), are significant sources of mortality for hatchling sea turtles entering the ocean from nesting beaches and during the swim-frenzy period as they migrate offshore (Vose and Shank, 2003). Although structures may only temporarily impede offshore progress of newly hatched sea turtles, a delay in the offshore migration may increase predation of sea turtle hatchlings (Glenn, 1998; Gyuris, 1994; Witherington and Salmon, 1992). Whelan and Wyneken (2007) found that most predation occurred between 38 m and 220 m from shore. During hatchling predation studies in Broward County, Florida, it was documented that predatory fish species, such as tarpon (*Megalops atlanticus*) and snappers (*Lutjanus* spp.), targeted sea turtle hatchlings and “learned” where to concentrate foraging efforts (Wyneken et al., 1998). While fish predators are likely to congregate around bottom structures, Glenn (1996) found that hatchling predation was higher over natural hardbottom than over sand or breakwater structures, while Stewart and Wyneken (2004) found that different bottom types did not affect predation rates.

Groins may indirectly impact nesting habitat downdrift of the structures. Groins are designed to trap sand that would otherwise be transported by longshore currents. In doing so, these structures lead to accretion of updrift beaches while causing accelerated erosion of downdrift beaches (USFWS, 2011; Greene, 2002). Groins, therefore, have to potential to cause degradation of sea turtle nesting habitat on shorelines downdrift of the structures. The groins proposed to be constructed between R-134+135 and R-138+551 as part of the Project have a tapered design, with the northernmost and southernmost groins shorter than the central groins, which will also work to minimize downdrift erosion. Modeling which was completed to assess the performance of the seven proposed groins proposed has shown potential downdrift impacts from the groins will be minimal. The updrift benefit of the groins would extend to roughly R-132.5. Under an average wave climate, there would be a small downdrift impact (3,100 c.y.). However, since it would be spread over a long area (R-138+551 to R-144), the effect in terms of fill density (c.y./foot) would be relatively small (CPE, 2013). The Project consists of a combination of groins and beach nourishment. The beach nourishment will result in minimizing the accretion on the updrift side and the corresponding erosion on the downdrift side.

Sea turtles may also benefit from the Project by gaining accessibility to a greater area of beach on which to nest. Sea turtles may elect not to nest on critically eroded beaches and abandon sections of beach if they determine that the nest location will not be suitable.

In this instance, nesting sea turtles may return to the ocean to find another more suitable, location. This project will repair eroded sections of beach and will widen the dry beach to provide additional nesting habitat as well as additional protection from storms. A nourished beach that is designed and built to mimic the natural beach system will likely benefit nesting sea turtles more than the eroded beach it replaces.

Effects of Interrelated or Interdependent Actions

The sand source for the proposed Project is planned to be a combination of stockpiled dredge material from the planned Phipps Project (alternating with use of a stockpile from the Mid-Town Project) within the Town of Palm Beach project limits (R-129-210 to R-134+135), and upland sand within the project limits along the County shoreline in South Palm Beach, Lantana, and Manalapan (R-134+135 to R-138+551). The Phipps and Mid-Town projects will be constructed outside of peak turtle nesting season; therefore, stockpiling sand and trucking the sand to the Town of Palm Beach project area will not directly impact nesting sea turtles, nests, or hatchlings.

Cumulative Effects

It is likely that the Phipps Project (alternating with use of a stockpile from the Mid-Town Project) will be constructed north of the Project Area concurrently with the proposed Project. It is also reasonable to expect that nourishment and dune restoration will be continue to be periodically constructed along the Palm Beach Island in the future. All previous and future nourishment projects (discussed in Section 2) on Palm Beach Island and nearby beaches represent actions that cumulatively impact sea turtle nesting habitat. Impacts include changes to the physical and chemical beach environment. If a nourishment project results in compaction of sand, female turtles may be deterred from nesting on a particular beach (Ernest and Martin, 1999). As a result, FDEP permit conditions require compaction testing and/or tilling of the beach. Alteration of the natural profile of the beach can cause sea turtles to nest closer to the water for the first year or two after nourishment (Trindell et al., 2005). Nesting closer to the water elevates the risk of nests being washed away due to erosion or storms (USFWS, 2011). Beach nourishment can result in other chemical and physiological changes in natural beach sand qualities such as sand color and moisture content (Nelson and Dickerson, 1989; Grain et al., 1995). The color of sand plays a role in heat transfer and retention properties of the sand. Altered temperature characteristics of a nesting beach may affect the nest incubation environment, which can in turn alter the sex ratio of unborn sea turtles in the nest, as temperature plays a direct role in determining the sex of the hatchling (Yntema and Mrosovsky, 1982; Godfrey and Mrosovsky, 1999). The effects of a single nourishment on parameters such as the nesting success and sex ratio of a sea turtle population may be insignificant, but the cumulative effects over several years and several nourishment events may be detrimental to a local population of a species.

On the other hand, the cumulative effects of multiple beach nourishments which have occurred in and around the proposed Project Area may have a net positive benefit, leading to an overall increase in sea turtle nesting and hatchling success rates due to expansion of suitable nesting beaches. This is reasonable to expect, providing that fill material is compatible with native sands and the fill profile mimics the natural profile. The regular addition of suitable beach material to the shorelines provides additional nesting habitat and protects existing nesting beaches from future storm-induced erosion, given that the grain size and color, and placement profile remain similar to the native beach. The sand which will be used in the proposed Project will comply with State standards, and will be similar to existing beach sand.

Increasing the number of coastal armoring and nearshore control structures on Palm Beach Island may create potential obstacles to turtle hatchlings. However, as discussed above, the proposed groins will likely have minimal impacts, if any, to turtle hatchlings since they will be constructed of solid concrete panels and will be perpendicular to the shoreline with no T-head terminus. The groins will be buried within the beach fill immediately post-construction, and after three years they may extend 10-40 feet seaward of MHW.

6.1.2. SWIMMING SEA TURTLES

Five sea turtle species are listed by NMFS as potentially occurring offshore of Florida in the waters of the Atlantic: loggerhead, green, leatherback, hawksbill, and Kemp's ridley. Potential impacts to these species are described below.

<u>Direct and/or Indirect Effects</u>

Beach Nourishment

The proposed Project would utilize a truck haul approach, which minimizes or eliminates the use of in-water vessels and the potential for sea turtle entanglement, entrainment or strike. However, beach restoration projects can indirectly affect sea turtles by burying nearshore foraging habitat. Studies have identified twelve genera shown to be preferred food items of *C. mydas* (Makowski et al., 2006; Wershoven and Wershoven, 1989). Five of the fourteen macroalgal genera documented on intertidal and nearshore hardbottom during the 2013 characterization survey within the proposed Project Action Area were identified as sea turtle preferred species, including *Dictyota, Dictyopteris, Bryothamnion, Dasycladus,* and *Jania* (CB&I, 2014).

Based on the engineering and Delft3D modeling analyses, it is anticipated that the Applicants' Preferred Alternative may result in permanent impacts to between 3.86 and 3.99 acres of hardbottom, and temporary impacts to between 9.53 and 9.93 acres of hardbottom due to direct sand placement and subsequent spreading (equilibration) of sand. It is likely that federal and state permits will require construction of mitigative artificial reefs to offset these impacts and to provide habitat similar to the nearshore hardbottom being impacted; a preliminary UMAM evaluation determined that between 6.55 and 6.66 of mitigation may be required to offset anticipated impacts (Draft UMAM Analysis provided as Appendix H to EIS). During construction of the artificial reefs, there is potential for direct impacts from vessels to swimming sea turtles and indirect impacts from a temporary increase in turbidity and noise. The potential effect of anthropogenic noise on sea turtles, which may include physiological and behavioral aspects, is still largely unknown due to the limited knowledge and understanding of their hearing capabilities and behavorial response (Dow Piniak et al., 2013). All vessels will comply with NMFS *Sea Turtle and Smalltooth Sawfish Construction Conditions* (NMFS, 2006) in order to minimize direct impacts to swimming sea turtles during construction of the mitigative reef.

Groin Construction

The construction of the groins may occur from either the land or using in-water construction, or a combination of the two methods. The in water construction is unlikely due to the location of the nearshore hardbottom formations which will prevent barges from approaching the shoreline. If the groins are installed using in-water methods, direct impacts to swimming sea turtles include the possibility of vessel strike. Also, indirect impacts to swimming sea turtles include a temporary increase in turbidity and noise during construction. However, all vessels will comply with NMFS *Sea Turtle and Smalltooth Sawfish Construction Conditions* (NMFS, 2006) in order to minimize direct impacts to swimming sea turtles during construction of the groins.

<u>Effects of Interrelated or Interdependent Actions</u>

The proposed Project is planned to use a combination of stockpiled dredge material from the planned Phipps Project (alternating with use of a stockpile from the Mid-Town Project) within the Town of Palm Beach project limits (R-129-210 to R-134+135), and upland sand within the County project limits in South Palm Beach, Lantana, and Manalapan (R-134+135 to R-138+551). The Phipps and Mid-Town projects will utilize either a hopper or cutterhead dredge to pump beach quality sand from an offshore borrow area. Hopper dredging occasionally results in sea turtle entrainment and death, even with seasonal dredging windows, turtle deflector drag heads in place, and concurrent relocation trawling (NMFS, 1997). Incidental takes of sea turtles are typically not reported from clamshell, pipeline cutterhead, or other types of dredges operating along southeastern coasts (Dickerson et al., 2004); however, two loggerhead takes by a cutterhead dredge were recently reported during a nourishment project in Manatee County, Florida (USACE, 2014) and another in Boca Raton, Palm Beach County, Florida (NMFS, 2014a). Potential impacts from dredging of offshore borrow areas which will be the sand source for the

Project Area between (R-129-210 to R-134+135) will be evaluated separately in association the Phipps and Mid-Town projects.

Cumulative Effects

It is reasonable to expect that nourishment projects will continue to be periodically constructed along the Palm Beach Island in the future. The proposed projects may be authorized under a 10-year permit and would allow for initial project construction and maintenance (renourishment) for up to two renourishments.. All previous and future nourishment projects (discussed in section 2) on Palm Beach Island and nearby beaches represent actions that cumulatively impact sea turtle marine habitat. Nourishment projects that involved dredging offshore borrow areas have the potential to directly impact swimming sea turtles, and equilibration of fill may indirectly impact swimming sea turtles through burial of hardbottom which provides foraging habitat.

6.1.3. LOGGERHEAD CRITICAL HABITAT

The proposed Project includes construction on the dry beach as well as nearshore, in-water construction and sediment placement. The beach nourishment project and construction of the groins, while built outside of peak nesting season, may have indirect impacts to nesting beaches in the Action Area (see Section 6.1.1), including USFWS-designated critical habitat unit LOGG-T-FL-12. The proposed Project, including construction of groins and mitigative artificial reefs, may also affect nearshore waters within the Action Area (discussed in Section 6.1.2), including NMFS-designated critical habitat unit LOGG-N-19. However, the Project is not expected to adversely modify designated loggerhead critical habitat on the beach or in the nearshore marine environment. It is expected that with construction of the Project, the affected loggerhead critical habitat, both terrestrial and marine, will continue to serve in its intended conservation role for the species. The Project is not anticipated to have a significant effect on loggerhead species persistence or the function of the NWA DPS of loggerhead critical habitat as a whole. Recently, NMFS and USFWS made similar determinations for a groin project on Longboat Key, Florida. NMFS determined that the groins would increase the nesting habitat, would not obstruct transit of turtles through the surf zone to the open water, and would not increase the likelihood of predator concentration or cause wave patterns to be modified to the extent that it would disrupt orientation nor cause excessive longshore currents (NMFS, 2014b). USFWS determined that the Longboat Key groin project “may affect” loggerhead NWA DPS critical habitat, but that with incorporation with conservation measures and Terms and Conditions in the USFWS Biological Opinion (BO), the project would “not destroy or adversely modify” loggerhead terrestrial critical habitat (USFWS, 2014).

6.2. SMALLTOOTH SAWFISH

Direct and/or Indirect Effects

Beach Nourishment

There have been three smalltooth sawfish sightings offshore the Town of Palm Beach since April of 2011, indicating the Action Area is located within the range of this species. The nearshore marine environment within the Project Action Area supports rock and reef habitats; however, increased turbidity during construction and anticipated burial of hardbottom resources are unlikely to impact sawfish, since a minimal amount of sawfish encounters have occurred over rock and reef formations (4% each) compared to observations over mud (61%) (Poulakis and Seitz, 2004). The preferred mud-bottom mangrove habitat primarily utilized by this species does not occur within the Action Area. Also, the proposed Project utilizes a truck-haul methodology for the dune restoration and beach fill activities; therefore, direct impacts to smalltooth sawfish are not anticipated. However, it is likely that artificial reefs will be required to be constructed as mitigation to offset Project impacts to natural hardbottom resources. During construction of the artificial reef, there is potential for impacts from vessels to smalltooth sawfish. However, all vessels will comply with NMFS *Sea Turtle and Smalltooth Sawfish Construction Conditions* (NMFS, 2006) in order to minimize direct impacts to sawfish during construction of the mitigative reef.

Groin Construction

The contractor will have the option to construct the proposed groins from the land or using in-water construction, or a combination of the two methods. If the groins are installed using in-water methods, direct impacts to smalltooth sawfish include the possibility of vessel strike. However, all vessels will comply with NMFS *Sea Turtle and Smalltooth Sawfish Construction Conditions* (NMFS, 2006) in order to minimize direct impacts to smalltooth sawfish during construction of the groins.

Effects of Interrelated or Interdependent Actions

The proposed Project is planned to use a combination of stockpiled dredge material from the planned Phipps Project (alternating with use of a stockpile from the Mid-Town Project) within the Town of Palm Beach project limits (R-129-210 to R-134+135), and upland sand within the County project limits in South Palm Beach, Lantana, and Manalapan (R-134+135 to R-138+551). The Phipps and Mid-Town projects will utilize either a hopper or cutterhead dredge to pump beach quality sand from an offshore borrow area. While utilization of an offshore borrow area increases potential for impacts with smalltooth sawfish, NMFS has determined that there has never been a reported take of a smalltooth sawfish by a hopper dredge (NMFS, 1997).

Cumulative Effects

In addition to being decimated by recreational and commercial fishery bycatch, smalltooth sawfish are also subject to habitat alteration and degradation (Carlson et al., 2007). Although these fish primarily utilize mangroves, seagrass and river banks as habitat, they have also been observed on coral reefs and hardbottom. These habitats are found along the southeast Florida coastline and have been impacted by numerous coastal construction activities over the years. Coastal protection efforts along Palm Beach Island have included construction of structures and beach nourishment projects, and the inlets to the north and south of the island are periodically dredged. It is therefore reasonable to expect that these actions will continue to occur, having a cumulative impact on smalltooth sawfish habitat.

6.3. MAMMALS

6.3.1. FLORIDA MANATEE

Direct and/or Indirect Effects

Beach Nourishment

Florida manatees' preferred habitat is warm freshwater, estuarine and nearshore coastal waters. Feeding areas are located in coastal and riverine systems, where shallow seagrass communities are found (USFWS, 2001). Seagrass is not located within the Action Area, but manatees may use the Action Area as a travel corridor. The proposed Project utilizes a truck-haul methodology for the dune restoration and beach fill activities, therefore direct impacts to manatees are not anticipated. However, it is likely that artificial reefs will be required to be constructed as mitigation to offset project impacts to natural hardbottom resources. During construction of the artificial reef, there is potential for impacts from vessels to manatees. However, all vessels will comply with *Standard Manatee Construction Conditions for In-Water Work* (FWC, 2011) in order to minimize direct impacts to manatees during construction of the mitigative reef.

Groin Construction

If the proposed groins are installed using in-water methods, direct impacts to manatees include the possibility of vessel strike. However, all vessels will comply with *Standard Manatee Construction Conditions for In-Water Work* (FWC, 2011) to reduce the potential for manatee impacts.

Effects of Interrelated or Interdependent Actions

The proposed Project is planned to use a combination of stockpiled dredge material from the planned Phipps Project (alternating with use of a stockpile from the Mid-Town Project) within the Town of Palm Beach project limits (R-129-210 to R-134+135), and upland sand within the County project limits in South Palm Beach, Lantana, and Manalapan (R-134+135 to R-138+551). The Phipps and Mid-Town projects will utilize either a hopper or cutterhead dredge to pump beach quality sand from an offshore borrow area. While utilization of an offshore borrow area increases potential for impacts with manatees, all vessels will comply with *Standard Manatee Construction Conditions for In-Water Work* (FWC, 2011) to reduce the potential for manatee impacts.

Cumulative Effects

Coastal protection efforts along Palm Beach Island have included construction of structures and beach nourishment projects. It is reasonable to expect that these actions will continue to occur, though since they will not be directly impacting SAV habitat they will have a minimal cumulative impact on manatees.

6.3.2. FLORIDA PANTHER

Direct and/or Indirect Effects

The proposed Project is planned to utilize upland sand within the County project limits in South Palm Beach, Lantana, and Manalapan (R-134+135 to R-138+551). The upland sand will be delivered from the upland mine via truck-haul to the Project Area. The preferred upland mines where sand will be transported from via truck haul to the Project Area are not located within the Florida panther habitat zones; however, transport of sand along the roadways from the Ortona mine may intersect with panther habitat. Therefore, the increased traffic and noise disturbance may impact the Florida panther along the truck routes (FWC, 2012). Apart from potential temporary disturbances, no long-term negative effects are anticipated.

Effects of Interrelated or Interdependent Actions

The proposed Project is planned to utilize stockpiled dredge material from the planned Phipps Project (alternating with use of a stockpile from the Mid-Town Project) within the Town of Palm Beach project limits (R-129-210 to R-134+135). The activities associated with the Phipps and Mid-Town projects will not occur in any of the panther habitat zones; therefore no impacts to panthers are expected to occur.

Cumulative Effects

Florida panthers inhabit inland areas such as large forested and wetland areas. They do not utilize coastal and beach environments. While beach nourishment projects do not directly impact this species, as offshore sediment resources continue to be depleted, this may result in more frequent use of upland mines. Therefore, cumulative effects to Florida panthers may result from continued construction of beach nourishment projects utilizing upland sand sources.

6.4. CORALS – ACROPORID CORALS AND RECENTLY LISTED CARIBBEAN CORAL SPECIES

Direct and/or Indirect Effects

Although it is anticipated that the Applicants' Preferred Alternative may result in permanent impacts to between 3.86 and 3.99 acres of hardbottom, and temporary impacts to between 9.53 and 9.93 acres of hardbottom due to direct sand placement and subsequent spreading (equilibration) of sand, recent nearshore hardbottom surveys conducted in October 2013 supported previous nearshore hardbottom data, which have not documented any of the five recently listed coral species nor any *Acropora* colonies within the Action Area (PBC-ERM, 2013; CB&I, 2014). Based on nearshore survey data which show no records of these species in the shallow nearshore hardbottom habitat within the Action Area, it is likely that the Project (beach nourishment and groin construction) will not cause direct or indirect impacts to these seven listed coral species.

Effects of Interdependent or Interrelated Actions

The proposed Project is planned to utilize a combination of stockpiled dredge material from the planned Phipps Project (alternating with use of a stockpile from the Mid-Town Project) within the Town of Palm Beach project limits (R-129-210 to R-134+135), and upland sand within the project limits in South Palm Beach, Lantana, and Manalapan (R-134+135 to R-138+551). The Phipps and Mid-Town projects will utilize either a hopper or cutterhead dredge to pump beach quality sand from an offshore borrow area. Utilization of an offshore borrow area increases the potential for impacts to offshore hardbottom (beyond the Action Area for the proposed Project). These deeper areas of hardbottom may support some of the seven listed coral species; therefore, there could be potential direct impacts from pipelines or indirect impacts from turbidity and sedimentation.

Cumulative Effects

A. cervicornis and *A. palmata* populations have declined dramatically since the 1970s due primarily to bleaching and disease. The five recently listed threatened coral species have also experienced declines over the last several decades throughout their ranges. Anthropogenic influences such as physical damage (vessel groundings, anchors, divers/snorkelers), increased land-based sources of pollution, and coastal construction have exacerbated these declines resulting in a synergistic effect that greatly diminishes the survival of these corals. Additionally, while ocean acidification has not been demonstrated to have caused appreciable declines in coral populations so far, it is considered to be a significant threat to corals by 2100 (Brainard et al., 2011).

6.5. BIRDS

Direct and/or Indirect Effects

Piping plovers and rufa red knots have been observed in Palm Beach County (e-Bird, 2015a; 2015b). Heavy machinery and equipment (e.g., trucks and bulldozers operating on Project Area beaches) may adversely affect any migrating and wintering piping plovers within the Action Area by disturbance and disruption of normal activities such as roosting and feeding, and possibly forcing birds to expend additional energy reserves to seek available habitat elsewhere (i.e. north or south of the Action Area). Burial and suffocation of invertebrate species will occur during each nourishment and renourishment cycle. Research by Peterson et al. (2006) suggests that impacts to foraging habitat for shorebird species may be short-term due to the temporary depletion of the intertidal food base. Timeframes projected for benthic recruitment and re-establishment following beach nourishment are between six months and two years (Greene, 2002). Beach wrack has also been recognized as important to shorebirds, including piping plovers, for camouflage and foraging. Since piping plovers spend the majority of their overwintering time in Florida foraging along the shoreline, the wrack line provides an important foraging resource for this species. Destruction of wrack through beach nourishment eliminates this habitat. However, piping plovers may also experience some benefit from the stabilization of existing beach habitat and the increase in available roosting habitat from this Project.

Construction of dunes associated with the proposed Project can lead to stabilization of the shoreline which, while beneficial to beach infrastructure as well as wildlife that utilize the beach such as nesting sea turtles, can potentially prevent the formation of overwashes which are an important habitat utilized by piping plovers. However, the Action Area for the Project contains and has historically contained dunes which have prevented the formation of overwash areas. Overwash areas do not exist in the Action Area; therefore, the proposed Project will not impact this type of habitat. Heavy construction equipment associated with dune construction and potential planting activities may also deter piping plover from utilizing the area on their migration routes, resulting in these birds selecting other suitable overwintering sites outside the Action Area.

Effects of Interdependent or Interrelated Actions

The proposed Project is planned to utilize a combination of stockpiled dredge material from the planned Phipps Project (alternating with use of a stockpile from the Mid-Town Project) within the Town of Palm Beach project limits (R-129-210 to R-134+135), and upland sand within the County project limits in South Palm Beach, Lantana, and Manalapan (R-134+135 to R-138+551). The construction of the Phipps Project and the stockpile of sand (alternating with use of a stockpile from the Mid-Town Project) that will be used for the proposed Project will involve the use of construction machinery and equipment on the beach and within potential piping plover roosting and foraging habitat. This activity may have impacts on the beaches including depletion of intertidal and beach infauna, and temporary disruption of roosting and foraging by piping plovers. Apart from potential temporary disturbances, no long-term negative effects to these birds are anticipated.

Cumulative Effects

Piping plovers and rufa red knots overwinter along Florida's coastline and forage along the sandy beaches of the Action Area and adjacent shorelines. Although infauna recovery has been documented after beach renourishment projects, the repetitive burial of beach infauna may eventually change the abundance and composition of infaunal communities, which can in turn affect food sources for the piping plover. Additionally, large-scale removal of beach wrack associated with beach grooming programs (beach cleaning and raking) removes habitat used by piping plovers for foraging and camouflage. It is reasonable to expect that nourishment projects will continue to be periodically constructed along the Palm Beach Island in the future. The proposed projects may be authorized under a 10-year permit and would allow for initial project construction and maintenance (renourishment) for up to three renourishments. All previous and future nourishment projects (discussed in Section 2.2) on Palm Beach Island and nearby beaches represent actions that may cumulatively impact piping plover and rufa red knot habitat.

6.6. BEACH JACQUEMONTIA

Direct and/or Indirect Effects

The presence of construction equipment used for beach nourishment and dune projects may mechanically damage existing plants, while sand placement, if done improperly, may bury extant plants. However, naturally occurring beach jacquemontia has become rare in Palm Beach County and, based on a recent survey, it has not been observed within the Action Area for the proposed Project (CB&I, 2014). Therefore, construction activities in the form of truck haul beach nourishment will not have any negative effects to beach jacquemontia.

Effects of Interdependent or Interrelated Actions

The proposed Project is planned to utilize a combination of stockpiled dredge material from the planned Phipps Project (alternating with use of a stockpile from the Mid-Town Project) within the Town of Palm Beach project limits (R-129-210 to R-134+135), and upland sand within the project limits in South Palm Beach, Lantana, and Manalapan (R-

134+135 to R-138+551). Beach jacquemontia is not found within the Action Area, therefore there is no potential for impacts to this species (FTG, 2003; CB&I, 2014).

Cumulative Effects

It is reasonable to expect that nourishment projects will continue to be periodically constructed along the Palm Beach Island in the future. The proposed projects may be authorized under a 10-year permit and would allow for initial project construction and maintenance (renourishment) for up to three renourishments. All previous and future nourishment projects on Palm Beach Island and nearby beaches represent actions that have the potential to cumulatively impact dune vegetation; however, beach jacquemontia is not known to occur on Palm Beach Island, so there are no cumulative impacts expected to this species (FTG, 2003; CB&I, 2014).

6.7. EASTERN INDIGO SNAKE

Direct and/or Indirect Effects

The proposed Project is planned to utilize upland sand within the County project limits in South Palm Beach, Lantana, and Manalapan (R-134+135 to R-138+551). The upland sand will be delivered from the upland mine via truck-haul to the Project Area. The preferred upland mines where sand will be transported from via truck haul to the Project Area are not located in habitats frequented by the eastern indigo snake (i.e. sandhill regions dominated by mature longleaf pines; hardwood forests; moist hammocks; and areas that surround cypress swamps). However, transport of sand along the roadways from the Ortona mine may intersect with these habitats. Therefore, the increased traffic and noise disturbance may impact the eastern indigo snake along the truck routes. Apart from potential temporary disturbances, no long-term negative effects are anticipated.

Effects of Interrelated or Interdependent Actions

The proposed Project is planned to utilize stockpiled dredge material from the planned Phipps Project (alternating with use of a stockpile from the Mid-Town Project) within the Town of Palm Beach project limits (R-129-210 to R-134+135). The activities associated with the Phipps and Mid-Town projects will not occur in any of the preferred habitat of eastern indigo snakes; therefore no impacts to eastern indigo snakes are expected to occur.

Cumulative Effects

Eastern indigo snakes primarily inhabit inland areas such as sandhill regions, flatwoods, praires, and hammocks. They do utilize coastal dune environments; however, much of the native dune system with the Action Area has been lost to beach erosion and intense coastal development. While beach nourishment projects do not directly impact this species, as offshore sediment resources continue to be depleted, this may result in more frequent use of upland mines. Therefore, cumulative effects to eastern indigo snakes may result from continued construction of beach nourishment projects utilizing upland sand sources.

7.0. CONSERVATION MEASURES SUMMARY

The conservation measures that will be taken to protect federally listed species and their habitat will follow construction guidelines as set forth by state and federal agencies. The following conservation measures will be implemented during project construction and during project-related activities.

7.1. SEA TURTLE CONSERVATION MEASURES

- *Project Timing*. Construction is anticipated to occur between November 1 and April 30 in order to avoid peak sea turtle nesting season. Should construction encroach into the nesting season, construction will comply with all permit and BO conditions. Construction will occur during daylight hours only, reducing the likelihood of interactions between machinery and nesting or hatchling sea turtles.

- *Construction Methods*. As proposed, this Project will be constructed using a truck-haul methodology, utilizing a combination of stockpiled dredge material from the planned Phipps Project (alternating with use of a stockpile from the Mid-Town Project) and upland sand resources, thus minimizing the potential for turtle take normally associated with dredging (dredging will be permitted separately for the Phipps and Mid-Town projects). Any in water support vessels that may be used for turbidity monitoring and/or to assist with construction of the proposed groins and artificial reefs will comply with the NMFS 2006 *Sea Turtle and Smalltooth Sawfish Construction Conditions.* These conditions require educating project personnel on how to monitor for the presence of sea turtles and how to respond if any are observed during water-related project activities. These conditions stipulate that if a sea turtle is observed within 100 yards of construction operations, all appropriate precautions shall be implemented to ensure its protection, including cessation of operation if the animal moves within 50 ft of any moving equipment. Any collision or injury to a sea turtle must be reported immediately to NMFS.

- *Compatibility of Sand with Native Beach Material*. All sand material placed will be similar to that already existing at the beach site in both coloration and grain size distribution and will be suitable for sea turtle nesting. The proposed Project is planned to utilize a combination of stockpiled dredge material from the planned Phipps Project (alternating with use of a stockpile from the Mid-Town Project) within the Town of Palm Beach project limits (R-129-210 to R-134+135), and upland sand within the project limits in South Palm Beach, Lantana, and Manalapan (R-134+135 to R-138+551). All sand will meet the requirements of Florida Administrative Code, Rule 62B-41.007(2)(j), ensuring that the sand material will be compatible with the existing beach sand. Sand will also comply with County sand specifications. Beach compatible sand is material that maintains the general character and functionality of the material occurring on the beach and in the adjacent dune and coastal system. Using sediment with similar grain size, carbonate content and color to that found on the existing beach minimizes impacts to sea turtle nesting and hatchling success (Greene, 2002).

- *Monitoring and Nest Relocation.* Sea turtle monitoring, nest evaluation and protection measures shall be conducted by marine turtle permit holders during the nesting season from March 1 through October 31. If construction occurs during sea turtle nesting season, the Applicants will coordinate directly with FWC on appropriate monitoring protocol and precautionary measures to follow in order to minimize impacts to nesting sea turtles and hatchlings. FWC guidelines will be used during any sea turtle monitoring and/or nest relocation activities related to project construction. Nighttime surveys for leatherback sea turtles shall begin when the first leatherback crawl is recorded per the terms and conditions (A9(a)) in the Statewide Programmatic Biological Opinion (SPBO).

- *Project Lighting*. Construction will be limited to daylight hours only; therefore, there will be no project lighting required. Beachfront lighting is regulated by the Palm Beach County Unified Land Development Code (ULDC) Article 14.A, Sea Turtle Protection and Sand Ordinance and the Palm Beach County Department of Environmental Resources Management (PBC-ERM) is responsible for implementing its measures. This ordinance requires that all coastal construction adhere to strict guidelines to eliminate impacts to sea turtles. Within the Project Area, Lantana and Manalapan are within the jurisdiction of the Article 14.A, ULDC, and The Town of Palm Beach and South Palm Beach have opted-out of the ordinance. Post-construction lighting surveys will also be conducted to monitor for any increased exposure to artificial light sources.

- *Beach Maintenance*. Immediately following completion of the Project, and prior to March 1 for three subsequent years, the Town of Palm Beach and the County will conduct beach tilling along the length of the Project Area as required by permits and the BO. This will reduce or prevent compaction of the nourished beach that could impact sea turtle nesting. During sea turtle nesting season, weekly visual surveys for escarpment formation will be conducted within the Project Area in compliance with permit requirements. These surveys will be conducted for three nesting seasons following beach nourishment. Any escarpments which exceed 46 cm (18 in) in height for a distance of 30 m (100 ft) will be reported in writing to the FDEP and mechanically leveled to the natural beach contour prior to March 1.

- *Mitigation Reefs*. In-water work for construction of mitigative artificial reefs would require implementation of the NMFS 2006 *Sea Turtle and Smalltooth Sawfish*

Construction Conditions. The reef construction would not be required to be restricted during the non-nesting season, and may occur during the calmer summer months to ensure proper reef construction and vessel maneuvering. Additionally, the reefs may increase the available habitat for sea turtles, in particular juvenile green turtles which may utilize the reef for shelter and foraging opportunities.

7.2. SMALLTOOTH SAWFISH CONSERVATION MEASURES

- *Construction Methods*. As proposed, this Project will be constructed using a truck-haul methodology, utilizing a combination of stockpiled dredge material from the planned Phipps Project (alternating with use of a stockpile from the Mid-Town Project) and upland sand resources, thus reducing potential impacts to smalltooth sawfish. Any in water support vessels that may be used for turbidity monitoring and/or to assist with construction of the proposed groins and artificial reefs will comply with the NMFS 2006 *Sea Turtle and Smalltooth Sawfish Construction Conditions* to further reduce potential smalltooth sawfish impacts. These conditions stipulate that if a sawfish is observed within 91 m (300 ft) of construction operations, all appropriate precautions shall be implemented to ensure its protection, including cessation of operation if the animal moves within 15 m (50 ft) of any moving equipment. Any collision or injury to a sawfish must be reported immediately to NMFS.

7.3. FLORIDA MANATEE CONSERVATION MEASURES

- *Construction Methods*. As proposed, this Project will be constructed using a truck-haul methodology, thus reducing potential impacts to manatees. Any in water support vessels that may be used for turbidity monitoring and/or to assist with construction of the proposed groins and mitigative artificial reefs will comply with the FWC 2011 *Standard Manatee Construction Conditions for In-Water Work*. These conditions include protection measures that will minimize the potential for significant impacts to manatees by project-related activities. This includes: operation of vessels at ‘idle speed/no wake’ at all times while in the immediate area and when the draft of the vessels provides less than four feet of clearance from the bottom; immediate shutdown of all in-water operations if a manatee comes within 15 m (50 ft) of construction activities; posting of temporary signs concerning manatees prior to and during all in-water activities; use of turbidity barriers that manatees cannot become entangled in; and, reporting any collisions or injury to a manatee to FWC and USFWS.

7.4. CORAL CONSERVATION MEASURES

- *Hardbottom Surveys.* In anticipation of the proposed Project, Palm Beach County conducted an *Acropora* survey on the nearshore hardbottom within the Action Area in October 2013 (provided as Appendix C to the EIS). The survey followed the NMFS 2007 Recommended Survey Protocol for *Acropora* spp (NMFS, 2007). No *Acropora* was observed during these investigations (PBC-ERM, 2013). CB&I also conducted a hardbottom characterization survey in the Action Area in October 2013, during which no *Acropora* spp and none of the five recently listed threatened Caribbean coral species were observed (CB&I, 2014). While no listed coral species are found within the Action Area for the proposed Project, a preliminary UMAM evaluation estimates that between 6.55 and 6.66 acres of mitigative artificial reef would be required to offset permanent impacts to between 3.86 and 3.99 acres of hardbottom, and temporary impacts to between 9.53 and 9.93 acres of hardbottom. Mitigation and monitoring for project impacts to hardbottom habitat will be implemented in compliance with permit requirements.

7.5. SHOREBIRD CONSERVATION MEASURES

- *Shorebird Surveys and Construction Methods*. It is likely that construction of the proposed Project will be required to follow the Conservation Measures outlined in the USFWS Programmatic Piping Plover Biological Opinion (P^3BO), which addresses impacts from shore protection activities on the non-breeding piping plover (USFWS, 2013d). These measures may include: implementation of surveys for non-breeding shorebirds (including red knots), placement of equipment in areas that would not be expected to be utilized by shorebirds, and other efforts such as a designated travel corridor for driving on the beach for construction, predator-proof trash receptacles, and educational signs at public access points.

8.0. EFFECTS DETERMINATIONS

Tables 8-1 and 8-2 present the effects determinations for each listed and proposed species and critical habitat with the potential to occur in the Action Area from beach nourishment and dune restoration (Table 8-1) and from construction of seven low profile groins (Table 8-2). These May Affect, Likely to Adversely Affect; May Affect, Not Likely to Adversely Affect (MANLAA); and No Effect determinations were concluded based upon the existing information available for each species and its occurrence, as well as conservation, monitoring and mitigation measures to avoid and minimize impacts to listed species. Determinations were also made as to whether or not the Project would adversely modify critical habitat within the Action Area. These effect determinations are presented in two separate tables to differentiate effects from beach nourishment and dune restoration (Table 8-1) and from construction of seven low profile groins (Table 8-2) in order to facilitate consultation with USFWS and NMFS on the separate projects proposed by the Town of Palm Beach and the County. Note that for sea turtles, separate effects determinations were made for species during nesting (under USFWS jurisdiction) and swimming (under NMFS jurisdiction) phases.

Table 8-1. Recommended effects determinations for federally listed and proposed species and critical habitat potentially occurring in the Action Area from beach nourishment and dune restoration.

Common Name	Scientific Name	Effects Determination
SEA TURTLES		**Nesting/In-Water**
Green	*Chelonia mydas*	Likely to adversely affect/No effect[1]
Hawksbill	*Eretmochelys imbricata*	MANLAA/No effect[1]
Kemp's Ridley	*Lepidochelys kempii*	MANLAA/No effect[1]
Leatherback	*Dermochelys coriacea*	Likely to adversely affect/No effect[1]
Loggerhead	*Caretta caretta*	Likely to adversely affect/No effect[1]
Eastern indigo snake	*Drymarchon corais couperi*	MANLAA
FISH		
Smalltooth sawfish	*Pristis pectinata*	No effect[1]
MAMMALS		
Florida manatee	*Trichechus manatus latirostris*	MANLAA
Florida panther	*Puma concolor coryi*	MANLAA
CORALS		
Boulder star coral	*Orbicella annularis*	No effect
Elkhorn coral	*Acropora palmata*	No effect
Mountainous star coral	*Orbicella faveolata*	No effect
Pillar coral	*Dendrogyra cylindrus*	No effect
Rough cactus coral	*Mycetophyllia ferox*	No effect
Staghorn coral	*Acropora cervicornis*	No effect
Star coral complex	*Orbicella franksi*	No effect
BIRDS		
Piping plover	*Charadrius melodus*	MANLAA
Rufa red knot	*Calidris canutus rufa*	MANLAA
PLANTS		
Beach jacquemontia	*Jacquemontia reclinata*	No effect

Table 8-1 (cont.). Recommended effects determinations for federally listed and proposed species and critical habitat potentially occurring in the Action Area from beach nourishment and dune restoration.

Common Name	Scientific Name	Effects Determination
CRITICAL HABITAT		
Acropora spp.		Will not adversely modify the Florida Unit
Loggerhead		Will not adversely modify designated terrestrial (USFWS) or marine (NMFS) critical habitat units

[1]If permits require construction of artificial reef habitat as mitigation for hardbottom impacts, then effects determination for swimming sea turtles and smalltooth sawfish is MANLAA.

Table 8-2. Recommended effects determinations for federally listed and proposed species and critical habitat potentially occurring in the Action Area from groin construction.

Common Name	Scientific Name	Effects Determination
SEA TURTLES		**Nesting/In-Water**
Green	*Chelonia mydas*	Likely to adversely affect/MANLAA
Hawksbill	*Eretmochelys imbricata*	MANLAA/MANLAA
Kemp's Ridley	*Lepidochelys kempii*	MANLAA/MANLAA
Leatherback	*Dermochelys coriacea*	Likely to adversely affect/MANLAA
Loggerhead	*Caretta caretta*	Likely to adversely affect/MANLAA
Eastern indigo snake	*Drymarchon corais couperi*	MANLAA
FISH		
Smalltooth sawfish	*Pristis pectinata*	MANLAA
MAMMALS		
Florida manatee	*Trichechus manatus latirostris*	MANLAA
Florida panther	*Puma concolor coryi*	MANLAA
CORALS		
Boulder star coral	*Orbicella annularis*	No effect
Elkhorn coral	*Acropora palmata*	No effect
Mountainous star coral	*Orbicella faveolata*	No effect
Pillar coral	*Dendrogyra cylindrus*	No effect
Rough cactus coral	*Mycetophyllia ferox*	No effect
Staghorn coral	*Acropora cervicornis*	No effect
Star coral complex	*Orbicella franksi*	No effect
BIRDS		
Piping plover	*Charadrius melodus*	MANLAA
Rufa red knot	*Calidris canutus rufa*	MANLAA
PLANTS		
Beach jacquemontia	*Jacquemontia reclinata*	No effect

Table 8-2 (cont.). Recommended effects determinations for federally listed and proposed species and critical habitat potentially occurring in the Action Area from groin construction.

Common Name	Scientific Name	Effects Determination
CRITICAL HABITAT		
Acropora spp.		Will not adversely modify the Florida Unit
Loggerhead		Will not adversely modify designated terrestrial (USFWS) or marine (NMFS) critical habitat units

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SOUTHERN PALM BEACH ISLAND COMPREHENSIVE SHORELINE STABILIZATION PROJECT

Essential Fish Habitat

U.S. Army Corps of Engineers
Jacksonville District

June 2016

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SOUTHERN PALM BEACH ISLAND COMPREHENSIVE SHORELINE STABILIZATION PROJECT ESSENTIAL FISH HABITAT ASSESSMENT

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1.0. INTRODUCTION

The Magnuson Fishery Conservation and Management Act of 1976, amended Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act, MSFCMA) by the Sustainable Fisheries Act of 1996, set forth a mandate to identify and protect important marine and estuarine fish and their habitat. The U.S. Congress enacted the Magnuson-Stevens Act to support the government's goal of sustainable fisheries. Crucial to achieving this goal is the maintenance of suitable marine fishery habitat quality and quantity. This goal is achieved through identifying and describing Essential Fish Habitat (EFH), describing non-fishing and fishing threats, and suggesting measures to conserve and enhance EFH. The Magnuson-Stevens Act defines EFH as "...those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (16. U.S.C. 1802 (10))."

Rules promulgated by the National Marine Fisheries Service (NMFS) in 2002 further clarify EFH with the following definitions: **waters** - aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; **substrate** - sediment, hardbottom, structures underlying the waters, and associated biological communities; **necessary** - the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and **spawning, breeding, feeding, or growth to maturity** - stages representing a species' full life cycle. EFH may be a subset of all areas occupied by a species. The 1996 amendments to the Magnuson-Stevens Act require regional fishery management councils and federal agencies to promote protection, conservation, and enhancement of EFH. The EFH provisions of the Magnuson-Stevens Act support one of the Nation's overall marine resource management goals -maintaining sustainable fisheries. Achieving this goal requires maintenance of the quality and quantity of habitats necessary for fishery resources.

The EFH mandates of the Magnuson-Stevens Act represent an effort to integrate fishery management, and habitat management by stressing the dependency of healthy, productive fisheries on the maintenance of viable and diverse estuarine and marine ecosystems. The consultation requirements in the Magnuson-Stevens Act direct federal agencies to consult with the National Oceanic and Atmospheric Administration's (NOAA) NMFS when any of their activities may have an adverse effect on EFH. An adverse effect is defined by EFH rules as "any impact which reduces quality and/or quantity of EFH… [and] may include direct, indirect, site-specific, or habitat wide impacts, including individual, cumulative, or synergistic consequences of actions" (50 CFR 600.810). The purpose of this EFH Assessment, as required by the Magnuson-Stevens Act, is to identify all EFH and managed species that may occur within the proposed Project Area for the Southern Palm Beach Island Comprehensive Shoreline Stabilization Project, and to examine potential adverse effects to these resources.

The South Atlantic Fisheries Management Council (SAFMC), one of eight regional fishery management councils in the United States, currently manages eight fisheries, including: penaeid shrimp, snapper grouper complex, Coastal Migratory Pelagic (CMP) species, golden crabs, spiny lobsters, coral and live bottom habitat, dolphin and wahoo, and sargassum (SAFMC, 2014a; Iverson, pers. comm., 2010). Red drum were jointly managed in state and federal waters by the SAFMC and the Atlantic States Marine Fisheries Commission (ASMFC) for nearly two decades, but the management of red drum was transferred to the ASMFC in 2008 and so this species is not assessed in this document (Arnott et al., 2013; Sramek, pers. comm., 2014; Karazsia, pers. comm., 2014). In addition to the fishery management plans (FMP) prepared by SAFMC, NMFS (Highly Migratory Species Management Unit, Office of Sustainable Fisheries) manages highly migratory species (HMS) such as tunas, billfishes, sharks, and swordfish. Some of the species managed by SAFMC and NMFS also fall under the jurisdiction of the ASMFC, which manages fishery resources from Maine through Florida.

During consultation, consideration must also be given to Habitats of Particular Concern (HAPC), which are described as subsets of EFH which are rare, particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally stressed area (NMFS, 2010). SAFMC has determined that the nearshore hardbottom resources from Cape Canaveral to Broward County, Florida, including the resources located adjacent to the Project Area, meet the criteria as HAPC for coral, coral reefs and live/hardbottom (SAFMC, 2009a, 2011).

The Town of Palm Beach and Palm Beach County (County) have both proposed shoreline stabilization projects that are adjacent to one another. The U.S. Army Corps of Engineers (USACE) determined that the proposed projects are "similar actions", and is therefore evaluating the environmental effects of these projects together (78 FR 40128). The comprehensive project has been named the Southern Palm Beach Island Comprehensive Shoreline Stabilization Project (the Project) and the Project Area comprises approximately 2.07 miles of shoreline and nearshore environment from Florida Department of Environmental Protection (FDEP) R-monuments R-129-210 to R-138+551 (Figure 1-1).

The USACE serves as the lead federal agency for Endangered Species Act (ESA) Section 7 and EFH consultations for this Project, and determined that an Environmental Impact Statement (EIS) was required - this EFH Assessment will supplement the EIS. The two projects that make up the Southern Palm Beach Island Comprehensive Shoreline Stabilization Project will each be constructed by the separate Applicants: the Town of Palm Beach and the County. While the USACE is evaluating the environmental effects of these projects together, the USACE will complete EFH consultation for the Town of Palm Beach and the County projects separately in association with their respective permit applications. This EFH assessment will assist NMFS Habitat Conservation Division with EFH consultation for both permit applications.

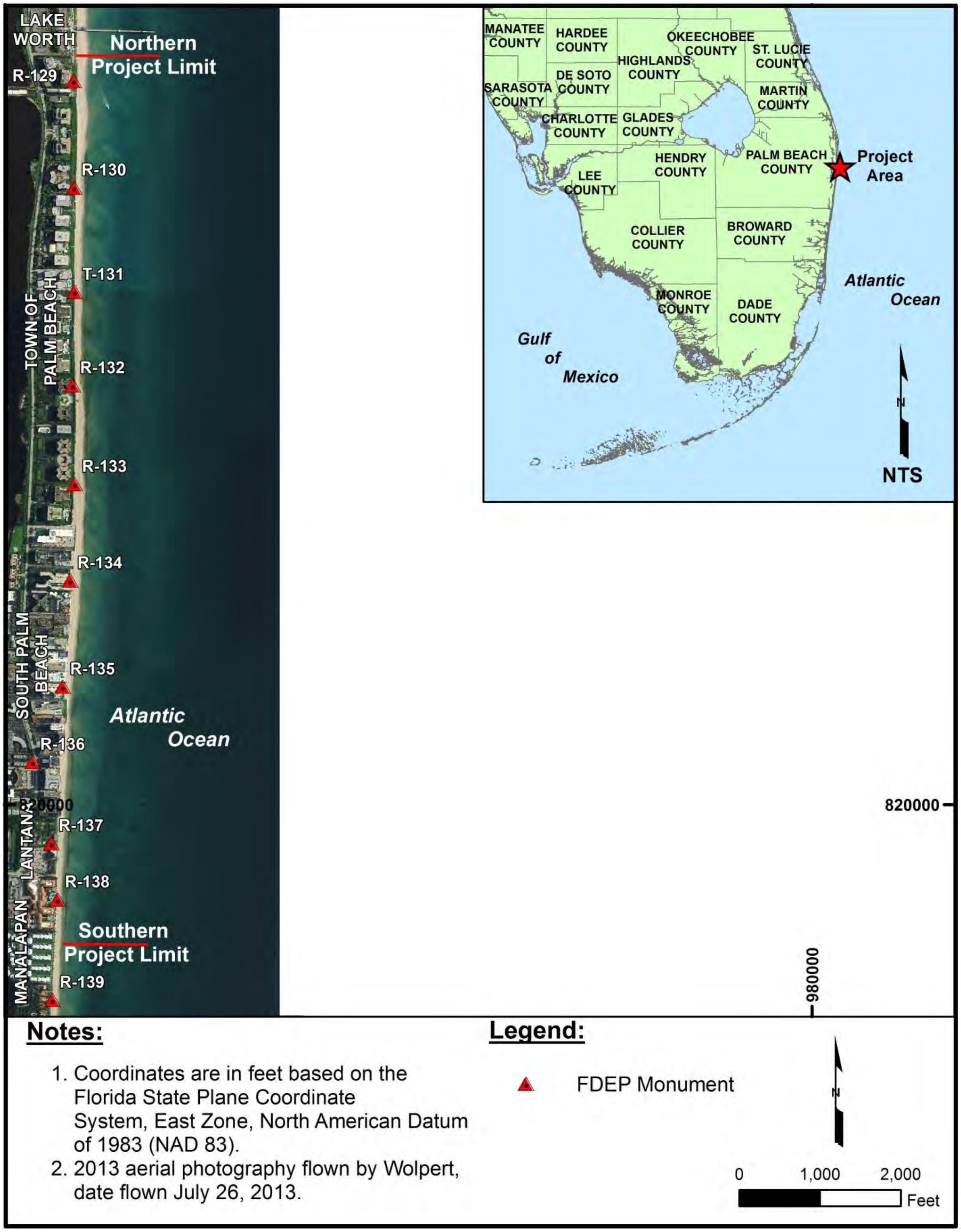


Figure 1-1. Location map of the Project Area.

This EFH Assessment includes: 1) a description of the proposed Project; 2) a description of EFH in the Project Area; 3) a description of managed species and life stages within the EFH and the HAPC located within the Project Area; 4) an assessment of anticipated impacts to the EFH; and 5) a discussion of proposed mitigation measures to minimize impacts to EFH.

The Project Area falls under the jurisdiction of the SAFMC, which is responsible for the conservation and management of fish stocks within the federal 200-mile limit of the Atlantic Ocean off the coasts of North Carolina, South Carolina, Georgia, and east Florida to Key West. Table 1-1 lists the important habitats within estuarine and marine areas of the South Atlantic region as designated by the comprehensive EFH amendment (SAFMC, 1998) and Fishery Ecosystem Plan (SAFMC, 2008). Although unconsolidated (soft) bottom is not defined as an EFH category in FMP Amendments by the SAFMC, it has been listed as EFH for certain life stages of snapper grouper, spiny lobster and shrimp FMPs (SAFMC, 2014b), and is therefore also included in Table 1-1. The Project Area encompasses only marine areas, specifically nearshore hardbottom and coral habitat, water column, and unconsolidated (soft) bottom.

Table 1-1. Essential Fish Habitat Identified in Fishery Management Plan Amendments of the South Atlantic Fisheries Management Council (SAFMC, 1998, 2008, 2014b; NMFS, 2010).

ESTUARINE AREAS	MARINE AREAS
Estuarine Emergent Wetlands Estuarine Scrub/Shrub Mangroves Submerged Aquatic Vegetation Oyster Reefs & Shell Banks Intertidal Flats Palustrine Emergent & Forested Wetlands Aquatic Beds Estuarine Water Column	Live / Hardbottom Coral & Coral reefs Artificial / Manmade reefs Sargassum Water Column Unconsolidated bottom (soft sediments)

2.0. PROJECT DESCRIPTION

2.1. PROPOSED PROJECT

The Applicants' goals and objectives for both nourishment projects are to provide more sand to the littoral system, create a stable beach and dune profile that will buffer the effects of storm surge and wave action, provide wildlife habitat, allow for recreational use, and protect upland infrastructure. The Proposed Project (designated as the Applicants' Preferred Project Alternative, "Project") is a combination of beach nourishment, dune nourishment, and coastal structures (Figure 2-1). Alternatives to the Preferred Project which are also being considered are presented below. These alternatives include scenarios in which only some (or none) of the elements of the Preferred Project are constructed and/or modified. This EFH evaluates potential impacts from the Applicants' Preferred Project Alternative (Alternative 2 below), which includes all potential project components: dune only, dune and beach nourishment, and beach nourishment with groins (Figure 2-1). All seven project alternatives were modeled using three grain sizes for the Town of Palm Beach (0.26, 0.36, and 0.60 mm) and one grain size for the County (0.36 mm) and are described in detail in the Southern Palm Beach Island Comprehensive Shoreline Stabilization Project EIS:

1. No Action Alternative (Status Quo)
2. The Applicants' Preferred Alternative: Beach and Dune Fill with Shoreline Protection Structures Project
3. The Applicants' Preferred Project without Shoreline Protection Structures
4. The Town of Palm Beach Preferred Project and County Increased Sand Volume Project without Shoreline Protection Structures
5. The Town Of Palm Beach Increased Sand Volume Project and County Preferred Project
6. The Town of Palm Beach Increased Sand Volume Project and County Increased Sand Volume Project without Shoreline Protection Structures

7b. The Town of Palm Beach Increased Sand Volume with Two Shoreline Protection Structures (The Coalition to Save Our Shoreline, Inc. (SOS) Alternative) and the County Preferred Project

Figure 2-1. Proposed Southern Palm Beach Island Comprehensive Shoreline Stabilization Project.

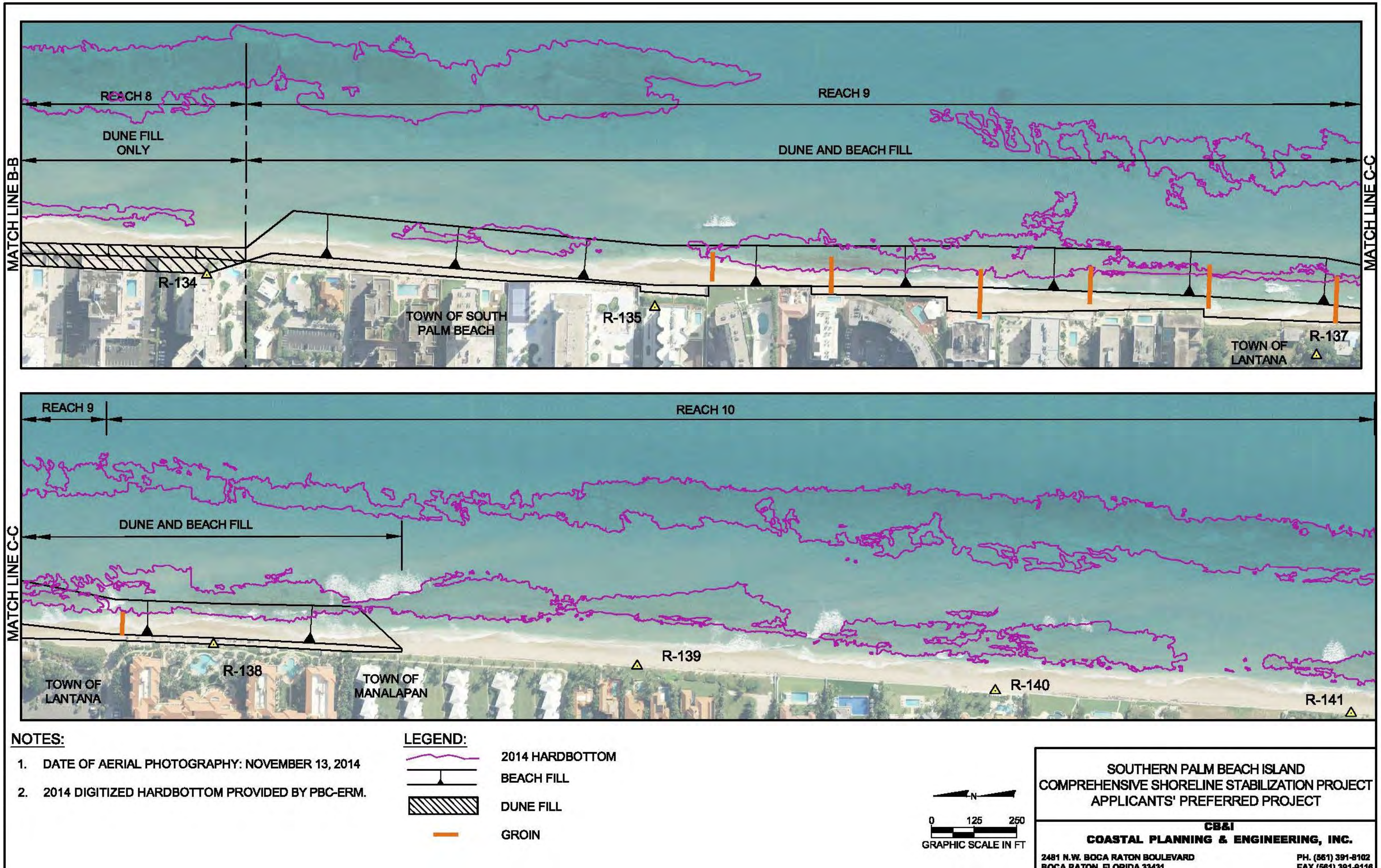


Figure 2-1 (cont.). Proposed Southern Palm Beach Island Comprehensive Shoreline Stabilization Project.

Table 2-1 presents the volumes required to implement each alternative based on physical surveys conducted in 2008/2009, 2011/2012 and 2014. All three of these conditions are presented for the following reasons: 1) the original project was developed based on 2008 conditions; 2) the modeling conducted during the initial analysis for this EIS in 2013 was based on the most recent conditions at the time (2011/2012); and 3) based on public comments, even more recent data was analyzed (2014), which was included in the Storm Induced Beach Change (SBEACH) analysis. Based on 2014 conditions, the Project would place approximately 142,800 cy of sand between R-129-210 and R-138+551 along the shorelines of the Towns of Palm Beach, South Palm Beach, Lantana and Manalapan (Figure 2-1). The sand volume will be split between the two Applicants' project areas – 65,200 cy of sand in the Town of Palm Beach and 77,600 cy in the County project area (Towns of South Palm Beach, Lantana and Manalapan). Sand placement below mean high water (MHW) includes approximately 3,400 cy within the Town of Palm Beach and approximately 26,600 cy within the County shoreline. The actual volume of sand needed to construct the project will be dependent on the project template and the condition of the beach (based on results of a physical survey) immediately prior to construction. From north to south, the Project would place dune sand only from R-129-210 to R-129+150, dune and beach sand from R-129+150 to T-131, dune sand only from T-131 to R-134+135 (Town of Palm Beach southern limit), and beach sand with seven (7) low-profile groins from R-134+135 to R-138+551. The groins would be placed perpendicular to the shoreline extending from the existing seawalls to the post-construction (beach fill) waterline.

Table 2-1. Construction template fill volumes (cy) based on surveys between 2008-2014.

Construction Template Fill Volumes (CY)				
Alternative	**Survey Area**	**2008/2009 Survey**	**2011/2012 Survey**	**2014 Survey**
Alternative 1	TOPB	0	0	0
	PB County	0	0	0
	Total	**0**	**0**	**0**
Alternative 2	TOPB	75,000	53,800	65,200
	PB County	75,000	63,500	77,600
	Total	**150,000**	**117,300**	**142,800**
Alternative 3	TOPB	75,000	53,800	65,200

	PB County	75,000	63,500	77,600
	Total	**150,000**	**117,300**	**142,800**
Alternative 4	TOPB	75,000	53,800	65,200
	PB County	160,000	172,100	187,800
	Total	**235,000**	**225,900**	**253,000**
Alternative 5	TOPB	96,000	100,900	121,700
	PB County	75,000	63,500	77,600
	Total	**171,000**	**164,400**	**199,300**
Alternative 6	TOPB	96,000	100,900	121,700
	PB County	160,000	172,100	187,800
	Total	**256,000**	**273,000**	**309,500**
Alternative 7b	TOPB	n/a	166,500	175,500
	PB County	n/a	63,500	77,600
	Total	**--**	**230,000**	**253,100**

It is anticipated that the mechanism for sand placement would involve use of a truck-haul approach. The sand source would be a combination of stockpiled dredge material from the Reach 7 Phipps Ocean Park Beach Restoration Project (Phipps) (SAJ-2000-00380) or the Mid-Town Beach Restoration Project (Mid-Town) (SAJ-1995-03779) for placement within the Town of Palm Beach project limits, and upland sand for placement within the County project limits. The Phipps and Mid-Town projects would utilize either a hopper or cutterhead dredge to obtain beach quality sand from an offshore borrow area. If the project schedules do not coincide, the Town of Palm Beach may truck in sand from upland mines. The Project has been designed at a nourishment interval of 3-4 years, depending on the rate of erosion. A shorter frequency between sand placement events would be expected if the erosion rate is accelerated due to hurricanes, tropical storms, swell events, nor'easters, or other shoreline eroding events. Future beach nourishment projects can be expected to match the currently proposed beach and dune profile, and require a similar volume of sand. The groin construction would only occur during the first construction event, but may require future operations and maintenance. Future maintenance of groins would require separate USACE authorization.

2.1.1. TRUCK HAUL OPERATIONS

Utilizing a truck-haul approach for a beach nourishment project involves several stages of transport: loading of material at the mine site, road transport via dump trucks, beachside delivery and stockpiling, transfer from stockpile to off-road vehicles, beach transport, placement, and finally, spreading of material and grooming to the design shape; however, if the project schedules do not coincide, the Town of Palm Beach may truck in sand from upland mines. The County prefers to utilize sand only from an upland mine.

Sand from either source must meet FDEP requirements for beach sand compatibility as per Florida Administrative Code (F.A.C.), Rule 62B-41.007(2)(j). These criteria apply to all beaches in Florida so that the sand closely resembles the “native” sand for biological, physical and aesthetic purposes. For the specific Project Area, any sand source must be consistent with the BMA cell-wide sediment quality specifications (Table 2-2) (FDEP, 2013a). The sand source used for the County project must also meet the County's technical sand specifications (provided as Appendix B to the EIS). According to the County’s technical standards, sand must be obtained from a source farther than 800 ft landward of the coastal construction control line, must be similar in color to the native beach material, must be free of construction debris, rocks, clay, or other foreign matter, must have less than 1% organic material, must be free of coarse gravel or cobbles, must have a particle size distribution ranging predominantly between 0.074 mm and 4.76 mm, and must be well-drained and free of excess water and have a moisture content of less than 10%. By adhering to the above standards and regulations, no foreign matter or unacceptable material as a component of the fill material is anticipated.

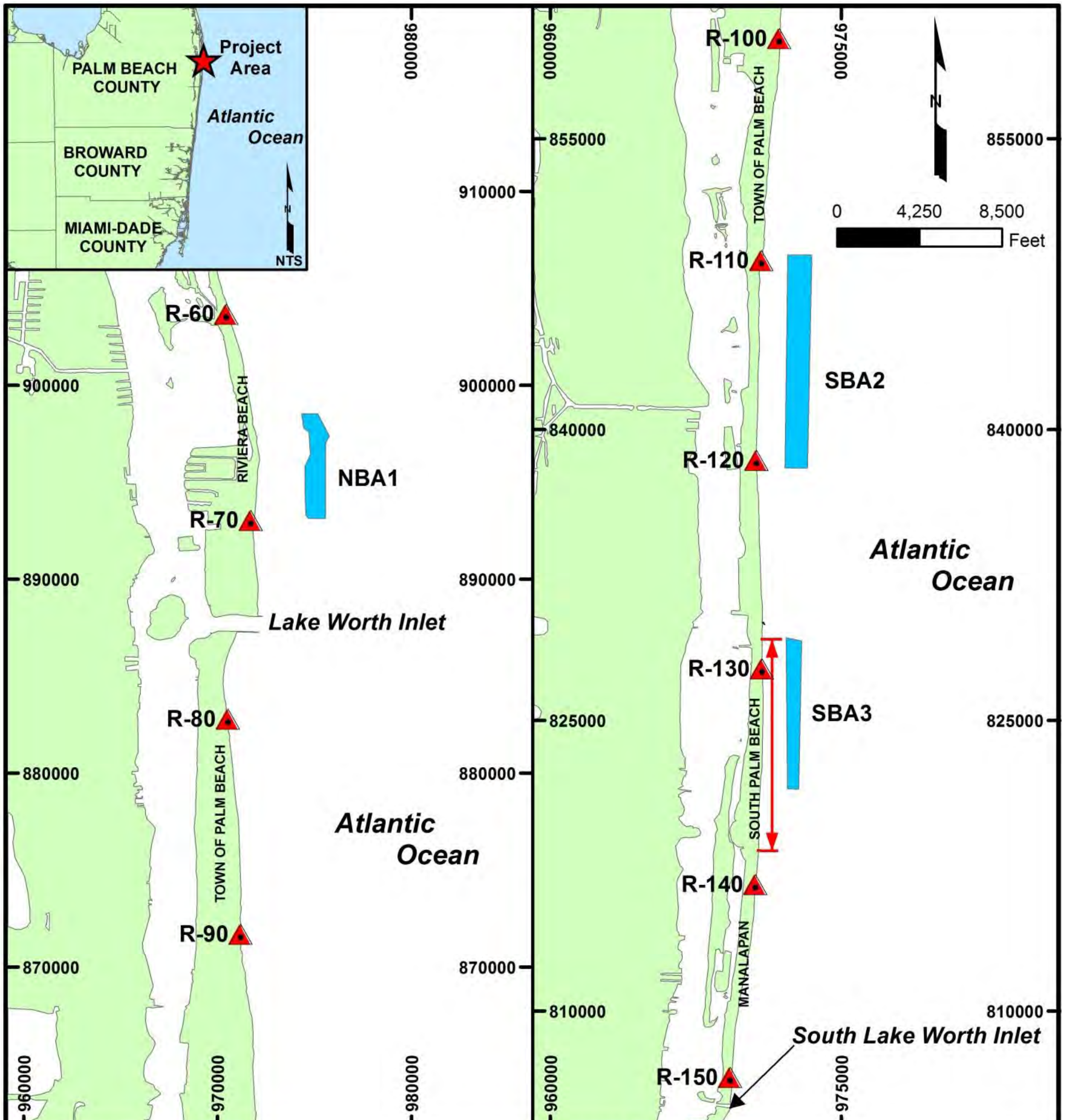
Table 2-2. Sediment compliance specifications (FDEP, 2013).

Sediment Parameter	Parameter Definition	Compliance Value
Mean Grain Size	Min and max values (using moment method calculation)	0.25 mm to 0.60 mm
Maximum Silt Content	Passing #230 sieve	2%
Maximum Fine Gravel Content*	Retained on #4 sieve	5%
Munsell Color Value	Moist value (chroma = 1)	6 or lighter

Note: the beach material shall not contain construction debris, toxic material, other foreign matter, coarse gravel or rocks.

***Shell content is used as the indicator of fine gravel content for the implementation of quality control/quality assurance procedures.**

Offshore sand source. A stockpile of dredged material from either the Phipps or Mid-Town project is the preferred sand source for placement in the Town of Palm Beach portion of the Project Area. This material will be dredged under authorization of the Palm Beach Island Beach Management Agreement (BMA) (FDEP, 2013) and the USACE permit numbers SAJ-2000-00380 (Phipps) or SAJ-1995-03779 (Mid-Town), and may include sand from North Borrow Area 1 (NBA1), South Borrow Area 2 (SBA2), South Borrow Area 3 (SBA3) (Figure 2-2) or any offshore sand source that is consistent with the BMA cell-wide sediment quality specifications (Table 2-2) (FDEP, 2013). The stockpiled sand will be located within the permitted Phipps and Mid-Town templates (alternating between the two projects) and will be considered an active stockpile so that sand is removed for transport to the Project Area soon after it is piled. The total proposed volume for placement within the Town of Palm Beach is approximately 65,200 cy, 3,400 cy of which will be placed below mean high water. If timing of the Phipps and Mid-Town projects does not allow for use of dredged sand, the Town of Palm Beach would consider using sand from an upland source.



Notes:

1. Coordinates are in feet based on the Florida State Plane Coordinate System, East Zone, North American Datum of 1983 (NAD 83).

Legend:

Southern Palm Beach Island Comprehensive Shoreline Stabilization Project

Project Limits

Borrow Area

FDEP Monuments

Figure 2-2. Potential borrow areas to be used during the Phipps and/or Mid-Town projects that may supply the fill for the Project within the Town of Palm Beach limits (R-129-210 to R-134+135).

Upland sand source. The County has proposed to utilize sand from E.R. Jahna Industries, Inc. Ortona Sand Mine (Ortona) and/or Stewart Mining Industries in Ft. Pierce. The Town of Palm Beach's preferred upland sand mine is Ortona, which has previously been utilized within the Town of Palm Beach. Each mine will be evaluated based on compliance with the F.A.C., Rule 62B-41.007(2)(j), the BMA cell-wide sediment quality specifications (Table 1-2), the County's technical sand specifications outlined in the County's Annual Dune and Wetlands Restoration contract (Appendix B to the EIS), sediment characteristics, location relative to the Project Area, compliance with state and federal laws and method of transport available. The sand would be placed on the beach mechanically, rather than hydraulically. Due to a larger mean grain size and smaller fines content, upland sand is expected to be more stable and produce less turbidity in the nearshore environment than sand obtained from offshore borrow areas (OAI, 2012). In-water work may occur if vessels are required during turbidity monitoring and for groin construction.

2.1.2. GROIN CONSTRUCTION

The County portion of this Project also includes the construction of seven (7) groins placed perpendicular to the shoreline extending from the existing seawalls to the post-construction (beach fill) shoreline in South Palm Beach, Lantana and Manalapan (R-134+135 to R-138+551) (Figure 2-1). The groins will be low-profile, meaning that they are designed to be level with the berm and are intended to blend in with the beach. They will be concrete king pile and panel groins with 46 cm (18 in) (+/-) wide H-piles spaced every 2.4-3.0 m (8-10 ft) (similar to structure shown in Photograph 2-1). Exact location and length of the groins will depend on the presence of nearshore hardbottom resources at the time of construction, but it is currently estimated that they will be approximately 27 m (90 ft) long and spaced approximately 91 m (300 ft) apart. As the sand naturally erodes from the beach, the groins would gradually become partially exposed until the next nourishment. The groins will be a disruption of the natural littoral sand transport system along the beach in this area, with sand accretion/sediment deposition occurring on the updrift side and erosion on the downdrift side of the groin field; however, the low-profile design of the groins is meant to minimize downdrift erosion by replicating the sloping nature of the beach face. They also can be defined as being short (USACE, 2003) in that they affect sediment transport on the dry and intertidal beach only. The construction of the groins may occur from either land-based operations or using in-water construction, or a combination of the two methods.

Photograph 2-1. Shoreward view of a concrete king pile and panel groin.

3.0. EFH IN THE PROJECT AREA AND MANAGED SPECIES

3.1. EFH IN THE PROJECT AREA

Of the EFH areas designated by the SAFMC, the Project Area (R-129-210 to R-138+551) encompasses only marine areas, specifically nearshore coral/live hardbottom, water column, and unconsolidated (soft) bottom. The following sections address the EFH in and near the Project Area. This EFH assessment includes analysis of potential direct and indirect impacts to EFH and managed species from sand placement and groin construction; this assessment does not include the effects associated with dredging offshore borrow areas or the activities associated with stockpiling the dredged material since EFH consultation will occur separately for those activities under the permitting processes for the Phipps and/or Mid-Town projects.

3.1.1. CORAL/LIVE HARDBOTTOM

The SAFMC classifies coral and live/hardbottom habitats as EFH. The Fishery Management Plan for Coral, Coral Reefs and Live/Hard Bottom Habitat of the South Atlantic Region (Coral FMP) defines coral reefs as nearshore hardbottoms, deepwater hardbottoms (including deepwater banks), patch reefs, and outer bank reefs. SAFMC has determined that the nearshore hardbottom resources from Cape Canaveral to Broward County, Florida, including the resources located adjacent to the Project Area, meet the criteria as HAPC for coral, coral reefs and live/hardbottom (SAFMC, 2009a, 2011). According to the SAFMC Final Habitat Plan for the South Atlantic Region (1998), hardbottom habitats in this area are generally low relief areas on continental shelves. They constitute a group of communities characterized by a thin veneer of corals and other biota overlying assorted sediment types.

The SAFMC designates coral, coral reef, and hardbottom habitats as EFH-HAPC for species managed under the snapper-grouper, spiny lobster, and coral, coral reef, and live/hardbottom FMPs. Additionally, sponge habitats are designated EFH-HAPC for the spiny lobster FMP. All demersal fish species under SAFMC management that associate with coral habitats are contained within the Coral FMP for snapper-grouper species and include some of the more commercially and recreationally valuable fish of the region. All of these species show an association with coral or hardbottom habitat during their life history. In groupers, the demersal life history of almost all *Epinephelus* species, several *Mycteroperca* species, and all *Centropristis* species, takes place in association with coral habitat (SAFMC 2009b). Coral, coral reef, and hardbottom habitats benefit fishery resources by providing food or shelter (SAFMC 1983).

Nearshore, shallow hardbottom, defined by FDEP (2013) as the 200-400 meter-wide strip from the shoreline, ranging from the supralittoral zone to the depth of -4 meters (0-13 ft), is found in much of southeast and central Florida, including portions of Broward, Palm Beach, Martin, St. Lucie, Indian River and Brevard Counties. Along most of the East Coast of Florida, the Pleistocene Anastasia Formation forms the main coastal bedrock outcrop (Finkl 1993; Esteves and Finkl, 1999). Anastasia limestone is comprised of sediments and mollusk shells (primarily the coquina clam *Donax)* that accumulated on shorelines 80,000-120,000 years ago (CSA, 2009). Formations that are exposed in the surf zone tend to have smooth surfaces that are abraded by wave and current action. In Palm Beach County, shoreline occurrences of the Anastasia Formation can be found between the Lake Worth Inlet and the South Lake Worth Inlet (also called Boynton Inlet) and occur in a range of morphological expressions of coquina, including inshore and offshore rock reefs (Finkl and Warner, 2005). The nearshore hardbottom within Palm Beach County, including within the Project Area, includes areas of wormrock (Photograph 3-1), formed by tube building sabellariid tubeworms (*Phragmatopoma* spp.) (USACE, 2012). Wormrock reefs provide a nursery for a variety of coastal fish and invertebrate species (FWC, 2014) and support associated assemblages of organisms, such as decapod crustaceans (Gore et al., 1978), which attract fish species.

Photograph 3-1. Wormrock, formed by tube building sabellariid tubeworms (*Phragmatopoma caudata*) as shown in the nearshore community adjacent to R-132 on October 21, 2013.

Field investigations determined that exposure of natural intertidal hardbottom formations located in the Project Area (Photograph 3-2) fluctuate with seasonal variations and storm events (CPE, 2007). These formations are ephemeral in nature and the quantity and quality of intertidal hardbottom changes drastically over short time periods (i.e. within months). Aerial delineations of exposed hardbottom between 2003 and 2014 within and adjacent to the Project Area show that not only does the actual location of exposed hardbottom change, but the total area of exposure has also varied drastically over time (Table 3-1; Figure 3-1).

Table 3-1. Exposed hardbottom acreage delineated from aerial imagery between 2003 and 2014 from R-127 to R-141+586.

Year of Delineation	Area (ac)
July 2003	5.22
July 2004	27.18

July 2005	37.92
July 2006	51.20
July 2007	41.69
July 2008	29.17
July 2009	3.06
June 2010	18.76
October 2010	8.64
October 2011	15.71
March 2012	16.62
July 2013	39.26
November 2014	49.77

Photograph 3-2. Intertidal hardbottom formation located in the Project Area adjacent to R-132 on October 21, 2013.

In situ assessments have been conducted on the nearshore intertidal and subtidal hardbottom formations in the Project Area within the last decade in association with several feasibility studies for coastal construction. Quantitative benthic assessments were conducted in 2006 and 2008 (CPE, 2007; CPE, 2009), hardbottom relief measurements were documented in 2009 and 2010 (CPE, 2010), aerial delineations of hardbottom (Figure 3-1) have been analyzed between 2003 and 2014 (FDEP, 2013), and investigations for listed coral species have been conducted (PBC-ERM, 2013). The most recent benthic survey was conducted in October 2013 to provide updated data of the nearshore habitat for planning and permitting of the proposed Project (CB&I, 2014; PBC-ERM, 2013). Previous surveys are consistent with the findings of the 2013 survey, which documented a benthic community (intertidal and nearshore subtidal hardbottom) dominated by turf algae, sediment, bare hard substrate and macroalgae. Common macroalgae genera have included *Padina, Dictyota, Hypnea, Dasycladus, Laurencia* and *Halimeda*. Wormrock (*Phragmatopoma caudata*) was also observed along with tunicates, sponges, zoanthids, bryozoans, scleractinian (stony) corals and octocorals. Photograph 3-3 shows the subtidal hardbottom offshore of R-135 that was dominated by small (mean < 6 cm) octocorals. The scleractinian species most frequently observed on the intertidal and subtidal hardbottom were *Siderastrea* spp. and *Solenastrea bournoni*. The most common genus of octocoral observed was *Pseudopterogorgia*, with colonies of *Pterogorgia, Muricea* and *Eunicea* documented, as well (CPE, 2005, 2006a, 2007; CB&I, 2014; CPE and CSI, 2011).

Photograph 3-3. Benthic community dominated by small octocoral colonies adjacent to R-135 on October 23, 2013 (CB&I, 2014).

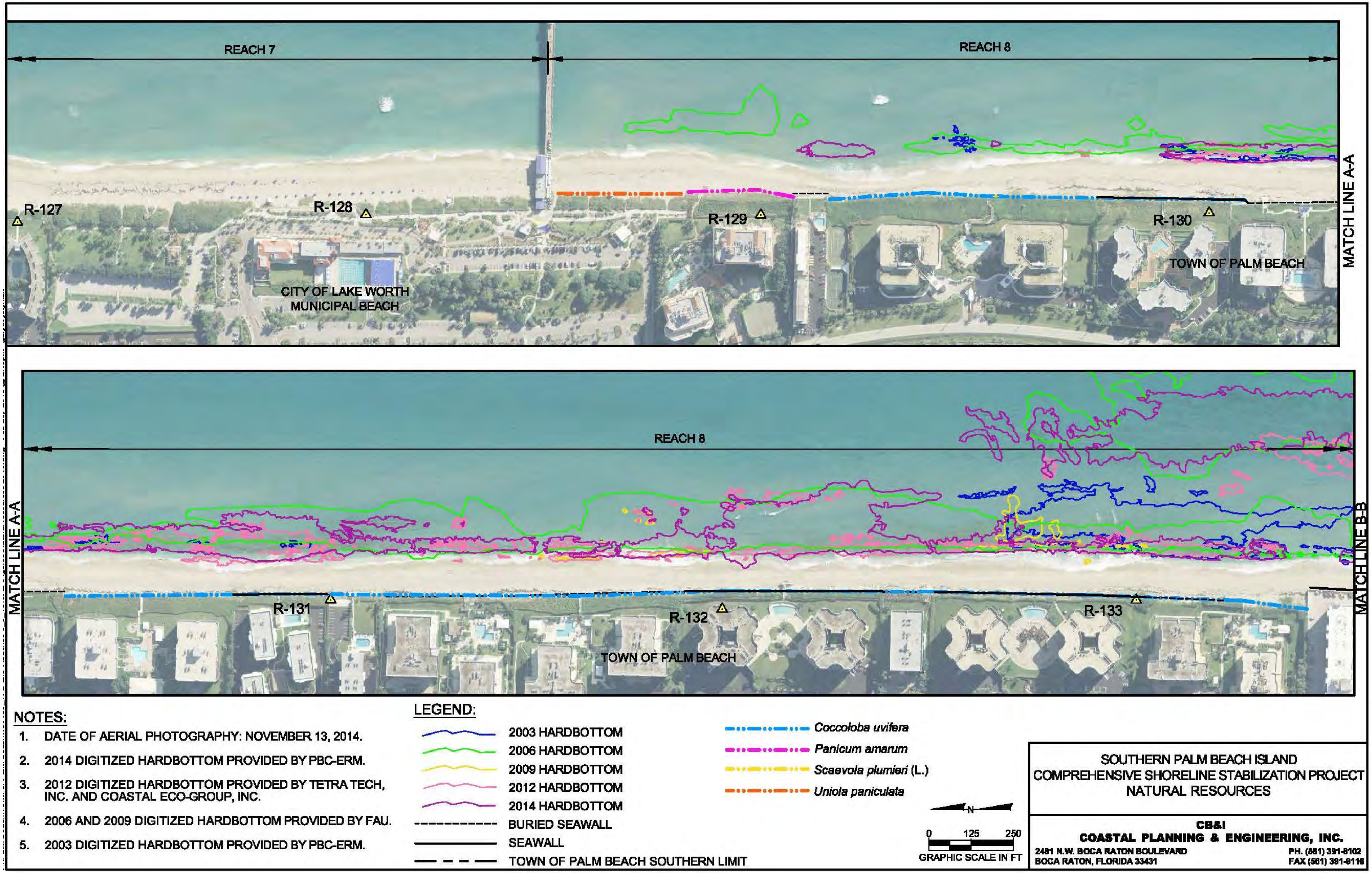


Figure 3-1. Nearshore hardbottom and dune resources.

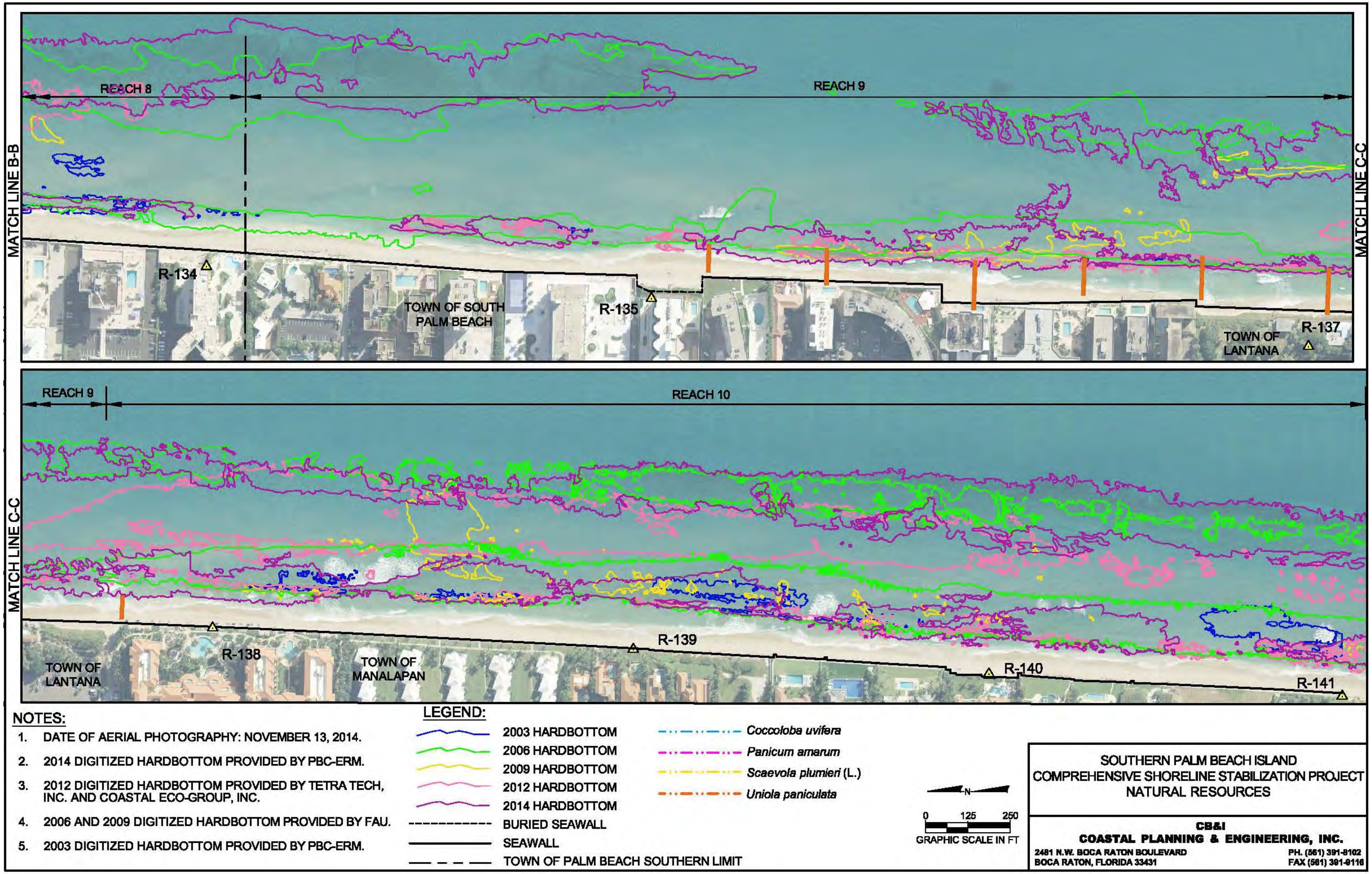


Figure 3-1 (cont.). Nearshore hardbottom and dune resources.

Managed species that may utilize the nearshore hardbottom habitat include species of the snapper-grouper complex, coastal inshore shark species, spiny lobster, and coral. Additional fish species are present offshore year round and may utilize the ephemeral hardbottom in nearshore waters at different life stages (Lindeman and Snyder, 1999). Section 4.1.3 provides additional information on potential impacts to fish populations in the nearshore hardbottom environment. Fish reported utilizing this habitat in the nearshore waters of the Project Area are included in Table 3-2 (CPE, 2005, 2007; CB&I, 2014).

Table 3-2. Fish observed over hardbottom resources in or adjacent to the Project Area (CPE, 2005, 2007; CB&I, 2014).

Common Name	Scientific Name	Common Name	Scientific Name
Sergeant-major	*Abudefduf saxatilis*	Spottail pinfish	*Diplodus holbrookii*
Honeycomb cowfish	*Acanthostracion polygonius*	Neon goby	*Elacatinus oceanops*
Scrawled cowfish	*Acanthostracion quadricornis*	Rock hind	*Epinephelus adscensionis*
Ocean surgeonfish	*Acanthurus bahianus*	Silver mojarra	*Eucinostomus aregenteus*
Doctorfish	*Acanthurus chirurgus*	Silver jenny	*Eucinostomus gula*
Blue tang	*Acanthurus coeruleus*	Mojarra sp.	*Eucinostomus* sp.
Black margate	*Anisotremus surinamensis*	Yellowfin mojarra	*Gerres cinereus*
Porkfish	*Anisotremus virginicus*	Nurse shark	*Ginglymostoma cirratum*
Sheepshead	*Archosargus probatocephalus*	Green moray	*Gymnothorax funebris*
Gray triggerfish	*Balistes capriscus*	Spotted moray	*Gymnothorax moringa*
Spotfin hogfish	*Bodianus pulchellus*	Purplemouth moray	*Gymnothorax vicinus*
Spanish hogfish	*Bodianus rufus*	White margate	*Haemulon album*
Eyed flounder	*Bothus ocellatus*	Tomtate	*Haemulon aurolineatum*
Saucereye Porgy	*Calamus calamus*	Caesar grunt	*Haemulon carbonarium*
Sheepshead porgy	*Calamus penna*	Smallmouth grunt	*Haemulon chrysargyreum*
Orangespotted filefish	*Cantherhines pullus*	French grunt	*Haemulon flavolineatum*
Sharpnose puffer	*Canthigaster rostrata*	Spanish grunt	*Haemulon macrostomum*
Yellow jack	*Carangoides bartholomaei*	Cottonwick	*Haemulon melanurum*
Bar jack	*Caranx ruber*	Sailor's choice	*Haemulon parra*
Blue runner	*Caranx crysos*	White grunt	*Haemulon plumierii*
Black seabass	*Centropristis striata*	Bluestriped grunt	*Haemulon sciurus*
Atlantic spadefish	*Chaetodipterus faber*	Grunt sp.	*Haemulon* sp.
Foureye butterflyfish	*Chaetodon capistratus*	Slippery dick	*Halichoeres bivittatus*
Spotfin butterflyfish	*Chaetodon ocellatus*	Clown wrasse	*Halichoeres maculipinna*
Banded butterflyfish	*Chaetodon striatus*	Blackear wrasse	*Halichoeres poeyi*
Atlantic bumper	*Chloroscombrus chrysurus*	Puddingwife	*Halichoeres radiatus*
Colon goby	*Coryphopterus dicrus*	Ballyhoo	*Hemiramphus brasiliensis*

Table 3-2 (cont'd). Fish observed over hardbottom resources in or adjacent to the Project Area.

Common Name	Scientific Name	Common Name	Scientific Name
Bridled goby	*Coryphopterus glaucofraenum*	Halfbeak / Flyingfish	*Hemiramphus* sp.
Longspined porcupinefish	*Diodon holocanthus*	Rock beauty	*Holacanthus tricolor*
Spot-fin porcupinefish	*Diodon hystrix*	Blue angelfish	*Holocanthus bermudensis*
Sand perch	*Diplectrum formosum*	Chub	*Kyphosus sectatrix*
Silver porgy	*Diplodus argenteus*	Hairy blenny	*Labrisomus nuchipinnis*
Mutton snapper	*Lutjanus analis*	Greater soapfish	*Rypticus saponaceus*
Gray snapper	*Lutjanus griseus*	Rainbow parrotfish	*Scarus guacamaia*
Mahogany snapper	*Lutjanus mahogoni*	Pacific spotted scorpionfish	*Scorpaena plumieri*
Lane snapper	*Lutjanus synagris*	Greater amberjack	*Seriola dumerili*
Saddled blenny	*Malacoctenus triangulatus*	Banded rudderfish	*Seriola zonata*
Yellow goatfish	*Mulloidichthys martinicus*	Belted sandfish	*Serranus subligarius*
Black grouper	*Mycteroperca bonaci*	Redband parrotfish	*Sparisoma aurofrenatum*
Gag	*Mycteroperca microlepis*	Redfin parrotfish	*Sparisoma rubripinne*
Yellowtail snapper	*Ocyurus chrysurus*	Stoplight parrotfish	*Sparisoma viride*
Reef croaker	*Odontoscion dentex*	Bandtail puffer	*Sphoeroides spengleri*
Banded jawfish	*Opistognathus macrognathus*	Dusky damselfish	*Stegastes adustus*
Pigfish	*Orthopristis chrysoptera*	Longfin damselfish	*Stegastes diencaeus*
Seaweed blenny	*Parablennius marmoreus*	Beaugregory	*Stegastes leucostictus*
Gulf flounder	*Paralichthys albigutta*	Bicolor damselfish	*Stegastes partitus*
Highhat	*Pareques acuminatus*	Cocoa damselfish	*Stegastes variablilis*
Glassy sweeper	*Pempheris schomburgki*	Needlefish	*Strongylura marina*
Gray angelfish	*Pomacanthus arcuatus*	Channel flounder	*Syacium micrurum*
French angelfish	*Pomacanthus paru*	Pipefish/Seahorse sp.	*Sygnathus* sp.
Spotted goatfish	*Pseudupeneus maculatus*	Sand diver	*Synodus intermedius*
Blue goby	*Ptereleotris calliurus*	Bluehead wrasse	*Thalassoma bifasciatum*
Lionfish	*Pterois volitans*	Great pompano	*Trachinotus goodei*
Smooth trunkfish	*Rhinesomus triqueter*	Yellow stingray	*Urobatis jamaicensis*
Atlantic guitarfish	*Rhinobatos lentiginosus*	Green razorfish	*Xyrichtys splendens*

3.1.2. UNCONSOLIDATED (SOFT) BOTTOM

Unconsolidated bottom is EFH for certain life stages of snapper grouper, spiny lobster, reef fish, stone crab, spiny lobster, corals and reefs, and penaeid shrimp FMPs (SAFMC, 2014b). This habitat type is also used to some extent by many coastal fish species. However, certain species are better adapted to, characteristic of, or dependent on shallow non-vegetated bottom. Flatfish, rays, and skates are well suited for utilization of unconsolidated bottom. Juvenile and adult fish species that forage on the rich abundance of microalgae, detritus, and small invertebrates are highly dependent on the condition of softbottom (SAFMC, 2009c).

Two ridges of hardbottom (intertidal and subtidal) are present almost continuously along the proposed Project Area. Due to the ephemeral nature of the hardbottom in this area, one or both may be buried at any given time. Unconsolidated bottom occurs between these nearshore ridges (see Figure 3-1) and sometimes on top of them. The direct placement and equilibration (offshore spreading) of sand from the Proposed Action will permanently bury and/or asphyxiate most infaunal and epifaunal organisms that inhabit the sand. Shallow subtidal softbottom environments may be highly impacted by water turbulence, suspended sediments, and unstable substrate resulting in low species diversity and faunal abundance (Wanless and Maier, 2007; Jordan et al., 2010; Manning et al., 2014). Shallow subtidal softbottom habitat is dominated by a mix of polychaetes (primarily spionids), gastropods (*Oliva* sp., *Terebra* sp.), portunid crabs (*Arenus* sp., *Callinectes* sp., and *Ovalipes* sp.) and burrowing shrimp (*Callianassa* sp.). In slightly deeper water [1-3 m (3-10 ft) depth], the dominant fauna are polychaetes, haustoriid, and other amphipod groups, and the bivalves *Donax* sp. and *Tellina* sp. (Marsh et al., 1980; Goldberg et al., 1985; Gorzelany and Nelson, 1987; Nelson, 1985). The quality of the material which will be obtained from upland or offshore sources for use in the Project will meet strict sediment criteria. The similarity of the sand material to the native sediment will aid in the recovery of the benthic communities impacted by the placement of the fill material.

3.1.3. MARINE WATER COLUMN

The SAFMC designates marine water column as EFH. It is the "medium of transport for nutrients and migrating organisms between river systems and the open ocean" (SAFMC, 1998). The water column from Dry Tortugas to Cape Hatteras serves as habitat for many marine fish and shellfish. Most marine fish and shellfish broadcast-spawn pelagic eggs and, thus utilize the water column during a portion of their early life history (e.g. egg, larval and juvenile stages). In general, snapper/grouper complex, penaeid shrimp, Sargassum, spiny lobster, coral and coral reefs, golden and stone crabs, and migratory/pelagic fishes utilize the water column (SAFMC, 1998). Important attributes of the water column include hydrodynamics, temperature, salinity, and dissolved oxygen.

3.2. MANAGED SPECIES

Of the fisheries managed by the SAFMC and NMFS, the following may occur within the Southern Palm Beach Island Comprehensive Shoreline Stabilization Project Area:

- Coral, Coral Reefs, and Live/Hardbottom
- Penaeid shrimp
- Snapper grouper complex
- Spiny lobster
- Coastal migratory pelagic species (including dolphin and wahoo)
- Coastal highly migratory species

Members of these groups occur in the Project Area for at least a portion of their life history. The following sections briefly summarize the EFH for these species and their respective life stages, as described in the relevant FMPs.

3.2.1. CORAL, CORAL REEFS, AND LIVE/HARDBOTTOM

The Fishery Management Plan for Coral, Coral Reefs and Live/Hardbottom Habitat of the South Atlantic Region (Coral FMP) defines coral reefs as nearshore hardbottoms, deepwater hardbottoms, patch reefs, and outer bank reefs. The Coral FMP includes hundreds of species found within coral reef and hardbottom communities. SAFMC has determined that the nearshore hardbottom resources from Cape Canaveral to Broward County, Florida, including the resources located adjacent to the Project Area, meet the criteria as HAPC for coral, coral reefs, and live/hardbottom (SAFMC, 2009a, 2011). Section 3.1.1 of this report summarizes the coral and live hardbottom habitat found within and adjacent to the Project Area, and the species of scleractinian corals, octocorals and fish which have been documented within this habitat.

3.2.2. PENAEID SHRIMP

The shrimp fishery in the South Atlantic includes five species: brown shrimp (*Farfantepeneaus aztecus*), pink shrimp (*Farfantepenaeus duorarum*), white shrimp (*Litopenaeus setiferus*), rock shrimp (*Sicyonia brevirostris*), and royal red shrimp (*Pleoticus robustus*) (SAFMC, 1998; NMFS, 1999a). The shrimp species of the southeastern U.S. occupy similar habitats with the greatest differences being in optimal substrate and salinity. In general, EFH is designated as varied inshore, pelagic, and benthic habitats from the Virginia/North Carolina border to southern Florida. Of these five managed species, pink shrimp are expected to occur within the Project Area as they are the only penaied species whose range includes south Florida (SAFMC, 1998).

Pink Shrimp (Farfantepenaeus duorarum)

Pink shrimp occur from southern Chesapeake Bay to the Florida Keys, and around the coast of the Gulf of Mexico to the Yucatan south of Cabo Catoche. Maximum abundance is reached off southwestern Florida and the southeastern Golfo de Campeche (SAFMC, 2010). Along the Atlantic Coast of the U.S., pink shrimp occurs in sufficient abundance to be of major commercial significance only in North Carolina. Pink shrimp spawn in water depths between 3.7 and 15.8 m (12 and 52 ft) and are most abundant in waters of 11-37 m (36-121 ft) although in some areas they may be abundant as deep as 65 m (213 ft). Pink shrimp are also common in the estuaries and shallow marine waters surrounding southern Florida and into deep waters (approximately 100 m) southeast of the Keys. Post-larval and juvenile pink shrimp are commonly found in seagrass habitats where they burrow into the substrate by day and emerge to feed at night. Shrimp that survive the winter grow rapidly in late winter and early spring before migrating to the ocean (SAFMC, 2010).

3.2.3. SNAPPER GROUPER COMPLEX

EFH for snapper grouper species includes coral reefs, live/hardbottom, submerged aquatic vegetation, artificial reefs, and medium to high profile outcroppings on and around the shelf break zone from shore to at least 183 m (600 ft) (but to at least 610 m/2000ft for wreckfish). The annual water temperature range in this area is sufficiently warm to maintain adult populations of members of this largely tropical complex (SAMFC, 2013a).

Of the species managed by the SAFMC, 60 are included in the snapper-grouper complex (SAFMC, 2013a). Because of its mixed-species nature, this fishery is challenging to manage. Through the original FMP and subsequent amendments, the SAFMC has addressed overcapitalization, implemented measures to rebuild overfished species, and is moving forward with the use of Marine Protected Areas (MPA) as a management tool for deepwater species.

The SAFMC's FMP for the snapper grouper resource was first implemented in 1983. Strict management measures, including prohibition of harvest in some cases, have been implemented to rebuild overfished species in the snapper grouper complex. In addition, the SAFMC has used traditional management tools such as bag limits, size limits, trip limits, commercial quotas, and spawning season closures to help rebuild stocks. The SAFMC also approved Amendment 14 to create a system of eight deepwater marine protected areas to help further protect deepwater snapper grouper species and their associated habitat (SAFMC, 2010b). More recently, the SAFMC has explored the use of Limited Access Privilege (LAP) Programs for the snapper grouper fishery, including a program specific for the golden tilefish commercial fishery. There are no MPAs or LAPs in the Project Area.

The following species are managed species that have been observed utilizing live/hardbottom within and adjacent to the Project Area (Table 3-2):

Gray Snapper *(Lutjanus griseus)*

This species occurs in the western Atlantic from Florida to Rio de Janeiro. Young fish are sometimes found as far north as Massachusetts. Habitat can include coral reefs, rocky areas, and wrecks; inshore, gray snapper can be found over smooth bottom, usually near pilings, seagrass meadows and mangrove thickets. They feed mainly at night on small fishes, shrimps, crabs, gastropods, cephalopods, and some planktonic items. Spawning usually occurs in the summer at the dusk of a full moon and in shallow waters. The lifespan of a gray snapper may be up to 21 years and individuals may reach lengths of 89 cm (35 in) and weights of 11 kg (25 lbs) (SAFMC, 2013b). They are an important commercial and game fish species. Gray snapper have been observed in the nearshore hardbottom habitat adjacent to the Project Area (CPE, 2006b).

Greater Amberjack *(Seriola dumerili)*

The greater amberjack occurs in the western Atlantic from Nova Scotia and Bermuda to Brazil, including the West Indies and Gulf of Mexico. Individuals that are at least five years of age, or 85 cm (33.5 in) long, spawn from March through July. Spawning concentrations occur in southeast Florida and the Keys. They may reach a size of 1.8 m (6 ft) and weigh nearly 91 kg (200 lbs). Voracious predators, greater amberjacks eat mostly crab, squid, and other fishes found on reefs. They are often found in small groups and are approachable to divers (SAFMC, 2013c). Greater amberjack has a minor commercial fishery value and is a recreational gamefish. This species has been observed in the nearshore hardbottom habitat adjacent to the Project Area (CPE, 2006b).

Mutton Snapper *(Lujanus analis)*

The mutton snapper ranges from Florida and Bermuda to Brazil. They occur in continental shelf areas, as well as clear waters around islands. Large adults are usually found among rocks and coral, while juveniles occur over sandy, vegetated bottoms. They form small aggregations during the day. Adults may make migrations to spawning sites and spawning activity occurs offshore and may peak during the summer and fall. Adults are generalized top predators on a variety of reef invertebrates and fishes, particularly slow moving or sedentary benthic and epibenthic prey species. Feeding predominately takes place near the bottom during the day or night (SAFMC, 1998). The mutton snapper is a highly valued commercial and gamefish species and is considered vulnerable due to fishing pressure. This species has been observed in the nearshore hardbottom habitat adjacent to the Project Area (CPE, 2006b; CB&I, 2014).

White Grunt *(Haemulon plumieri)*

White grunts occur in tropical and warm-temperature waters, inhabiting irregular bottom areas of the continental shelf from Virginia to Brazil, including Bermuda, the Caribbean, and the Gulf of Mexico. White grunts are sexually mature during their third year, or when they reach about 25 cm (10 inches) long. Spawning occurs in the late spring and summer. The species is reported to live as long as 13 years, attaining a length of 63.5 cm (25 inches) and weight of 3.6 kg (8 lbs). White grunts are carnivores that feed on bottom-dwelling invertebrates by rooting around in the sand and shell hash between rocky ledges and at the bases of coral formations (SAFMC, 2013d). They are a gamefish and a minor commercial fishery species. White grunts have been observed in the nearshore hardbottom habitat of the Project Area (CPE, 2006b; CB&I, 2014).

3.2.4. SPINY LOBSTER

EFH for spiny lobster includes nearshore shelf/oceanic waters; shallow subtidal bottom; seagrass habitat; unconsolidated bottom (soft sediments); coral and live/hard bottom habitat; sponges; algal communities (*Laurencia*); and mangrove habitat (prop roots). In addition, the Gulf Stream is EFH because it provides a mechanism to disperse spiny lobster larvae (SAFMC, 1998). In Florida, HAPCs for spiny lobster include Florida Bay, Biscayne Bay, Card Sound, and coral/hardbottom habitat from Jupiter Inlet through the Dry Tortugas.

Caribbean Spiny Lobster (*Panulirus argus*)

The spiny lobster fishery is managed throughout its range from North Carolina through Texas. The commercial fishery and a large proportion of the recreational fishery occur in waters offshore of south Florida, primarily off Monroe County in the Florida Keys (Marx and Herrnkind, 1986). The principal habitat used by spiny lobster is offshore coral reefs and seagrass to depths of 80 m or more (Marx and Herrnkind, 1986). Areas of high relief on the continental shelf serve as spiny lobster habitat and include coral reefs, artificial reefs, rocky hardbottom substrates, ledges and caves, sloping softbottom areas, and limestone outcroppings. Spiny lobster spawn in offshore waters along the deeper reef fringes (Marx and Herrnkind, 1986). Adult males and females occasionally inhabit bays, lagoons, estuaries, and shallow banks; however, they are not known to spawn in these shallower areas.

3.2.5. COASTAL MIGRATORY PELAGIC SPECIES INCLUDING DOLPHIN AND WAHOO

Coastal migratory pelagic (CMP) species managed under the SAMFC, such as King mackerel, Spanish mackerel, cobia, common dolphinfish, and wahoo utilize the marine water column. EFH for these species includes sandy shoals of capes and offshore bars, high profile rocky bottom and barrier island ocean-side waters, from the surf to the shelf break zone. In addition, all coastal inlets and all state-designated nursery habitats of particular importance to CMPs are considered EFH (SAFMC, 1998). The Gulf Stream is also considered EFH because it provides a mechanism to disperse CMP larvae. Within the spawning area, eggs and larvae are concentrated in the surface waters.

The Gulf Stream, Charleston Gyre, Florida Current, and pelagic *Sargassum* are considered EFH for dolphin and wahoo (SAFMC, 2003). EFH-HAPC for dolphin and wahoo in the Atlantic include: The Point, The Ten-Fathom Ledge and Big Rock (North Carolina); The Charleston Bump and The Georgetown Hole (South Carolina); The Point off Jupiter Inlet (Florida); The Hump off Islamorada (Florida), The Marathon Hump off Marathon (Florida); The “Wall” off the Florida Keys, and Pelagic *Sargassum* (SAFMC, 2003).

Dolphin *(Coryphaena* spp.)

Dolphinfishes, including the common dolphin *(Coryphaena hippurus)* and pompano dolphin (*Coryphaena equiselis),* are highly prized commercial and recreational fish species found in tropical and subtropical seas. Both species may breed year-round. Dolphin is an oceanic species that may be found on the continental shelf. The maximum life span of dolphin is estimated at four years. Adult dolphins are opportunistic, top level predators, feeding upon a variety of fish and crustaceans (Palko et al., 1982).

Wahoo (*Acanthocybium solandri)*

Wahoo are circumtropical and subtropical, including the waters of the Caribbean and Mediterranean seas. They are an oceanic, epipelagic species frequently solitary or forming small loose aggregations rather than compact schools. Wahoo feed primarily on fish and squid. They are an important sport fish in some areas, although there have been reports of ciguatera poisoning in wahoo (Lewis, 1986).

King Mackerel (*Scomberomorus cavalla)*

EFH for king mackerel includes sandy shoals of capes and offshore bars, rocky bottom and barrier island waters from the surf to the shelf break zone (SAFMC, 1998). King mackerel are reef-associated fish, often occurring in clear waters over outer reef areas and inshore and continental shelf waters (Collette and Nauen, 1983). They are "coastal pelagic" species that inhabit open waters near the coast. King mackerel prefer warm waters, and seldom enter waters below 68° F (20° C). Their affinity for warm water and the availability of food result in extensive migrations along the southeastern United States, as the fish venture south in the fall and north in the spring. As the largest of the mackerels, the king mackerel may reach a length of 1.7 m (5.5 ft) and weigh 45.4 kg (100 lbs). They feed on other migratory fishes, squid and shrimp, and may be seen leaping out of the water in pursuit of prey.

Adults spawn over the outer continental shelf from May to October. The pelagic eggs are found offshore over depths of 35-180 m (115-590 ft) in spring and summer. Larvae occur over the middle and outer continental shelf, principally in the north-central and northwestern Gulf of Mexico. Juveniles are found from inshore to the middle shelf waters (Fishwatch, 2013a).

King mackerel is an important species for recreational and commercial fisheries throughout its range and is valued as a sport fish year-round in Florida. They are caught as far north as the Gulf of Maine, but are more often found from Virginia south to Brazil, including the Caribbean and the Gulf of Mexico.

Spanish mackerel (*Scomberomorus maculata)*

Similar to king mackerel, Spanish mackerel are reef associated fishes feeding primarily on fishes, shrimp, and squid. Spanish mackerel are found in the waters of the Atlantic ocean from Cape Cod to Miami and migrate in large schools over great distances along the shoreline. EFH for the Spanish mackerel includes sandy shoals of capes and offshore bars, rocky bottom and barrier island ocean-side waters including the Project Area (SAFMC, 1998).

Spanish mackerel are found off the U.S. Atlantic coast and in the Gulf of Mexico. Although they mostly inhabit open waters, they are sometimes found over deep grass beds and reefs, or shallow estuaries (SAFMC, 2013f). The pelagic eggs are found over the inner continental shelf at depths greater than 50 m (164 ft) in spring and summer. Larvae occur over the inner continental shelf, mainly in the northern Gulf of Mexico. Juveniles occur in estuarine and coastal waters. Adults are found in inshore coastal waters (greater than 75 m; 246 ft) and may enter estuaries in pursuit of baitfish.

While the king mackerel is valued in sport fishing all year long, the Spanish mackerel is fished primarily in the winter months (SAFMC, 2013e).

Cobia (*Rachycentron canadum)*

Cobia EFH includes high salinity bays, estuaries, and seagrass habitat, in addition to the aforementioned EFH for coastal pelagic species. The cobia is a highly prized recreational fish that can be found worldwide in tropical, subtropical, and warm temperate waters (Fishwatch, 2013b). Adults are a highly migratory species that range from the South Atlantic to Mid-Atlantic Bights. Cobia are generally found on sandy shoals of capes and offshore bars, high profile rock bottoms and barrier island/ocean side waters from the surf zone to the shelf break, but from the Gulf Stream shoreward (SAFMC, 2013f). They are generally found over reef and often associate with structures such as pilings and wrecks, and favor the shade of these structures. Cobia prefer water temperatures in excess of 68° F (20^{o} C) and salinities greater than 25 ppt (SAFMC, 2013f).

Cobia are known to live up to 10 years and reach a length of 1.8 m (6 ft) and a weight exceeding 45 kg (100 lbs) (SAFMC, 2013b). Females are usually larger than males, and reach sexual maturity when they are 91 cm (36 in) long. A male will reach sexual maturity at 61 cm (24 in) (SAFMC, 2013b). Cobia spawn in both estuarine and coastal bays (Fishwatch, 2013b). The spawning season extends from late June to mid-August along the southeastern United States and from late summer to early fall in the Gulf of Mexico.

They are adaptable to their environment and are voracious predators that forage primarily near the bottom. Cobia feed primarily on crabs and to a lesser extent, other benthic invertebrates and fishes. Adults may be found solitary or in small groups and are known to associate with rays, sharks, and other large fish (Fishwatch, 2013b). Cobia are fished both commercially and recreationally and have been observed in the nearshore waters adjacent to the Project Area (Baron, pers. obs., 2003).

Little Tunny *(Euthynnus allettaratus)*

The little tunny is found in tropical and subtropical waters including the inshore habitat within the Mediterranean, Caribbean, Atlantic Ocean and Gulf of Mexico, and often forms large, elliptical schools that extend up to two miles on the long axis. Life expectancy is around five years. Spawning season occurs throughout most of the year, except December. When females are approximately 79 cm (31 in), or 6 kg (14 lbs), they will lay up to 1.8 million eggs. The Little Tunny feeds mainly on small crustaceans, squid and small fishes (SAFMC, 2013g).

Cero *(Scomberomorus regalis)*

Also referred to as gray tilefish, this species is very similar to the mackerel. It is common only off the coast of Florida, although federal regulations for this species include areas 3 to 200 miles off the coasts of North Carolina, South Carolina, Georgia and east Florida (SAFMC, 2013h).

3.2.6. COASTAL HIGHLY MIGRATORY SPECIES

Coastal highly migratory species (HMS) managed by NMFS, such as tuna and coastal sharks, may also utilize the marine water column in or near the Project Area. Several pelagic HMS species may occur in the waters extending out to the western edge of the Gulf Stream, but are more commonly found in water depths greater than 100 m. Table 3-3 lists coastal HMS species with the potential to occur within or adjacent to the Project Area. Pelagic HMS are not listed, as they generally occur in water depths greater than 25 m (82 ft), which is outside of this Project's influence.

Most species found in federal waters are managed by Fishery Management Councils (FMCs). These Councils, through NMFS, implement regulations for species in their area. However, HMS such as Atlantic tunas, swordfish, sharks, and billfish are different in that they are found throughout the Atlantic Ocean and must be managed on domestic and international levels. Due to these concerns, on November 28, 1990, the President of the United States signed into law the Fishery Conservation Amendments of 1990 (Pub. L. 101-627) (NMFS, 2010). According to NMFS, identifying EFH for tuna, swordfish, and many pelagic shark species is challenging because, although some HMS may frequent the neritic waters of the continental shelf as well as inshore areas, they are primarily blue-water (i.e., open-ocean) species. Most of these species frequent coastal and estuarine habitats during various life stages and travel over great horizontal distances, commonly migrating vertically within the water column (NMFS, 1999b).

Table 3-3. Coastal highly migratory species (HMS) that have the potential to occur adjacent to the Project Area (J=juvenile; A=adult) (NMFS, 1999b). Measurements (m) represent isobath.

Common Name	Scientific Name	EFH
Coastal HMS		
Atlantic bluefin tuna	*Thunnus thynnus*	J, A = coastal waters to EEZ boundary
Great hammerhead	*Sphyrna mokarran*	J, A = coastal waters to 100 m
Nurse shark	*Ginglymostoma cirratum*	J, A = shoreline to 25 m
Bull shark	*Carcharhinus leucas*	J = inlets, estuaries, < 25 m
Lemon shark	*Negaprion brevirostris*	A = inlets, estuaries, < 25 m
Scalloped hammerhead shark	*Sphyrna lewini*	J = shoreline to 200 m
Dusky shark	*Carcharhinus obscurus*	J = shallow coastal waters, inlets, estuaries to the 500 m
Spinner shark	*Carcharhinus brevipinna*	Early J = coastal waters to 25 m
Tiger shark	*Galeocerdo cuvieri*	J, A = coastal to Gulf Stream
Bonnethead shark	*Sphyrna tiburo*	J = shallow coastal waters, inlets, estuaries, < 25 m

Due to the variety of habitats utilized by most HMS during various life stages, most HMS have the potential to occur somewhere in the Project Area. EFH for HMS was updated in the Final Amendment 1 to the Consolidated Atlantic Highly Migratory Species Fishery Management Plan (NMFS, 2009). Table 3-3 lists HMS with life stages in designated EFH located in the Project Area.

Atlantic Bluefin Tuna *(Thunnus thynnus)*

Although not likely to be found within the Project Area, the range of Atlantic bluefin includes nearshore marine waters of the Western Atlantic (Fishbase, 2013). Atlantic bluefin tuna exhibit a seasonal migratory behavior by moving from spring spawning grounds within the Gulf of Mexico through the Straits of Florida to feeding grounds off the northeast U.S. coast. The western Atlantic stock has a range from Newfoundland south into the Gulf of Mexico and the Caribbean and was once believed to be separated from the east Atlantic stock by the Labrador Current. However, the May 2011 Status Review Report of the Atlantic Bluefin Tuna (NMFS, 2011a) cites studies that note that bluefin tuna are moving across the Atlantic but return to their original spawning grounds. Western north Atlantic bluefin tuna inhabit spawning grounds within the Gulf of Mexico and the Florida Straits from mid-April to mid-June. Even though individual bluefin tuna may spawn more than once a year, a single annual spawning period has been recognized for the western Atlantic stock (NMFS, 1999b). Bluefin tuna can grow to more than 650 kg (1,400 lbs) in weight and 3 m (10 ft) in length. Maximum age is estimated to be more than 20 years. Adult bluefin tuna feed on squid, pelagic crustaceans, and schooling fishes such as anchovies, and hakes (NMFS, 2005). The bluefin tuna is an important commercial species and is becoming rare due to massive overfishing (NMFS, 2005).

Great Hammerhead shark *(Sphyrna mokarran)*

Although not likely to be found within the Project Area, great hammerhead sharks are circumtropical, solitary fish found in both the open ocean and in shallow coastal waters (NMFS, 2013). Little information is available on early juvenile stages. Adults are caught in coastal longline shark fisheries, as well as in pelagic tuna and swordfish longlines fisheries. Great hammerheads are vulnerable to overfishing because of their biennial reproductive cycle and because they are caught both in directed fisheries and as bycatch in tuna and swordfish fisheries (NMFS, 1999b).

Nurse shark *(Ginglymostoma cirratum)*

The nurse shark inhabits littoral waters in both sides of the tropical and subtropical Atlantic, ranging from tropical West Africa and the Cape Verde Islands in the east, and from Cape Hatteras, North Carolina to Brazil in the west. They are also found in the eastern Pacific, ranging from the Gulf of California to Panama and Ecuador (Bigelow and Schroeder, 1948). Nurse sharks are a shallow water species, often found lying motionless on the bottom under coral reefs or rocks. They often congregate in large numbers in shallow water (FLMNH, 2010a) and have been observed on the nearshore hardbottom adjacent to the Project Area (Table 3-3).

Juveniles are also found around mangrove islands in south Florida. Large numbers of nurse sharks often congregate in shallow waters off the Florida Keys and the Bahamas at mating time in June and July (Fowler, 1906; FLNMH, 2010a).

Bull shark *(Carcharinus leucas)*

Bull sharks are large, shallow water sharks that are cosmopolitan in warm seas and estuaries and may be present within the Project Area. In the Gulf of Mexico, bull sharks constitute 3% of the shark catch in the directed shark fishery and are vulnerable to overfishing because of their slow growth and limited reproductive potential. Neonates are found in temperatures of 28.2°C to 32.2°C (82.8°F to 90.0°F)and in salinities between 18.5 and 28.5 ppt. Juveniles are found in temperatures of 21.0°C to 34.0°C (69.8°F to 93.2°F) and in salinities between 3.0 and 28.3 ppt (NMFS, 1999b).

Lemon shark *(Negaprion brevirostris)*

The lemon shark is a common tropical shallow water shark, inhabiting coral reefs and shallow coastal areas and may be present within the Project Area. The primary population in U.S. waters is found off south Florida and uses coastal mangroves as some of its nursery habitat. Although the lemon shark is caught throughout its range, it is not a commercially important species along the Atlantic coast (NMFS, 1999b).

Scalloped hammerhead *(Sphyrna lewini)*

The scalloped hammerhead is the most common hammerhead in the tropics and can be found schooling in large numbers (Compagno, 1984). It migrates seasonally along the eastern United States and may be present within the Project Area. The scalloped hammerhead is considered overfished because it forms very large schools that make it vulnerable to the gillnet fishery (NMFS, 1999b).

Dusky shark *(Carcharhinus obscurus)*

The dusky shark is a large (about 3.7 m/12 ft) shark species that is common in warm and temperate continental waters throughout the world (NMFS, 1999b) including the Project Area. It occurs from the surf zone to well offshore and from the surface to depths of 400 m (1,300 ft). Long migrations associated with seasonal temperature changes have been observed. Currently, factors for decline include illegal landings in both commercial and recreational shark fisheries, as well as bycatch from longlining fisheries (NMFS, 2011b). It is also commonly taken as bycatch in the swordfish and tuna longline fisheries (NMFS, 1999b).

Spinner shark *(Carcharhinus brevipinna)*

The spinner shark is a common coastal pelagic occupying warm-temperate and tropical waters. This shark is often seen in schools and gets its name due to its habit of leaping out of the water and spinning (FLMNH, 2010b). The impacts of fisheries to this species are unknown, although its habits are similar to those of the blacktip and its vulnerability to fishing pressure is also likely similar (NMFS, 1999b). This species is also known to commonly migrate along the eastern coast of Florida, including the nearshore waters of Palm Beach County.

Tiger shark *(Galeocerdo cuvier)*

The tiger shark is one of the larger species of sharks with characteristic tiger-like markings and unique teeth that make it easy to identify. They inhabit warm waters in both deep oceanic and shallow coastal regions, potentially within the Project Area, and is considered one of the most dangerous species of sharks, responsible for many attacks on humans (FLMNH, 2010c). The nursery areas for tiger sharks appear to be offshore, though they have not been described. The tiger shark is frequently caught in coastal shark fisheries but is usually discarded due to low fin and meat value (NMFS, 1999b).

Bonnethead shark (*Sphyrna tiburo)*

The bonnethead is a small shark species (< 1 m/3.3 ft) that inhabits shallow coastal waters where it frequents sandy or muddy bottoms (NMFS, 1999a) and may be present within the Project Area. Juveniles are often found on the west coast of Florida. This species is at a low risk of overfishing because it is fast growing, reproduces annually, and is not targeted by fisheries due to its small size.

4.0. ASSESSMENT OF IMPACTS AND MITIGATION MEASURES

Sand placement and groin construction activities associated with the Project each have the potential for direct effects (proposed action occurs at the same time and place as the effect), indirect effects (reasonably foreseeable effects caused by the action that occur later in time or farther from the action), and/or cumulative effects (which are those that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions) to EFH and managed species. The affected EFH adjacent to the Project Area include nearshore hardbottom, unconsolidated (soft) bottom, and water column due to sedimentation and turbidity. This section assesses potential impacts to these resources that may occur due to project construction.

4.1. IMPACTS TO EFH

4.1.1. IMPACTS TO CORAL/LIVE HARDBOTTOM

Burial/Sedimentation. Placement and equilibration of beach sand will impact nearshore hardbottom resources. Hardbottom closest to shore will be directly buried by placement of beach sand during construction, while equilibration will impact additional hardbottom following construction. Due to the ephemeral nature of the hardbottom in this area, the USACE determined that a time-average analysis of the amount of hardbottom exposed over 10 years would best represent the habitat since it smooths out short-term fluctuations and provides longer-term trends by averaging a function over iterations of time. The 2014 dataset was added during updates to the EIS extending the time-average analysis over 11 years. The engineering and Delft3D modeling results (Appendix G to the EIS) generated sediment accumulation polygons that were overlaid on the aerial delineations of exposed hardbottom between 2003 and 2014. These areas were time-averaged to estimate impact areas. Based on these analyses, it is anticipated that the Project may result in permanent impacts to between 3.86 and 3.99 ac of hardbottom as well as temporary impacts to between 9.53 and 9.93 ac of hardbottom due to direct sand placement and subsequent spreading (equilibration) of sand (Figures 4-1 through 4-3 based on the range of grain sizes modeled). Using these areas of impact and benthic characterization data, a preliminary Uniform Mitigation Assessment Method (UMAM) evaluation was conducted (provided as Appendix H to the EIS). This draft UMAM analysis determined that between 6.55 and 6.66 ac of mitigation may be required to offset these impacts to intertidal and subtidal hardbottom. There are no offshore coral reefs that would be directly affected by the Project. When offshore borrow areas are utilized for the Phipps and Mid-Town projects (permitted separately), coral reefs will be avoided by requiring vessel transit areas and pipeline corridors free of hardbottom.

Managed species/groups that have been observed utilizing or may potentially utilize the nearshore hardbottom habitat within the Project Area include coral, shrimp, spiny lobster, species of the snapper grouper complex, and some coastal pelagic species. Although the Project is anticipated to result in permanent impacts and temporary impacts to hardbottom EFH, mobile species utilizing this habitat are unlikely to be adversely affected. Juvenile penaeid shrimp are generally confined to estuarine waters and will not be affected by construction activities along the coast. Adult shrimp and lobsters have adaptations to escape adverse conditions, for example pink shrimp are able to bury in the substrate (SAFMC, 1998). The high mobility of the managed finfish species will allow these fish to move to other undisturbed areas outside of any Project effects. Species which are temporarily displaced from the Project Area may find suitable hardbottom habitat north, south, or east of the Project Area. Once Project construction is completed, finfish are expected to return to the Project Area.

Mobile species or those exhibiting specific adaptive traits are less likely to be affected by the anticipated impacts, however, it is important to consider potential impacts that may occur to these species during different stages of their life. For instance, during a study in Palm Beach County, Lindeman and Snyder (1999) found that fish abundances and species diversity were significantly lower following beach nourishment. Lindeman and Snyder attributed this to the limited mobility of fish during early life stages and argued that the nearshore hardbottom is essential habitat for commercially and ecologically important fish species during larval and early life stages. Likewise, a literature synthesis conducted in 2009 suggested that temporary impacts due to nearshore hardbottom burial may result in a decrease in invertebrate diversity, specifically noting individuals during juvenile and larval life stages (CSA, 2009).

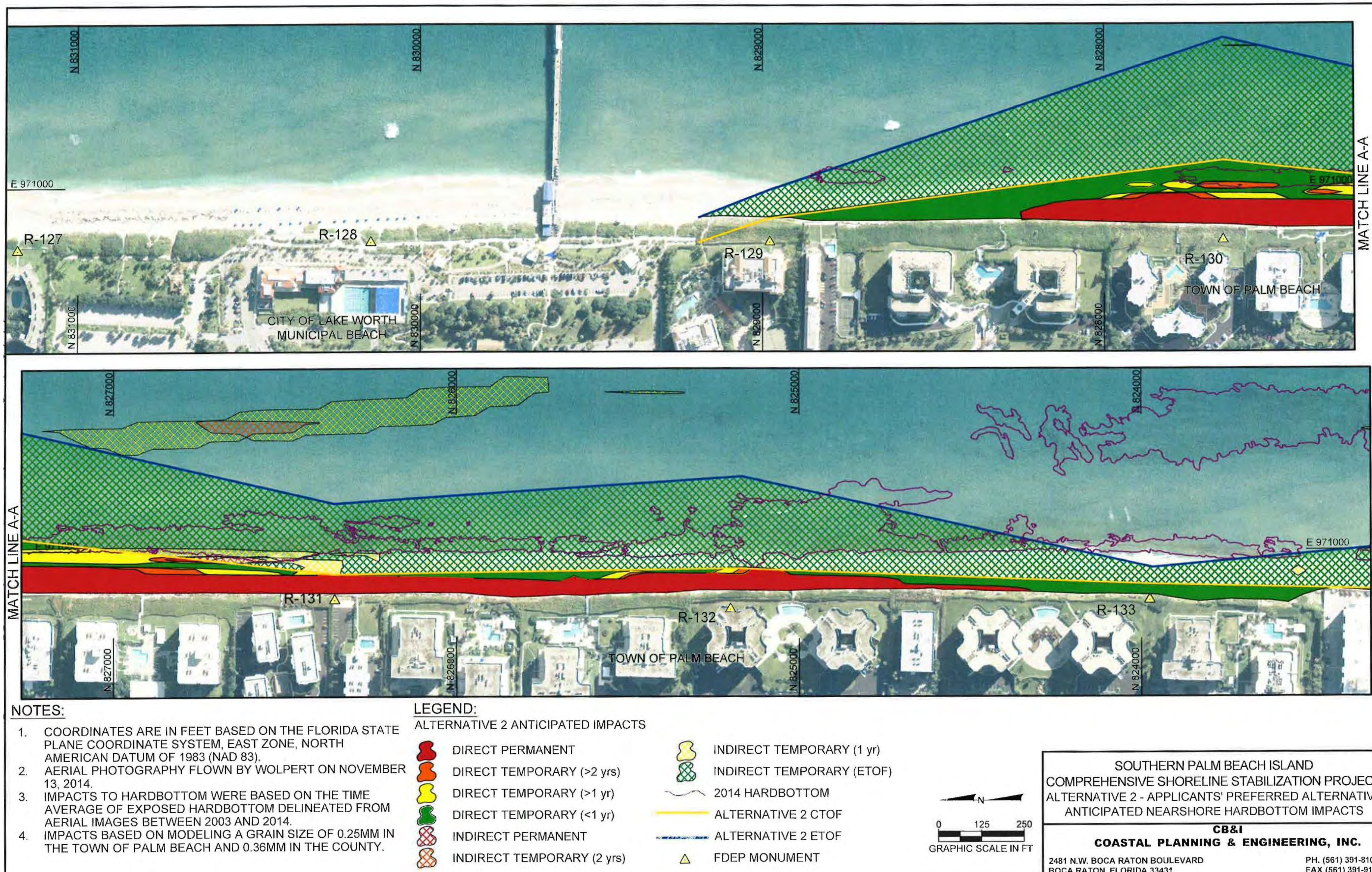


Figure 4-1. Anticipated impacts to nearshore hardbottom resources from Alternative 2 – Applicants' Preferred Alternative. Impacts based on modeling a grain size of 0.25 mm in the Town of Palm Beach and 0.36 mm in the County.

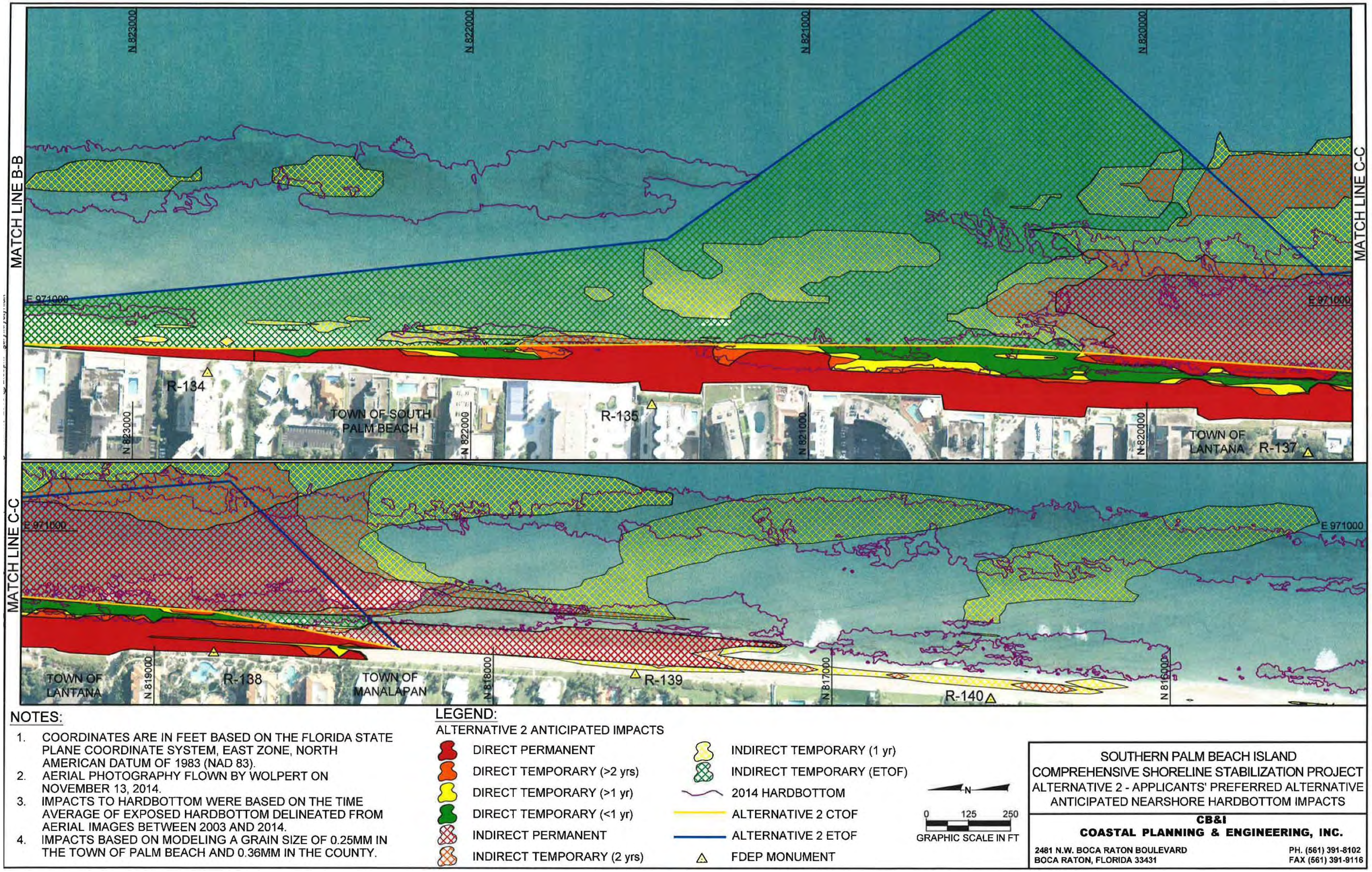


Figure 4-1 (cont.). Anticipated impacts to nearshore hardbottom resources from Alternative 2 – Applicants' Preferred Alternative. Impacts based on modeling a grain size of 0.25 mm in the Town of Palm Beach and 0.36 mm in the County.

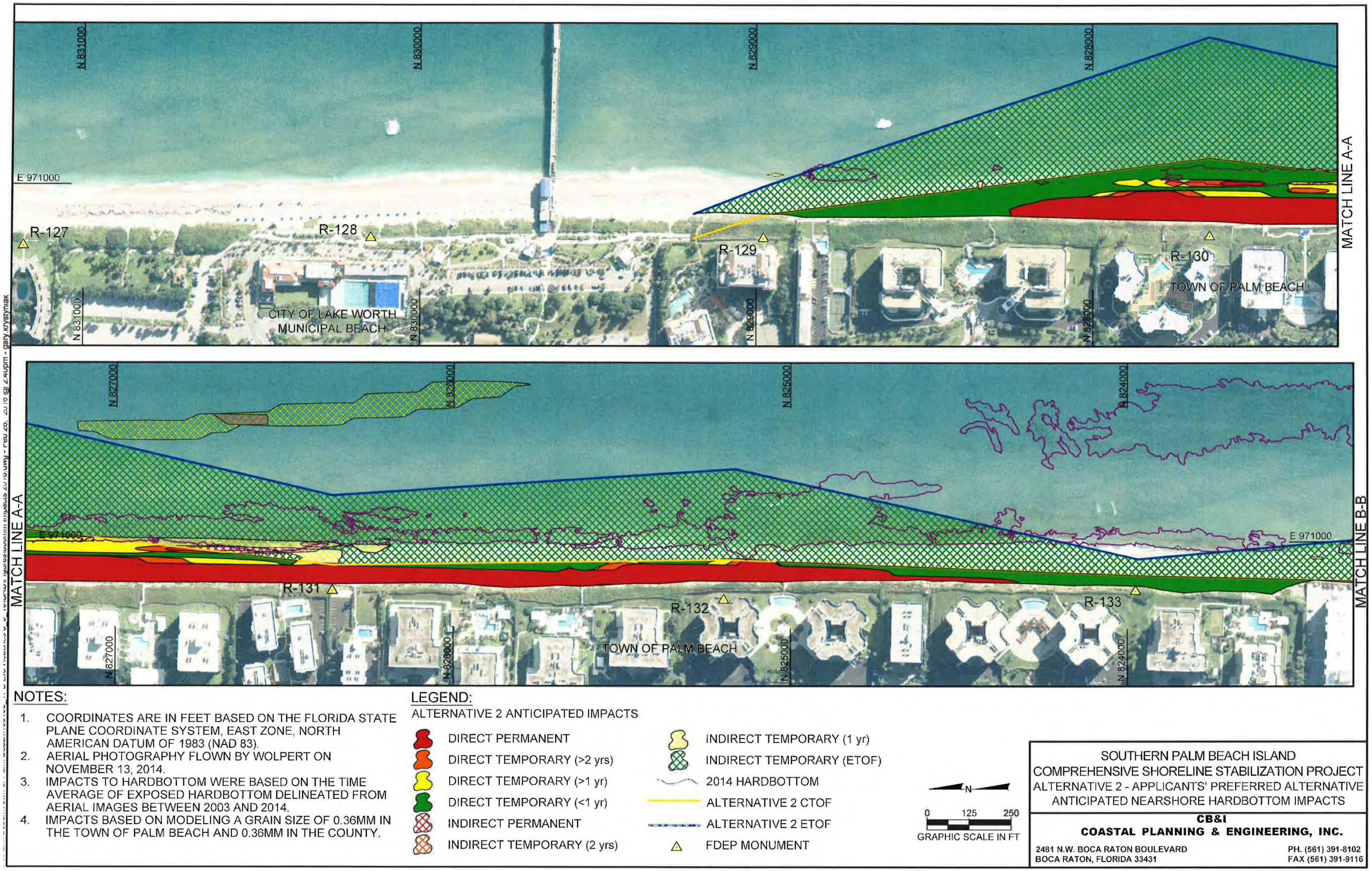
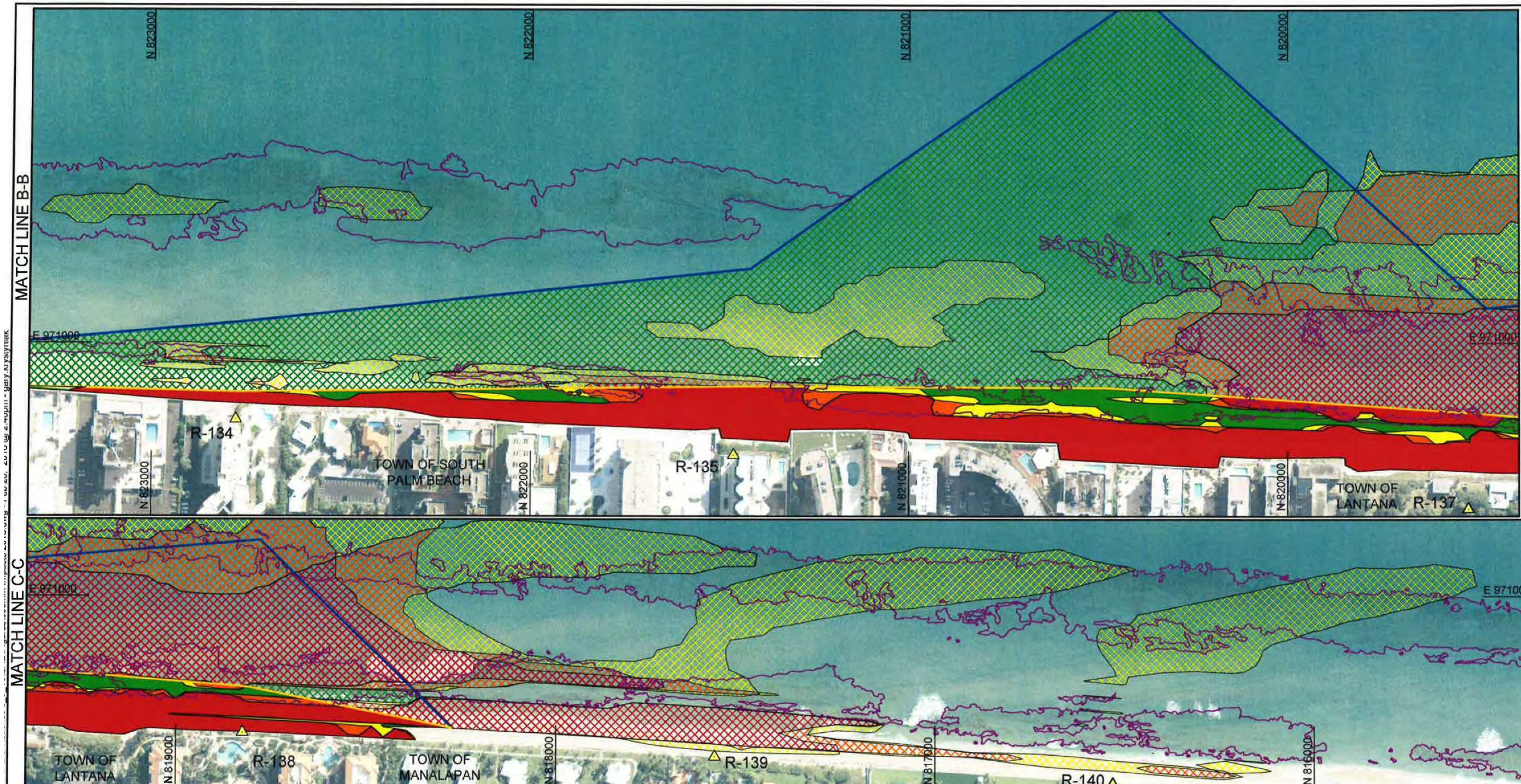


Figure 4-2. Anticipated impacts to nearshore hardbottom resources from Alternative 2 – Applicants' Preferred Alternative. Impacts based on modeling a grain size of 0.36 mm in the Town of Palm Beach and 0.36 mm in the County.



NOTES:

1. COORDINATES ARE IN FEET BASED ON THE FLORIDA STATE PLANE COORDINATE SYSTEM, EAST ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
2. AERIAL PHOTOGRAPHY FLOWN BY WOLPERT ON NOVEMBER 13, 2014.
3. IMPACTS TO HARDBOTTOM WERE BASED ON THE TIME AVERAGE OF EXPOSED HARDBOTTOM DELINEATED FROM AERIAL IMAGES BETWEEN 2003 AND 2014.
4. IMPACTS BASED ON MODELING A GRAIN SIZE OF 0.36MM IN THE TOWN OF PALM BEACH AND 0.36MM IN THE COUNTY.

LEGEND:

ALTERNATIVE 2 ANTICIPATED IMPACTS

- DIRECT PERMANENT
- DIRECT TEMPORARY (>2 yrs)
- DIRECT TEMPORARY (>1 yr)
- DIRECT TEMPORARY (<1 yr)
- INDIRECT PERMANENT
- INDIRECT TEMPORARY (2 yrs)
- INDIRECT TEMPORARY (1 yr)
- INDIRECT TEMPORARY (ETOF)
- 2014 HARDBOTTOM
- ALTERNATIVE 2 CTOF
- ALTERNATIVE 2 ETOF
- FDEP MONUMENT

N

0 125 250

GRAPHIC SCALE IN FT

SOUTHERN PALM BEACH ISLAND
COMPREHENSIVE SHORELINE STABILIZATION PROJECT
ALTERNATIVE 2 - APPLICANTS' PREFERRED ALTERNATIVE
ANTICIPATED NEARSHORE HARDBOTTOM IMPACTS

CB&I
COASTAL PLANNING & ENGINEERING, INC.
2481 N.W. BOCA RATON BOULEVARD
BOCA RATON, FLORIDA 33431
PH. (561) 391-8102
FAX (561) 391-9116

Figure 4-2 (cont.). Anticipated impacts to nearshore hardbottom resources from Alternative 2 – Applicants' Preferred Alternative. Impacts based on modeling a grain size of 0.36 mm in the Town of Palm Beach and 0.36 mm in the County.

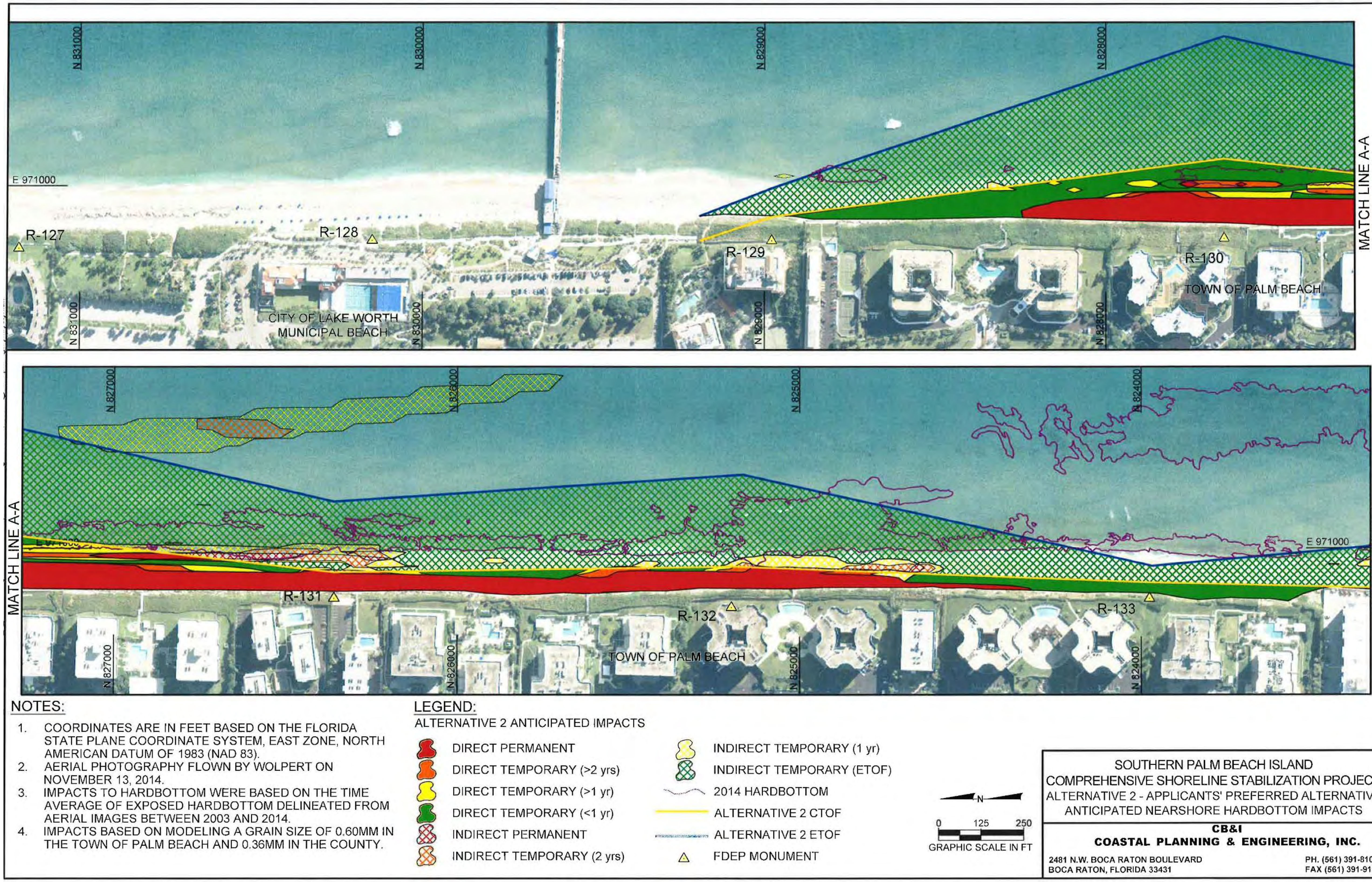


Figure 4-3. Anticipated impacts to nearshore hardbottom resources from Alternative 2 – Applicants' Preferred Alternative. Impacts based on modeling a grain size of 0.60 mm in the Town of Palm Beach and 0.36 mm in the County.

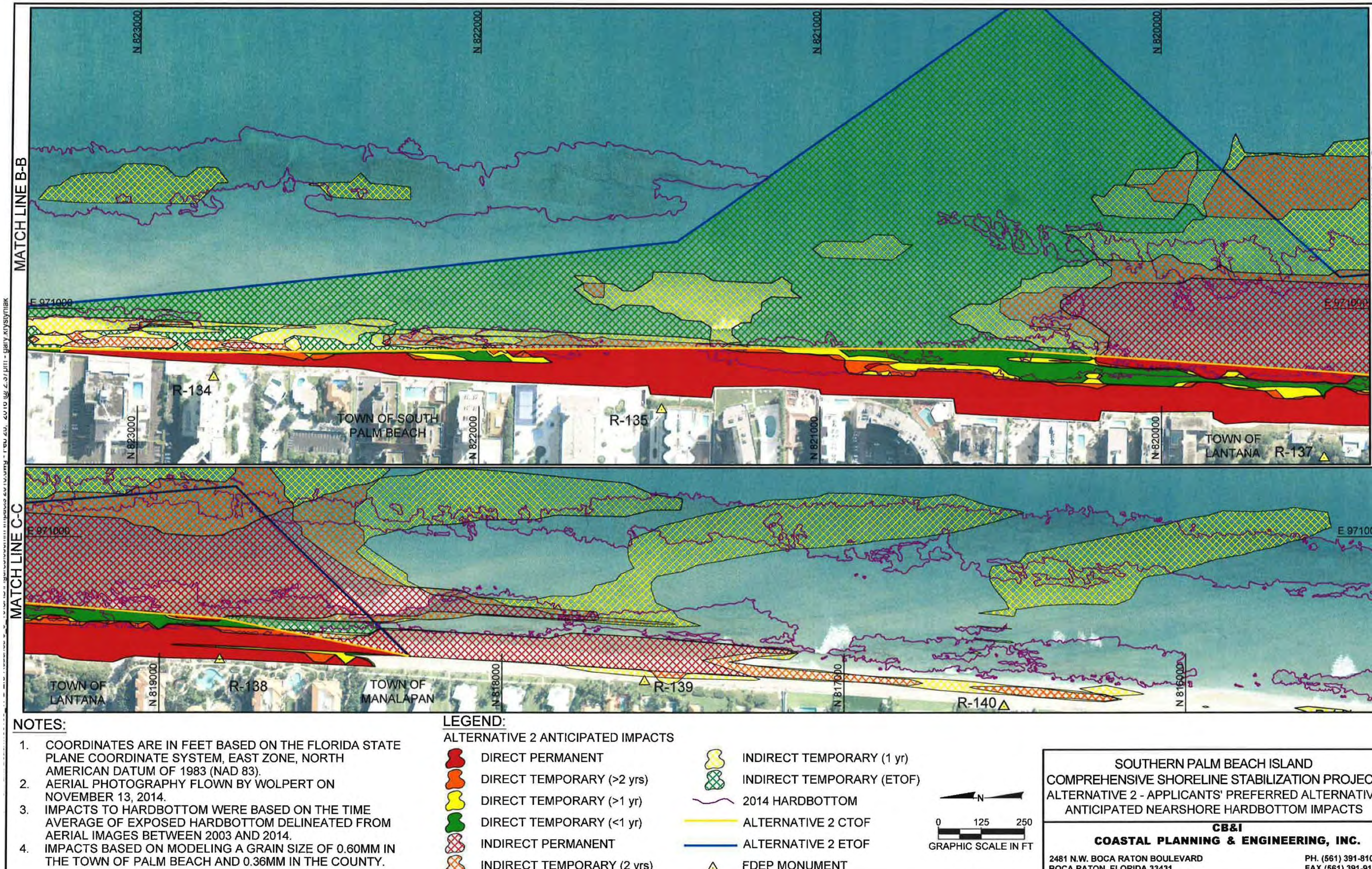


Figure 4-3 (cont.). Anticipated impacts to nearshore hardbottom resources from Alternative 2 – Applicants' Preferred Alternative. Impacts based on modeling a grain size of 0.60 mm in the Town of Palm Beach and 0.36 mm in the County.

4.1.2. IMPACTS TO UNCONSOLIDATED (SOFT) BOTTOM

Burial/Sedimentation. Sand placement impacts to unconsolidated bottom include direct burial of benthic organisms as the beach is widened. Effects of burial are dependent on sediment type, depth of sediment, and the size and behavior of infaunal or epifaunal organisms (including the species' ability to burrow and species' mobility) (SCDNR, 1995). Direct burial results in mortality to sessile or attached animals, while some motile species can survive by moving either horizontally outside the placement area, or vertically to the surface of the sand placement (NRC, 1995). Mortality during sedimentation has been found to depend on a species' ability to burrow through redeposited sediments and the rate at which sediment is deposited (IMG, 2004). Maurer et al. (1978) found that nearshore infaunal species are capable of burrowing through sand up to 40 cm (15.7 in). Generally, deposits greater than 20-30 cm (8-12 in) eliminate all but the largest and most vigorous burrowers (Maurer et al., 1978). If the bottom is covered with greater than 50 cm (20 in) of sand, most of the benthic fauna will be unable to move up through the placed sand (Maurer et al., 1978). Although the wet beach infauna can adapt to fluctuations in the natural environment, the addition of sediment to the wet beach would have immediate, short-term negative impacts, specifically in areas where placement of beach sand will exceed 40 cm (15.7 in) in depth.

However, infauna inhabiting the shallow nearshore marine habitat in the Project Area are adapted to a dynamic environment and, therefore, the recovery of these communities can take place relatively quickly (Nelson, 1993). Nelson (1993) indicates that many organisms that reside in intertidal zones are more adaptable to fluctuations in their environment, including high sediment transport and turbidity levels. A review of infaunal studies revealed that invertebrate recovery following placement of dredged material in relatively stable, unstressed marine environments generally takes between one and four years, while recovery in more naturally stressed areas is faster, often achieved within nine months (Bolam and Rees, 2003; Kotta et al., 2009). A study conducted in Brevard County, Florida, found that distribution, abundance and diversity of nearshore benthic fauna did not experience significant negative effects following beach nourishment (Gorzelany and Nelson, 1987). Most studies that did find impacts to nearshore infaunal communities generally found only limited or short-term alterations in the abundance, diversity and species composition (NRC, 1995). However, more recent studies have shown a maintained decrease of infaunal and epifaunal macroinvertebrates after sand displacement activities (Wanless and Maier, 2007; Manning et al., 2014).

Groin Construction. The County portion of this Project also includes the construction of seven low-profile groins placed perpendicular to the shoreline extending from the existing seawalls to the post-construction (beach fill) shoreline in South Palm Beach, Lantana and Manalapan (R-134+135 to R-138+551). If groin construction follows placement of the beach nourishment project, impacts would occur to dry beach habitat. If the groins are constructed before the nourishment project, narrow trenches will be excavated for each groin and piles will be driven into the dry beach and intertidal softbottom habitat; this construction would result in minimal impacts to a small area of intertidal softbottom. Infauna within the softbottom resources should only be temporarily displaced, therefore allowing recovery following disturbance.

4.1.3. IMPACTS TO WATER COLUMN

Turbidity. Turbidity is caused by the suspension or resuspension of sediments into the water column. Turbidity can affect fish feeding activities, movement, and respiration. Placement of sand along the shoreline may cause temporary increases in turbidity in the nearshore marine environment, which can impact the marine water column. For the proposed Project, these impacts are not anticipated to extend beyond the duration of construction activities; however, the higher the percentage of fines within the sand, the more likely that increases in turbidity will occur as the sand equilibrates. During construction of the Project, fish and other motile species can avoid most of the direct effects of beach nourishment by temporarily leaving impacted areas and traveling to other suitable areas. These species can return to these areas following conclusion of construction activity. Surveys of nearshore fish populations conducted in Florida before and after beach nourishment showed no evidence of any adverse impacts on the abundance and composition of the fishes sampled (NRC, 1995). However, Lindeman and Snyder (1999) found the opposite results during a study in Palm Beach County. During this research, fish abundances and species diversity were significantly lower following beach nourishment. It is argued that the nearshore hardbottom is essential habitat for commercially and ecologically important fish species during larval and early life stages where motility is often restricted. Likewise, a literature synthesis conducted in 2009 suggested that temporary impacts due to nearshore hardbottom burial may result in a decrease in invertebrate diversity, specifically noting individuals during juvenile and larval life stages. Furthermore, stating that beach nourishment can affect fishery resources by creating a chronic source of suspended sediments, which can interfere with foraging by fish and shrimp by abrading their gills and other soft tissues (CSA, 2009).

Noise. Disturbance caused by the construction operations necessary for placement of sand, groin construction and artificial reef construction in the nearshore marine environment will temporarily impact those species which typically utilize the water column in that area. Noise has been documented to influence fish behavior. Fish detect and respond to sound utilizing its cues to hunt for prey, avoid predators, and for social interaction (LFR, 2004). Some reef fish larvae have been shown to respond to sound stimuli as a sensory queue to settlement sites (Stobutzki and Bellwood, 1998). Alterations of background noise may impair the ability of newly settled fishes to locate preferred substrate. Changes in noise levels also may affect feeding or reproductive activities of reef fishes that depend on sound for these activities (Myrberg and Fuiman, 2002). Due to the short duration of this Project, the impacts of underwater noise on fish populations are expected to be temporary and localized.

4.1.4. CUMULATIVE EFFECTS

The incremental effect of nourishing the Project Area over the next 50 years, when added to projects that are reasonably expected to occur in the future are considered here. The Project as proposed includes a relatively modest amount of fill, and smaller-scale coastal structures to minimize the effects on the environment. The anticipated maintenance interval of the Project is every four years in the Town of Palm Beach and every three years in the County portion. Based on placement of approximately 65,200 cy every four years (approximately 3,400 cy placed below MHW), the Town of Palm Beach project would be nourished 12 times over the next 50 years. It is assumed that there may be two storm events that require additional nourishments during this timeframe; therefore, approximately 14 nourishments requiring 912,800 cy of sand would occur within the Town of Palm Beach portion of the Project Area. Using the same total volume of approximately 77,600 cy (26,600 cy placed below MHW), the County project would require approximately 18 nourishments (16 plus two storm nourishments), which totals about 1,396,800 cy. It should be noted that this volume is an estimate but will actually depend on the conditions of the beach prior to construction and the volume needed to fill the permitted template. Other projects that are reasonably expected to occur in the future are the Phipps (SAJ-2000-00380) and Mid-Town (SAJ-1995-03779) Projects, located approximately 0.6 miles and 5.6 miles north of the Project Area. These renourishment projects were recently completed – Mid-Town in 2015 and Phipps in 2016. The Mid-Town Project was renourished with approximately 1 million cy of sand between R-90.4 and R-100.4 and Phipps was renourished with approximately 1.1 million cy between R-116 and R-127. The 2014 permit for Mid-Town expires in 2019 and is for a one-time regulated activity, whereas the 2015 permit for Phipps provides a 10-year authorization with renourishments as needed within the proposed template. Both of these projects anticipate an 8-year nourishment cycle.

Although the Project described herein proposes to place a small amount of sand below MHW, past, present and projects that are likely to occur within the foreseeable future on Palm Beach Island may contribute to cumulative impacts to EFH.

4.2. MITIGATION MEASURES

The Project has been designed to maximize coastal protection while minimizing impacts to nearshore hardbottom. For example, the Project includes placement of sand on the dune only from R-129-210 to R-129+150 and from R-131 to R-134+135, both of which are adjacent to nearshore hardbottom. Of the 142,800 cy of sand volume proposed for the preferred alternative, only 30,000 cy will be placed below MHW. The proposed Project will use beach compatible sand (meeting FDEP requirements for beach sand compatibility as per F.A.C., Rule 62B-41.007(2)(j)), similar to the existing beach sand, which will reduce impacts to infauna, speed up recovery time, decrease turbidity due to project construction, and provide suitable habitat to increase the chance of successful sea turtle nesting.

Although measures have been incorporated into the Project design to minimize impacts to EFH, it is anticipated that construction of the proposed Project will result in permanent and temporary impacts to hardbottom due to direct sand placement and subsequent spreading (equilibration) of sand. In order to detect unanticipated project-related impacts, a pre-construction biological assessment of the nearshore hardbottom habitat will document the existing conditions of the hardbottom resources and provide a baseline for post-construction comparisons. The pre- and post-construction monitoring plans will be coordinated with National Marine Fisheries Service Habitat Conservation Division prior to a permit decision. Construction of mitigative artificial reefs will likely be required by federal and state agencies to offset impacts to hardbottom resources. Based on a preliminary UMAM evaluation (provided as Appendix H to the EIS), between 6.55 and 6.66 ac of mitigative artificial reef would be required to offset these permanent and temporary impacts to intertidal and subtidal hardbottom habitat. Biological and physical monitoring will assess project performance and success of the mitigative artificial reef.

Appendix I to the EIS provides the Applicants' draft mitigation plans, including potential locations of the artificial reef sites. The location of the mitigation reefs will be within the nearshore environment, in relatively close proximity to the Project Area as per FDEP requirements to ensure it will have similar ecological functions and services for the affected fisheries. In general, nearshore mitigative artificial reefs are located in subtidal areas where there is a thin veneer of sand overlying a consolidated rock layer to avoid reef subsidence, but not located where permanent or ephemeral hardbottom resources have been documented to avoid indirect impacts or construction-related impacts.

Typical issues related to mitigation reefs include:

- Reef subsidence if there is no underlying rock to serve as a foundation.
- Located within appropriate water depth range: if placed in water depths that are too deep, target species normally associated with nearshore hardbottom will likely not utilize the reef.

- Structural differences between impacted resources, i.e. rugosity (natural flat pavement type hardbottom vs. rubble rip-rap boulders).
- Performance and success criteria of mitigation reefs.
- Material used for reef construction.

During construction of the proposed Project, water quality monitoring will be conducted at the sand placement sites to ensure turbidity levels comply with permit requirements.

5.0. CONCLUSION

It is anticipated that the proposed Project may adversely impact hardbottom and softbottom, and will temporarily impact the marine water column for various life stages of managed species. Effects that may result from the Project include: direct burial of hardbottom and infauna due to sand placement, localized displacement of infauna within the groin footprint, temporary noise disturbance during groin construction, and the potential for temporarily elevated turbidity. Although the Project described herein proposes to place a small amount of sand below MHW, the USACE has determined that the action may adversely affect EFH.

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