

## **Marine Biological Monitoring in Broward County, Florida**

### **Nova Southeastern University Oceanographic Center (NSUOC)**

#### **Agreement Exhibit A-2 Activity 7.1: Stony Coral Transplantation**

#### **Stony Coral Removal and Transplantation Summary**

### **I. Background**

Broward County is currently engaged in the design and implementation of a Shore Protection Project. The Project will consist of the placement of compatible sand on the beaches of Broward County in Segment III (from Port Everglades to the Miami-Dade/Broward County line). Construction of Segment III is schedule to begin April 2005.

There are hardbottom resources within the beach construction equilibrium toe of fill (ETOF) along Segment III. In order to minimize impacts to these resources, stony corals were removed from this hardbottom and transplanted to nearby mitigation reefs (boulders). This summary only addresses Agreement Exhibit A-2 Activity 7.1 for Segment III construction.

### **II. Scope of Work**

#### **1. Agreement Exhibit A-2 Activity 7.1**

The following language is from the Agreement.

7.1 Part one (1) of Stony Coral Transplantation for each Segment, Consultant (NSUOC) shall locate approximately between 1000 and 2000 stony coral colonies (15 cm diameter or larger) within the area of estimated ETOF impact, remove the colonies from the substrate, transport the colonies and transplant the colonies to the mitigation reef sites nearby.

Agreement Exhibit B-2 (cost for services) Item 17 states that NSUOC has a maximum of 25 days to complete fieldwork.

#### **2. Additional Effort Requested by Florida DEP**

On 11 September 2003, a pre-transplantation meeting was held at NSUOC. Broward County EPD, Florida DEP, and NSUOC personnel were present. During this meeting DEP requested that an area of special concern be added to the colony search area. This area is offshore monuments R100 and R101 and is east of the ETOF. Because this area does not fall within the area defined by the Agreement, concentrated effort in this area was to occur after the areas within the ETOF were completed. Regardless of this additional effort, field work was still to end after 25 days.

### **III. Summary of Effort**

#### **1. Team Members**

NSUOC researchers were present during all field activities. NSUOC researchers were responsible for defining daily activities, identifying colonies to be removed, recording removal data, identifying areas for transplantation, and recording transplantation data. In

order to maintain consistency in the effort, 3 trained and experienced NSUOC research divers were involved in the field work. A minimum of 2 of these research divers were present during all 25 field days.

Industrial Divers Corporation (IDC) was hired as a subcontractor by NSUOC. IDC provided diver, vessel, and equipment support. In order to maintain consistency in the effort, 5 experienced IDC divers were involved in the field work. Of these 5, 3 would be present during most of the field days. NSUOC has previously worked with IDC on 4 projects that have included coral removal and transplantation.

## **2. Colony Search Area**

As defined above, the colony search areas included hardbottom within the ETOF and the DEP added area offshore R100-R101. Coastal Planning & Engineering (CP&E) had previously identified hardbottom areas within the ETOF. We used the project GIS developed by CP&E to locate these hardbottom areas and acquire the specific GPS points which guided the colony search and helped keep track of progress. The GPS points used to guide the colony search area within the DEP added area were marked on a map and approved by DEP prior to field work.

Using the project GIS, specific GPS points along hardbottom edges within the ETOF were recorded. GPS points were recorded along these edges every 50 meters. Figures 1-5 show the locations of the hardbottom areas within the ETOF and the locations of these GPS points. Segment III was divided into 2 sections, John U. Lloyd (JUL) (Figure 1) and Hollywood (HWD) (Figures 2-5). The JUL GPS points were numbered 1-24, and HWD GPS points were numbered 1-34. HWD also had 5 additional GPS points recorded for the DEP added area (points 22a-22e) (Figure 2).

These project GIS generated search areas and GPS points were approved during the 11 September 2003 pre-transplantation meeting at NSUOC. At this meeting, the group also decided to include a 10 m buffer area east of these points along the ETOF in which colonies would be removed. Therefore, the search area for stony coral colonies, having a living tissue axis greater than 15 cm, was defined by hardbottom areas within the ETOF including a buffer area approximately 10 m east of the ETOF. No colony search was conducted within the ETOF that did not have hardbottom identified by the project GIS.

## **3. Field Activities**

### **1. Colony Search and Removal**

The GPS points generated from the project GIS were used to guide the searches. Surface buoys were deployed at these GPS points. Divers would use these points as visual reference for the east boundary of the search areas. The divers would estimate whether a colony of sufficient size was within 10m east of a "line" between these buoys. The west search area boundary was defined by the inshore edge of the hardbottom.

When an appropriate colony was located, the NSUOC researcher would record the colony species and the nearest buoy number. This provided information on the areas which had colonies removed.

Colonies were removed from the substrate using hammers and chisels. All attempts were made to reduce fragmentation when removing the colonies. The colonies were hand carried to the vessel and stored in coolers to control temperature and reduce light exposure. Several colonies were too large to be lifted by divers so a hand winch onboard the vessel was used to lift the colony out of the water. Generally, colony search and removal was conducted in the morning to minimize colony out of the water time and to allow for sufficient colony transplantation time in the afternoon.

## **2. Colony Transplantation**

All colonies were transplanted to boulders at the northern end of mitigation reef 7 (Figure 6). NSUOC researchers chose boulders that had a flat enough surface to allow for efficient transplantation. Colonies were sorted by species, and species were grouped when transplanted. The goal was to approximate a 2-3% cover on boulders with transplants. During our group discussion on 11 September 2003, it was agreed to generally transplant 3 colonies per boulder. There were some exceptions when 4 or 5 small colonies were transplanted on a boulder or 1 or 2 large colonies were transplanted on a boulder.

Colonies were transplanted using Portland Type II cement. NSUOC researchers would place the colonies on the appropriate boulders. Cement was mixed on board the vessel, put into buckets, and carried to the boulders. The surface of the boulder was scraped to remove algae and loose sediment, cement was pressed onto the boulder, and the colony was pressed into the cement. Care was taken to use the appropriate amount of cement to cover the entire base of the colony without covering live tissue.

The Agreement requires a minimum of 25% of the transplanted colonies to be monitored. These colonies are to represent the species distribution of the transplanted colonies. During each transplantation day, the appropriate number of boulders with colonies that would equal 25% of those transplanted that day were tagged. The plastic tags (approximately 1 x 3 inches) were secured to the boulders using a nail and cement.

## **IV. Transplantation Results**

### **1. Work period**

NSUOC received the notice to begin field work in August 2004. Personnel from Florida DEP and Broward County EPD were present during the first 2 days of field work (24 and 25 August 2004). After the second day all groups (NSUOC, BC EPD, DEP, and IDC) were comfortable and confident with the normal crew of 3 IDC divers and 2 NSUOC researchers continuing the work. The 25 field days took much longer to complete than anticipated. The 2 hurricanes that impacted our area in late August and September essentially stopped work through September and into October. The safe removal and transplantation of stony coral colonies in nearshore, shallow water requires flat seas (<3 ft) and good water visibility. These field conditions become rare in the fall and winter. The 25<sup>th</sup> field day was 11 January 2005. A 26<sup>th</sup> field day was completed on 10 February 2005 to check 3 NSUOC buoy locations which did not have recorded colony removal data.

## 2. Colony Removal Summary

A total of 654 colonies (approximately >15 cm) were removed during the project. Table 1 lists the number of colonies for each species and the number of colonies included in the monitoring program. Table 2 list the number of colonies removed near each of the NSUOC buoy numbers (see Figures 1-5) and the corresponding R monuments.

A total of 10 species were removed and transplanted. *Solenastrea bournoni* was the most common species followed by *Diploria clivosa* and *Dichocoenia stokesii* (Table 1). Very few colonies were removed from the hardbottom areas offshore JUL (10 colonies). The remaining 644 colonies were removed from hardbottom areas offshore HWD. Of these colonies 294 were removed from hardbottom areas within the ETOF and 360 were removed from the DEP added area offshore R monuments 100 and 101.

In the Agreement Exhibit A-2 Activity 7.1 (and in DEP permit 0163435-001-JC and COE permit SAJ-1999-5545 item 9), it states that approximately between 1000 and 2000 colonies will be located and transplanted. The total of 654 colonies (only 294 within the ETOF) actually removed represents the reality of what was present and includes not only all colonies greater than or equal to 15 cm in diameter but also includes colonies between 10-15 cm in diameter.

The number of 654 colonies removed is well within the uncertainty of the original estimation of the number of corals that might have been present. Although it is possible that some colonies in this size class were missed during the field work, it is unlikely, especially given the care that was given to the search process. The original estimate of 1000 to 2000 colonies was based on two calculations. One utilized a survey of numbers of colonies in nearshore reef habitat in August 2001 within a total of 260 square meters in both Segment II and Segment III (available in the Broward County GIS). The other utilized stony coral species counts (and size distributions) from Broward County Annual Survey sites (6 first reef sites within a total of 180 square meters). This gave a total of data from 0.1 acres (440 m<sup>2</sup>) to estimate stony coral populations in the 8.9 acres of potential impact reef. Accordingly the estimate was only meant to provide an approximation, not an absolute number of colonies. One variable that likely lead to the over-estimation of the number of colonies > 15 cm involved using the abundance and size frequency data from the First Reef (a slightly richer habitat) to extrapolate to the nearshore habitat. In summary, the 654 corals actually collected is a reasonable achievement given the high degree of variability that was recognized to be present within the original estimation.

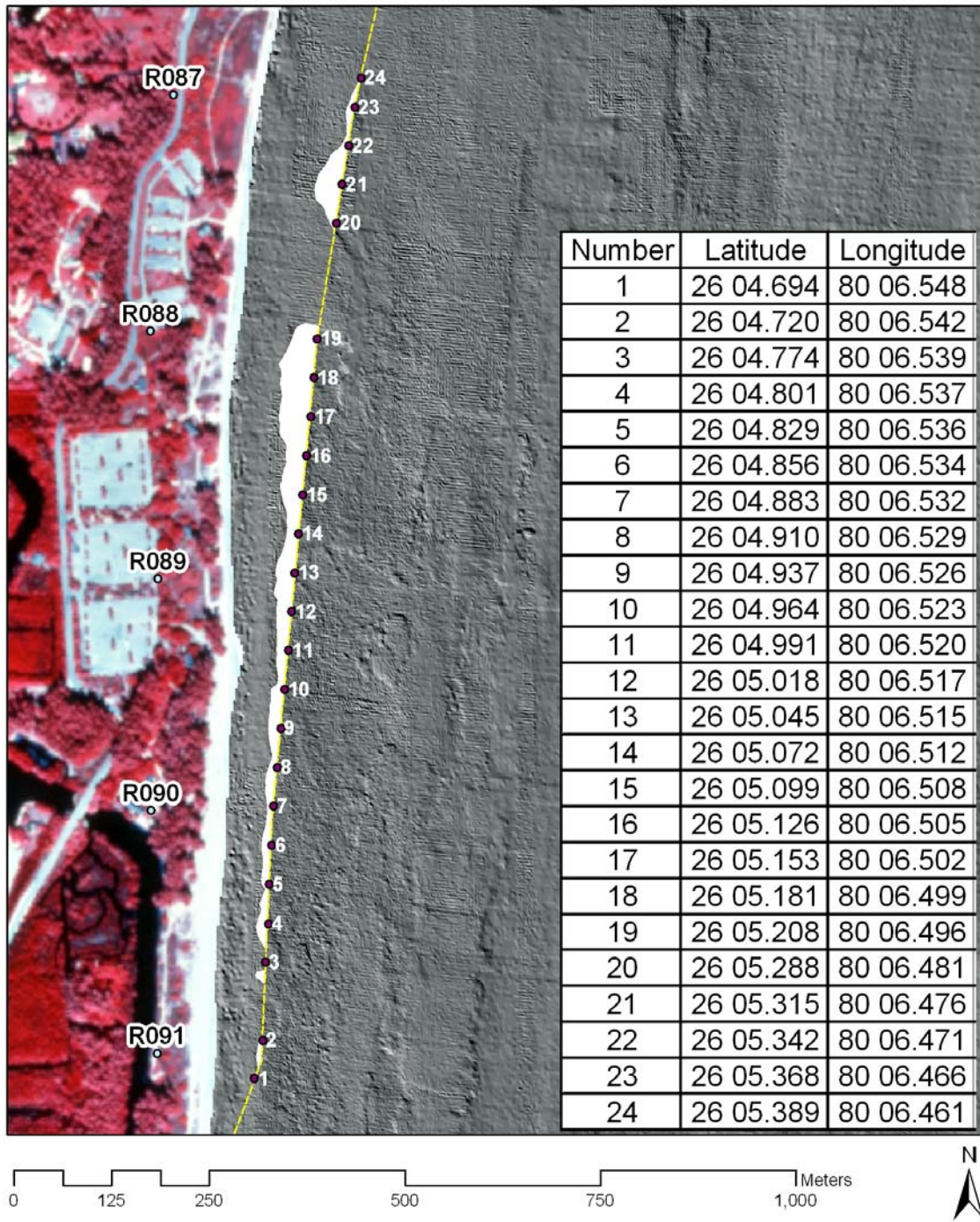


Figure 1. Map showing the NSUOC buoy locations (red dots), ETOF (yellow line), hardbottom areas within ETOF (white polygons), and R monuments offshore John U. Lloyd State Park.

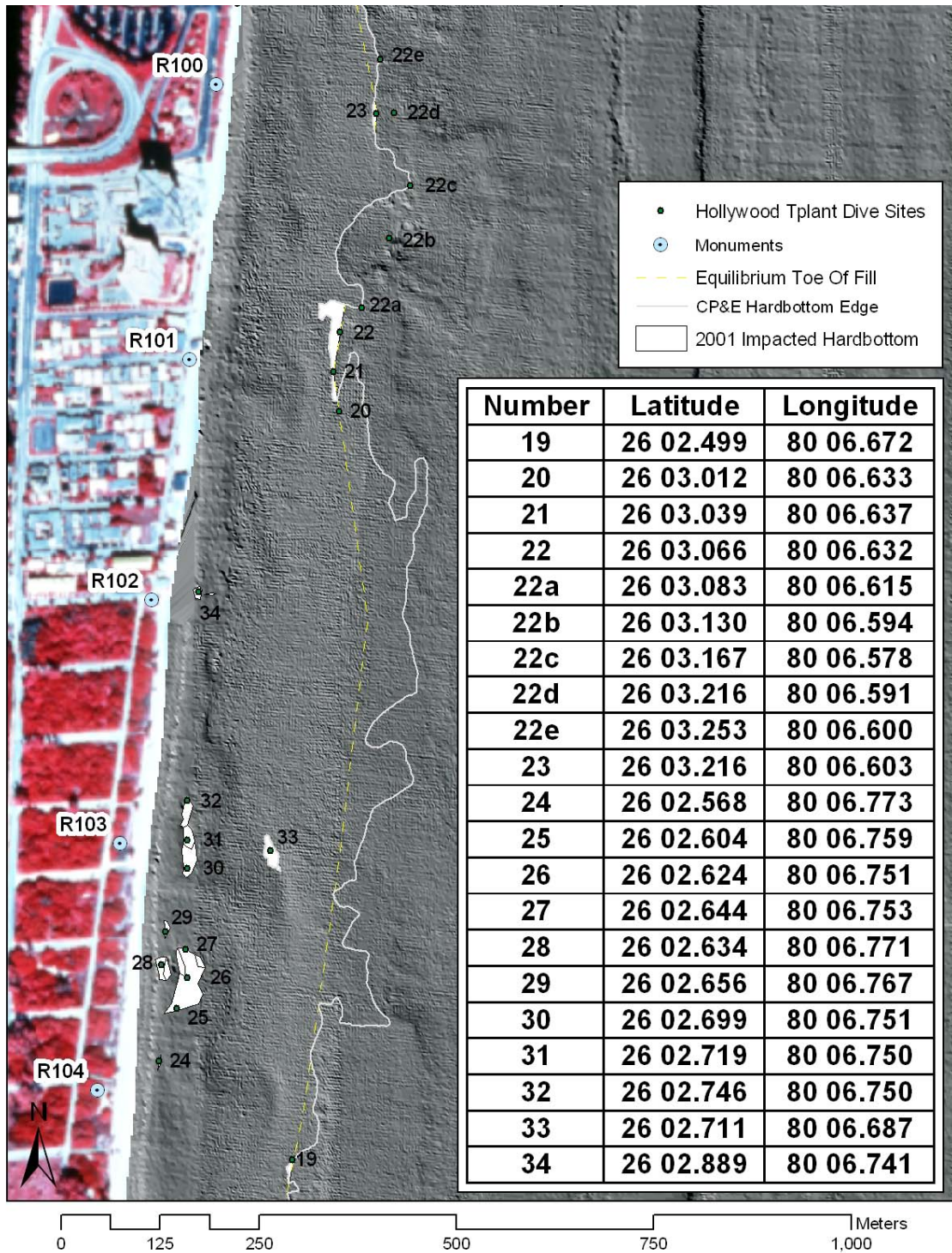


Figure 2. Map showing the NSUOC buoy locations, ETOF, hardbottom areas within ETOF, and R monuments offshore north Hollywood. The DEP added area is outlined by buoys 22a-22e.

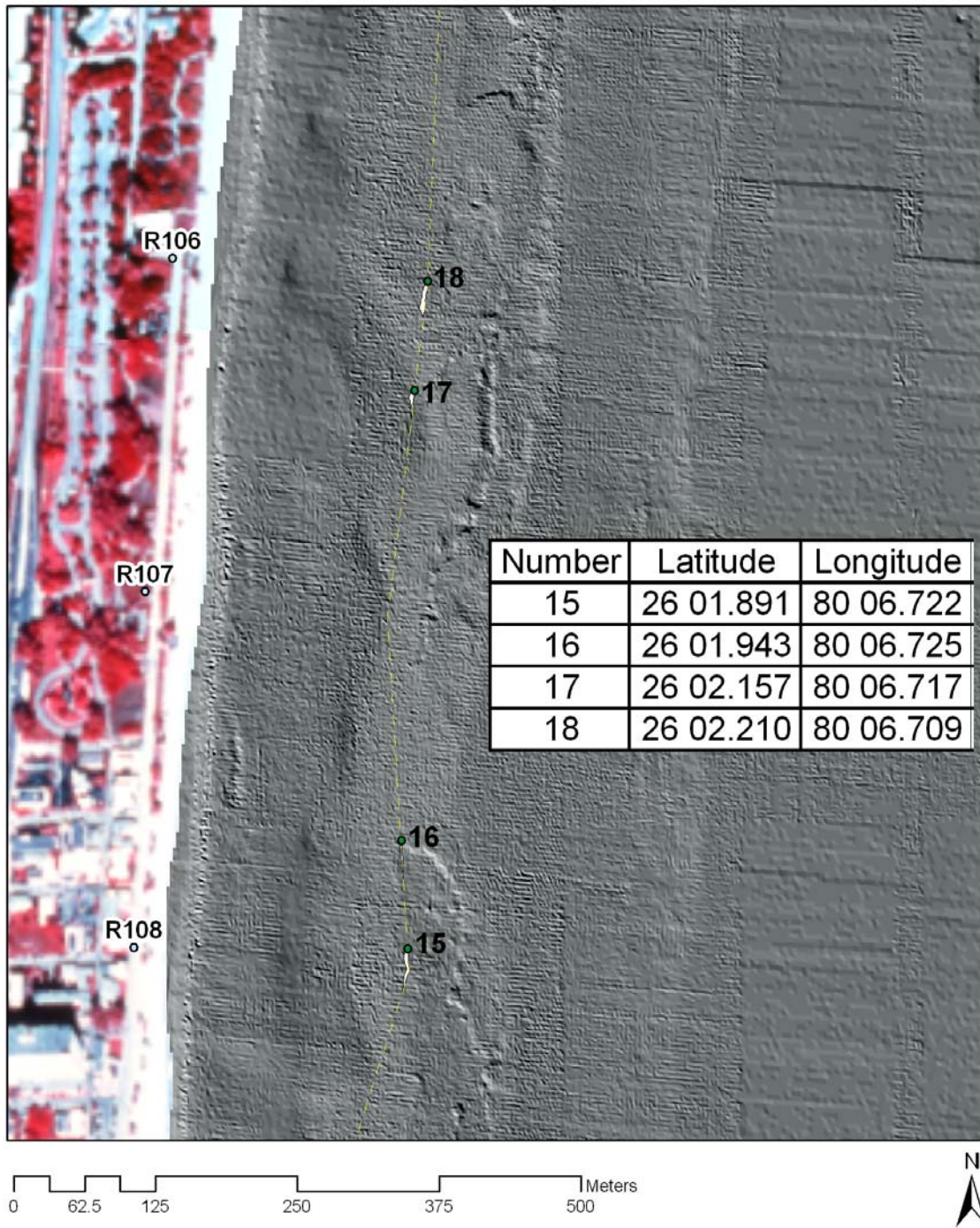


Figure 3. Map showing the NSUOC buoy locations, ETOF, hardbottom areas within ETOF, and R monuments offshore north-central Hollywood.

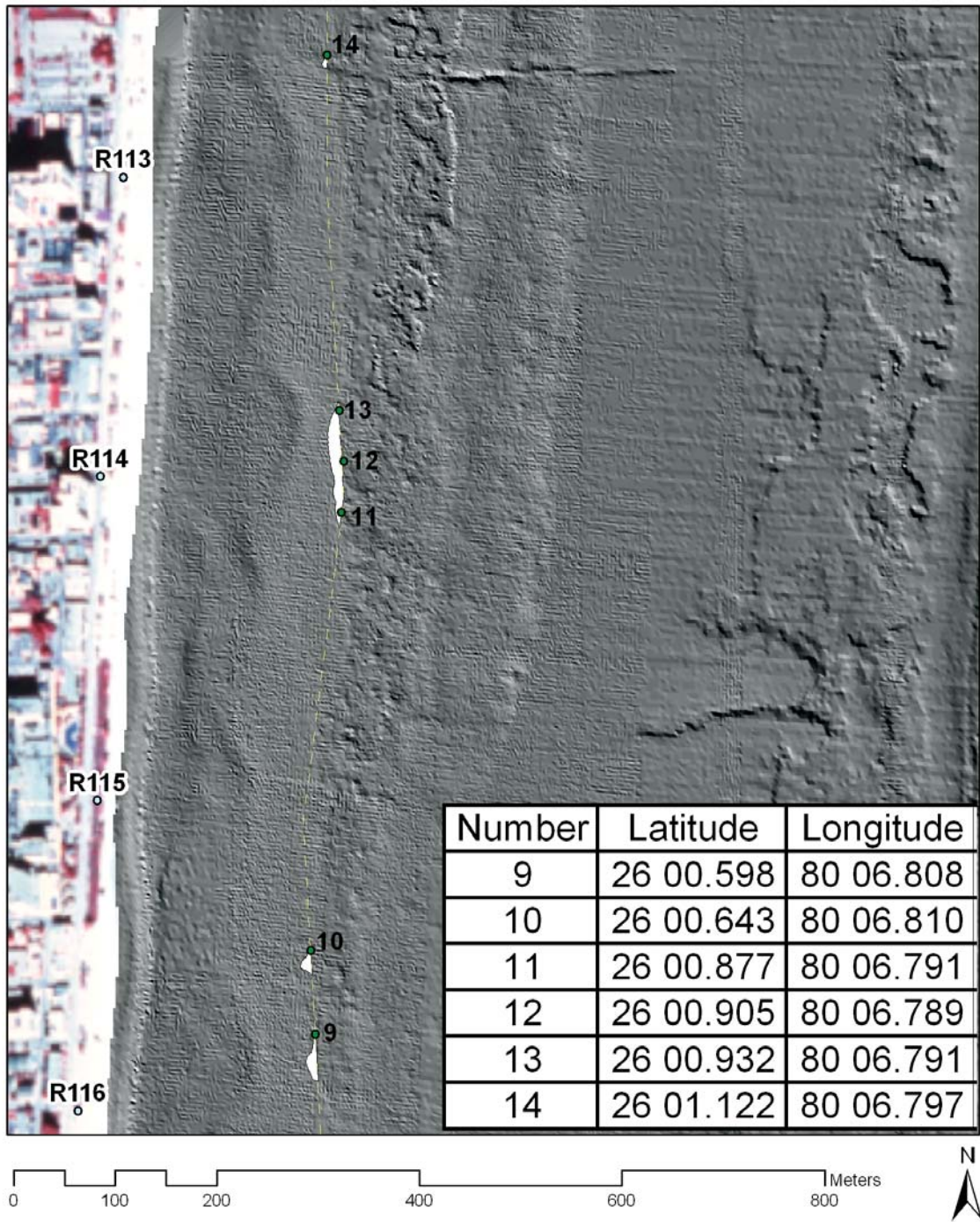


Figure 4. Map showing the NSUOC buoy locations, ETOF, hardbottom areas within ETOF, and R monuments offshore south-central Hollywood.

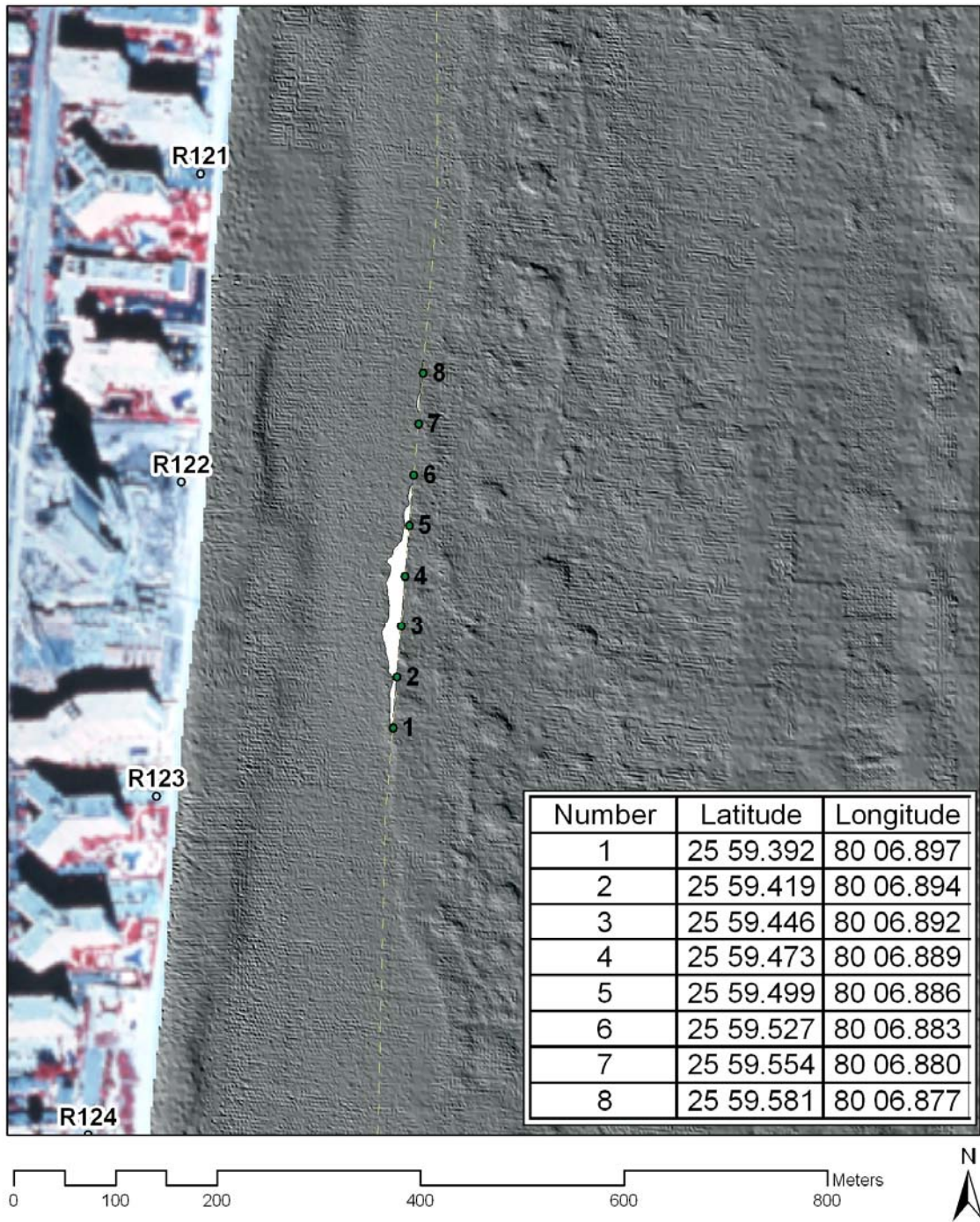


Figure 5. Map showing the NSUOC buoy locations, ETOF, hardbottom areas within ETOF, and R monuments offshore south Hollywood.

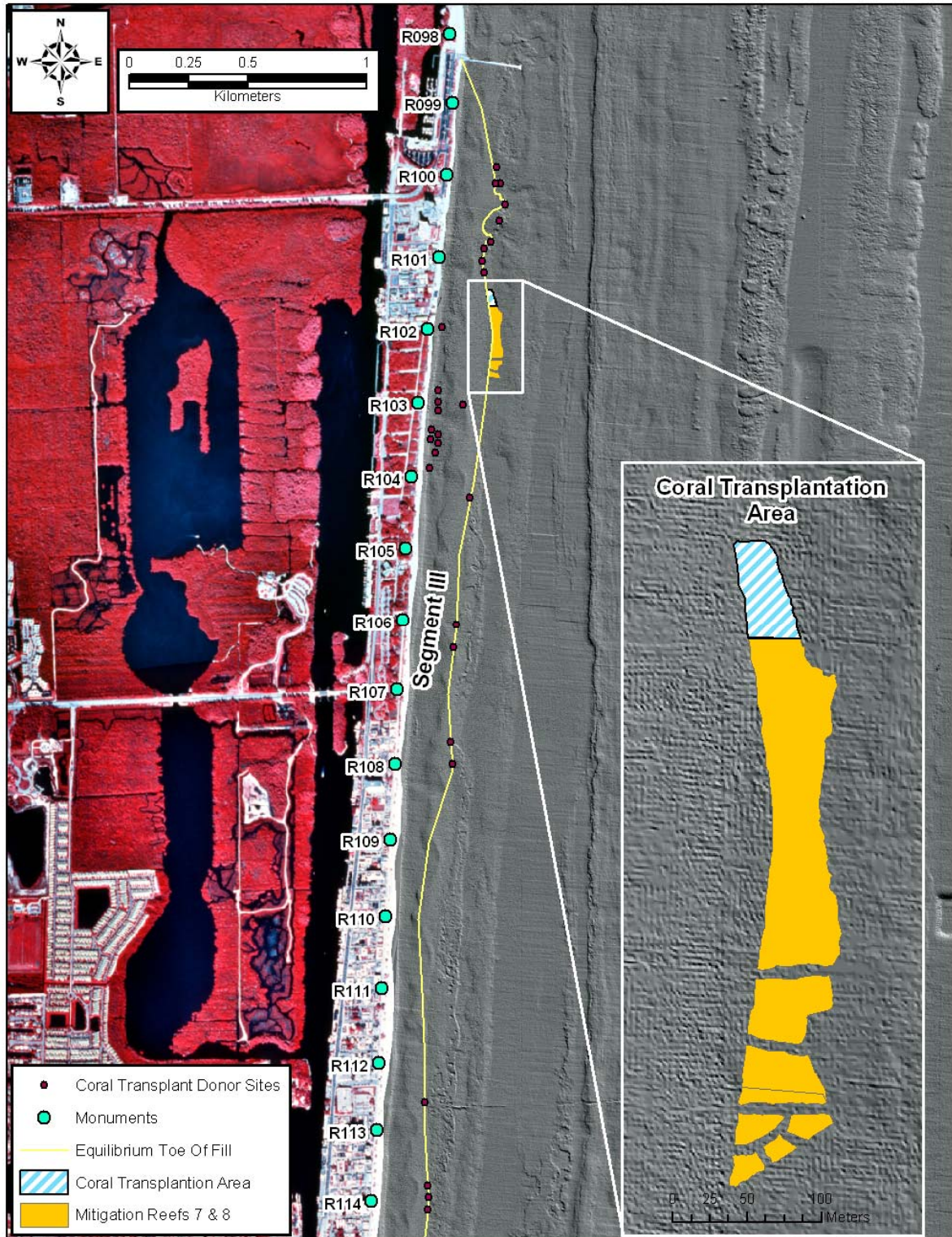


Figure 6. Map showing the mitigation reef 7 in relation to Hollywood beach and inset shows the northern area of mitigation reef 7 which has transplants.

Table 1. Species list of coral colonies removed and transplanted, and the number of each species to be monitored. The 169 colonies is greater than the Agreement minimum 25% (163) to be monitored.

<b>Coral Species</b>	<b># Colonies Removed</b>	<b># Colonies Monitored</b>
<i>Solenastrea bournoni</i>	408	90
<i>Diploria clivosa</i>	140	36
<i>Dichocoenia stokesi</i>	63	18
<i>Stephanocoenia michelini</i>	17	11
<i>Colpophyllia natans</i>	7	3
<i>Oculina diffusa</i>	7	4
<i>Diploria strigosa</i>	5	3
<i>Porites astreoides</i>	4	2
<i>Siderastrea siderea</i>	2	1
<i>Montastraea cavernosa</i>	1	1
<b>Total</b>	<b>654</b>	<b>169</b>

Table2. Number of colonies removed near each NSUOC buoy and R monument. The NSUOC buoys 22b-22e are the DEP added area. \*Buoy 23 data is included with buoy 22d data. \*\*Buoy 22a data is included with buoy 22b data. See Figures 1-5 for buoy locations.

<b>Location</b>	<b>R Monument</b>	<b>Buoy #</b>	<b>Colonies Removed</b>
Hwd	R122	1	0
Hwd	R122	2	0
Hwd	R122	3	105
Hwd	R122	4	32
Hwd	R122	5	47
Hwd	R122	6	0
Hwd	R121	7	0
Hwd	R121	8	0
Hwd	R115	9	0
Hwd	R115	10	10
Hwd	R114	11	41
Hwd	R113	12	9
Hwd	R113	13	24
Hwd	R112	14	3
Hwd	R108	15	0
Hwd	R107	16	0
Hwd	R106	17	0
Hwd	R106	18	0
Hwd	R104	19	0
Hwd	R101	20	0
Hwd	R101	21	13
Hwd	R101	22	0
Hwd	R100	23	*
Hwd	R103	24	0
Hwd	R103	25	0
Hwd	R103	26	0
Hwd	R103	27	0
Hwd	R103	28	0
Hwd	R103	29	0

Table 2. Continued

<b>Location</b>	<b>R Monument</b>	<b>Buoy #</b>	<b>Colonies Removed</b>
Hwd	R103	30	0
Hwd	R103	31	0
Hwd	R102	32	0
Hwd	R103	33	0
Hwd	R102	34	0
Hwd	R100	22b	236**
Hwd	R100	22c	8
Hwd	R100	22d	70
Hwd	R100	22e	46
JUL	R091	1	0
JUL	R091	2	0
JUL	R090	3	0
JUL	R090	4	0
JUL	R090	5	0
JUL	R090	6	0
JUL	R090	7	0
JUL	R089	8	0
JUL	R089	9	0
JUL	R089	10	1
JUL	R089	11	0
JUL	R089	12	1
JUL	R089	13	1
JUL	R088	14	0
JUL	R088	15	1
JUL	R088	16	1
JUL	R088	17	2
JUL	R088	18	2
JUL	R088	19	1
JUL	R087	20	0
JUL	R087	21	0
JUL	R087	22	0
JUL	R087	23	0
JUL	R087	24	0