FINAL REPORT

SURF CITY/NORTH TOPSAIL BEACH, N.C.
SHORE PROTECTION PROJECT, HARDBOTTOM RESOURCE CONFIRMATION AND CHARACTERIZATION STUDY

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FINAL REPORT

SURF CITY/NORTH TOPSAIL BEACH, N.C. SHORE PROTECTION PROJECT, HARDBOTTOM RESOURCE CONFIRMATION AND CHARACTERIZATION STUDY

USACE Contract W912HN-08-C-0009

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ACRONYMS

BEAMR	Benthic Ecological Assessment for Marginal Reefs (developed by CPE)
cm	centimeter
CPE	Coastal Planning & Engineering, Inc.
DGPS	differential global positioning system
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EOD	end of day
GPS	global positioning system
m^2	square meter
MATER	Mid-Atlantic Technology and Environmental Research, Inc.
NAVSTAR GPS	Navigation Signal Timing and Ranging Global Positioning System
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanic and Atmospheric Administration
SCNTB	Surf City/North Topsail Beach [Shore Protection Project]
SCUBA	self-contained underwater breathing apparatus
SOD	start of day
SOW	Scope of Work
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard

ABSTRACT

In order to assess potential dredging and beach nourishment impacts to significant hardbottom resources within and adjacent to the Surf City/North Topsail Beach Shore Protection Project area, the U.S. Army Corps of Engineers requires a more refined biological characterization and analysis of flora and fauna species associated with hardbottom resources within the study area. Between March 18 and March 24, 2008, ANAMAR Environmental Consulting, Inc. and Coastal Planning & Engineering, Inc. biologists conducted investigations of potential hardbottom resources in nearshore and offshore areas identified by sidescan data interpretation.

No hardbottom habitat was observed at the eight potential nearshore hardbottom sites landward of the -23–foot NGVD depth of closure; these sites were determined by diver investigations to be coarse gravel and shell hash. Divers did confirm the presence of hardbottom resources at two sites (NS10 and NS12) seaward of this line by a distance of 625 feet and 535 feet, respectively. Poor visibility did not allow for the characterization of any benthic community that might have been present. Hardbottom resources were identified and characterized within all five borrow areas investigated. Overall, most offshore hardbottom areas in this study were characterized by a combination of low- and moderate-relief habitats. Borrow Area J had the least amount of hardbottom and was the most ephemeral of all areas investigated. The other borrow areas had varying degrees of benthic cover often related to the associated habitat relief; however, as seen at sites in Borrow Area G, some low-relief areas were home to the most diverse, well-established, and apparently persistent benthic communities. This study did not investigate seasonal variation in hardbottom community composition within these habitats.

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1 PROJECT BACKGROUND

In order to assess potential dredging and beach nourishment impacts to significant hardbottom resources within and adjacent to the Surf City/North Topsail Beach (SCNTB) Shore Protection Project, the U.S. Army Corps of Engineers (USACE) requires a more refined biological characterization and analysis of flora and fauna species associated with hardbottom resources within the study area. The study area is located off Surf City and North Topsail Beach, North Carolina (within Pender and Onslow Counties, respectively) and is depicted on Map 1. The nearshore investigation sites are located approximately 1100 feet from shore between the -18 and the -30-foot NGVD contours from the Surf City/Topsail Beach town border and extending through the southern end of North Topsail Beach. The offshore investigation sites are located within five offshore borrow sites located approximately 3 to 5 miles from the coast in water depths between -30 and -47 feet NGVD.

Hardbottom investigations and characterization for the SCNTB Shore Protection Project were completed by ANAMAR Environmental Consulting, Inc. and Coastal Planning & Engineering, Inc. (CPE) biologists between March 18 and 24, 2008. The services provided under the Scope of Work (SOW) (Appendix A) are intended to satisfy baseline condition needs as described by state and federal regulatory agency personnel for development of the project Environmental Impact Statement (EIS) and Essential Fish Habitat (EFH) Assessment for the federal shore protection project.

2 OVERVIEW OF PAST INVESTIGATIONS

Through the permitting process for the non-federal beach nourishment project for the Town of North Topsail Beach, CPE conducted surveys to characterize hardbottom habitats in the nearshore zone along North Topsail Beach and in the vicinity of an offshore borrow area designed by CPE. These surveys included sidescan sonar surveys covering the nearshore area along the entire length of the Town of North Topsail Beach from -3 feet to -30 feet and the vicinity in and around the offshore borrow area. CPE marine biologists conducted *in situ* investigations in June, August, and October 2005 as well as in June 2006 in the nearshore (-18 feet to -25 feet NGVD) and offshore (-36 feet to -44 feet NGVD) waters off North Topsail Beach (see Appendix B, Observation Reports). Field investigations were performed to confirm the delineations of potential and probable hardbottom resources in the project area to collect benthic community data from representative locations.

As part of a preliminary investigation of seven proposed borrow areas for beach nourishment projects at Surf City and North Topsail Beaches, North Carolina, the USACE contracted Mid-Atlantic Technology and Environmental Research, Inc. (MATER) to conduct a submerged cultural resource survey of the borrow sites. As part of this survey, MATER collected sidescan sonar data of the borrow areas between October 14, 2004, and May 10, 2005. MATER reviewed the data to identify and delineate areas interpreted as hardbottom habitat. These areas were defined by MATER as areas larger than 1,800 m^2. Further designations were made by MATER with respect to the amount of relief interpreted at each location: a designation of "low" relief was applied to areas with less than 0.5 meters of vertical relief, "moderate" relief was applied to areas between 0.5 and 2 meters of relief; "high" relief (greater than 2 meters) was not applied to any areas. (Moser and Taylor, 1995).

CPE conducted sidescan sonar surveys off North Topsail Beach for the Town's proposed Shoreline Protection Project in 2004 and 2005. After determining potential and probable hardbottom locations from sidescan sonar interpretation for the North Topsail Beach Shoreline Protection Project, CPE marine biologists conducted *in situ* investigations in June, August, and October 2005 in the nearshore (-19 to -26 feet NGVD) and offshore (-37 to -45 feet NGVD) waters of North Topsail Beach. Field investigations were conducted to confirm the presence of hardbottom resources in the project area and to collect benthic community data from representative locations. Hardbottom communities were characterized using the Benthic Ecological Assessment for Marginal Reefs (BEAMR) developed by CPE. Underwater video documentation was conducted as well.

Nearshore investigations of the northern section of the project area confirmed intermittently exposed hardbottom between USACE baseline Stations 1030+00 to 1070+50. However, poor visibility prevented CPE marine biologists from conducting further detailed benthic characterizations of the hardbottom communities in this area.

In the central nearshore section of the project area, hardbottom was exposed between Stations 850+50 to 880+50. Results of these investigations confirmed relief up to 35 centimeters (cm) and sediment depth up to 10 cm. Sediment type was dominated by sand and shell with occasional mud. Shell fragments were commonly observed in the limestone substrate, and a thin veneer of sediment was present over the surface. Sessile benthos observed include bryozoans, annelids (feather duster worms), and macroalgae.

Offshore hardbottom investigations within 300 meters of the proposed borrow area identified hardbottom communities with relief measured between 0.3 and 1.3 meters. Sessile benthos observed during these investigations included macroalgae, octocorals, encrusting red algae, sessile worms, and some stony corals. Visual observations of the standing sediment indicated a composition of primarily sand and shell fragments. Some of the sites were also found to be ephemeral in nature. In June 2005, CPE marine biologists confirmed hardbottom at two offshore sites, which were later observed to be covered with greater than 60 cm of mud during the October 2005 investigations.

Offshore investigations during 2005 also included probable hardbottom areas identified from the sidescan sonar results located in the New River Inlet Outcrop Significant Natural Heritage Area. Both low-relief ($\leq$30 cm) and moderate-relief (up to 2.0 meters) hardbottom features were confirmed by diver investigations. Tunicates, sponges, encrusting red algae, and hydroids were observed, and the stony coral *Oculina robusta* was common on the moderate-relief sites.

In June 2006, a segment of shoreline (Stations 580+00 to 781+00) was added to the North Topsail Beach Shoreline Protection Project. Investigations were subsequently conducted in August 2006 to determine if nearshore hardbottom resources were present in this southern section of the project area or if hardbottom existed near the proposed offshore borrow area. As during the 2005 investigations of the area, benthic characterization of confirmed hardbottom habitats included the use of BEAMR methodology supported by video documentation. Results of these investigations showed the benthic habitat was similar in species composition to the offshore sites characterized in 2005, with tunicates, sponges, macroalgae, bryozoans, stony corals, and octocorals observed. Nearshore hardbottom in the southern segment of the project area was confirmed between Stations 720+00 and 740+00; however, poor visibility precluded further benthic characterization.

In July 2006, Geodynamics of Pine Knoll Shore, North Carolina, conducted a nearshore sidescan sonar survey for USACE. The sidescan coverage included the region from approximately 260 meters offshore out to 610 meters offshore along the entire extent of the town of Surf City, North Carolina. Areas of high backscatter were delineated as potential hardbottom areas by Geodynamics of Pine Knoll Shores, North Carolina. The March 2008 biological investigations off Surf City and North Topsail Beach were

conducted based on results of these nearshore surveys and on the sidescan survey data collected offshore by MATER in 2004 and 2005.

3 METHODS

3.1 Sidescan Data Evaluation and Site Selection

The hardbottom investigation study areas were delineated based on review of the results of existing multibeam and sidescan sonar data collected in the nearshore zone and from USACE high-resolution sidescan sonar surveys (conducted by Geodynamics) of the borrow areas (conducted by MATER). The resulting sidescan sonar mosaics in the nearshore zone and hardbottom delineation maps of resources within the borrow sites were utilized to define sampling locations and develop a basic design for benthic characterization assessments for the SCNTB Shore Protection Project.

During this first stage of the investigation, the remote sensing data were evaluated prior to selection of transects and subsequent field data collection. The intent of this phase of the project was to re-evaluate the USACE data and determine if previously identified hardbottom resources could be further classified as unconsolidated sediments, shell hash, or rubble. Although each of these resources has its own associated floral and faunal communities, further delineation using the remote sensing data could allow the research team to focus investigations on the resource characterization aspect of this project rather than the hardbottom presence/absence determinations.

The number and spacing of transects proposed for these investigations were based on the USACE SOW which specified a minimum number of sites to be investigated within each study area. The estimated number of sites within the nearshore zone was defined by USACE as eight sites comprised of two dives on the small, individual high-backscatter anomalies that appear as circular sites in the sidescan imagery and six dive sites occurring on the finger-like projections running perpendicular to the shoreline. If exposed hardbottom was confirmed, three site characterization and temporary transect documentation investigations were to be performed, one transect to characterize an isolated high-backscatter anomaly, and two transects to characterize representative examples of the finger-like projections (see Map 2).

USACE also stipulated that offshore investigations be conducted at five borrow sites (G, J, L, O, and T) and determined the number of temporary transects to be established at each site as follows: G = 2; J = 2; L = 2; O = 3; and T = 3.

After evaluation of the sidescan sonar and multibeam data sets for the project area, ANAMAR and CPE presented the results of proposed transect locations to USACE for approval on March 6, 2008, before initiation of field investigations (see Appendix C for Sidescan Presentation). Predetermined transects with a starting point, an ending point, and a given heading for divers to swim were established to allow divers to traverse transitional zones from one bottom type to another (i.e., to pass across the transition from a sandy bottom to a hardbottom). These transects allowed divers to more easily locate and observe the targeted transition or bottom features that were the focus of the

investigation. These sites were reviewed again and prioritized by USACE on March 16, 2008, during the field initiation meeting with ANAMAR and CPE.

3.2 Survey Vessel Navigation and Positioning Quality Control

The operational status of the U.S. Coast Guard (USCG) beacon at New Bern, North Carolina, was verified prior to and following all survey operations. Likewise, at the start and end of each survey day, positioning was verified from previously surveyed monuments used by CPE. This process involved physically aligning the vessel with a previously surveyed monument (usually located on a pile marking a channel, a specific boat slip, or a pile at a fuel dock) and collection of a start-of-day (SOD) or end-of-day (EOD) fix using the navigation system. These fixes were checked against existing monument coordinates to determine accuracy and functionality of the navigation system. All SOD and EOD fixes, as well as known monument coordinates, will be provided upon request.

The navigation and positioning system used during the field survey was a Trimble Differential Global Positioning System (DGPS) interfaced to Hypack Inc.'s HYPACK MAX®. A Pro Beacon receiver provides DGPS correction from the USCG navigational beacon at New Bern, North Carolina. The DGPS initially receives the civilian signal from global positioning system (GPS) NAVSTAR satellites. The locator automatically acquires and simultaneously tracks the NAVSTAR satellites while receiving precisely measured code-phase and Doppler-phase shifts, which enable the receiver to compute the position and velocity of the vessel. The receiver then determines the time, latitude, longitude, height, and velocity once per second. The GPS accuracy, with differential correction, provides a position accuracy of 1 to 4 feet, which is within the accuracy needed for precise mapping of biological and marine resources. The USACE test of the USCG beacon (294 kHz) in New Bern determined accuracy within 5 feet approximately 94% of the time.

The HYPACK MAX® program is the navigation and hydrographic surveying system used to process all GPS position data. On-line screen graphic displays include the transect location in the form of targets, pre-plotted survey lines, an updated boat track across the survey area, adjustable left/right indicators, and other positioning information (e.g., boat speed, quality of fix, line bearing). All data obtained were recorded onto the computer's hard drive and transferred to a CD-ROM or external memory source at the end of each day, providing a backup of the raw survey data.

Navigational control was maintained on an IBM-compatible PC running HYPACK MAX® software, which was configured to acquire data from the differential GPS receiver system and which superimposed the survey plan on the project area. The HYPACK MAX® software was also used to establish track lines and specific targets in each of the study segments while providing relative course correction information to the helmsman as the vessel was maneuvered to specific locations.

3.3 Field Operations: Hardbottom Investigation and Characterization

Field operations were conducted in accordance with the USACE SOW and detailed notes were maintained. Original data sheets and field logs are presented in Appendices D and E, respectively.

3.3.1 Nearshore Investigations

Based on the USACE SOW, the investigations were planned to utilize a two-phased approach where resource presence/absence was confirmed, with habitat characterization following that determination. Phase I was intended to ground-truth potential hardbottom resources identified from the sidescan sonar and multibeam surveys (conducted by Geodynamics). In this phase, divers were deployed on eight potential nearshore hardbottom sites, including two on the small individual high-backscatter anomalies that appear as circular sites in the sidescan imagery and six on the finger-like projections running perpendicular to the shoreline landward of the -23-foot NGVD depth of closure, at depths between -20 to -25 feet NGVD (see Table 1 and Map 2). Divers collected a surface sediment sample in a 1-gallon Ziploc™ bag at the start of each dive to assess the sediment characteristics of each nearshore sample site and to provide supporting data suggesting rationale for high-backscatter features interpreted from sidescan sonar imagery.

Table 1. Nearshore Dive Coordinates and Headings

Location	Start Easting	Start Northing	Heading (Degrees)	Sample 1 (Bag #)	Sample 1 Easting	Sample 1 Northing	Sample 2 (Bag #)
NS3	2445225	252319	37	13	2445256	252347	16
NS4	2446784	253567	200	14	2446784	253567	N/A
NS5	2447101	253598	46	8	2447101	253598	N/A
NS6	2447195	253820	197	5	2447185	253770	3
NS7	2447715	254095	50	15	2447715	254095	12
NS8	2448068	254480	61	4	2448068	254480	6
NS9	2448842	255085	247	1	2448780	255016	2
NS10	2444712	250975	N/A	Unmarked	2444646	250908	N/A
NS11	2444944	251923	47	9	2444975	252104	7
NS12	2442067	249268	92	17	2442067	249268	N/A

Divers then conducted a limited proximity search on a predetermined heading based on the potential location of the hardbottom resource as determined by interpretation of sidescan data. Without ground-truthing data for these nearshore sites, there would be no confirmation data of the sidescan imagery interpretation, which initially interpreted these sites as hardbottom. If they encountered a transition in sediment quality or grain-size, divers collected another sediment sample and, by dunking a diver-towed

dive flag, signaled to the boat crew to record the location of the transition using the HYPACK MAX® software onboard the vessel. Throughout the dive, biologists collected notes corresponding to each sediment zone and took photographs and video whenever visibility permitted.

Phase II of the nearshore investigations was planned to take place if Phase I confirmed the presence of any hardbottom resources. This phase would document and characterize the benthic community found on three of the eight nearshore sites along temporary transects. No hardbottom resources were found in Phase I of the nearshore investigations; therefore, Phase II was not implemented. Instead, USACE approved investigations of two additional nearshore potential hardbottom sites identified by sidescan interpretation and located seaward of the -23–foot NGVD depth of closure (Sites 10 and 12, Map 2). These sites more closely resembled exposed rock outcrops on the seafloor than any of the seafloor features located landward of the depth of closure.

3.3.1.1 Sediment Sample Analysis

Sediment samples collected in the nearshore area were described and visually characterized by ANAMAR using the Unified Soil Classification System (see Table 2). Photographs of the samples were taken and are presented in Appendix F.

3.3.2 Offshore Investigations

USACE stipulated that offshore investigations be conducted at five borrow sites (T, O, L, J, and G) and determined the number of temporary transects to be established at each site as follows: T = 3; O = 3; L = 2; J = 2; and G = 2 (see Table 3 and Maps 3a, 3b, and 3c, presented in order from north to south, Borrow Area T to G). Upon examining the sidescan data collected within Borrow Site J, it was determined by CPE personnel that no acoustic return resembling that of low-relief hardbottom existed within the area identified by MATER as low-relief hardbottom. At the same time, two areas were identified within Borrow Site J which did exhibit acoustic returns suggesting hardbottom habitat. Based on these observations, one transect was planned within the area identified by MATER as low relief and one transect targeted an area within Borrow Site J but outside the MATER low-relief delineation. Temporary transects were established at each hardbottom community study site selected for investigation during offshore investigations. Transects were determined by divers *in situ*, with a minimum of 10 meters and a maximum of 20 meters in length, depending upon the field conditions present and the nature and extent of the hardbottom community being characterized. Transects were generally established and documented in an orientation that collected data on the average condition of the habitat, without intent to bias the characterization to more- or less-productive segments of the community. When possible, transects were positioned to include any transitions in relief or habitat composition.

Table 2. Unified Soil Classification System

Unified Soil Classification (USC) System (from ASTM D 2487)				
Major Divisions			**Group Symbol**	**Typical Names**
Course-Grained Soils More than 50% retained on the 0.075 mm (No. 200) sieve	**Gravels** 50% or more of course fraction retained on the 4.75 mm (No. 4) sieve	Clean Gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		Gravels with Fines	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sands 50% or more of course fraction passes the 4.75 (No. 4) sieve	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		Sands with Fines	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
Fine-Grained Soils More than 50% passes the 0.075 mm (No. 200) sieve	**Silts and Clays** Liquid Limit 50% or less		ML	Inorganic silts, very fine sands, rock four, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly/sandy/silty/lean clays
			OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays Liquid Limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
			CH	Inorganic clays or high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly Organic Soils			PT	Peat, muck, and other highly organic soils

Prefix: G = Gravel, S = Sand, M = Silt, C = Clay, O = Organic
Suffix: W = Well Graded, P = Poorly Graded, M = Silty, L = Clay, LL < 50%, H = Clay, LL > 50%

Table 3. Offshore Dive Coordinates and Headings

Transect	Distance (meters)	Heading (degrees)	Start Easting	Start Northing	End Easting	End Northing
T1	20	125	2504275	270241	2504332	270199
T3	20	40	2505416	269763	2505464	269821
T4	20	54	2505445	271805	2505491	271837
O1	20	304	2467348	246798	2467287	246839
O3	20	357	2468736	246135	2468732	246223
O4	10	182	2468933	249941	2468931	249906
L1	20	143	2466228	240354	2466280	240284
L2	20	166	2466474	240483	2466489	240420
J1	NA	N/A	No Transect Established			
J2	10	216	2455267	232483	2455247	232456
G1	15	151	2443167	220534	2443191	220492
G3	18	68	2443388	219853	2443465	219885

3.3.2.1 BEAMR Methodology

Benthic communities were evaluated using the CPE BEAMR method. Each BEAMR sample was taken from a 0.25-square-meter (m^2) quadrat. The number of quadrats (and total area sampled) was planned to be dependent upon the length of transect, with a minimum of 10 and a maximum of 20 quadrats sampled along each transect and with quadrats to be placed at 1-meter intervals for the total length of the transect. However, following the first day of field investigations on March 18, 2008, a modification to this method was requested by ANAMAR and CPE. Divers determined that a reduction in the number of quadrats would be necessary to complete each hardbottom assessment in a single dive due to limitations on dive time at depths of -40 to -50 feet NGVD using air and National Oceanic and Atmospheric Administration (NOAA) dive tables. ANAMAR and CPE proposed that BEAMR data be collected within 10 quadrats regardless of the length of the transect (10 to 20 meters). Fewer quadrats would not only be more time-efficient, but would also provide a more reasonable sampling of the hardbottom without redundancy of data. These quadrats would be evenly spaced along the transect to ensure that any transitions in habitat or relief would be represented in the data. This proposed modification was approved by USACE and was incorporated into the work plan for the remainder of the project.

When conducting BEAMR along each transect, the southwest corner of the quadrat was aligned with the precise point of the sample location along the survey tape, and this location was recorded on each quadrat datasheet. BEAMR datasheets have a standardized layout, and prompt biologists to enter data in all fields (Figure 1).

The BEAMR methodology samples three core characteristics in each quadrat: physical characteristics, abiotic and biotic percent cover, and coral density. Physical characteristics recorded include maximum relief within the quadrat (to the nearest cm) and maximum sediment depth (to the nearest cm). As with all non-consumptive surveys, BEAMR is necessarily constrained to visually conspicuous organisms with well-defined discriminating characteristics.

With BEAMR, visual estimates of planar percent cover of all sessile benthos are pooled to 18 major functional groups. Functional groups include sediment, macroalgae, turf algae, encrusting red algae, sponge, hydroid, octocoral, stony coral, tunicate, bare hard substrate, seagrass, anemone, zoanthid, *Millepora* sp., sessile worm (including wormrock, *Phragmatopoma* spp.), bivalve, bryozoan, and sessile arthropod. Percent cover is estimated for each functional group (0% to 100%, minimum of 1% if present) and the total cover of all functional groups always totals 100%. Sediment is further described as sand, shell-hash, or mud. The macroalgae percent cover data are identified to genus level for all genera with at least 1% cover.

Project Name		Site Name / Transect Name	
Date		Data Collector	

Quad Label: Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos…	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-…			
Total Must = 100%			

Quad Label: Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos…	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-…			
Total Must = 100%			

Standard Abbreviations: and abbreviation formats

Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg…
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex… except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int..
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
Other Biota Specified: Anemone, Annelid, Bivalve, Barnacle, Bryozoan, *Millepora* sp., Seagrass, Zoanthid

Figure 1. Example of BEAMR Data Entry Form

Each octocoral and stony coral colony is identified and the maximum height or diameter is measured to the nearest cm. Octocorals are identified to genus and stony corals are identified to species whenever possible. The smallest colony size recorded in the BEAMR method is 1 cm for individuals less than or equal to 1 cm. Abnormal conditions of each colony are recorded (i.e., bleaching, disease, and stress). BEAMR specifies stony corals and excludes hydrocorals (*Millepora* sp.) from this component of the survey.

During BEAMR surveys, the biologist looks for indications of natural sediment movement stress. Visual inspections include identifying whether benthic organisms are being, or have recently been, stressed. Visual inspections include observations and evaluation of the following stress indicators:

- Standing sediment on hard corals, soft corals, sponges, macroalgae, or other benthic organisms that is not removed by normal currents or wave actions;
- Signs of bleaching (partial or complete) or disease within the hard or soft coral colonies markedly greater than the level found in the baseline data or comparison stations;

- Excessive mucus produced by hard corals to remove sediment from their surface; and/or
- Color mottling of benthic organisms (e.g., soft corals, algae, sponges).

In addition to the biological and physical information collected during the SCNTB BEAMR survey, line-intercept sampling was used to assess physical characteristics of the substrate (i.e., sand cover vs. hardbottom exposure). The observer noted the locations along the transect where hardbottom and sand (sand patches greater than 0.5 meters in length, depths $\geq$1 cm) intercepted.

The structural complexity of the hardbottom habitat was also assessed by collecting a gross rugosity measurement for each transect. Reef rugosity is commonly measured by carefully laying a known length of tape or chain along the contour of a reef and measuring the linear distance over which the chain extends. The contoured length of the transect must be equal to or greater than the straight-line length of the transect. In these investigations, divers extended a survey tape along the length of the sampling transect, carefully fitting the tape to the contours of the substrate. The resulting ratio (length of rugosity tape divided by horizontal length of transect) provided a dimensionless index of topographic complexity, which reflected both the underlying geology and live benthic community.

BEAMR Quality Control

BEAMR quality assurance/quality control (QA/QC) occurs at several stages. Qualified biologists are trained in the BEAMR Standard Operating Procedure (CPE, 2006). The standard BEAMR datasheet used *in situ* prompts biologists to complete all fields. During the first data collection dive, CPE biologists collected BEAMR data on the same quadrats and compared observations to remove the potential for inter-observer error. Throughout all field investigations, divers noted any questionable identifications of organisms; these identifications were clarified during the dive with the other biologist, when possible, or immediately following the dive when necessary. When data collection was complete, CPE utilized an Access-based BEAMR data entry tool that is similar in appearance to the BEAMR datasheet. This data entry form has built-in QA features such as standardized spellings, number format validation, and automatic summation of functional group percent cover (must total 100%). A standard QA protocol is applied once all data are entered, during which the electronic data are checked against the original datasheets.

A single Access database was developed to manage all biological data collected for this study. This database eases QA/QC operations, data management, and portability to GIS and provides relatively secure data storage.

3.3.2.2 Video Transect Documentation

Underwater visibility was sufficient (>1 meter) to capture video imagery at each offshore hardbottom site, allowing biologists to document conditions and habitats along transects. Still images were also taken to supplement video on offshore sites.

A survey tape was stretched the length of each temporary transect and used to delineate distance and the transect center line during the video documentation of the hardbottom. The video surveys were conducted by a biologist using SCUBA and a digital video camera (a 4-mm Sony TRV-900 video camera in an Ikelite housing, or similar equipment). The camera was set to fully automatic operation, "steadyshot," and "progressive scan," recording 15 frames per second at 640 x 480 resolution. The biologist swam at approximately 4 to 5 meters per minute while filming each video transect. Video of the seafloor beneath each transect line was taken at a height of 40 cm. A convergent laser guidance system indicated the precise height of 40 cm from the benthos (Figure 2), and a panoramic/oblique view of the transect and surrounding area was filmed as a separate video documentation of the habitat during the field investigations. The survey tape was removed following the completion of each video transect.

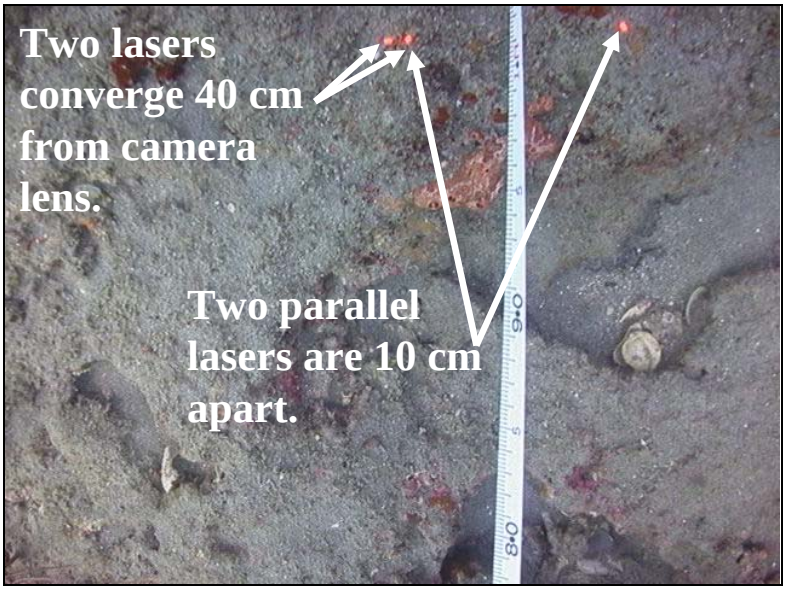


Figure 2. Laser Guidance System in Use on Hardbottom Substrate (photo taken in Broward County, Florida)

3.3.2.3 Fish Observations

Limited underwater visibility characteristics of the study area did not allow for formalized fish census surveys using standard methods. Additionally, winter water temperatures have been shown to stress the hardbottom fish populations of North Carolina, limiting fish abundance and diversity during this time of the year (Kirby-Smith,

1989; Street *et al.,* 2005). Therefore, no formal fish surveys were planned or conducted during this investigation. Anecdotal observations of fish species were made during all investigations in order to create a list of identified fish species.

4 RESULTS

4.1 Nearshore Investigations

This section presents the results of Phase I of the nearshore investigations on the eight potential nearshore hardbottom sites, including two on the small individual high-backscatter anomalies that appear as circular sites in the sidescan imagery (Sites NS4 NS6) and six on the finger-like projections running perpendicular to the shoreline (Sites NS3, NS5, NS7, NS8, NS9, and NS11) at depths between -20 and -25 feet NGVD, landward of the -23–foot NGVD depth of closure. Sediment samples were collected at the start of each dive and also at any transition between sediment types (Appendices F and G). Sediment depth was also recorded to the nearest centimeter at the start of each dive, measuring from the surface of the sediment down until the ruler could not penetrate any further due to the presence of either underlying hardbottom or densely compacted sediment. When no hardbottom resources were found in Phase I of the nearshore investigations, USACE approved investigations of two additional nearshore potential hardbottom sites (NS10 and NS12) identified by sidescan interpretation (Map 2). These sites were located seaward of the -23-foot NGVD contour (depth of closure) line by a distance of 625 feet and 535 feet, respectively. Results for these two additional sites are also included in this section. These additional ground-truthing data further validate the independent sidescan interpretation conducted by CPE personnel for this study. Furthermore, these additional ground-truthing verification dives, in conjunction with the sidescan interpretation, support the conclusion that no hardbottom habitat exists landward of the -23-foot NGVD contour (depth of closure).

Individual nearshore site sediment classifications, descriptions, and photos are presented in Appendix F.

4.1.1 Site NS3

Site NS3 appeared as a finger-like projection on the sidescan data. Divers began the dive on coarse sediment/shell hash with a depth of 22 cm and swam on a 37° heading until they reached a transition to fine sand. No hardbottom was found. Poor visibility prohibited collection of video or photographs.

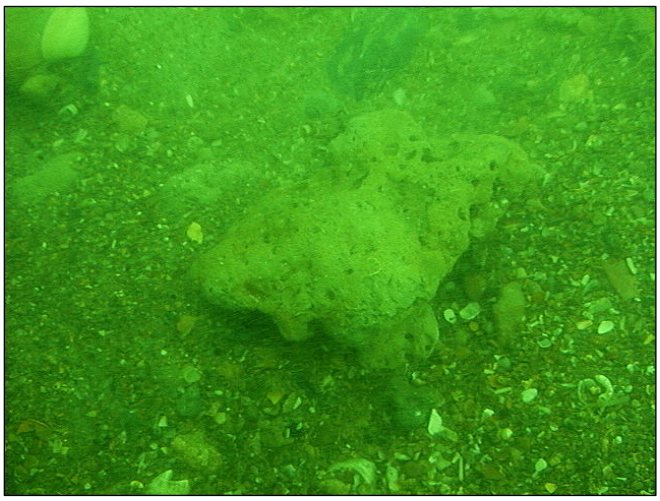
4.1.2 Site NS4

Site NS4 appeared as a circular high-backscatter anomaly on the sidescan data. Divers descended onto fine soft sand with no shell and with a depth of 11 cm. Divers swam on a 200° heading, but no transitions to shell hash or hardbottom were found. Poor visibility prohibited collection of video or photographs.

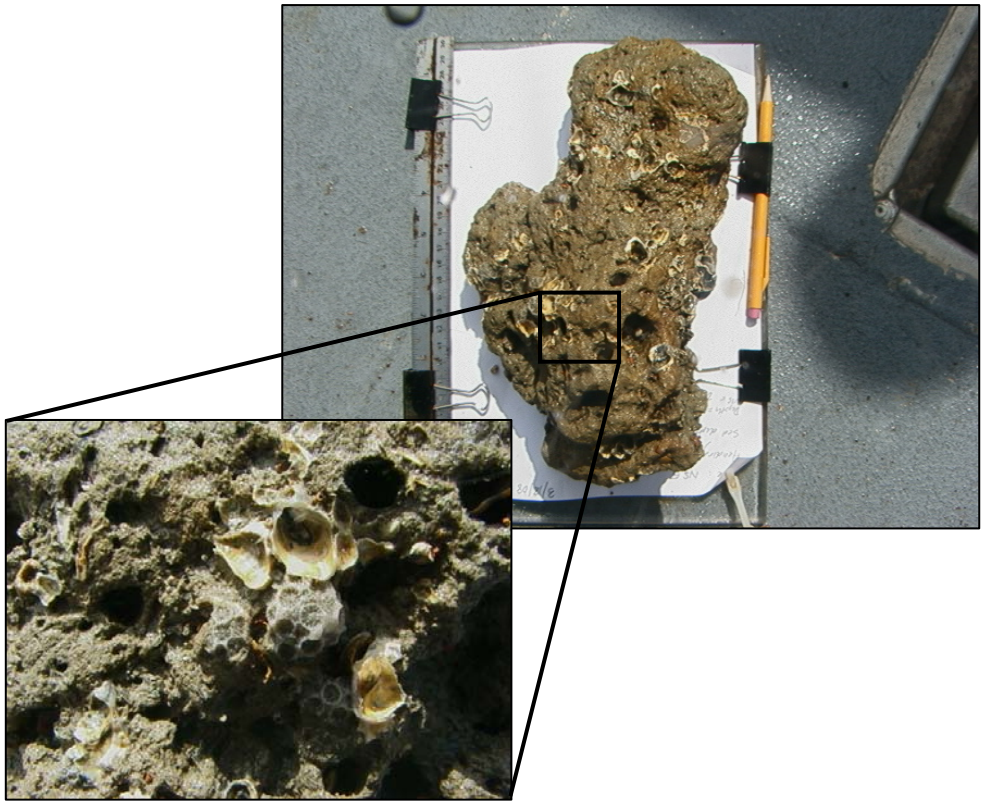
4.1.3 Site NS5

Site NS5 appeared as a finger-like projection on the sidescan data. Divers descended onto coarse sediment/shell hash with a depth of 17 cm. Sparse cobble (loose, unattached rocks) was observed (Photograph 1). Divers collected one of these rocks as

a sample; it was covered with several small (1 to 2 cm) dead *Oculina* sp. colonies and dead barnacles and oysters (Photograph 2). Divers continued on a 46° heading, but no transitions in sediment quality and no hardbottom were observed. Visibility was sufficient for collection of video (see enclosed DVD) and photographs.



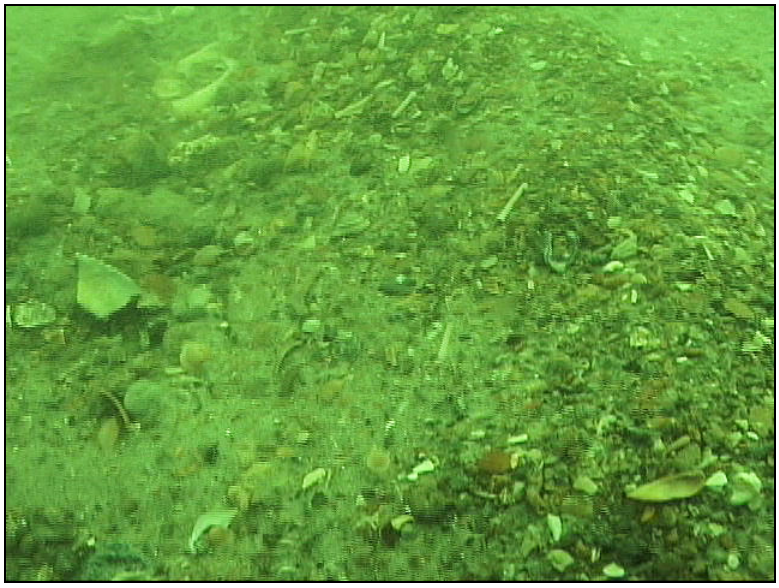
Photograph 1. Coarse sand/shell hash mixed with cobble (approximately 30 cm X 15 cm), observed at NS5.



Photograph 2. Rock (approximately 28 cm X 15 cm) collected on nearshore site NS5 upon USACE request; inset shows close-up of small (1 to 2 cm) *Oculina* sp. Skeletons

4.1.4 Site NS6

Site NS6 appeared as a circular high-backscatter anomaly on the sidescan data. Divers began the dive on soft fine sand with a depth of 23 cm and swam on a 197° heading until they reached coarse sediment/shell hash with sparse cobble (rocks ranging from fist-sized to approximately 1 foot) (Photograph 3). All rocks were loose (unattached); no hardbottom was found. Divers ended the dive when they transitioned back to fine sand. Visibility was sufficient for collection of video (see enclosed DVD) and photographs.



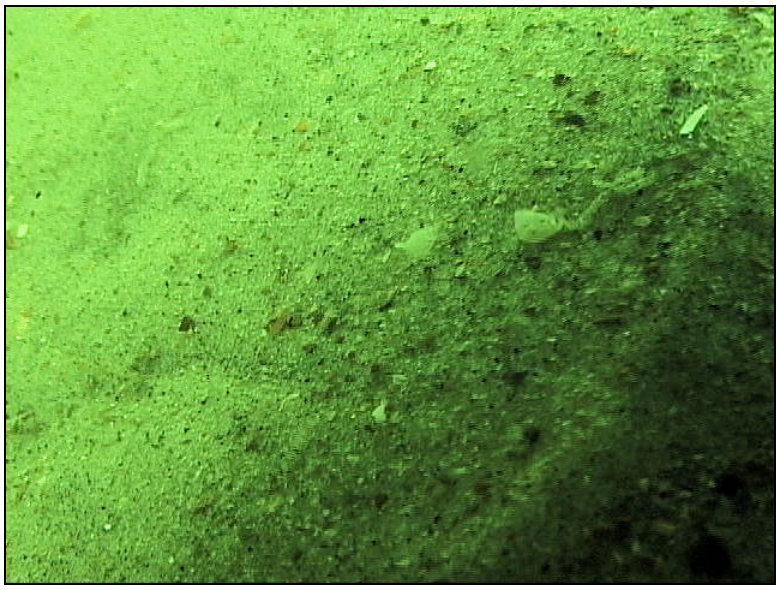
Photograph 3. Coarse sand/shell hash observed at NS6

4.1.5 Site NS7

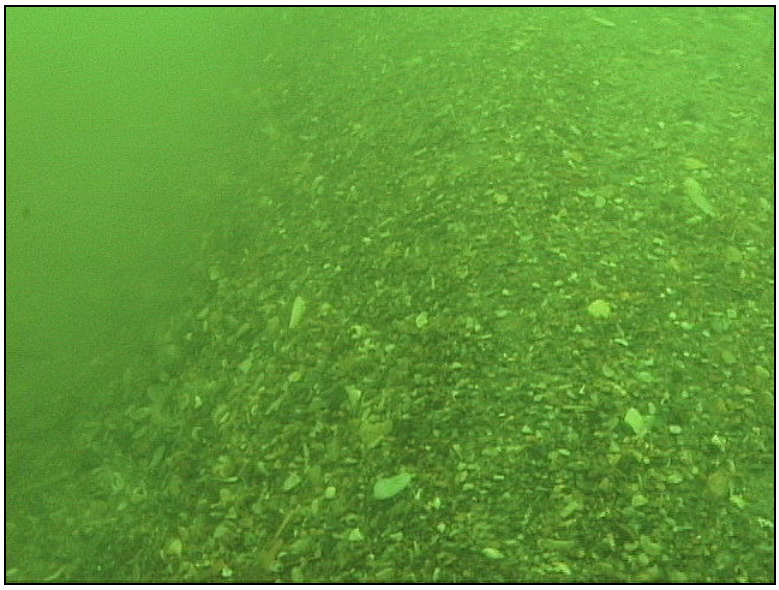
Site NS7 appeared as a finger-like projection on the sidescan data. Divers began the dive on fine sand with a depth of 23 cm and swam on a heading of 50° until they crossed a transition into coarse sediment/shell hash. No hardbottom was found. Poor visibility prohibited collection of video or photographs.

4.1.6 Site NS8

Site NS8 appeared as a finger-like projection on the sidescan data. Divers descended onto fine soft sand with no shell (Photograph 4) with a depth of 24 cm. Divers swam on a 61° heading until they crossed a transition to ripples of coarse sediment/shell hash (Photograph 5). No hardbottom was found. Visibility was sufficient for collection of video and photographs; divers observed a cannonball jellyfish (*Stomolophus meleagris*) on this dive. See accompanying DVD for video footage of this observation.



Photograph 4. Fine sand observed at NS8



Photograph 5. Ripples of coarse sand/shell hash observed at NS8

4.1.7 Site NS9

Site NS9 appeared as a finger-like projection on the sidescan data. Divers initiated the dive on course sediment/shell hash with a depth of 21 cm and swam on a heading of 247° until they crossed a transition into fine soft sand with no shell. No hardbottom was found. Visibility was sufficient for collection of video (see enclosed DVD).

4.1.8 Site NS11

Site NS11 appeared as a finger-like projection on the sidescan data. Divers descended onto fine sand with a depth of 26 cm and swam on a 47° heading until they reached coarse sediment/shell hash with mud (small ridges of coarse sediment with channels of mud between). Divers surfaced upon reaching the transition back to fine sand. Poor visibility prohibited collection of video or photographs.

4.1.9 Site NS10: Additional Nearshore Dive 1

Site NS10 was located seaward of the -23–foot contour, but was investigated to verify the presence of hardbottom suggested by interpretation of the sidescan data. Divers descended directly onto hardbottom interspersed with some sand patches (fine sand, depth of 5 cm). Poor visibility prohibited any images or video of organisms, but divers could feel a maximum relief of approximately 15 cm. Sea urchin identification (by touch) indicates this hardbottom is inhabited by benthic biota.

4.1.10 Site NS12: Additional Nearshore Dive 2

Site NS12 was located seaward of the -23–foot contour but was investigated to verify the presence of hardbottom suggested by interpretation of the sidescan data. Divers descended onto coarse sediment/shell hash, with a depth of 25 cm. Divers detected (by touch) a single patch of hardbottom (or possibly a large rock) approximately 75 cm long and 7 cm in relief. Divers swam on a 92° heading until they reached fine sediment. Poor visibility prohibited collection of video or photographs.

4.2 Offshore Investigations

This section presents the results of the offshore investigations conducted within Borrow Sites T, O, L, J, and G. Twelve temporary transects were planned to be established among the borrow areas for benthic characterization as follows: T = 3; O = 3; L = 2; J = 2; and G = 2. However, no hardbottom was found at Site J1, thus hardbottom is described only for the remaining 11 transects. Results are presented for each transect and are divided into physical and benthic community characteristics. The Physical Characteristics sections summarize physical information collected through biologist field notes, line intercept, BEAMR, and rugosity data. The Benthic Community sections summarize the functional group, coral species, and macroalgae genera data collected by BEAMR and do not include quadrats that contained 100% sand. The stony coral *Oculina* sp. refers to colonies that have sometimes been identified as *O. arbuscula, O. varicosa,* or *O. robusta.* The taxonomic status of *Oculina* is currently under review by geneticists to determine if more than one species exists and if geographic boundaries separate the species. Preliminary results indicate that there is little genetic variation between *O. arbuscula, O. varicosa*, and *O. robusta* (M.W. Miller, pers. comm.). When presenting octocoral results, the term “Telestaceans” is used to refer to colonies that could be *Carijoa riisei, Telesto fruticulosa,* or *T. nelleae* (DeVictor and Morton, 2007;

S.T. DeVictor, pers. comm.); these species are difficult to discern *in situ*, and so are grouped together for identification purposes in this study.

Table 4 summarizes the physical characteristics of each transect. The maximum relief in this table is based on either the highest relief recorded in the quadrats by BEAMR or on additional notes about the site taken by the biologists *in situ*, whichever was greater. In Table 4, rugosity is the ratio of the total length of the rugosity tape (extended over the contours of the site) divided by the survey transect length. Figure 3 summarizes the percent cover of the major functional groups observed on each transect. Table 5 includes the density and average size of hard corals and octocorals found at each site and Table 6 lists the average percent cover of macroalgae genera found on each transect. Table 7 presents the Shannon diversity indices calculated based on the functional group data.

Table 4. Physical Characteristics of the Hardbottom at Each Transect

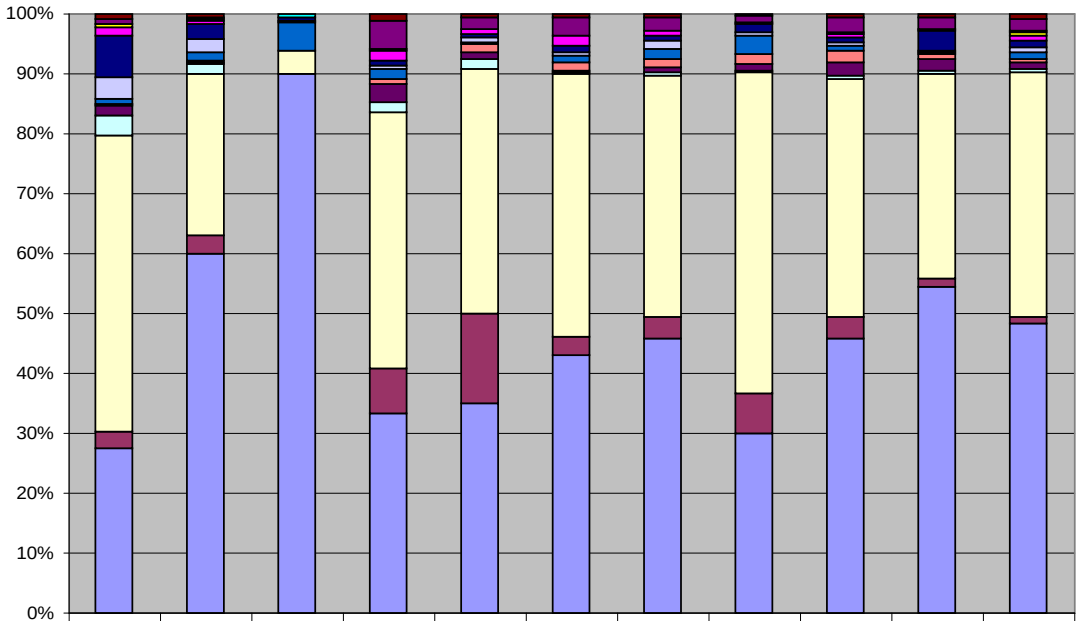
	Transect										
Physical Parameters	**G1**	**G3**	**J2**	**L1**	**L2**	**O1**	**O3**	**O4**	**T1**	**T3**	**T4**
Length of Transect (m)	15	18	10	20	20	20	20	10	20	20	20
Number of Quadrats Surveyed	10	10	9	10	10	10	10	10	14	10	10
Number of 100% Sediment Quadrats	0	5	6	1	2	4	3	7	0	2	4
Max Relief (cm)	19	21	2	50	55	26	36	30	47	14	22
Average Relief (cm)	12.7	10.6	0.7	15.6	6.6	12.5	10.9	10.7	4.6	7.0	14.2
Relief Classification*	L	L	L	M	M	L	L	L	L	L	L
Rugosity	1.01	1.02	1.03	1.03	1.03	1.03	1.01	1.03	1.07	1.02	1.03
Average Sediment Depth (cm)	4.7	6.8	8.3	3.3	2.1	4.5	4.3	6.0	2.0	4.5	6.2

* L = Low relief [<0.5 m (50 cm)], M = Moderate relief [0.5-2 m (50-200 cm)] (Moser & Taylor 1995)

Table 5. Coral Density and Average Colony Size for Each Offshore Transect

	***Oculina* sp.**		***Leptogorgia hebes***		***Leptogorgia virgulata***		**Telestaceans***		***Titanideum frauenfeldii***	
	Density (colonies m^{-2})	Avg. Size (cm)	Density (colonies m^{-2})	Avg. Size (cm)	Density (colonies m^{-2})	Avg. Size (cm)	Density (colonies m^{-2})	Avg. Size (cm)	Density (colonies m^{-2})	Avg. Size (cm)
G1	10.1	3.9	0.0	0	0.3	6.3	1.6	3.6	0.0	0
G3	10.6	1.6	0.0	0	2.6	12.6	1.6	1.9	0.2	3.0
J2	0.7	2.5	0.3	18.0	1.7	69.6	0.0	0	0.3	12.0
L1	3.1	1.7	0.0	0	0.0	0	4.2	4.3	0.0	0
L2	1.4	3.7	0.0	0	0.0	0	1.0	4.5	0.0	0
O1	2.3	1.6	0.0	0	0.3	1.0	2.7	4.8	0.0	0
O3	3.0	2.4	0.0	0	0.0	0	4.1	3.0	0.0	0
O4	1.3	1.3	0.0	0	0.7	29.5	8.7	2.8	0.0	0
T1	1.2	1.2	0.0	0	0.0	0	1.1	2.4	0.5	2.1
T3	0.3	1.0	0.0	0	0.1	3.0	0.0	0	0.1	3.0
T4	13.2	1.0	0.0	0	4.8	5.7	0.7	2.5	0.2	8.0

***** "Telestaceans" refers to colonies that could be *Carijoa riisei, Telesto fruticulosa,* or *T. nelleae*



	G1	G3	J2	L1	L2	O1	O3	O4	T1	T3	T4
Sessile Worm	0.9	0.6	0	1.0	0.5	0.7	0.4	0.3	0.5	0.6	0.8
Bryozoan	0.7	0.2	0	4.9	2.1	2.8	2.4	1.0	2.5	1.8	2.0
Barnacle	0	0	0.7	0.2	0	0.2	0	0	0.1	0	0.3
Anemone	0.7	0.4	0	0.1	0	0	0	0	0.1	0	0.3
Bare Hard Substrate	1.3	0.4	0	1.4	0.8	1.5	0.7	0.3	0.6	0.4	0.8
Tunicate	7.0	2.6	0.3	0.9	0.5	1.2	0.9	1.3	0.9	3.4	1.2
Scleractinian	3.7	2.2	0.3	0.7	0.8	0.7	1.4	0.7	0.5	0.3	0.8
Octocoral	0.6	1.4	4.7	1.7	0.3	1.2	1.7	3.0	0.9	0.3	1.2
Hydriod	0.5	0.2	0	0.9	1.4	1.2	1.3	1.7	1.9	0.9	0.7
Sponge	1.5	0.4	0	2.9	1.1	0.5	0.9	1.0	2.3	1.9	1.0
Encrusting Red Algae	3.4	1.6	0	1.7	1.8	0.2	0.6	0.3	0.7	0.5	0.7
Turf Algae	49.5	27.0	4.0	42.9	40.8	43.8	40.1	53.7	39.7	34.4	40.7
Macroalgae	2.8	3.0	0	7.3	15.0	3.2	3.7	6.7	3.5	1.3	1.2
Sediment	27.4	60.0	90.0	33.4	35.1	43.0	45.9	30.0	45.9	54.5	48.3

Figure 3. Average Percent Cover of Major Functional Groups on Offshore Transects as Determined by BEAMR (quadrats containing 100% sand cover were not included in this analysis)

Table 6. Average Percent Cover of Macroalgae Genera on Offshore Transects as Determined by BEAMR (quadrats containing 100% sand cover were not included in this analysis)

	Caulerpa	*Codium*	*Cryptonemia*	*Dasya*	*Gelidiella*	*Gelidium*	*Halymenia*	*Lobophora*	*Sargassum*	*Wrangelia*
G1	0	0	0	0.4	0	0	0.3	0.4	1.2	0
G3	0	0	0	0.8	0	0	0	0	1.6	0
J2	0	0	0	0	0	0	0	0	0	0
L1	0	0	0.1	0	0	0.1	0	0	4.9	0.6
L2	0	0	0	0	0	0.3	0	0	14.1	0
O1	0	0	0	0.2	0	0	0	0	2.5	0
O3	0	0.3	0	0.1	0	0.6	0	0	1.9	0
O4	0	0	0	0	0	0	0	0	6.0	0
T1	0	0.1	0	0	0.1	0	0	0	2.0	0.1
T3	0	0	0	0	0	0	0	0	0	0
T4	0.2	0	0	0	0	0	0	0	0.2	0

Table 7. Shannon Diversity on Offshore Transects as Determined by Functional Group Cover Using BEAMR (quadrats containing 100% sand cover were not included in this analysis)

	S	H'
G1	13	1.515
G3	13	1.192
J2	6	0.438
L1	14	1.553
L2	12	1.421
O1	13	1.268
O3	12	1.293
O4	12	1.289
T1	14	1.310
T3	12	1.163
T4	14	1.222

S = functional group richness.
H' = Shannon diversity index

4.2.1 Borrow Area T

4.2.1.1 Transect T1

Physical Characteristics: Divers established a temporary 20-meter transect starting on a sand area adjacent to the hardbottom and extending at a 125° heading, over a ledge 47 cm high and (Photograph 6) continuing over the elevated hardbottom platform. Hardbottom was continuous; line intercept did not document any sand patches >0.5 meters in length. Maximum vertical relief was 47 cm, average vertical relief of the transect (not including the ledge) was 4.6 cm, and overall gross rugosity of the transect (rugosity tape length divided by transect length) was 1.07.

Benthic Community: There was approximately 46% cover by sediment and 40% cover by turf algae along this transect. Macroalgae comprised 3.5% cover, with *Sargassum* the dominant macroalgae genus (2.0% cover). There was 2.3% sponge cover along this transect, consisting primarily of the encrusting sponge *Cliona celata*. Bryozoan cover was 2.5% and was dominated by the spiral-tufted bryozoan *Bugula turrita* and unidentified fan bryozoans. There were several large *Oculina* sp. colonies (approximately 15 cm diameter) located along the ledge, but within the quadrats along the rest of the relatively low-relief transect, the *Oculina* sp. colonies were much smaller (average 1.2 cm diameter), with an average density of 1.2 colonies m^{-2}. Octocorals observed at this site included *Leptogorgia virgulata* along the high-relief ledge and *Titanideum frauenfeldii* (average density 0.5 colonies m^{-2}) and Telestaceans (average density 1.1 colonies m^{-2}) along the transect. Based on functional group abundance, T1 had a calculated Shannon diversity index (H') of 1.310. Many black sea bass (*Centropristis striata*) and several spottail pinfish (*Diplodus holbrookii*) were observed along this transect, especially by the ledge. Several seastars, *Arbacia* urchins (*Arbacia*

punctulata), and a single lentel sea spider (*Anopodactylus lentus*) were also observed (see Appendix H for photographs of biota).

Due to air limitations, only 14 of the 20 quadrats were sampled. Based on this experience, the methods were modified to require only 10 evenly spaced quadrats for all future offshore investigations regardless of the transect length.

Photograph 6. Hardbottom ledge (47-cm relief) observed along the start of Transect T1.

4.2.1.2 Transect T3

Physical Characteristics: Divers established a temporary 20-meter transect extending from sand onto hardbottom with a transitional relief of 14 cm at a 40° heading. Hardbottom was located along 17 total meters of the transect, with line intercept documenting a patch of sand between 3.0 and 6.0 meters along the transect. Maximum vertical relief was 14 cm, average vertical relief of the transect was 7.0 cm, and overall gross rugosity of the transect was 1.02.

Benthic Community: Two of the 10 quadrats sampled with BEAMR contained 100% sand cover and therefore are not included in the following analysis of benthic cover. Within the remaining eight quadrats, there was approximately 55% cover by sediment and 35% cover by turf algae. Macroalgae comprised 1.3% cover, with no macroalgae species accounting for 1% cover in any of the BEAMR quadrats. There was 1.9% sponge cover along this transect. Tunicates were abundant at this site (3.4% cover) and were comprised primarily of condominium tunicates (*Eudistoma* spp.). Stony coral cover was sparse, with several large *Oculina* sp. colonies (greater than 10 cm in diameter) observed at this site, but only two small *Oculina* sp. colonies (each 1.0 cm in diameter) were found along the transect (average density 0.3 colonies m^{-2}). Octocoral

cover was low, with a single *L. virgulata* (height of 3.0 cm) and a single *T. frauenfeldii* colony (height of 3.0 cm) documented along the transect. Many taller colonies of these species, as well as *L. hebes,* were observed at this site but did not occur within the sampling quadrats. A Shannon diversity index of H' = 1.163 was calculated for this site. Several black sea bass (*C. striata*) and a sheepshead (*Archosargus probatocephalus*) were observed at this site. Several sea stars and a tulip snail (*Fasciolaria tulipa*) were also observed (see Appendix H for photographs of biota).

4.2.1.3 Transect T4

Physical Characteristics: Divers established a temporary 20-meter transect running from sand onto hardbottom of 15 cm relief along a 54° heading. The transect increased in relief towards the end of the transect and extended beyond a 22-cm ledge back onto sand at the end of the transect. Hardbottom was located along 17.8 total meters of the transect, with line intercept documenting patches of sand between 0.0 and 1.0 meters and between 15.1 and 16.3 meters along the transect. Maximum vertical relief was 22 cm, average vertical relief was 14.2 cm, and overall gross rugosity was 1.03.

Benthic Community: Four of the 10 quadrats sampled with BEAMR contained 100% sand cover and therefore are not included in the following analysis of benthic cover. Within the remaining six quadrats there was approximately 48% cover by sediment and 41% cover by turf algae. Macroalgae comprised 1.2% cover, with *Sargassum* and *Caulerpa* the dominant macroalgae genera but accounting for <1% cover each. Sponge and tunicate cover were 1.0% and 1.2%, respectively. Though they accounted for <1% cover, there was a high abundance of small stony corals at this site, with 79 small *Oculina* sp. colonies (average 1.0 cm in diameter) found along the transect (average density 13.2 colonies m^{-2}). Octocorals, including *L. virgulata, L. hebes, T. frauenfeldii* and Telestaceans, were also abundant (average density 5.7 octocoral colonies m^{-2}). *L. virgulata* was the most common octocoral observed at this site, accounting for 20 of the 34 total octocoral colonies documented in the quadrats. A Shannon diversity index of 1.222 was calculated for this site. There were several black sea bass (*C. striata*) and arbacia urchins (*A. punctulata*) observed at this site (see Appendix H for photographs of biota).

4.2.2 Borrow Area O

4.2.2.1 Transect 01

Physical Characteristics: Divers established a temporary 20-meter transect running from sand onto hardbottom of 8 cm relief along a 304° heading. Hardbottom was located along only 9.6 total meters of the transect, with line intercept documenting patches of sand between 4.0 and 7.3 meters and between 10.1 and 17.2 meters along the transect. Maximum vertical relief was 26 cm, average vertical relief was 12.5 cm, and overall gross rugosity was 1.03.

Benthic Community: Four of the 10 quadrats sampled with BEAMR contained 100% sand cover and therefore are not included in the following analysis of benthic cover. Within the remaining six quadrats, there was approximately 43% cover by sediment and 44% cover by turf algae. Macroalgae comprised 3.2% cover, with *Sargassum* the dominant genus at 2.5% cover and *Dasya* present at <1% total cover. Sponge and tunicate cover were 0.5% and 1.2%, respectively. Bryozoan cover was 2.8% and was dominated by *B. turrita* and unidentified fan bryozoans. Fourteen *Oculina* sp. colonies ranging from 1.0 cm to 6.0 cm (average 1.6 cm diameter) were documented on this transect (average density 2.3 colonies m^{-2}). Octocorals, including *L. virgulata, L. hebes, T. frauenfeldii.* and Telestaceans, were observed at this site. Telestaceans were the most common, accounting for 16 of the 18 total octocoral colonies documented in the quadrats. A Shannon diversity index of 1.268 was calculated for this site. Several black sea bass (*C. striata*), *Arbacia* urchins (*A. punctulata*), and various sea stars were observed (see Appendix H for photographs of biota).

4.2.2.2 Transect 03

Physical Characteristics: Divers established a temporary 20-meter transect starting on hardbottom of 4 cm relief along a 357° heading. Relief increased towards the end of the transect (Photograph 7), reaching a maximum relief of 36 cm. Hardbottom was located along only 8.5 total meters of the transect, with line intercept documenting patches of sand between 4.2 and 10.4 meters and between 14.2 and 19.5 meters along the transect. Average vertical relief was 10.9 cm and overall gross rugosity was 1.01.

Benthic Community: Three of the 10 quadrats sampled with BEAMR contained 100% sand cover and therefore so are not included in the following analysis of benthic cover. Within the remaining seven quadrats, there was approximately 46% cover by sediment and 40% cover by turf algae. Macroalgae comprised 3.7% cover, with *Sargassum* the dominant genus at 1.9% cover and *Dasya*, *Codium*, and *Gelidium* present with 1.0% combined cover. Sponge and tunicate cover was 0.9% for each. Bryozoan cover was 2.4% and was dominated by *B. turrita.* Twenty-one *Oculina* sp. colonies ranging from 1.0 cm to 10.0 cm (average 2.4 cm diameter) were documented on this transect (average density 3.0 colonies m^{-2}). Telestaceans were the only octocorals documented at this site, with 29 colonies found along the transect (average density 4.1 colonies m^{-2}). A Shannon diversity index of 1.293 was calculated for this site. Several black sea bass (*C. striata*) were observed (see Appendix H for photographs of biota).

Photograph 7. Low-relief hardbottom (36 cm) observed at the end of Transect O3 (black sea bass, *C. striata*, in foreground)

4.2.2.3 Transect 04

Physical Characteristics: Divers established a temporary 10-meter transect running from sand onto a hardbottom ledge of 30 cm relief along a 182° heading. Hardbottom was located along only the first 3.0 meters of the transect and a small patch of hardbottom was located between 8.0 and 8.5 meters (Photograph 8), with the remaining 6.5 meters of the transect buried by sand. Maximum vertical relief was 30 cm, average vertical relief was 10.7 cm, and overall gross rugosity was 1.03.

Benthic Community: Seven of the 10 quadrats sampled with BEAMR contained 100% sand cover and therefore are not included in the following analysis of benthic cover. Within the remaining three quadrats, there was approximately 30% cover by sediment and 54% cover by turf algae. Macroalgae cover was 6.7%, with *Sargassum* the dominant genus at 6.0% cover. Four *Oculina* sp. colonies (average 1.3 cm diameter) were documented in these three quadrats (average density 1.3 colonies m^{-2}). Octocorals accounted for 3.0% cover, comprised of two *L. virgulata* colonies 10.0 cm and 49.0 cm tall and 26 Telestaceans, ranging from 1.0 cm to 7.0 cm in diameter. A Shannon diversity index of 1.289 was calculated for this site. No fish were observed. See Appendix H for photographs of biota.

Photograph 8. Small patch of hardbottom located between 8.0 and 8.5 meters on Transect O4

4.2.3 Borrow Area L

4.2.3.1 Transect L1

Physical Characteristics: Divers established a temporary 20-meter transect running from the sand along a 143° heading, over a ledge of 28 cm relief, and over several hardbottom formations separated by crevices. The transect ended beyond a hardbottom ledge of 37 cm relief. Hardbottom was located along 15 meters of the transect, with line intercept documenting sand patches from 2.0 to 6.0 meters and from 19.0 to 20.0 meters. Maximum vertical relief was approximately 50 cm and was found on a ledge along one of the hardbottom formations on the transect (Photograph 9). The average vertical relief was 15.6 cm and overall gross rugosity was 1.03.

Benthic Community: One of the 10 quadrats sampled with BEAMR contained 100% sand cover and therefore is not included in the following analysis of benthic cover. Within the remaining nine quadrats, there was approximately 33% sediment cover and 43% turf algae cover along this transect. Macroalgae cover was 7.3%, with *Sargassum* the dominant macroalgae genus at 4.9% cover. *Cryptonemia* sp., *Gelidium* sp., and *Wrangelia* sp. were also present. There was 2.9% sponge cover along this transect. Bryozoan cover was highest of any site at 4.9% and was dominated by the spiral-tufted bryozoan *B. turrita* and unidentified fan bryozoans. Twenty-eight *Oculina* sp. colonies ranging from 1.0 cm to 5.0 cm (average 1.7 cm diameter) were documented on this transect (average density 3.1 colonies m^{-2}). Telestaceans were the only octocorals documented, with 38 colonies found along the transect (average density 4.2 colonies m^{-2}). A Shannon diversity index of 1.553 was calculated for L1, the highest diversity of any site. Many black sea bass (*C. striata*) were observed at this site, especially along

ledges and in the crevices between hardbottom formations (Photograph 10). See Appendix H for photographs of biota.

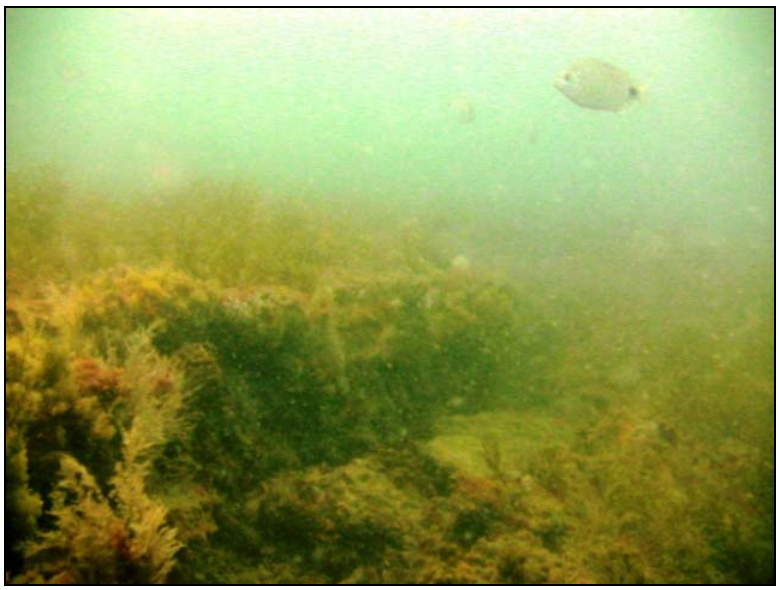
Photograph 9. Moderate-relief hardbottom ledge observed along Transect L1

Photograph 10. Hardbottom ledge with black sea bass (*C. striata*) at Transect L1

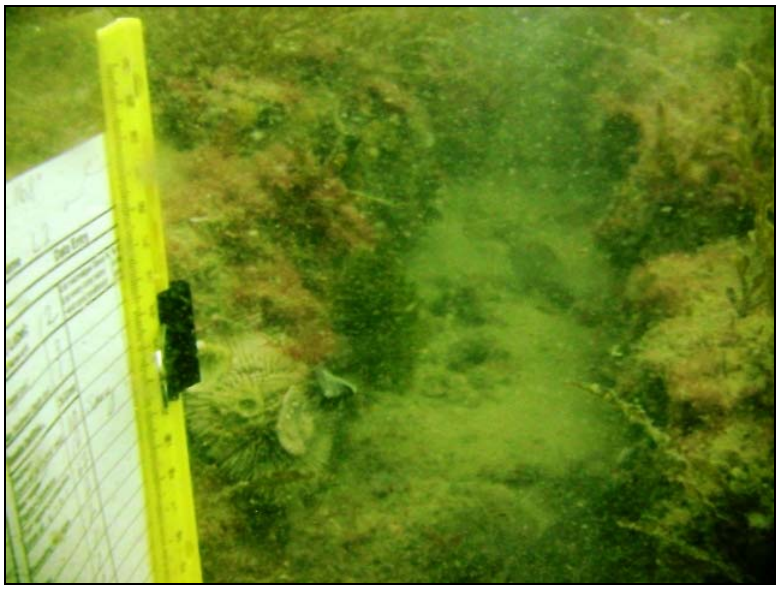
4.2.3.2 Transect L2

Physical Characteristics: Divers established a temporary 20-meter transect running from the sand over a ledge of 34 cm relief along a 166° heading. Hardbottom was located along the first 15 meters of the transect, with line intercept documenting sand from 15.0 to 20.0 meters. Maximum vertical relief, found on a ledge near the transect, was approximately 55 cm (Photograph 11). There were also several crevices separating hardbottom formations (Photograph 12). Average vertical relief of the transect was 6.6 cm and overall gross rugosity was 1.03.

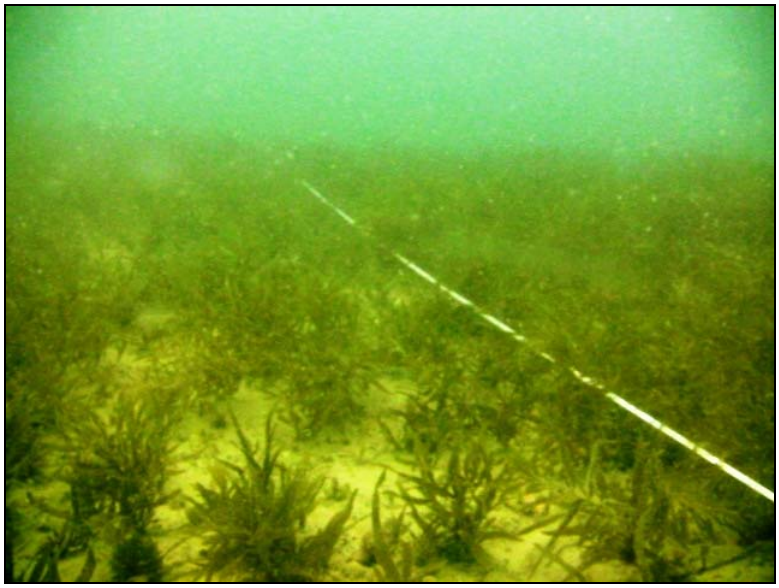
Benthic Community: Two of the 10 quadrats sampled with BEAMR contained 100% sand cover and therefore were not included in the following analysis of benthic cover. Within the remaining eight quadrats, there was approximately 35% sediment cover and 41% turf algae cover. Macroalgae cover was the highest of all sites at 15.0%, with *Sargassum* the dominant genus at 14.1% cover; the last 5 meters of the transect were buried in sand but supported a high density of *Sargassum* (Photograph 13). There was 1.1% sponge cover along this transect and less than 1.0% tunicate cover. Bryozoan cover was 2.1. Eleven *Oculina* sp. colonies ranging from 1.0 cm to 7.0 cm (average 3.7 cm diameter) were documented on this transect (average density 1.4 colonies m^{-2}). Telestaceans were the only octocorals documented at this site, with 8 colonies documented along the transect (average density 1.0 colony m^{-2}). A Shannon diversity index of 1.421 was calculated for this site. There were many black sea bass (*C. striata*), spottail pinfish (*Diplodus holbrookii*), sheepshead (*A. probatocephalus*), and *Arbacia* urchins (*A. punctulata*) observed, especially along the ledges. See Appendix H for photographs of biota.



Photograph 11. Hardbottom ledge with spottail pinfish (*D. holbrookii*) on Transect L2



Photograph 12. Crevices separating hardbottom formations on Transect L2

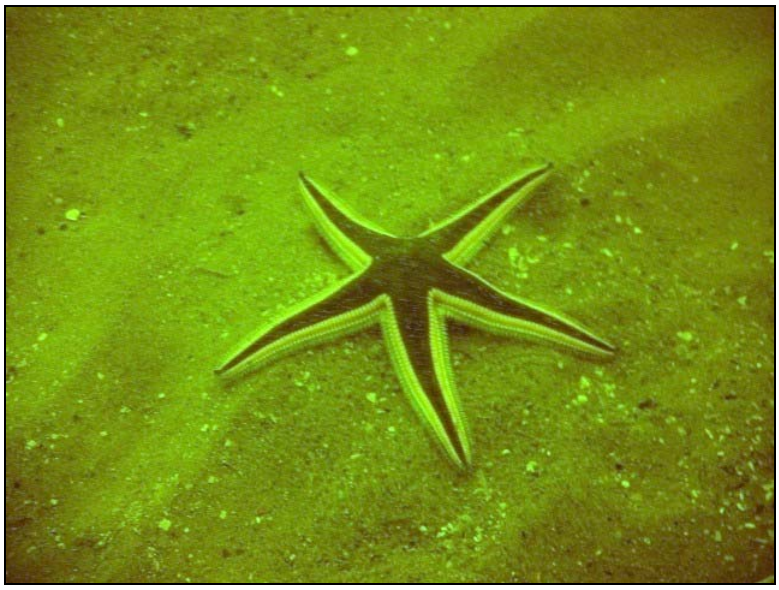


Photograph 13. Last 5 meters of Transect L2 buried in sand but supporting a high density of *Sargassum* sp.

4.2.4 Borrow Area J

4.2.4.1 Site J1

No hardbottom was observed in this study area. Divers descended on the selected site but found only fine sediment. Many beaded sea stars (*Astropecten articulatus)* were observed in this area (Photograph 14).



Photograph 14. Beaded sea stars (*A. articulatus*) observed on the sand at Site J1

4.2.4.2 Transect J2

Physical Characteristics: Divers established a temporary 10-meter transect running from the sand over a small patch of hardbottom of 2 cm relief along a 216° heading. Hardbottom was located along only the first 2 meters of the transect, with line intercept documenting sand from 2.0 to 10.0 meters. Maximum vertical relief was 2.0 cm and overall gross rugosity was 1.03. Sediment depth increased steadily from 2.0 cm at the start of the transect to 30 cm at the end.

Benthic Community: Six of the nine quadrats sampled with BEAMR contained 100% sand cover (due to diver error, only nine quadrats were sampled at this site) and therefore were not included in the following analysis of benthic cover. Within the remaining three quadrats, there was 90.0% sediment cover and 4.0% turf algae cover. No macroalgae or sponge cover was documented. Two *Oculina* sp. colonies, 2.0 cm and 3.0 cm in diameter, were present on the exposed hardbottom on this transect. *Oculina* sp. colonies (some alive, some dead) were also observed on branches of *L. virgulata* colonies (Photograph 15) at this site. There were also many *Oculina* sp. skeletons observed on low-relief hardbottom patches (Photograph 16). There was 4.7% octocoral cover, including colonies of *L. virgulata, L. hebes,* and *T. frauenfeldii.* The *L. virgulata* colonies were tall on this transect, with an average height of almost 70 cm. These colonies were found growing on patches of exposed hardbottom, but were also observed in great number emerging from the buried areas of the site (Photograph 17). A Shannon diversity index of 0.438 was calculated for J2, the lowest diversity of any site. No fish were observed. See Appendix H for photographs of biota.

Photograph 15. *Oculina* sp. colonies observed on branches of *L. virgulata* colonies near Transect J2

Photograph 16. *Oculina* sp. skeletons observed on low-relief hardbottom patches near Transect J2

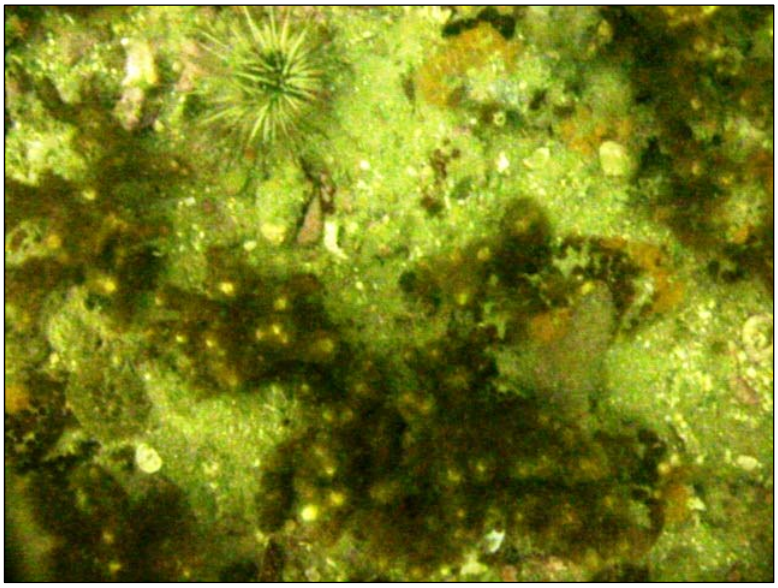
Photograph 17. Tall *L. virgulata* colonies emerging from the sand in buried areas on Transect J2

4.2.5 Borrow Area G

4.2.5.1 Transect G1

Physical Characteristics: Divers established a temporary 15-meter transect running from the sand over hardbottom of 19 cm relief along a 151° heading. Hardbottom was located along 12 meters of the transect, with line intercept documenting sand patches from 0 to 1.0 meters and 13.0 to 15.0 meters. Maximum vertical relief was 19.0 cm, average relief was 12.7 cm, and overall gross rugosity of the transect was 1.01.

Benthic Community: There was 27.4% sediment cover and 49.5% turf algae cover. Macroalgae cover was 2.8%, with *Sargassum* the dominant macroalgae genus (1.2% cover), and *Dasya, Halymenia* and *Lobophora* also present. Tunicate cover was relatively high, with an average cover of 7.0%. Stony coral cover was also high compared to other transects, at 3.7%; 101 *Oculina* sp. colonies were documented along this transect, with an average density of 10.1 colonies m^{-2} (Photograph 18). The *Oculina* sp. colonies ranged in size from 1.0 cm to 21.0 cm in diameter (average 3.9 cm diameter). There was less than 1% octocoral cover, including 19 colonies of *L. virgulata* and Telestaceans. A Shannon diversity index of 1.515 was calculated for G1, the second highest of any of the sites. Many black sea bass (*C. striata*) and *Arbacia* urchins (*A. punctulata*) were observed at this site. See Appendix H for photographs of biota.

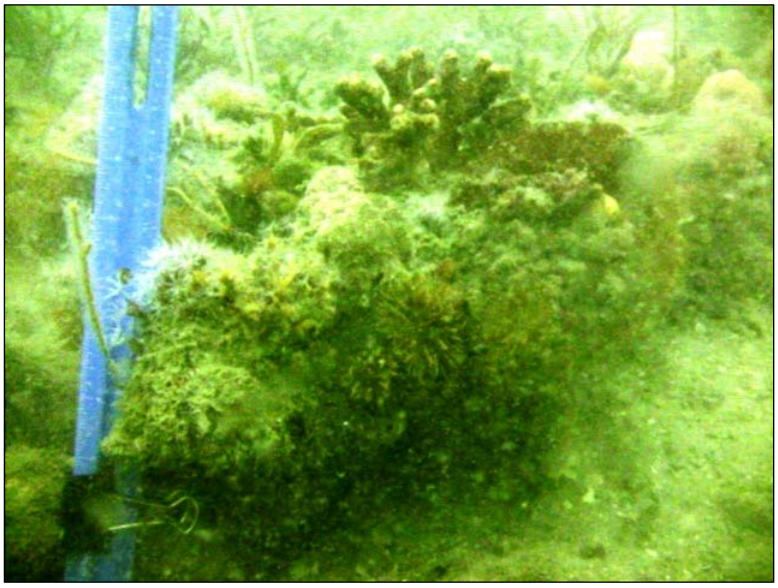


Photograph 18. Stony coral cover was highest at Transect G1, with 3.7% cover by *Oculina* sp.

4.2.5.2 Transect G3

Physical Characteristics: Divers established a temporary 18-m transect running from the sand over hardbottom of 21 cm relief along a 68° heading. Hardbottom was located along twelve meters of the transect, with line intercept documenting sand patches from 7.0 to 11.0 meters and 13.0 to 15.0 meters. Maximum vertical relief was 21.0 cm, average relief was 10.6 cm, and overall gross rugosity was 1.02.

Benthic Community: Five of the 10 quadrats sampled with BEAMR contained 100% sand cover and therefore were not included in the following analysis of benthic cover. Within the remaining five quadrats there was 60.0% sediment cover and 27.0% turf algae cover. Macroalgae cover was 3.0%, with *Sargassum* the dominant macroalgae genus (1.6% cover); *Dasya* sp. was also present (0.8% cover). Average sponge cover was <1% and tunicate cover was 2.6%. Stony coral cover was 2.2%, and 53 *Oculina* sp. colonies were documented in these five quadrats, with an average density of 10.6 colonies m^{-2}. The *Oculina* sp. colonies ranged in size from 1.0 cm to 18.0 cm in diameter (average 1.6 cm diameter). The larger colonies were found on higher-relief areas of hardbottom, where there was also high cover by other organisms such as anemones, octocorals, tunicates, and sponges (Photograph 19). There was 1.4% octocoral cover along the transect, including 22 colonies of *L. virgulata*, *T. frauenfeldii,* and Telestaceans. A Shannon diversity index of 1.192 was calculated for this site. Several black sea bass (*C. striata*) and *Arbacia* urchins (*A. punctulata*) were observed at this site. See Appendix H for photographs of biota.



Photograph 19. Higher-relief areas of hardbottom supported adult *Oculina* sp. colonies and high cover by other organisms, such as anemones, octocorals and tunicates

5 DISCUSSION

5.1 Nearshore Environment

No hardbottom habitat was observed within the eight selected areas previously delineated by Geodynamics as potential nearshore hardbottom sites landward of the -23–foot NGVD depth of closure. It was determined that those areas that appeared as small, circular, individual high-backscatter anomalies and as finger-like projections running perpendicular to the shoreline in the sidescan imagery were not hardbottom formations, but were actually regions of coarse gravel and shell hash. Similar features have been identified off North Topsail Beach, Topsail Beach, and Wrightsville Beach. These features were first described as sorted bedforms by Murray and Thieler (2004) and Gutierrez *et al.* (2005). The features are thought to be the result of a feedback mechanism whereby an existing deposit of coarse shell hash and gravel material is built upon and segregated from fine material due to wave motion interacting with the enhanced roughness of the seafloor bed around these patches of coarse material (Murray and Thieler, 2004). This interaction between wave motion and seafloor roughness results in near-bed turbulence that is greatly enhanced relative to other areas of the seafloor. The increase in near-bed turbulence enhances entrainment and inhibits settling of fine material, thereby further expanding and maintaining the coarse patches of material.

When no hardbottom resources were found in Phase I of the nearshore investigations, USACE approved investigations of two additional nearshore potential hardbottom sites identified by sidescan interpretation seaward of the -23–foot NGVD depth of closure. Using diver ground-truth data from previous dives, a more refined analysis and interpolation of sidescan imagery for hardbottom resources was possible. Diver confirmation of hardbottom in areas which, in the sidescan interpretation, appeared to more closely resemble exposed rock outcrops on the seafloor than any of the seafloor features located landward of the depth of closure, would add further confidence to the sidescan data interpretation for presence/absence of hardbottom (Figure 4). Although visibility was minimal, divers verified the existence of hardbottom at Site NS10, observing (by feel) a vertical relief of approximately 15 cm. A sea urchin was found on this hardbottom area, indicating that this hardbottom is inhabited by benthic biota. There were also sand patches of 5 cm depth scattered across the hardbottom. Divers also found some hardbottom at Site NS12, but due to the limited visibility they could not verify whether it was a permanent hardbottom formation or a large unattached rock. Figure 4 shows the differences in acoustic signatures generated by the hardbottom, the rippled shell hash/gravel bottoms, and fine sand.

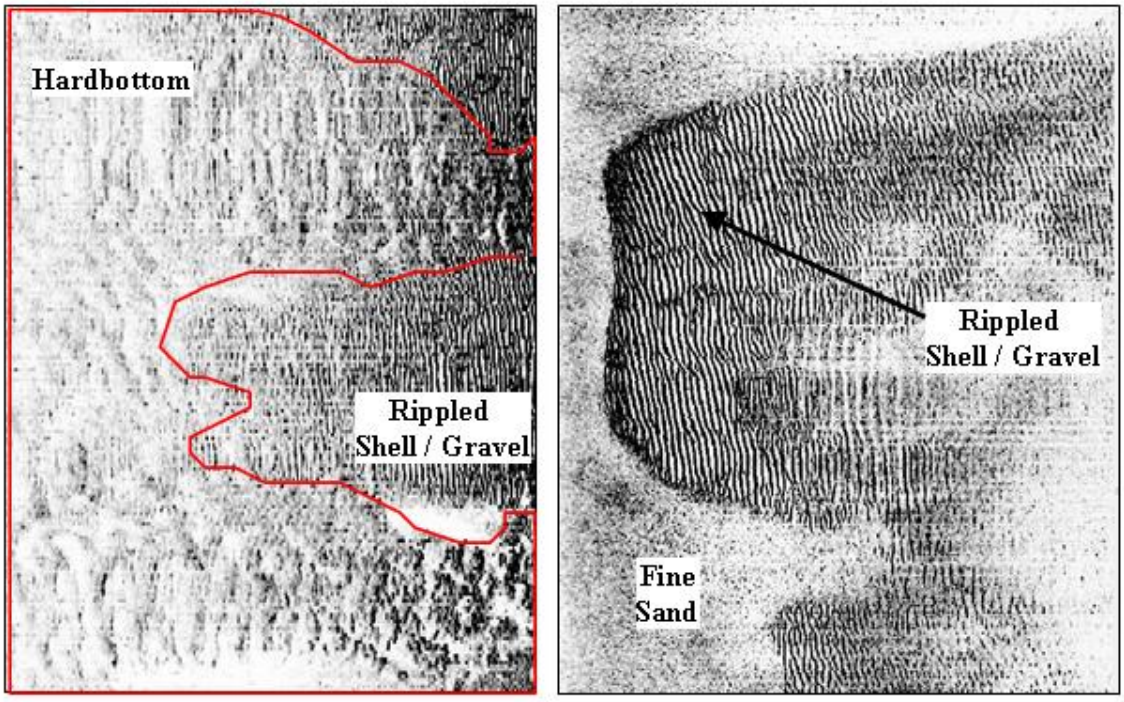


Figure 4. Screen Captures of Sidescan Sonargraph Depicting the Acoustic Signature of Areas Confirmed to Be Rock Outcrops (Left) and Areas Confirmed to Be Rippled Shell Hash and Gravel Deposits (Right) in the Nearshore Environment

5.2 Offshore Hardbottom Resources

Hardbottom habitat with varying relief and total area were confirmed at 11 of the 12 offshore sites investigated (no hardbottom was found at Site J1). Some sites had small patches of hardbottom with relatively undeveloped benthic communities, whereas other sites contained extensive hardbottom habitat with diverse, well-established biological communities. Many of these sites contained a combination of low to moderate relief and some ephemeral habitat.

Younger, more ephemeral areas are typically distinguished by low percent cover by scleractinian corals, which are relatively slow-growing and unable to survive frequent burial. *Oculina varicosa* has documented growth rates from 1 to 2 cm per year, but with slower growth likely under marginal conditions, such as those found on low-relief ephemeral habitats (SMS, 2007; Koenig, 2001). Octocorals, on the other hand, are relatively opportunistic and fast-growing and therefore better able to re-establish themselves following frequent burial. Tall octocoral colonies often survive periodic burial of the substrate; while their bases are buried, their branches may extend above the sand and continue to feed. One study in the northern Gulf of Mexico (Gotelli, 1988) found that buried juvenile colonies of *Leptogorgia virgulata* grew at a significantly

greater rate than unburied colonies, presumably to elevate polyps into the water column above the sand layer.

Physical characteristics and benthic community composition can provide insights into the state of a hardbottom habitat, such as how ephemeral or persistent it is over time. For instance, low- relief, high sand cover, and the presence of small, dead, or no *Oculina* colonies would suggest that an area is likely ephemeral; periodic burial of hardbottom habitat prevents the survival and growth of stony corals. On the other hand, some hardbottom sites may have relief high enough that the colonies can escape burial, and so these areas may support a well-developed benthic community including biota such as mature *Oculina* colonies, diverse macroalgae, sponge and tunicate cover, and mobile organisms such as fish, sea urchins, and sea cucumbers. However, relief of each site observed in this study was not necessarily correlated with the diversity or amount of benthic growth. Rock outcrops, particularly those with low relief, can become buried and unburied by the natural processes of sand movement across the seafloor and when hard substrate is exposed, a live bottom community may develop on the hard surfaces and persist for many years, later becoming covered by varying thicknesses of sand (Street *et al.,* 2005). An example of this may be seen at the hardbottom characterized by transect G1, which was observed to have low relief yet supported a mature stony coral and tunicate assemblage as described under Borrow Area G below.

When evaluating relief among these offshore hardbottom sites, rugosity measurements did not appear to be an effective method for comparing sites. This measurement approximated an overall relief index for the transect but could not detect small-scale changes in relief that existed at each site. Most of the offshore hardbottom areas characterized in these investigations exhibited varying levels of relief over the length of the formation that might not be wholly captured by a single linear transect; isolated high-relief patches or ledges of hardbottom were often accompanied by larger low-relief areas or by sand patches. Many sites had some areas of well-developed benthic cover, with others showing signs of frequent burial. General summaries of the hardbottom habitats found within each borrow area follow.

Borrow Area T

Borrow Area T is the northernmost area investigated and is closest to New River Inlet. Three sites, T1, T3 and T4, were characterized here. Site T1 had a more distinct ledge (47 cm) that leveled off into a contiguous low-relief environment, while sites T3 and T4 were generally low-relief hardbottom with intermittent patches of sand. There were several large *Oculina* sp. colonies (approximately 10 cm to 15 cm diameter) observed along the ledge at Site T1 and on some higher-relief areas of T3, indicating that these areas have not been recently buried. However, beyond those higher-relief spots at T1 and T3 and along the entire area found at T4, the habitats were generally low in relief and the *Oculina* sp. colonies were small, typically 1 cm in diameter, suggesting that these habitats were more ephemeral in nature.

Borrow Area O

Three transects, O1, O3 and O4, were characterized at Borrow Area O. Hardbottom was intermittent at these transects, with patches of sand separating them. Site O4 had a very small hardbottom area, occurring along only the first 3 meters of the transect, plus one small patch of hardbottom that had clearly been recently buried by sand (Photograph 8). Although the hardbottom was patchy among these sites, some higher-relief formations supported adult *Oculina* sp. colonies and extensive sponge and tunicate populations. The lower-relief areas appeared more ephemeral, as suggested by the lack of adult *Oculina* sp. colonies.

Borrow Area L

Two transects, L1 and L2, were established and characterized at Borrow Area L. These transects exhibited the highest maximum relief of any site (50 and 55 cm, respectively). The most diverse and rugose parts of each site occurred at the beginning of each transect. The first few meters of L1 consisted of large slabs of moderate-relief hardbottom formations separated by deep crevices, while the end of the transect crossed a distinct ledge of moderate relief. L2 was characterized by a moderate-relief ledge at the beginning of the transect and continued onto a flat plateau covered in the macroalgae *Sargassum* sp. (L2 had the highest macroalgae cover of any site). On such moderate-relief hardbottoms, horizontal surfaces are usually dominated by macroalgae such as *Sargassum* and *Dictyota*, while vertical surfaces and overhangs are dominated by a diverse array of sponges, bryozoans, hydrozoans. and tunicates (Mallin *et al.*, 2000). While the ledges and moderate-relief portions of these transects appeared persistent, with mature stony coral colonies and diverse invertebrate faunal assemblages (L1 had the highest diversity index of any site), the lower-relief portions of each transect may be more ephemeral. For example, Telestaceans and macroalgae were the primary biota observed along the plateau found on L2. The presence of these fast-growing groups in a veneer of sediment and the lack of larger stony coral colonies may indicate periodic burial or sand scouring of the less-rugose portions of the transects.

Borrow Area J

Two transects, J1 and J2, were established and characterized in Borrow Area J, which contained the least amount of hardbottom habitat of any of the borrow areas investigated. No hardbottom was observed along J1 and only a small patch of hardbottom with a relief of 2 cm was observed at the beginning of J2. This hardbottom appeared extremely ephemeral; the observed hardbottom became buried in sand within the first 3 meters of the transect and small partially or totally dead *Oculina* colonies were observed. Small *Oculina* colonies were also observed growing attached to taller *Leptogorgia virgulata* colonies, presumably to get above the sand deposition level. Tall colonies of the octocoral *L. virgulata* were observed protruding through the sand out to approximately 4 meters.

Borrow Area G

Two transects, G1 and G3, were established and characterized in Borrow Area G. Although length of the formations was less than 20 meters at both sites (transects were 15 and 18 meters, respectively), and though both transects were primarily low-relief, G1 and G3 supported the highest percent stony coral cover and stony coral density of any of the borrow area sites after T4 (coral density at T4 was driven by the abundance of recruit-sized colonies). G1 had the second-highest diversity index of any site, the highest percent tunicate cover, and supported primarily large mature colonies of *Oculina* sp. Also, these transects exhibited relatively low cover by octocorals and macroalgae. The larger size of organisms at these sites, particularly stony corals, as well as the lack of opportunistic species such as octocorals (especially at G1), indicate that the hardbottom habitat within Borrow Area G is well-developed and persistent despite the low relief of the formations.

Overall, hardbottom resources differed among the sites. Some areas were characterized by large contiguous hardbottom, some included patchy intermittent rock outcroppings, and others contained distinct ledge features. Figure 5 shows the differences in the acoustic signatures generated by the various hardbottom formations found offshore, as well as the random backscatter signature at Site J1 where no hardbottom was observed.

The North Carolina Coastal Habitat Protection Plan states that the composition of invertebrate, algal, and fish communities found in hardbottom habitats varies with temperature and depth. The hardbottom communities in warm-temperate regions such as North Carolina are physically stressed by changes in water masses and seasonal fluctuations in water temperature. Because of this stress, hard coral and reef fish abundance and diversity in temperate hardbottom habitats are limited and often vary by season (Street *et al.,* 2005). The information presented in this study is the result of a one-time assessment of a select number of hardbottom areas. Sampling of a greater number of sites or sampling over different times of the year might detect patterns or differences in benthic communities due to spatial or seasonal influences. Based on the information collected during this investigation, there were no apparent effects from the New River Inlet on the benthic community found at the northernmost Borrow Area T; these transects had communities similar in diversity, abundance, and composition to those transects on hardbottom habitats found farther south.

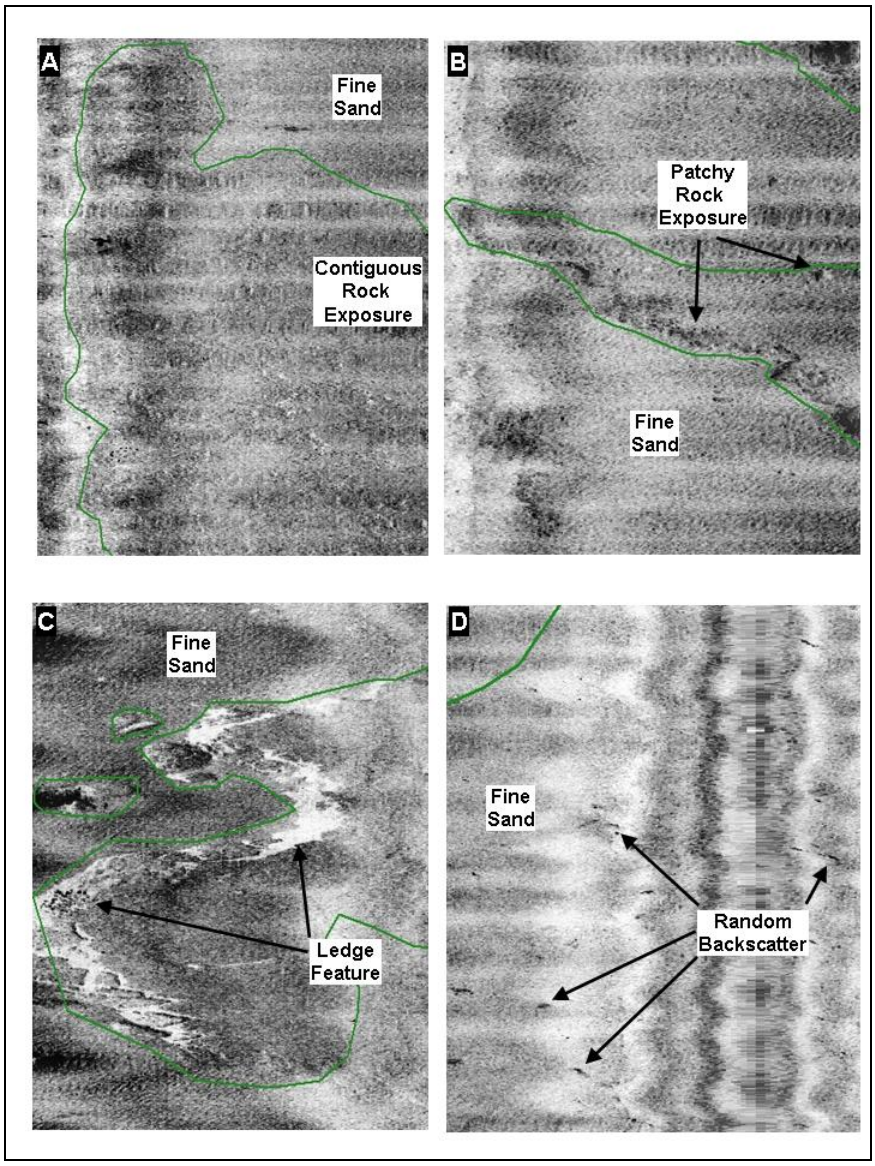


Figure 5. Sidescan Sonargraphs Showing Four Acoustic Signatures Investigated within the Borrow Areas.

- **(A)** Contiguous Rock Outcrop in the Vicinity of G1,
- **(B)** Patchy Rock Outcrop in the Vicinity of J2,
- **(C)** Rock Ledge in the Vicinity of L2,
- **(D)** Random Backscatter Attributed to Possible Fish or Other Water Column Disturbances in the Vicinity of J1

The fish assemblages found on these sites showed very little variation. Black sea bass (*Centropristis striata*) were ubiquitous, observed at almost every site. Spottail pinfish (*Diplodus holbrookii*) and sheepshead (*Archosargus probatocephalus*) were also observed, but in much fewer numbers. While these fish were observed across hardbottom areas of all levels of relief, they seemed to prefer the habitats provided by moderate-relief ledges and crevices between hardbottom formations.

6 CONCLUSIONS

No hardbottom habitat was observed at the eight potential nearshore hardbottom sites landward of the -23-foot NGVD depth of closure; these sites were actually regions of coarse gravel and shell hash. Divers did confirm the presence of hardbottom resources at two sites (NS10 and NS12) seaward of this line by a distance of 625 feet and 535 feet, respectively. Poor visibility did not allow for the characterization of any benthic community that might have been present. Hardbottom resources were identified and characterized within all five borrow areas investigated. Overall, most hardbottom areas investigated in this study were characterized by a combination of moderate- and low-relief habitats. Most areas included some regions of relatively moderate-relief rock outcroppings or ledges that were able to support adult *Oculina* sp. colonies and high cover by tunicates and sponges, and other areas of lower relief that were subject to more frequent burial and so were characterized by low stony coral cover (either very few *Oculina* sp. colonies, or small 1-cm recruits) and higher cover by fast-growing octocorals. These findings are similar to those by Mallin *et al.* (2000), who concluded that low-relief hardbottom habitats in North Carolina are often subject to periodic sand scour and periodic burial. As a result, these hardbottom habitats often harbor benthic communities with relatively low biotic diversity, dominated by a few emergent octocorals and sponges. On moderate-relief hardbottom formations, horizontal surfaces are usually dominated by macroalgae, while vertical surfaces and overhangs are dominated by a diverse array of sponges, bryozoans, hydrozoans, and tunicates (Mallin *et al.*, 2000). Based on the detailed sidescan sonar data interpretation and the two dives performed in Borrow Area J, it appears that this is the only borrow area where the observed hardbottom is low and appears highly ephemeral, with no areas of persistent hardbottom communities. The other borrow areas had varying degrees of benthic cover, often related to the associated habitat relief, with the exception of sites investigated in Borrow Area G where low-relief areas were home to the most diverse and persistent benthic communities observed.

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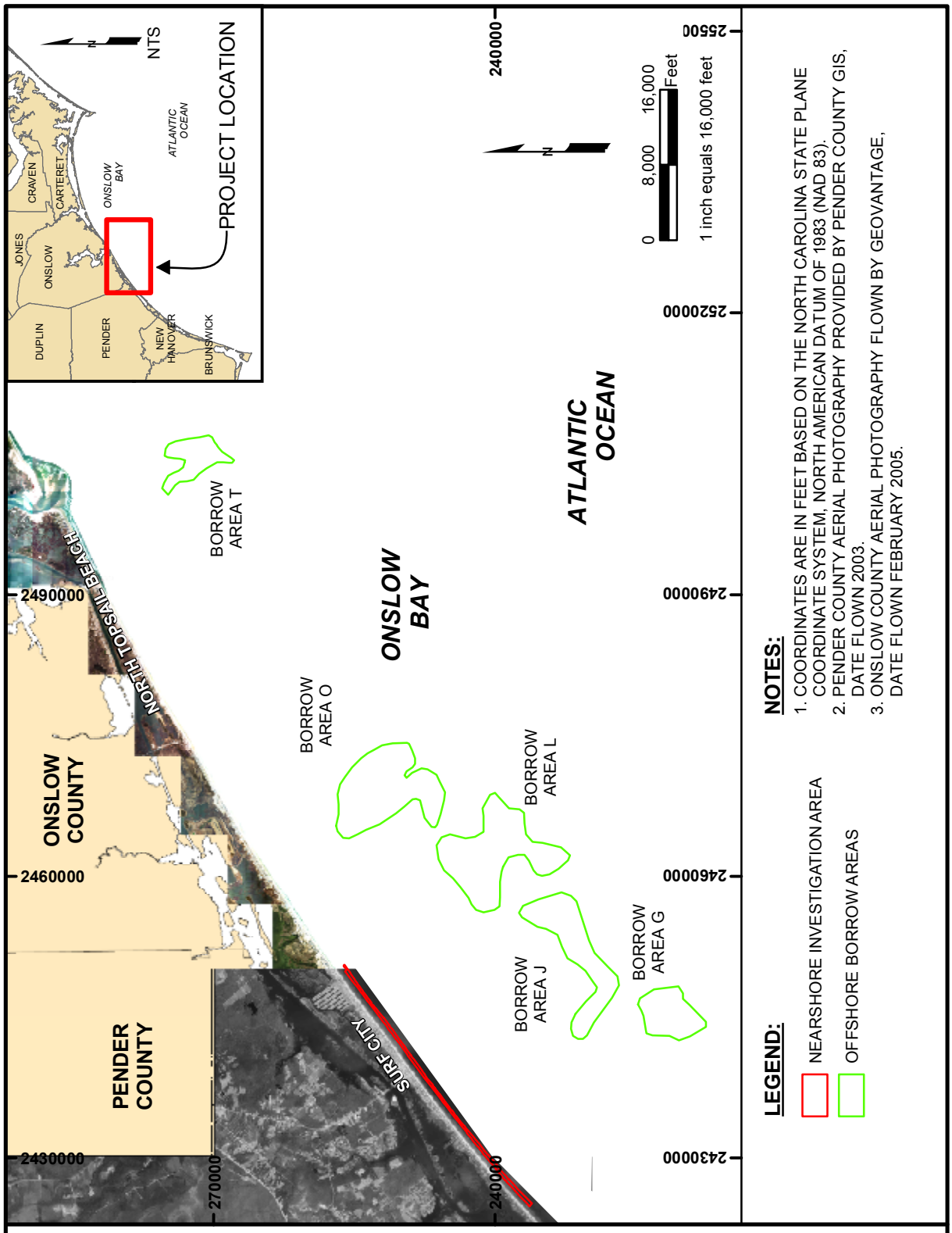
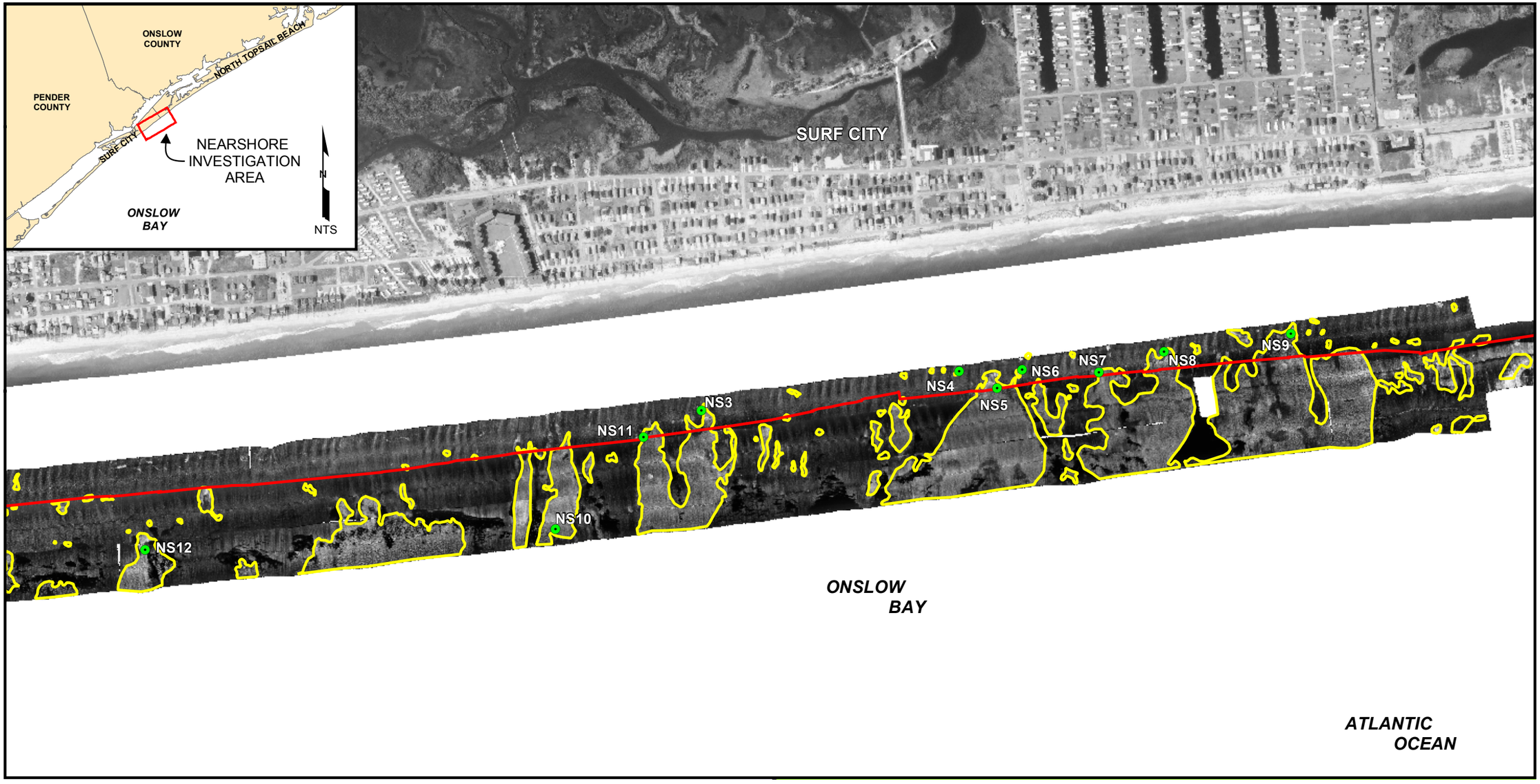
MAP 1



TITLE: **MAP1. SURF CITY/ NORTH TOPSAIL BEACH, N.C. SHORE PROTECTION PROJECT HARDBOTTOM RESOURCE CONFIRMATION AND CHARACTERIZATION STUDY PROJECT LOCATION MAP**

DATE: 04/11/08	BY: KW/HMV	COMM NO: 4600.59

MAP 2



NOTES:

1. COORDINATES ARE IN FEET BASED ON THE NORTH CAROLINA STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM OF 1983 (NAD 83).
2. PENDER COUNTY AERIAL PHOTOGRAPHY PROVIDED BY PENDER COUNTY GIS, DATE FLOWN 2003.
3. ONSLOW COUNTY AERIAL PHOTOGRAPHY FLOWN BY GEOVANTAGE, DATE FLOWN FEBRUARY 2005.

LEGEND:

- NEARSHORE DIVE LOCATIONS
- USACE DEPTH OF CLOSURE (-23 FT CONTOUR)
- POTENTIAL AREAS TO INVESTIGATE (CONDUCTED BY GEODYNAMICS)

0 400 800 Feet

1 inch equals 800 feet

TITLE:

SURF CITY/ NORTH TOPSAIL BEACH, N.C.
SHORE PROTECTION PROJECT
HARDBOTTOM RESOURCE CONFIRMATION AND CHARACTERIZATION STUDY
NEARSHORE INVESTIGATIONS

DATE: 04/11/08	BY: KW/HMV	COMM NO: 4600.59	**FIGURE 2**

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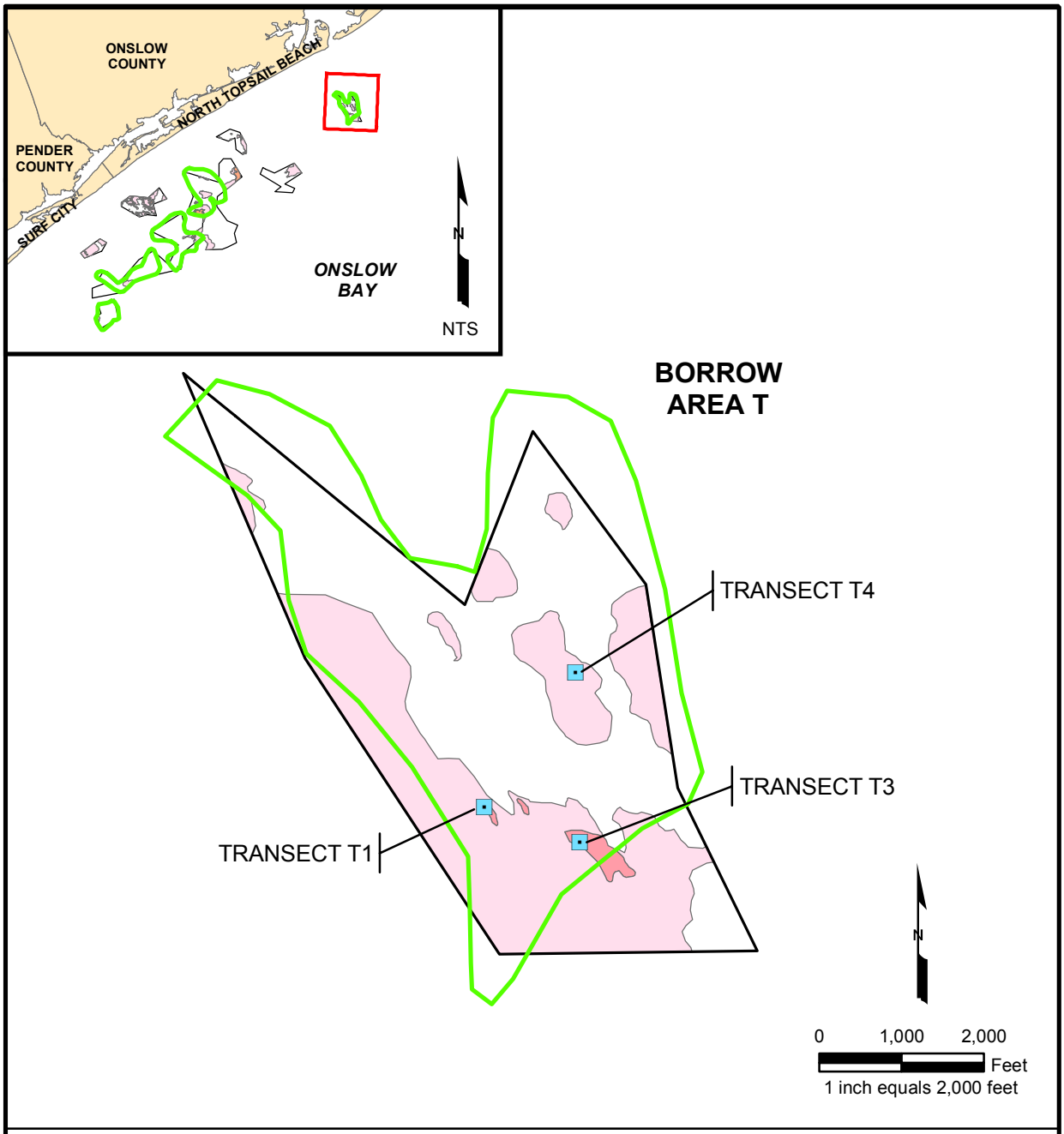
MAP 3a



NOTES:

1. COORDINATES ARE IN FEET BASED ON THE NORTH CAROLINA STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM OF 1983 (NAD 83).
2. SIDESCAN SONAR DATA COLLECTED BY MATER BETWEEN OCTOBER 14, 2004 AND MAY 10, 2005.

LEGEND:

- HARDBOTTOM CHARACTERIZATION TRANSECTS
- OFFSHORE BORROW AREA
- EXTENT OF MATER SIDESCAN DATA

MATER HARDBOTTOM DELINEATION:

- MODERATE RELIEF
- LOW RELIEF

TITLE:

SURF CITY/ NORTH TOPSAIL BEACH, N.C. SHORE PROTECTION PROJECT
HARDBOTTOM RESOURCE CONFIRMATION AND CHARACTERIZATION STUDY
OFFSHORE INVESTIGATIONS: BORROW AREA T

DATE: 04/11/08	BY: KW/HMV	COMM NO: 4600.59	**FIGURE: 3a**

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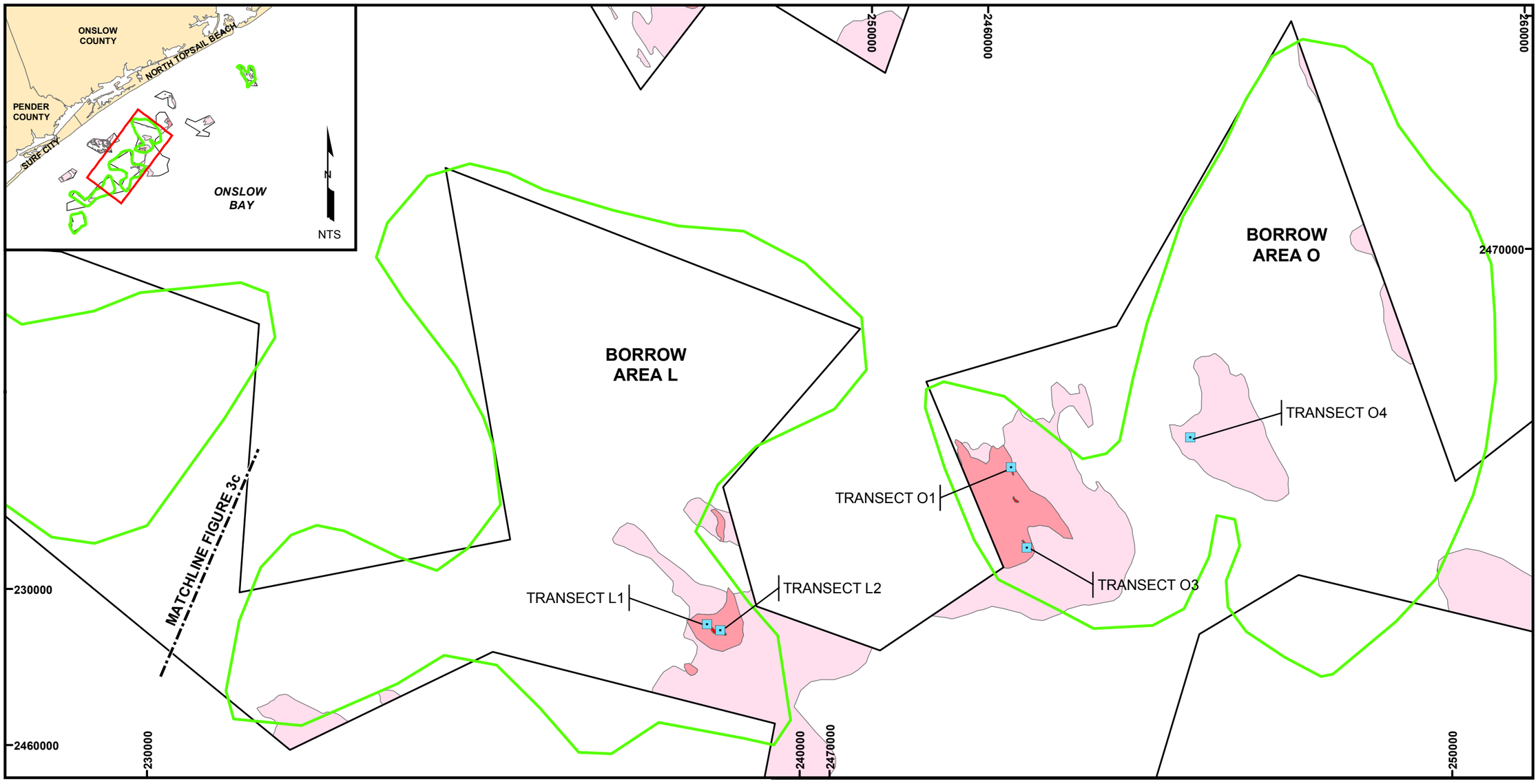
MAP 3b



NOTES:

1. COORDINATES ARE IN FEET BASED ON THE NORTH CAROLINA STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM OF 1983 (NAD 83).
2. SIDESCAN SONAR DATA COLLECTED BY MATER BETWEEN OCTOBER 14, 2004 AND MAY 10, 2005.

LEGEND:

- HARDBOTTOM CHARACTERIZATION TRANSECTS
- OFFSHORE BORROW AREAS
- EXTENT OF MATER SIDESCAN DATA

MATER HARDBOTTOM DELINEATION:

- HIGH RELIEF
- MODERATE RELIEF
- LOW RELIEF

0 1,000 2,000 Feet

1 inch equals 2,000 feet

TITLE:

**SURF CITY/ NORTH TOPSAIL BEACH, N.C.
SHORE PROTECTION PROJECT
HARDBOTTOM RESOURCE CONFIRMATION
AND CHARACTERIZATION STUDY
OFFSHORE INVESTIGATIONS:
BORROW AREAS L AND O**

DATE: 04/11/08	BY: KW/HMV	COMM NO: 4600.59	**FIGURE 3b**

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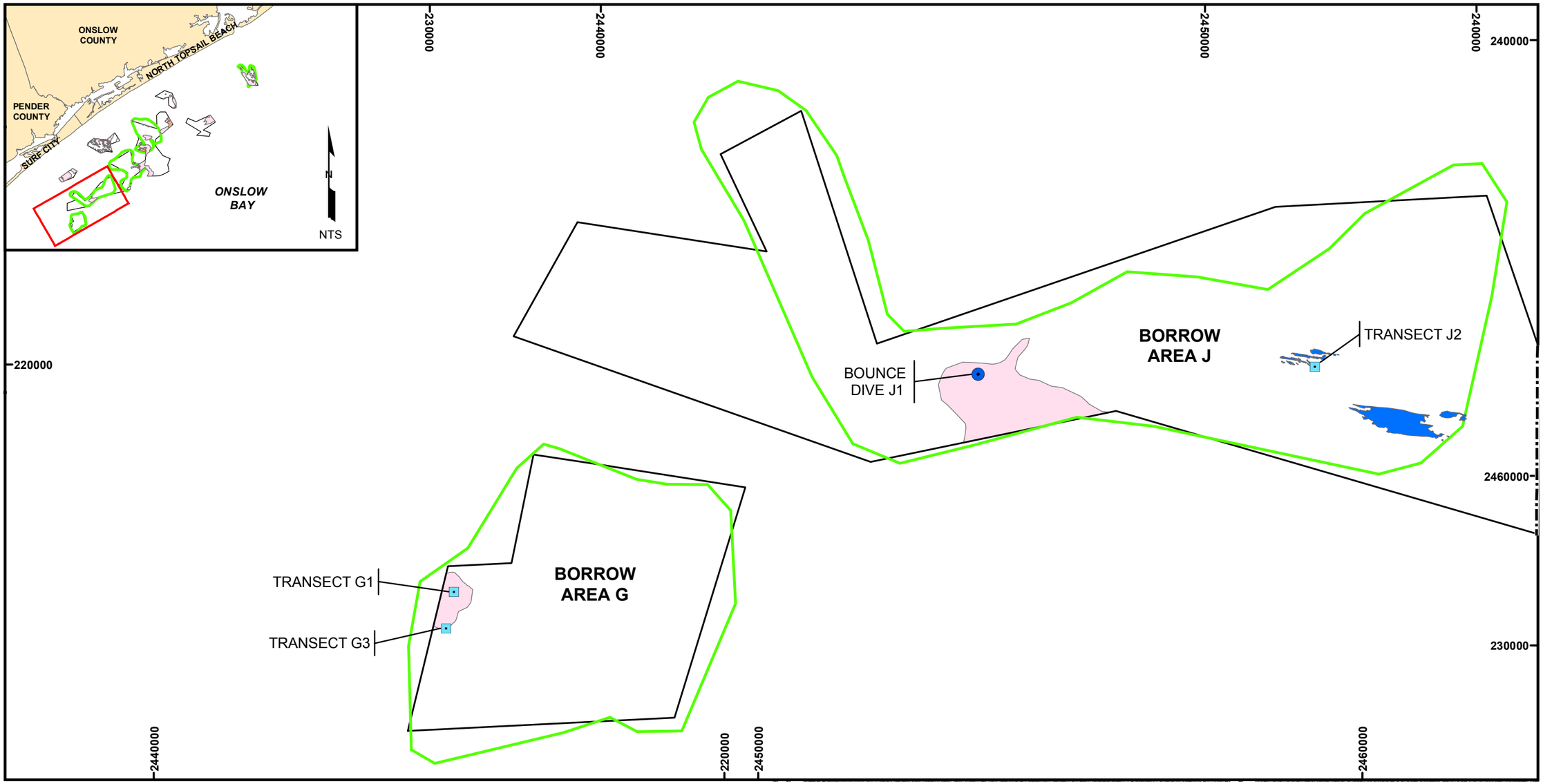
MAP 3c



NOTES:

1. COORDINATES ARE IN FEET BASED ON THE NORTH CAROLINA STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM OF 1983 (NAD 83).
2. SIDESCAN SONAR DATA COLLECTED BY MATER BETWEEN OCTOBER 14, 2004 AND MAY 10, 2005.

LEGEND:

- RECONAISSANCE BOUNCE DIVE
- HARDBOTTOM CHARACTERIZATION TRANSECTS
- OFFSHORE BORROW AREAS
- EXTENT OF MATER SIDESCAN DATA
- CPE PROBABLE ROCK OUTCROPS

MATER HARDBOTTOM DELINEATION:

- LOW RELIEF

0 1,000 2,000 Feet

1 inch equals 2,000 feet

TITLE:

**SURF CITY/ NORTH TOPSAIL BEACH, N.C.
SHORE PROTECTION PROJECT
HARDBOTTOM RESOURCE CONFIRMATION
AND CHARACTERIZATION STUDY
OFFSHORE INVESTIGATIONS:
BORROW AREAS G AND J**

DATE: 04/11/08	BY: KW/HMV	COMM NO: 4600.59	**FIGURE 3c**

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APPENDICES

APPENDIX A

SCOPE OF WORK (SOW)

Environmental Resources Section September 06 2006

DESCRIPTION OF SERVICES

Collection and Analysis of Data Pertaining to Potential Nearshore and Offshore Hard Bottom Resources Relative to the Surf City / North Topsail Beach Shore Protection Project

1. Background –In order to assess potential dredging and beach nourishment impacts to these significant hard bottom resources relative to the Surf City / North Topsail Beach (SCNTB) Shore Protection Project, the U.S. Army Corps of Engineers, Wilmington District requires a more refined biological characterization and analysis of flora and fauna species associated with nearshore and offshore hard bottom resources identified within the vicinity of the project. Previous side scan and mulitbeam surveys performed by the Corps have identified areas of potential low relief hard bottom in the nearshore environment (-18 to -30 ft. NGVD) and within identified borrow sites located offshore (>30 ft. NGVD). Areas identified as potential nearshore hard bottom resources may be impacted as a result of project construction, cross shore beach profile adjustment, or longshore spreading of beach fill. Furthermore, in order to provide sufficient compatible sand resources for the 50 year project, hopper dredging activities are expected to approach within 400 ft. of previously identified low relief hard bottom. Detailed biological characterization of these resources must be completed In order to better assess potential direct and/or indirect impacts of the dredging operation.

Currently, hard bottom habitat mapping and characterization is being conducted near the proposed sites by Coastal Planning and Engineering, Inc. (CPE) for the Towns of North Topsail Beach and Topsail Beach as part of their locally funded Shore Protection permit projects. Plan development and implementation of marine resource investigations as a component of the North Topsail Beach permit project were coordinated with and reviewed and approved by state (NCDCM, NCDMF, NCWRC, NCDWQ, etc.) and federal (USFWS, NMFS, etc.) agency representatives. Project Delivery Team (PDT) members identified for the permit projects are also PDT members for the federal SCNTB Shore Protection project. In a hard bottom sub-group PDT meeting conducted on 09 August 2007 for the federal project, agency representatives recommended additional hard bottom resource investigations be performed within the identified impact area of the project, consistent with the scope and methods of the work which is already being performed for the permitted North Topsail Beach. This additional data would satisfy baseline condition needs for the development of the Environmental Impact Statement (EIS) and Essential Fish Habitat (EFH) assessment for the federal project.

2. Project Site Description. The areas to be investigated are located in the nearshore and offshore environments located off of Surf City and North Topsail Beach, North Carolina. The nearshore area is located approximately 1100 ft. from shore between the -18 to -30 ft. NGVD contours from the Surf City/Topsail Beach town border extending through the southern end of North Topsail beach (Figures 1-3). The offshore (Figure 4) areas are located within 8 offshore borrow sites located approximately 3-5 miles offshore ranging in depths between –30 and –47 ft. NGVD.

3. Description of Supplies/Services - The purpose of this investigation is to confirm the presence and/or absence of hard bottom resources as well as biologically characterize identified sites located within the nearshore and offshore (borrow sites) environments of Surf City and North Topsail Beach, North Carolina relative to proposed dredging and beach nourishment actions. The locations of the potential areas to be investigated are identified in Figures 1-4. The nearshore investigation will require a phased approach to

confirm the (1) presence and/or absence of hard bottom resources and, if necessary, (2) characterize the identified hard bottom habitat including fish species observation and identification. The offshore investigation will characterization of the benthic hard bottom community as well as observation and identification of fish species.

Nearshore. Phase one shall utilize existing USACE nearshore side scan sonar and multibeam data, including previously delineated potential hard bottom locations, to develop and implement a dive plan, using marine biologists and, if necessary, geologists, for groundtruthing pre-determined potential hard bottom sites for visual confirmation. Sites selected for groundtruthing shall include but are not limited to representative areas outside, within, and along the edge of previously delineated potential hard bottom sites on side scan and multibeam imagery. The presence or absence of hard bottom habitats shall be documented through visual observations and video documentation. If no exposed hard bottom resources are evident within select areas, the investigators shall conduct a limited proximity search and photographically document their findings. Evaluations shall be made and surface grab samples obtained to assess the sediment characteristics of each sample site and suggest a rational for back-scatter differences previously identified through side scan imagery. Furthermore, an evaluation of the surface sediment thickness relative to potential underlying geologic formations (sandstone, limestone, etc.) shall be made. If the data suggest an ephemeral hard bottom system with a thin veneer of sediment cover, an estimate of exposure or persistence of the feature shall be documented.

If exposed hard bottom is confirmed, phase two shall be implemented within identified sites. Phase two shall delineate and characterize the hard bottom habitat as well as observe and document fish species present within the vicinity of the hard bottom. The areas inspected for presence and characterization of hard bottom habitat will be mapped using the provided side scan data and a differential Global Positioning System (DGPS) and HYPACK program and data incorporated into GIS for visual interpretation. Biological characterization shall be performed using appropriate methods for ecological assessments of the types of hard bottoms found off North Topsail Island (marginal reefs) and include digital video techniques for investigating marine resources. Transects shall be established at appropriate locations and spacing intervals in order to prepare an accurate assessment and characterization of hard bottom resources in the identified areas. The rationale for number and spacing of transects developed within the survey area shall be supported by existing pier reviewed literature regarding the number of transects necessary to sufficiently characterize a known hard bottom community. Fish transect counts shall correspond with selected transects for benthic characterization. Characterization and sampling methodology shall be sufficient to represent a baseline determination of hard bottom habitat conditions that could provide a quantitative and qualitative data set that would be utilized to assess and comparatively evaluate changes in the benthic macro-invertebrate and macro-algal communities at each site throughout future monitoring events, if deemed necessary..

Offshore (Borrow Areas): Existing USACE high resolution side scan sonar surveys (conducted by Mid-Atlantic Technology and Environmental Research, Inc. (MATER)) of the borrow areas and subsequent hard bottom delineation maps shall be utilized to define sampling locations and design for benthic characterization assessments as well as observation of fish species. Specifically, areas defined by MATER as low relief hard bottom located within the borrow areas relative to identified sand borrow sources shall be considered in the sampling design. The rationale for number and spacing of transects developed within the survey area shall be supported by existing peer reviewed literature regarding the number of transects necessary to sufficiently characterize a known site. Furthermore, the location of transects shall be sufficient to encompass the potential differences in habitat conditions relative to depth of water, nearness to New River Inlet, etc. Characterization of the hard bottom habitat as well as observation and documentation of fish species presence within the vicinity of the hard bottom shall be performed. DGPS and HYPACK

programs will be used for mapping transect sites and shall be incorporated into GIS for visual interpretation. Biological characterization shall be performed using the same ecological assessment and digital video techniques discussed in the nearshore investigation section of this scope. Benthic characterization and sampling methodology shall also be sufficient to represent a baseline determination of hard bottom habitat conditions that could provide a quantitative and qualitative data set that would be utilized to assess and comparatively evaluate changes in the benthic macro-invertebrate and macro-algal communities at each site throughout future monitoring events, if deemed necessary.

4. Report. The Contractor shall prepare an initial field appraisal of data deemed relevant for the Surf City North Topsail (SCNTB) Shore protection Project. This appraisal shall be in the form of a management summary or letter report. This appraisal shall be developed as fieldwork progresses so that it is available as soon as possible after completion of the fieldwork. The Contractor shall also prepare a draft and final research report of the investigations. The report shall discuss all aspects of the investigation and shall identify the methods used in the survey. The report shall contain this Description of Services as an appendix. The report shall also follow the guidelines of paragraphs 5 and 6, below.

5. Reports.
The following reports must be submitted:

1. Work Plan and Quality Assurance Project Plan (Work Plan / QAPP/Dive Operations plan)
2. Site Specific Safety and Health Plan – Accident Prevention Plan
3. Draft Hard Bottom Assessment Report.
4. Final Hard Bottom Assessment Report.

Draft and final reports shall contain at least the following sections/chapters:

a. *Cover and title page*. The cover and title page shall indicate the title of the project report, the authors, the contract number, the sponsoring agencies, and date. The title page must also have the signature of the Principal Investigator or other individual responsible for actual completion of the project.

b. *Abstract.* The abstract shall be a brief summary of where and why the survey took place, the results of the study, and recommendations for further work. Abstracts are generally ½ page or less in length.

c. *Acknowledgements*. This section should mention all individuals or organizations that contributed to successful project fulfillment.

d. *Table of Contents, List of Figures and Tables*. It is important that the contents accurately reflect page numbers in both the draft and final reports.

e. *Introduction or Project Background.* This section should explain why the survey is necessary and should refer to the legal requirements.

f. *Overviews of past investigations.* The Contractor shall compile and review available data, reports, maps, and side scan and multibeam surveys pertaining to bottom habitats within the study area. The Contractor shall gather information through database literature searches, telephone interviews, and meetings with identified sources of information. This overview of previous studies and data collected develops the context within which hard bottom resources shall be evaluated and used as a guide to developing criteria for transect location and spacing for characterizing hard bottom resources.

g. *Field and Analytical Methods*. This section shall include a description of the equipment that was used in the field survey and how it was operated. This section should note restrictions, shortcomings, or problems of the research and how they have been overcome or controlled.

h. *Analysis and Results.* This section should include a full verbal description of each confirmed hard bottom resource including species composition, percent sediment cover, fish observations, etc..

i. *References.* The report shall contain references for work cited in the report.

j. *Description of Services.* This Description of Services shall be included as an appendix to the report.

6. Requirements for Report Submission.

The data obtained will be presented in graphical, tabular, and written text as appropriate (See Appendix A). The draft and final testing reports will undergo internal technical review and quality assurance review by persons with appropriate technical qualifications to ensure that the report meets the project requirements specified in the technical work plan and the QA goals.

The draft and final reports will consist of 8 1/2" by 11" pages with drawings folded, if necessary to this size. The report margins shall be suitable for use in a durable 3-ring binder. A decimal numbering system will be used with each section having a unique decimal designation. Reports that require extensive editing, have extensive errors, or are not in the required formats will be rejected and re-submittal will be required. All submittals under shall be sent to Wilmington District. Any maps, drawings, figures, sketches, databases, spreadsheets, or text files prepared for this report shall be provided in both hard copy and digital form. The digital copies of reports and other text documents shall be provided in Microsoft Word 2000. Spreadsheet files and data files shall be provided in Microsoft Excel 2000 format. All text, spreadsheet, and database files shall be delivered compact disk read-only memory (CD-ROM) with ISO-9660 format. A copy of the report must also be provided as an Adobe Acrobat .pdf file. Geographic data shall be provided in feet and projected into the North Carolina State Plane coordinate system.

Five copies of the draft and final reports (hard copies and CD) shall be submitted to the Wilmington District.

Field Logbook. Personnel conducting the sampling and testing shall record all necessary documentation in appropriate field logbooks. All entries shall be dated and time of entry recorded. All aspects of the sample collection, handling, and field observations shall be documented in the field logbooks. Sample collection equipment used to collect samples and persons collecting samples shall be documented. Water depth, sample location, sample penetration, and descriptive characteristics of collected sediments should also be documented. Field records are a basis for later written reports and therefore should be complete and factual.

Daily Quality Control Report. A daily quality control report (DQCR) will be prepared for each day sampling activities are conducted. The DQCR shall contain at a minimum the following information:

1. Work Performed. Sections of the sampling and analysis plan shall be referenced. Relevant information regarding the sample collection, sample shipping, and ancillary measurements taken should be included.

2. Departures from Sampling and Analysis Plan. Any departure from the approved sampling plan or corrective actions required should be identified in the DQCR. Verbal or written changes to the sampling should be documented.

Data Reduction, Validation, and Reporting

Data Record The data record will consists of all information sample locations, sample logs, visual classifications, analytical data, and laboratory data as applicable.

Project documentation and data include, but are not limited to, project reports, field investigations reports, sample information, analytical data records (hard copy and electronic data deliverables), and statistical analyses. Supplemental documentation such as nonconformance reports, variance reports, records of telecon/meeting notes, letters of transmittal, general correspondence, project proposal/plans, drawings, along with project documentation and data, will comprise the project files. Copies of these documents may exist elsewhere in hard copy and electronic form but the originals shall represent the project record and be kept in the project file. The project file shall be kept in a secure, central location and indexed by contract number and type for easy cross-referencing. At the conclusion of the contract, the project file will be duplicated onto CD and submitted to the Wilmington District.

All digital files, final hard-copy products, source data acquired for this project, and related materials shall become the property of the US Army Corps of Engineers, Wilmington District and will not be issued, distributed, or published by the contractor without prior approval.

7. Government Furnished Property. The Corps shall furnish all reports and associated data for previously contracted geological and biological investigations performed off of Topsail Island as discussed in sections 1 and 3 of this scope. This will include but is not limited to side scan sonar and mulitbeam imagery data of the nearshore environment and within the proposed offshore borrow areas.

8. Safety. The U.S. Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1, is available on line at:

http://www.usace.army.mil/inet/usace-docs/eng-manuals/em385-1-1/toc.htm.

The Contractor is responsible for maintaining a safe and healthy work environment for all employees at all times. This includes reasonable provisions for proper lighting, seating, and shelter from weather, and access to accommodations for adequate rest, food, and water. The Contractor shall provide all personnel and equipment necessary for safe and effective completion of all archaeological and related services as detailed in this Description of Services. In addition, the following terms shall be met:

a. *Safety and Activity Hazard Analysis Plan*. In consultation with the Wilmington District Contracting Officers Representative, the contractor shall determine the need for a Safety and Hazard Analysis Plan. This plan shall be required if the work environment or the work itself if found to be atypical of the work normally performed under this contract, and if that work presents hazards not normally encountered and accounted for as a routine part of task orders issued pursuant to the basic contract. When consultation determines that a Safety and Hazard Analysis Plan is required, the Contractor shall adhere to applicable sections of EM 385-1-1, "Safety and Health Requirements Manual," Appendix A, and the activity hazard analysis shall identify potential hazards that are specific to the work being conducted under this Description of Services. Requirements for the activity hazard analysis are presented in EM 385-1-1 at Section 19, *Floating Plant and Marine Activities*. All employees shall be made aware of these hazards and the appropriate preventative, remedial, and first aid measures. The Contractor's proposed Safety and Hazard Analysis Plan shall be submitted not later than 5 working days after receipt of notification of award. The Plan must include a tentative fieldwork schedule.

b. *Survey Vessel*. The survey vessel shall be supplied by the Contractor and shall be of sufficient size to contain all required survey and safety equipment, and provide temporary shelter to the field crew. The survey vessel shall meet all relevant U.S. Coast Guard safety criteria for the crew size, equipment, and tasks being performed. The survey vessel shall have available a litter, emergency oxygen, first aid supplies, personal floatation devices, marine VHF radio, and cellular telephone.

c. *CPR and First Aid*. All field crew personnel shall have current and valid certification in CPR and First Aid.

9. Scientific Diving Operations. Currently EM 385-1-1 requires that all contract divers have commercial diving Certifications. Refer to paragraphs 30.A.06, 30.A.07 and 30.A.08. In order to allow for scientific diving operations under this task order the Jacksonville District will need to submit a request for a waiver from this requirement as provided in Appendix N of EM 385-1-1. Approval of this request for waiver will be required prior to conducting any diving operations under this task order. In order to expedite this process the following information shall be submitted by the bidder in their proposal package. This information shall include: a) the contractor's Dive Safety Manual, b) diving resumes for each of the contractor's divers (to include the number of logged dives and total bottom time, a list of training certificates and experience, and copies of all certification cards), c) techniques and methods to be used to conduct the work, d) a statement (or other proof) regarding the contractor's diving safety record, and e) an activity hazard analysis for the work to be conducted.

10. Dive Planning and Safety.

a. The Contractor shall provide all personnel and equipment necessary for safe and effective completion of all scientific diving and related services. The Contractor must meet all provisions of this paragraph and shall conduct all diving operations in strict accordance with an approved dive safety plan to be prepared by the Contractor. The Contractor is required to coordinate the dive safety plan directly with Mr. William (Bill) Harris, Wilmington District Safety Officer (910-251-4698), and the Wilmington District Dive Coordinator, Mr. Roger Bullock (910-251-4822). The Wilmington District may have a Dive Safety Inspector on site throughout diving operations.

b. The dive boat shall be Contractor supplied and of sufficient size to contain all dive gear and provide temporary shelter to divers, crew, and the Wilmington District Dive Inspector. The dive boat shall be anchored at the site and display both the international A (Alpha) and the sport diver's flag (white stripe on red background). The dive vessel shall meet all relevant U.S. Coast Guard safety criteria for the crew size, equipment, and tasks being performed. The dive boat shall have available a litter, emergency oxygen, first aid supplies, personal floatation devices, marine VHF radio, and cellular telephone.

c. All divers must have current dive and medical certification, including CPR and First Aid. All divers shall produce evidence of having had a medical examination and physician's certification for diving within the previous 12 months and evidence of chest examination by radiography within the previous 36 months. These certifications must be on file with the WDDC prior to the dive safety meeting, unless otherwise approved. The dive boat shall be supplied with an onboard oxygen supply, and a person certified to administer oxygen shall be onboard at all times during dives.

d. The Contractor must prepare and coordinate a Dive Plan with the Wilmington District Dive Coordinator (WDDC) prior to undertaking any diving in connection with this project. All work shall be performed in accordance with the terms of the approved Dive Plan. All diving activities shall be accomplished in compliance with EM 385-1-1, "Safety and Health Requirements Manual," and all dives shall be conducted and logged in accordance with the dive tables and standards of the U.S. Navy Diving Manual, Volume 1; pages 7-16. If for any reason, the Dive Plan, as approved, is altered in depth, mission, or equipment, the WDDC shall be contacted in order that he may review the changes prior to continuance of the diving operations. The Contractor's proposed Dive Plan should be submitted not later than 10 working days after issuance of the purchase order initiating work to be accomplished under this Description of Services. The Plan must include a tentative dive schedule. It shall be the Contractor's responsibility for scheduling dives in coordination with local maritime agencies in order to avoid conflicts with ship traffic or other maritime activities on the river. A pre-dive safety meeting shall be held at a site and time to be designated by the WDDC. All divers, all dive support personnel, the dive inspector, and the WDDC shall attend the meeting. The Contractor's dive plan must list all project personnel by tasks.

e. The following items shall be submitted by the Contractor after award of the contract, with sufficient time allowed for review by the District Diving Coordinator, prior to the first dive.

i. Dive Operations Plan, to include all the items specified in paragraph 30.A.17 of EM 385-1-1. This plan shall contain information specific to the diving operations to be performed on each dive. A generalized, philosophical discussion of diving, or enumeration of diving-related theory will NOT be accepted.

ii. Activity Hazard Analysis, pursuant to paragraph 30.A.18. This must address specific hazards anticipated for each diving operation to be performed, and must specifically address other work of any kind being conducted concurrently that could interface with of affect the diving operation, such as crane lifts, as well as methods for communications between such other work, crane operators, etc., and the divers. Applicable lock out, tag out, and safe clearance procedures must also be included in the analysis.

iii. Up-to-date resume denoting diving-related training, level of certification and experience for each diver. Diving resumes for each of the divers must include at a minimum, the

number of logged dives and total bottom time, a list of training certificates and experience, and copies of all certification cards.

iv. Medical certification from a physician as to each diver's fitness/suitability for diving, as required by paragraph 30.A.10, EM 385-1-1. This certification must be from a licensed physician within the 12-month period immediately preceding any dive performed under this delivery order, and must be renewed at 12-month intervals.

v. Proof of current training in CPR, first-aid and use of emergency oxygen systems for each member of the dive team, as required by paragraph 30.A.09 of EM 385-1-1.

vi. Copies of certifications and/or documentation to demonstrate that the compressor(s) used to provide breathing air for the divers have been tested at six-month intervals, and meet the air purity requirements specified in paragraph 30.E.05 of EM 385-1-1.

vii. Identification of the first-aid kit, oxygen resuscitation system, and stokes litter or backboard (with floatation device) to be available at the dive site, as required by paragraph 30.E.11 of EM 385-1-1. Additionally, a statement, or other proof, regarding the diving safety record must be submitted.

f. Appropriate number of diving personnel shall be furnished for each dive, as required by Appendix O, Manning Levels for Dive Teams, EM 385-1-1 and Appendix P, CESAJR 385-1-1.

11. Payment. The Contractor's bid shall include all provisions for weather delays, equipment repair and adjustment, holidays, etc. Payments will be made on a monthly basis upon receipt and acceptance by the Contracting Officer's Representative of a monthly progress letter and invoice. Invoices will not be processed unless a progress letter has been provided that indicates in detail the progress of work during the billing period. Payment of partial or final invoices may be withheld until all deliverables are received and accepted by the Wilmington District.

12. Schedules.
The task in contained in this Scope of Work shall be completed according to the Table 5.1 schedule. Adjustments to the schedule must be previously approved by the Contracting Officer. The work shall proceed in a continuous stepwise manner until complete.

Table 5.1
Schedule

	Estimated Schedule Calendar Days After Award
Kick-off Meeting	5
Submit Draft Work/QAPP/APP	10
CESAW Comments on Work Plan/QAPP/APP	15
Begin Field Work / Assessment	25
Complete Field Work	45

Submit Draft Report	60
Submit Final Report	80

The Contracting Officer may amend the report schedule if she determines that modifying the contract to include diving or other services is in the best interest of the government. In that case, the draft report and final report schedules will be renegotiated.

APPENDIX A

Standard Formats and Requirements for Digital Data

Appendix A

Standard Formats and Requirements for Digital Data Provided to the Wilmington District U.S. Army Corps of Engineers Under Contract

(CESAW-TS-PE September 2007)

The following paragraphs represent the format for electronic files being delivered as part of any contract. These paragraphs do not specify content or what the electronic files should contain. The content or data represented should be specified in the basic Scope of Work.

1. Specifications For Digital Data. Any maps, drawings, figures, sketches, databases, spreadsheets, or text files prepared under the terms of this contract shall be provided in both hard copy and digital form, unless otherwise specified in the Scope of Work. The hard copy deliverables shall be defined in the body of the basic Scope of Work.

2. Text, Spreadsheet, and Database Files: The U.S. Army Corps of Engineers, Wilmington District standard computing software is Microsoft Office. Reports and other text documents shall be provided in Microsoft Word 2000 (or higher version) format and Adobe Portable Document Format (PDF). Spreadsheet files shall be provided in Microsoft Excel 2000 format. Databases shall be provided in Microsoft Access format, unless otherwise specified in the basic Scope of Work. Prior to database development, the contractor shall provide the Government with a Technical Approach Document and Entity Relationship Diagram for approval which describes the contractor's technical approach to designing and developing the database. All text, spreadsheet, and database files shall be delivered on compact disk read-only memory (CD-ROM) with ISO-9660 format.

3. Digital Mapping and Data Standards: The U.S. Army Corps of Engineers, Wilmington District utilizes Microstation for Computer Assisted Drafting and Design CADD**.** Data provided must be readable by Microstation SE or higher to provide design drawings, sketches, or figures. All digital files provided in Microstation shall be provided in feet and projected into the North Carolina State Plane coordinate system. The maps shall use the GRS 1980 spheroid and the North American Datum 1983 (WGS-84, and shall be provided on CD-ROMs

4. Geographic Information System (GIS) Data Delivery Format:

a. Digital geographic maps and the related digital information shall be developed using double precision and delivered in uncompressed ARC/INFO export file format (.e00) using ARC/INFO Release 8.0 or higher. The Wilmington District will also accept ARC/View Shape files readable by ARC/View 3.x or ARC GIS ARC/View 81. ARC/INFO, ARCView 3.x and ARC GIS ARC/View8.1 are geographic information system software applications produced by the Environmental Systems Research Institute of Redlands, California, and is the GIS software suite used by U.S. Army Corps of Engineers, Wilmington District.

b. Digital geographic maps and the related digital information shall be usable on a IBM compatible personal computer system using the Windows NT 4.0 or Windows 2000 operating

systems. This data shall be provided on compact disk read-only memory (CD-ROM) with ISO-9660 format. Digital information may alternatively be delivered on 100mb ZIP Disks.

5. General Digital Standard for CADD and GIS Files

a. Geographic data shall be provided in feet and projected into the North Carolina State Plane coordinate system. The maps shall use the GRS 1980 spheroid and the North American Datum 1983 (WGS-84). Vertical upland topographic surveys shall use NGVD 1929. Hydrographic survey will reference the local dredging datum which will be provided in the project scope of services. No offsets shall be used. Each map layer or coverage shall have a projection file. Map or drawing scales will be determined by the Contracting Officer's Representative for the contract. Mapping accuracy for the agreed scales will conform to the American Society for Photogrammetry and Remote Sensing (ASPRS), "Accuracy Standards for Large-Scale Maps" and "Interim Accuracy Standards for Large-Scale Maps" (ASPRS, 1991). Copies of the ASPRS Accuracy Standards can be obtained by contacting:

American Society for Photogrammetry and Remote Sensing
5410 Grosvenor Lane, Suite 210
Bethesda, MD 20814-2160

ASPRS accuracy standards can also be found on the Internet at:

http://www.asprs.org

b. Geographic data must be provided in a form that does not require translation, preprocessing, or post processing before being used in the U.S. Army Corps of Engineer's System. However, the Contractor shall consult with the Government (specifically the Geographic Information Systems Coordinator) concerning the use of alternative delivery formats such as MicroStation SE or higher to provide design drawings, sketches, or figures. All digital files provided in Microstation shall be in the same projection and use the same coordinate system, datum, and units as stated above, and shall be provided on 3.5 inch, high density diskettes, 100mb Zip Disks, or CD-ROMs.

c. Geographic Data Structure: All geographic information shall be developed in a structure consistent with the Spatial Data Standards (SDS), Version 1.9, released in December 1999, or a higher version if available at the time of this project. The Contractor shall consult with the Government concerning modifications or additions to the SDS. The Government may approve modifications to the Standard if it is determined that SDS does not adequately address subject data sets. Copies of the SDS may be obtained by contacting:

Director, U.S. Army Engineer Waterways Experiment Station
Tri-Service CADD/GIS Technology Center
Attn: CEWES-IM-DA/Smith
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Electronic copies of the Standards are also available from the Tri-Service CADD/GIS Technology Center's Internet homepage at URL address:

http://tsc.wes.army.mil

d. Geographic Data Documentation: For each digital file delivered containing geographic information (regardless of format), the Contractor shall provide documentation consistent with the "Content Standards for Digital Geospatial Metadata, June 1998" published by the Federal Geographic Data Committee. The documentation shall include but is not limited to the following: the name and description of the map layer or coverage, the source of the data and any related data quality information such as accuracy and time period of content, the type of data coverage (point, line, polygon, etc.), the field names of all attribute data and a description of each field name, the definition of all codes used in the data fields, the ranges of numeric fields and the meaning of these numeric ranges, the creation date of the map layer and the name of the person who created it. A point of contact shall be provided to answer technical questions. A metadata generation software, called Document.aml, is available from ESRI for use with ARC/INFO to help in the production of the required metadata. Corpsmet 95 metadata software is available from the U.S. Army Geospatial Clearinghouse at http://corpsgeo1.usace.army.mil/. Copies of the FGDC metadata standard can be obtained by contacting:

FGDC Secretariat
c/o U.S. Geological Survey
590 National Center
Reston, Virginia 22092
(703) 648-5514

FGDC metadata standards can also be found on the Internet at:
http://www.fgdc.gov

e. Geographic Data Review: The digital geographic maps, related data, and text documents shall be included for review in the draft and final contract submittals. The reviews may include a visual demonstration of the geographic data on the Windows NT computer system in the Environmental Resources Section GIS Unit's. Actual installation of the digital data from the CD-ROM onto the computer will be conducted by GIS Unit personnel. However, the Contractor shall have a technical consultant available at each review to assist with any digital data discrepancies. The data will be analyzed for subject content and system compatibility. Review comments to data and text shall be incorporated by the Contractor prior to approval of the final submittal.

f. Ownership: All digital files, final hard-copy products, source data acquired for this project, and related materials, including that furnished by the Government, shall become the property of U.S. Army Corps of Engineers, Wilmington District and will not be issued, distributed, or published by the Contractor.

APPENDIX B

FIELD OBSERVATION REPORTS FROM JUNE AND AUGUST 2006

SUMMARY OF FIELD OBSERVATIONS

Date:	June 2006
Project:	North Topsail Beach Shoreline Protection Project
Location:	North Topsail Beach, North Carolina
Commission Number:	4600.21
Field Representatives:	Erin Hague, Robert Baron, Angela Delaney - Marine Biologists; and Patrick Bardes - Marine Biologist Technician

CPE marine biologists conducted *in situ* investigations in June, August and October 2005 in the near shore (-18 to -25 feet) and offshore (-36 to -44 feet) waters of North Topsail Beach. Field investigations were performed to confirm the delineations of potential and probable hardbottom resources in the project area to collect benthic community data from representative locations.

From June 21 through 24, 2005, CPE marine biologists confirmed the sidescan sonar results of potential and/or probable hardbottom located 1) in the near shore of Onslow Beach, 2) offshore of New River Inlet near a potential sand source location, 3) in the near shore of the north section of North Topsail Beach, and 4) at select sites in the vicinity of the offshore borrow area.

Field investigations conducted from August 3 through 7, 2005 included diver verification of potential and/or probable hardbottom areas located 1) in the New River Inlet Significant Natural Heritage Area, 2) in the central section, including the establishment of four (4) temporary transects (TS5 to TS8) on confirmed hardbottom, 3) along the northwest hardbottom edge between TS10 through TS13, and SNHA 4) at the three USACE sites resulting in only one site (TS9) as diver verified hardbottom. Refer to Figure 1.

The June and August 2005 investigations confirmed near shore hardbottom resources located approximately 350 meters (1,150 feet) from the February-March 2002 mean high water line; and offshore hardbottom areas located 121.9 to 304.9 meters (400 to 1,000 feet) from the proposed borrow area. The hardbottom communities identified by the sidescan sonar results and confirmed by marine biologists in June and August 2005, were quantified in the project GIS to determine the total identified near shore (2,000 feet or less from shore) and offshore (greater than 2,000 feet from shore) hardbottom resources. The near shore hardbottom community totaled 260,537m^2 and the offshore hardbottom totaled 1,652,857m^2. The 'rule of thumb' applied to hardbottom communities without a baseline dataset is to characterize +/-1/10,000th of the area to achieve adequate representation. In using this approach, the optimum sample area is approximately 26m^2 and 165m^2 for the near shore and offshore hardbottom communities, respectively.

Researchers conducted near shore and offshore investigations from October 20 through 23, 2005 to ground-truth and characterize diver verified hardbottom resources identified during the June and August 2005 field investigations. Ten (10) temporary transects (TS5

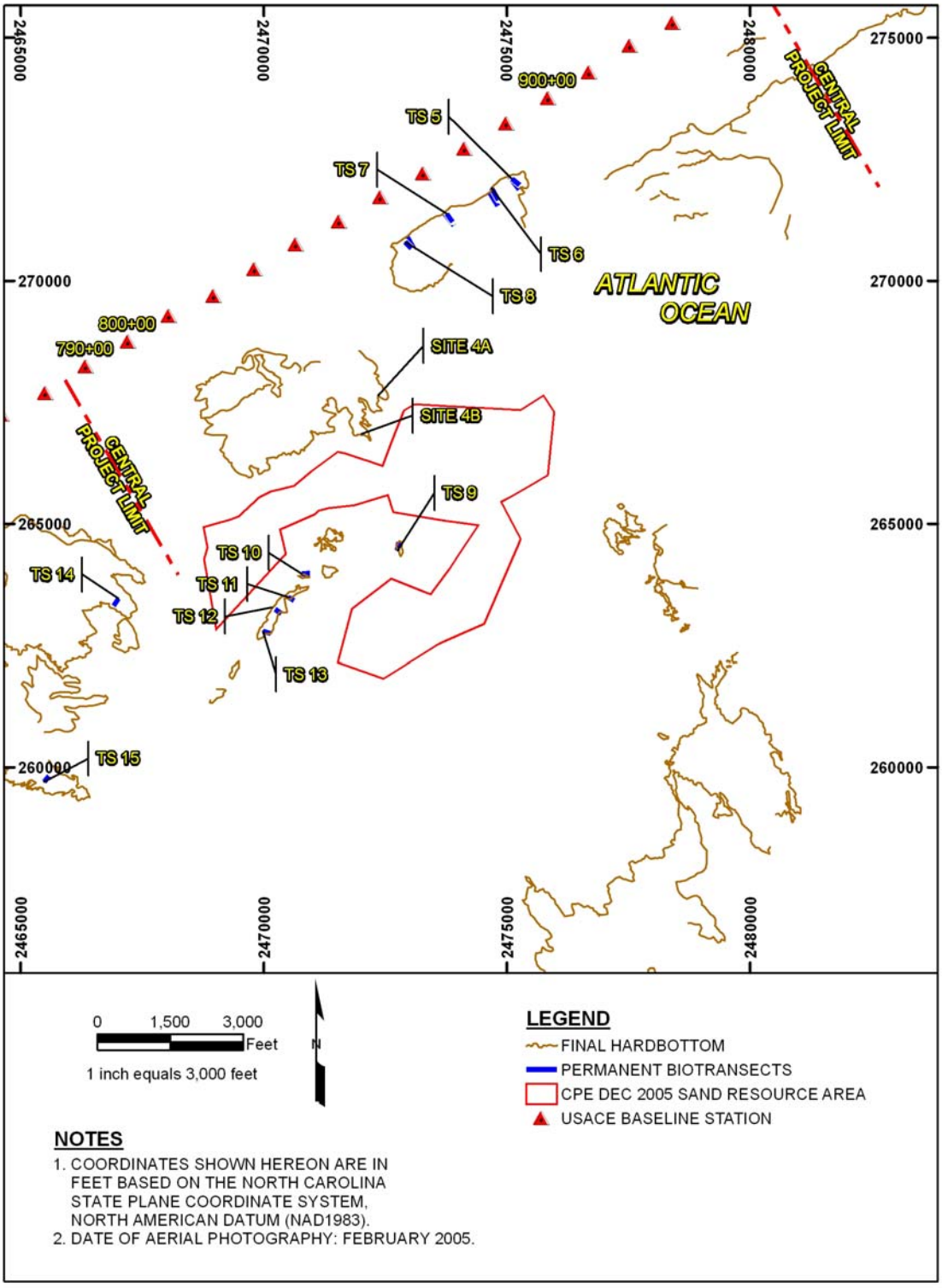


Figure 1

North Topsail Beach
Hardbottom Monitoring Stations

to TS15) were established to characterize the near shore (TS5 to TS8) and the offshore (TS9 to TS15) hardbottom resources. See Figure 1.

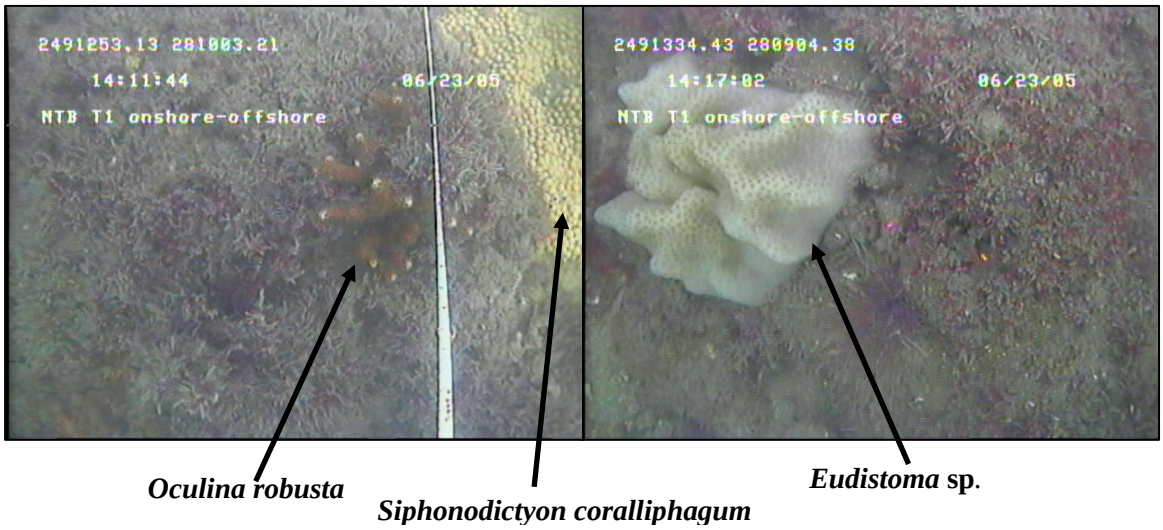
Two methods of habitat characterization and documentation were used during these investigations: 1) the Benthic Ecological Assessment for Marginal Reefs (BEAMR) developed by Coastal Planning & Engineering, Inc., and 2) digital video that may be used to further analyze the hardbottom communities present within each study area. The biological community data collected in October 2005 was input into the project database to be included in a comprehensive pre-construction baseline survey assessment. Refer to the December 2005 Marine Resources Baseline Investigation Plan regarding the BEAMR methodology and video documentation (CPE, 2005).

A summary of findings from the 2005 investigations are provided below.

Near shore Hardbottom Resources

Northern Section

Photos 1 and 2 shown below are representative of the hardbottom features confirmed in the north section (TS1) in June 2005. Heavy sediment and particulate loading observed in the water column during the video collection prevented CPE marine biologists from completing the flora and fauna surveys (visibility ranged from 0 to ≤30cm). The optical capabilities of a video camera far exceeds human visual optics, therefore the images shown below appear to be in relatively clear water. Further investigations of the north section confirmed hardbottom intermittently exposed between USACE baseline stations 1030+00 to 1070+50.



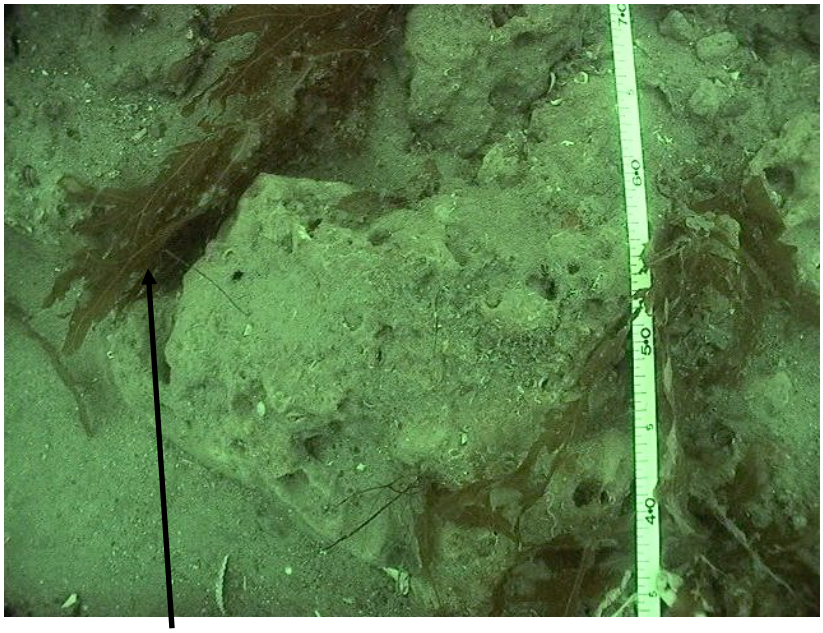
Photos 1 and 2 – Representative biotic coverage at TS1 shown above includes stony coral (*Oculina robusta*), sponge (*Siphonodictyon coralliphagum*) and tunicate (*Eudistoma* sp.).

During the June 2005 investigations at TS1, investigators used a $1m^2$ sample quadrat to collect a representative sample. The measuring tape was laid across the hardbottom feature and was stretched perpendicular to the shoreline for a total of 100 meters, sampling every 10 meters along the transect. Observations of the physical and biological

characteristics of the hardbottom features at TS1 documented the following: minimum and maximum relief recorded 0cm and 60cm, respectively; sediment type is comprised of sand and shell (average sediment depth is 3.2cm); macroalgae cover averaged 4.3% (algal species include *Gelidium*, *Graciliaria*, with *Cryptonemia* and *Dasya* as the dominant types); bare hard substrate averaged 15.4%; stony coral cover (*Oculina robusta*) averaged 1%, ranging in size from $\leq$1 to 7 cm; additional functional groups included bryozoans, annelids, porifera, hydroids and tunicates. Poor visibility (averaging 1 to 4 inches) prevented CPE marine biologists from conducting further detailed benthic characterizations on the near shore hardbottom communities of the north section during August and October 2005 investigations. As a result of these limiting conditions, the near shore sample area was limited to the central section.

Central Section

In the central section, hardbottom is exposed between stations 850+50 to 880+50. Four (4) temporary monitoring transects (TS5 to TS8) were established in August and October 2005 on the confirmed hardbottom area. In October, investigators used a 0.25 square meter ($0.25m^2$) quadrat to sample every 2.5 meters along the 60m temporary transects, for a total sample size of $24m^2$. Similar to the offshore monitoring efforts, the BEAMR methodology was used to collect physical and biological characteristics of the hardbottom features in the central section. Results of these investigations confirmed an average relief of 7.32 cm, with a maximum relief measuring 35 cm. Sediment depth averaged 2.3 cm with a maximum depth measured to 10 cm. Sediment type was dominated by sand and shell, with occasional mud, averaging 36% cover of the total sample area. See Photo 3 showing the irregular topography and Rhodophyte (*Cryptonemia* sp.) observed at TS7. *Cryptonemia* is typically found in low-light habitats, which is supported by the poor visibility observed during the 2005 in-water investigations (Littler and Littler, 2000).



***Cryptonemia* sp.**

Photo 3 – Exposed hardbottom in near shore zone of central section (TS7).

Shell fragments were commonly observed in the limestone substrate, along with a thin veneer of sediment on the limestone. Bryozoans were occasionally observed representing 1% of the sample quadrat in the central section. As opposed to sessile annelids (feather duster worms) which ranged from 0 to 80% cover (ave. 6%) along TS7. Macroalgae cover at stations TS5 through TS8 was documented on 1% of the sample quadrats, dominated by *Cryptonemia* sp. shown above, with occasional *Gracilaria* sp.

The average non-biotic cover (e.g., turf, cyanobacteria, sediment, and bare hard substrate) occurring along the near shore hardbottom sample area is 87.3%. While the average macrobiotic cover is 10.5%.

The fish species observed during the near shore characterization was limited to the black sea bass (*Centropristis striata*). No other fish species were seen during the in-water investigations due to the limited visibility.

A summary of the hardbottom investigations conducted offshore of New River Inlet in June 2005 are not included in this report since the proposed activities for this area are no longer included in the project.

The June 2005 in-water investigations of the nine (9) sites conducted in the near shore of Onslow Beach confirmed coarse sand, fine silt and wooden debris.

Offshore Hardbottom Resources

In June 2005, CPE marine biologists investigated eight (8) probable hardbottom areas (formerly NTB BA Sites 1 through 8) within 300 meters of the proposed borrow area. All eight sites were confirmed hardbottom of varying relief and benthic community coverage. In August 2005, three (3) additional sites (USACE Sites 1 through 3) were investigated for the presence or absence of hardbottom habitats. Only USACE Site 3 was confirmed as hardbottom by CPE marine biologists; while USACE Sites 1 and 2 were confirmed as shell hash. These sites were documented by visual observations of the benthic communities, video documentation and mapping using DGPS positioning and HYPACK®MAX software. A summary of in-water observations conducted at USACE Sites 1 and 2 are not provided in this report.

Due to their proximity to the borrow area, the rock/sand interface at TS10 through TS13 were mapped in August 2005 to delineate the extent of hardbottom communities near the borrow area. The offshore hardbottom located near TS 11 through TS 13 measured 1 to 4 feet in height.

Hardbottom characterizations of the offshore communities were conducted in October 2005, which included the establishment of seven (7) 50 m temporary transects at TS9 through TS15 (formerly USACE 3, BA 1 and 2, 7 and 8). In June 2005, CPE marine biologists confirmed hardbottom at Sites 4A and 4B. However, in October 2005, the hardbottom at these sites was found covered with greater than 60 cm of mud. Therefore a temporary transect was not established at this location.

Transects were established at the sand/rock interface and extended in a southerly direction, away from the borrow area. The distance from the proposed borrow area to

TS15 is approximately 4,400 feet. Project dredging affects are not anticipated due to the distance from the sand resource area, therefore this site will be reported as the control transect (see Figure 1).

Sample stations were established every 2.5 m along the temporary transects using a $1m^2$ sample quadrat for a total representative sample size of $140m^2$. The BEAMR surveying method was conducted at each of these offshore sites to identify benthic community coverage and diversity, as well as sediment depth and cover.

The average macrobiotic cover per sample quadrat is 5.4% along the offshore transects. Sessile benthos observed along the hardbottom is dominated by macroalgae, octocorals, encrusting red algae, sessile worms and stony corals (presented in decreasing order). The dominant macroalgae observed along the offshore transects is the red algae *Cryptonemia*. The octocoral *Leptogorgia virgulata* averages the greatest percent cover along the offshore transects. This octocoral is one of the most common types found in the South Atlantic Bight, ranging from Chesapeake Bay to Georgia, to the western coasts of Florida and Brazil (SERTC, 2006). *Titanideum frauenfeldii* occurs less frequently on the offshore hardbottom. This octocoral commonly occurs on rock and sand mixed substrates located in current-swept environments (NOAA, 2006). The stony coral *Oculina robusta* is present along most offshore transects as recruits ($\leq$3cm). This shallow water form of *Oculina* has a temperature range of 52 to 93 ^{o}F and is abundant off the west coast of Florida (Reef, 2006; Humann, 2002). Results from aquarium observations conducted by the Reef Ball Foundation, Inc. indicated that *O. robusta* is "very hardy" and has a high silt tolerance (Reef, 2006). Refer to Photo 4.

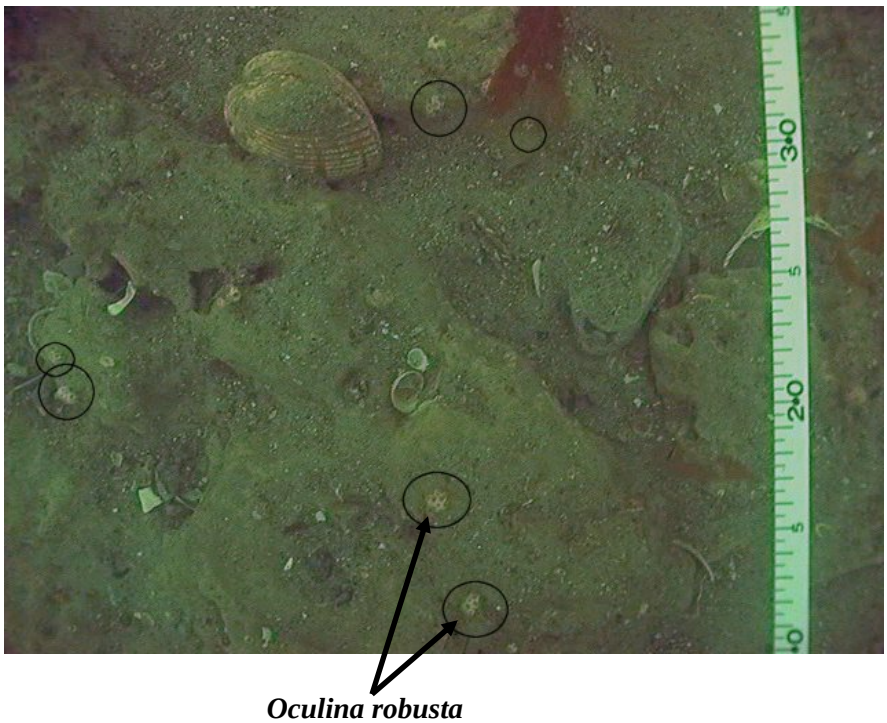


Photo 4 – *Oculina robusta* stony coral recruits observed at TS9 during the October 2005 in-water investigations.

The average non-biotic cover (e.g., turf, cyanobacteria, sediment, and bare hard substrate) occurring along the offshore hardbottom, as observed along the representative monitoring transects, is 94.2%. The maximum height measured within the offshore sample quadrats is 35 cm (average 4 cm). The average sediment cover per sample quadrat is 83.5% with a maximum depth measured at 30 cm (average depth 9 cm). Visual observations of the surface sediment indicated that it is primarily composed of sand and shell fragments.

New River Inlet Outcrop- Significant Natural Heritage Area (SNHA)

In August 2005, CPE marine biologists investigated four (4) probable hardbottom areas identified from the side scan sonar results and located in the New River Inlet Outcrop SNHA. The four areas are identified in the project GIS as SNHA 1, 2, 4 and 4A. All four probable hardbottom areas are located in the western region of the SNHA. Both SNHA 1 and 2 are low relief ($\leq$ 30 cm) hardbottom features with 3 to 4 cm of sediment covering the rock. Tunicates, sponges, encrusting red algae and the stony coral *Oculina robusta* were common at both sites. The *O. robusta* corals ranged in size from 2 to 5 cm at SNHA 2. No attached macroalgae was observed at SNHA 1. At SNHA 2, the chlorophytes *Caulerpa* and *Codium* were present, as well as the phaeophytes *Dictyota*, *Lobophora* and *Sargassum*.

Investigation areas SNHA 4 and 4A are located in proximity to one another near the northwest corner of the New River Inlet Outcrop SNHA. SNHA 4 is a ridge and trough feature that was observed with a thin veneer of sand and silt. The maximum relief measured at this site was 45 cm. CPE marine biologists observed a 2.1 meter stepping ledge with a maximum base depth of 32 feet and a minimum platform depth of 25 feet. In addition to the organisms observed at SNHA 1 and 2; hydroids, red cyanobacteria mats, the rhodophyte *Gracilaria* and the red coralline algae *Amphiroa* were also observed. *O. robusta* colonies observed at SNHA 4A were measured between 2 and 3 cm, with an occasional 5 cm colony.

The following table lists the finfish observed near the offshore hardbottom stations during the August 2005 investigations.

Common Name	Scientific Name
GRUNTS	**HAEMULIDAE**
White Grunts	*Haemulon plumierii*
Tomtate	*Haemulon aurolineatum*
pigfish	*Orthopristis chrysoptera*
Unidentified juvenile grunts	*Haemulon* sp.
PORGIES	**SPARIDAE**
Spottail Pinfish	*Diplodus holbrooki*
Pinfish	*Lagodon rhomboides*
Longspine Porgy	*Stenotomus caprinus*
Sheepshead	*Archosargus probatocephalus*
Scup	*Steotomus chrysops*
DRUMS	**SCIAENIDAE**
Highhat	*Pareques acuminatus*
GOATFISH	**MULLIDAE**
Dwarf Goatfish	*Upeneus parvus*
COMBTOOTH BLENNIES	**BLENNIIDAE**
Seaweed Blenny	*Parablennius marmoreus*
MACKERELS	**SCOMBRIDAE**
Spanish Mackerel	*Scomberomorus maculatus*
PUFFERFISH	**TETRAODONTIDAE**
Bandtail Puffer	*Sphoeroides spengleri*
Sharpenose Puffer	*Canthigaster rostrata*
SEABASSES AND GROUPERS	**SERRANIDAE**
Black Sea Bass	*Centropristis striata*
Pygmy Sea Bass	*Seranniculus pumilio*
Belted Sandfish	*Serranus subligarius*
JACKS	**CARANGIDAE**
Bar Jack	*Caranx ruber*
Mackerel Scad	*Decapterus macarellus*
Unidentified Scad	*Selar/Decapterus* sp.
SPADEFISH AND SILVERSIDES	**EPHIPPIDAE**
Atlantic Spadefish	*Chaetodipterus faber*
TOADFISH AND SCORPIONFISH	**BATRACHOIDIDAE**
Leopard Toadfish	Opsanus pardus
WRASSES	**LABRIDAE**
Slippery Dick	*Halichoeres bivittatus*
FLOUNDER	**PARALICHTHYIDAE**
Summer Flounder	Paralichthyus dentatus
LIZARDFISH	**SYNODONTIDAE**
Sand Diver	*Synodus intermedius*
REMORA	**ECHENEIDAE**
Whitefin Sharksucker	*Echeneis neucratoides*

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FIELD OBSERVATION REPORT

DATE:	August 29-30, 2006
PROJECT:	North Topsail Beach Shoreline Protection Project
COMMISSION NUMBER:	4600.55/5
LOCATION:	North Topsail Beach, North Carolina
FIELD REPRESENTATIVES:	E. Hague (Senior Marine Scientist), M. Lybolt (Senior Marine Biologist), C. Barrett (Marine Biologist), J. Craft (Marine Biologist), K. Willson (Coastal Geologist), A. Spencer (Marine Technician)

Introduction

In June 2006, the Southern Section (USACE baseline stations 580+00 to 781+00) was added to the North Topsail Beach Shoreline Protection project. Investigations were therefore needed to determine if hardbottom resources are located in the nearshore (152 to 457 m)of the South Section or near the extended offshore borrow area approximately 767 m from the 2002 mean high water line at USACE baseline stations 850+00 to 890+00.

Sidescan sonar surveys were first conducted in August 2006 by Coastal Planning & Engineering, Inc. (CPE) geologists to determine if potential and probable hardbottom resources exist in the extended project area. Following the survey data reduction, CPE marine biologists and geologists conducted underwater (SCUBA) reconnaissance surveys to confirm the presence or absence of these resources. In addition to confirming hardbottom resources, goals of these investigations included: 1) establish two additional temporary monitoring transects (TS 16 and TS 17) near the offshore borrow area, as requested by the NCDCM; 2) collect baseline turbidity samples in the nearshore and offshore water column; and 3) collect relief measurements monitoring stations TS 11 and TS 12; and 4) determine the feasibility of placing hardbottom monitoring stations in the nearshore of the Southern Section.

Mobilization

Two field boats (Scuba Tech – *M/V Tsunami* and *M/V Seahawk*) were mobilized at 0700 hours on August 29th. The CPE crews arrived at the first investigation sites at approximately 0900 hours. Air temperature during the survey was approximately 83°F (28°C). Sea state conditions were 0.6 to 0.9 m at 0900 hours and increased to 1.2 to 1.8 m at 1400 hours. Winds ranged from 10 to 15 mph and a north current of $\leq$0.5 knots was observed. The two boats with CPE crew returned to the dock at 1600 hours.

On August 30th, one field boat (*M/V Tusnami*) was mobilized by the CPE crew with a captain from Scuba Tech. The crew left the fuel dock at 0730 hours and arrived at the first site at 0825 hours. Air temperature during the survey was approximately 83°F (28°C). Sea state conditions were 0.6 to 0.9 m seas at 0900 hours and increased to 1.2 to 1.8 m at 1430 hours. Winds ranged from 10 to 25 mph with a slight north current. The CPE crew returned to the dock at 1700 hours.

Methods

The divers descended on a buoy deployed near the center of each potential and/or probable hardbottom area, and proceeded to conduct an exploratory search around the buoy for significant benthic resources. If none were found in the vicinity of the buoy, divers would then swim a compass bearing through the longest axis of the potential habitat. If an isolated resource or point of interest was observed, divers would record the location by pulling the dive flag below the surface of the water several times, signaling the boat crew to record the position using a Trimble AgDGPS Global Positioning System (GPS) with Pro Beacon. The buoy was on the shortest possible tether, such that the buoy was positioned directly over the sampling location. The positioning data were recorded and stored in the HYPACK 6.2a software program, a multi-functional navigation and hydrographic surveying program. Transitions in sediment were also recorded (*e.g.*, mud to sand, shellhash).

Benthic characterization along the temporary transects (confirmed hardbottom habitat) included the BEAMR methodology supported by videographic documentation.

Results

Investigations conducted offshore of USACE baseline station 850+00 (seaward of TS 5 to TS 8) confirmed mud, sand and shellhash. No hardbottom resources were found in this area. Refer to Figure 1.

Temporary transects were established offshore of USACE baseline station 800+00, identified as TS 16 and TS 17. BEAMR data was collected at these sites by a qualified marine biologist to characterize the benthic community. Underwater video was also collected along the transect line. Sample data was recorded every 2.5 m along the 50 m transect. Species observed were similar to those recorded at the offshore transects, with the exception of the octocorals *Titanidium* sp. and *Carijoa* sp.

At TS 11 and TS 12, relief measurements were collected landward side of the exposed hardbottom formation to determine if these features qualified as "high relief" under the North Carolina definition. The North Carolina code NCAC 07H. 0208(b)(12)(A)(iv)) states "*Mining activities shall not be conducted on or within 500 meters of significant biological communities, such as high relief hardbottom areas. High relief is defined for this standard as relief greater than or equal to one-half meter per five meters of horizontal distance*." Vertical relief was measured for five meters in either direct (northeast and southwest) from the start of the transect. The results determined that the average relief along TS 11 is 0.16 m; while average relief along TS 12 ranges from 0.40 to 0.45 m. Relief measurements collected at the time of these investigations determined that these resources do not qualify as high relief under the State definition. BEAMR data and video was also collected at TS 11 and TS 12.

Underwater investigations conducted in the nearshore of the Southern Section confirmed to areas of hardbottom resources (near USACE baseline station 670+00 and between 725+00 and 750+00). CPE marine biologists attempted to establish temporary transects (TS 18 and TS 19) between 725+00 and 750+00, however poor visibility prevented divers from collecting data. These sites will be included in future investigations. Refer to Figure 2.

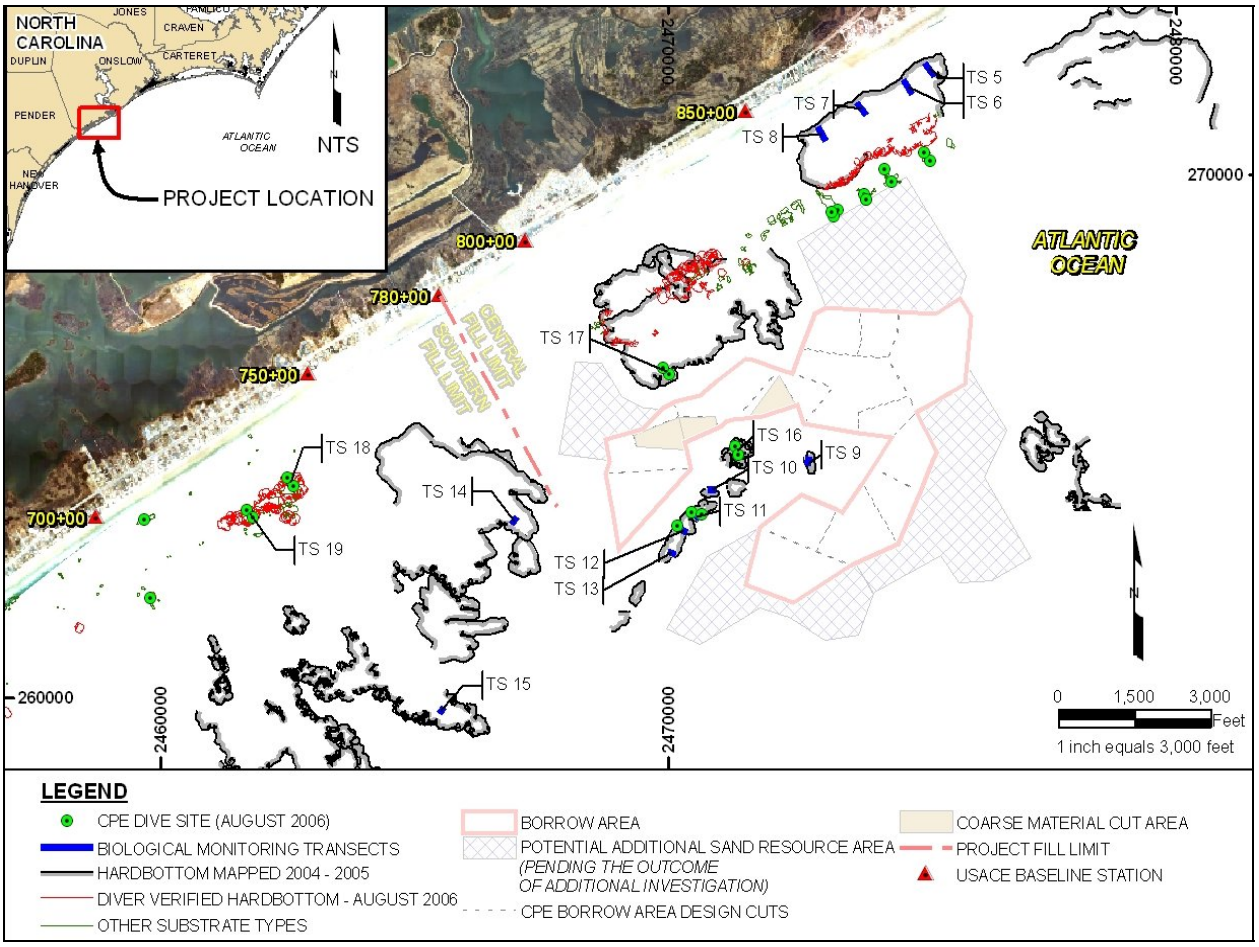


Figure 1. Underwater investigation sites of potential and probable hardbottom resources. August 2006 dive locations shown as green targets.

Water quality data was also collected at four sites in the nearshore and offshore during the August 2006 investigations. Turbidity levels were measured using a LaMotte 2020 turbidimeter. In the nearshore (USACE baseline stations 590+00 and 595+00), turbidity levels were measured at 35.2 and 9.67 Nephelometric Turbidity Units (NTU). Samples were collected at depth, approximately 2 m above the seafloor.

Turbidity samples collected in the offshore, at depth, include TS 12 (4.5 NTU), TS 16 (0.50 and 0.76 NTU) and TS 19 (-17.6, 22.5 and 23.0 NTU). Surface samples were also collected at TS 17 which averaged 0.43 NTU. The results of the turbidity sampling confirmed the poor visibility observed during the underwater investigations.

Additionally, the hardbottom edge digitized from the 2005 and 2006 sidescan sonar surveys at TS 18 and TS 19 indicated a change in exposed hardbottom from 5.25 acres in 2005 to 8.27 acres in 2006. The three acre change in exposed hardbottom confirms the ephemeral nature of this resource.

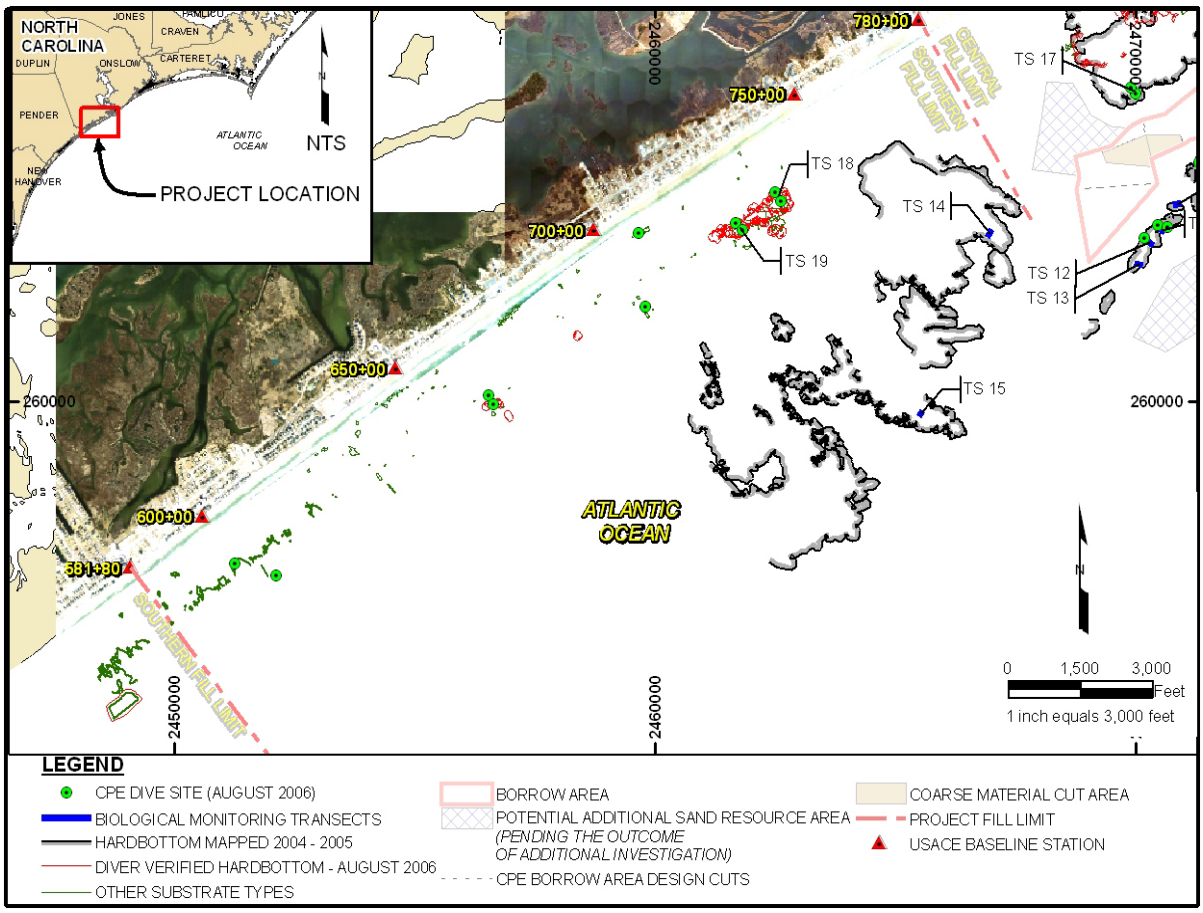


Figure 2. Underwater investigations in the nearshore of the Southern Section confirmed two hardbottom areas (near USACE baseline station 670+00 and between 725+00 and 750+00).

P:\North Carolina\North Topsail Beach\4600.08-35 Environmental\Hardbottom Investigations

APPENDIX C

PRE-DIVE SIDESCAN PRESENTATION
(DELIVERED TO USACE MARCH 6, 2008)

Surf City / North Topsail Beach, N.C. Shore Protection Project Hardbottom Resource Confirmation and Characterization Study

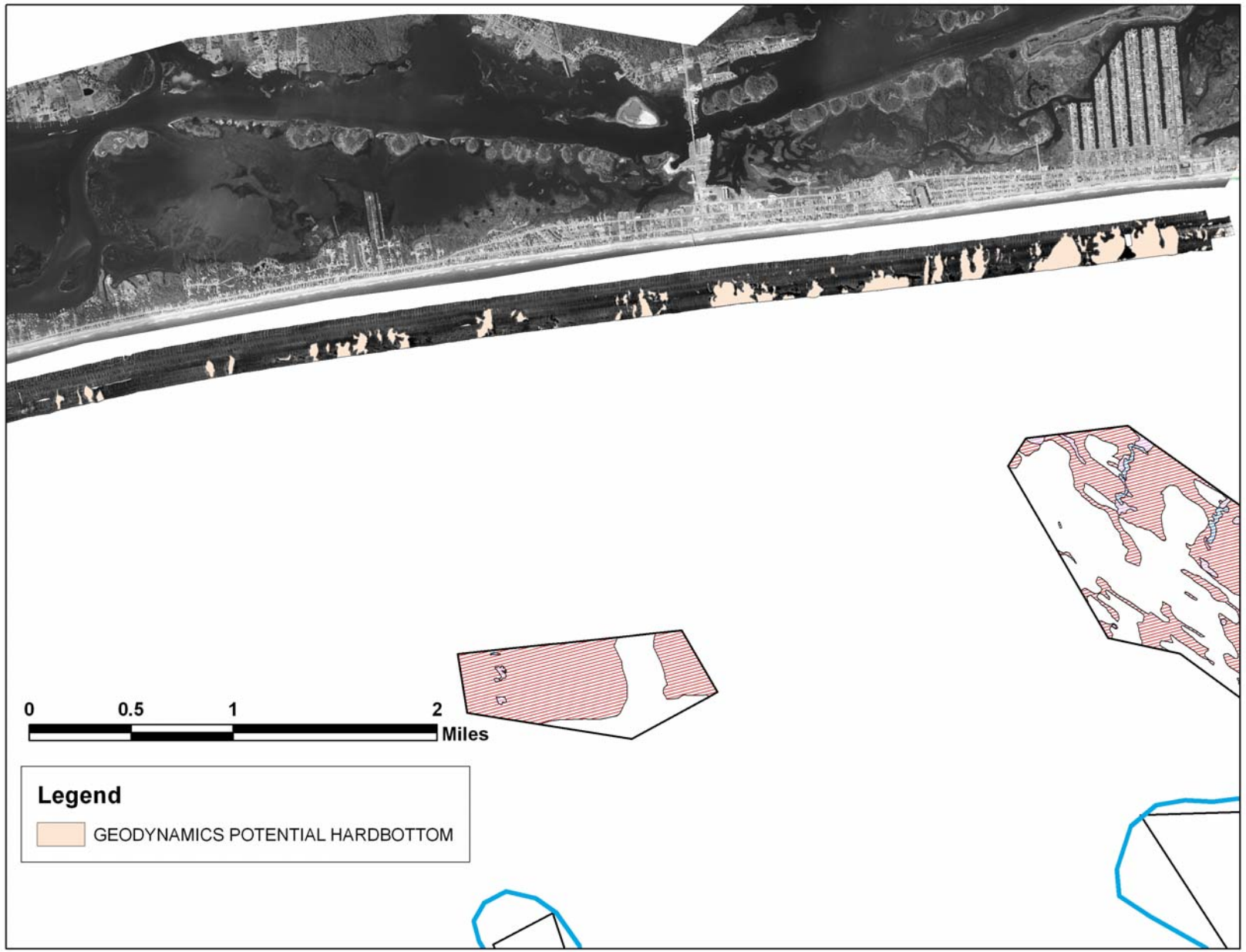
SIDESCAN SONAR REVIEW

Ken Willson (CPE)

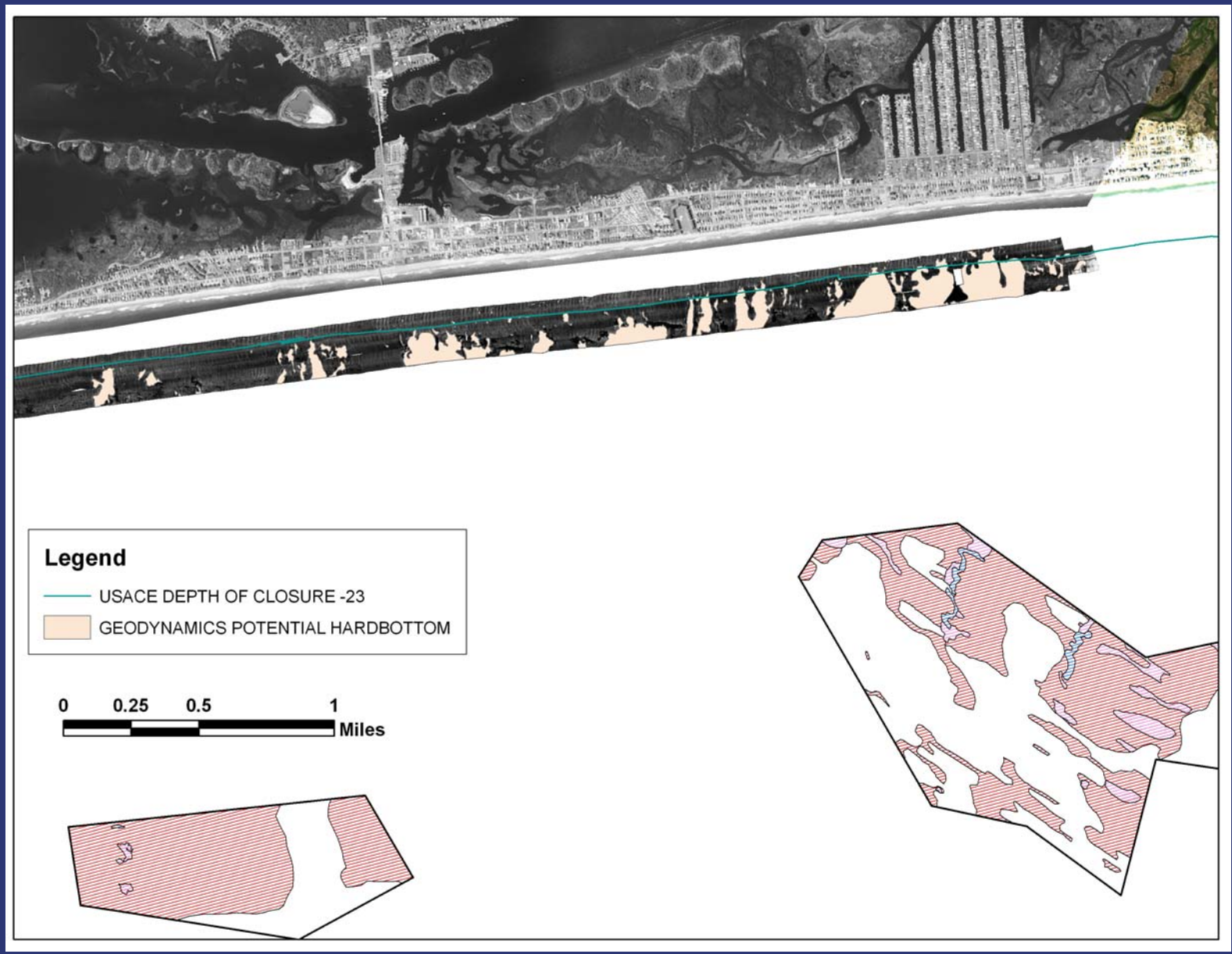
ANAMAR Environmental Consulting, Inc.

COASTAL PLANNING & ENGINEERING CPE

Nearshore Sidescan



Nearshore Depth of Closure



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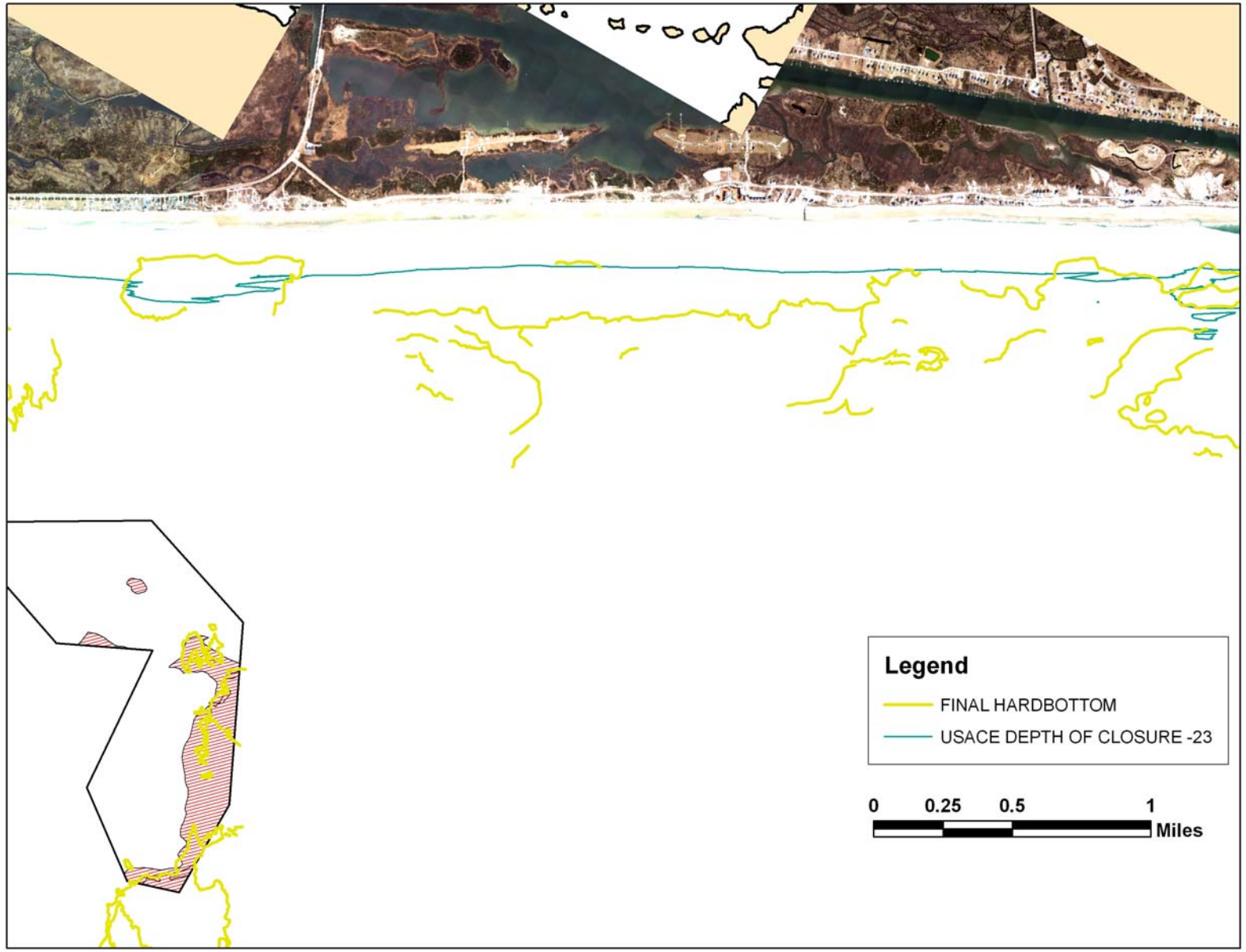
CPE Coastal Planning & Engineering

Nearshore Depth of Closure



ANAMAR Environmental Consulting, Inc.

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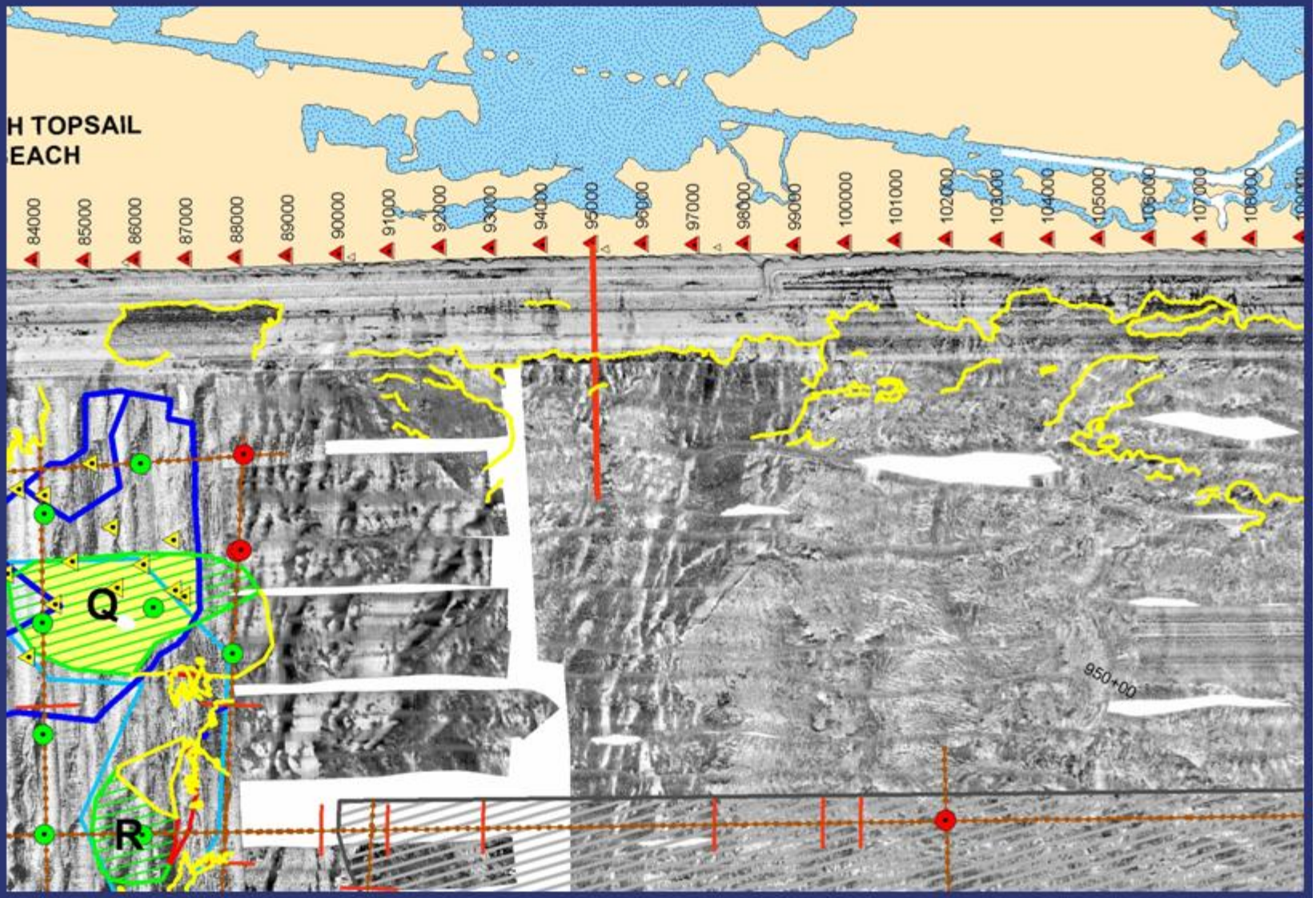
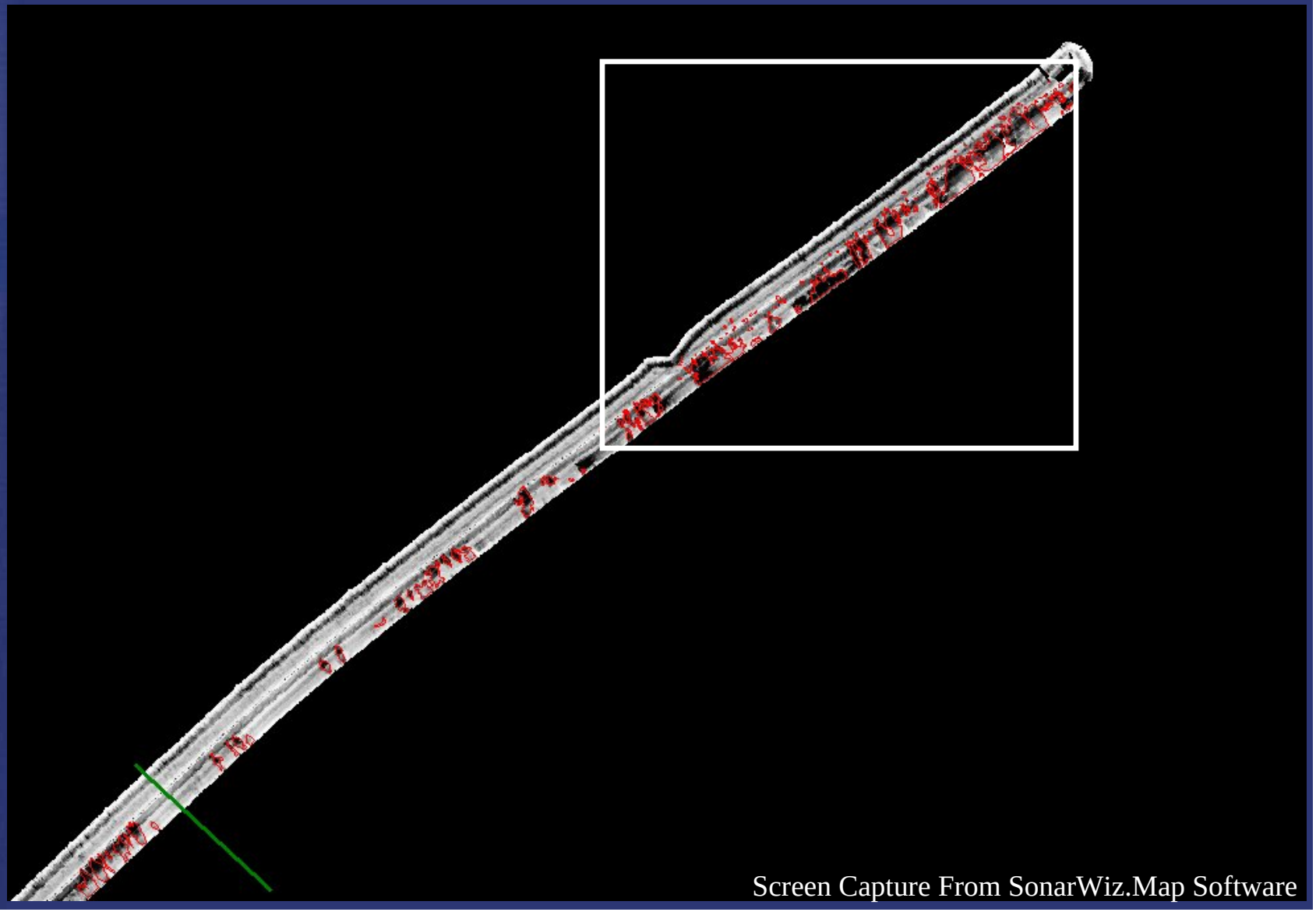
Comparison of Coverage



ANAMAR
Environmental Consulting, Inc.

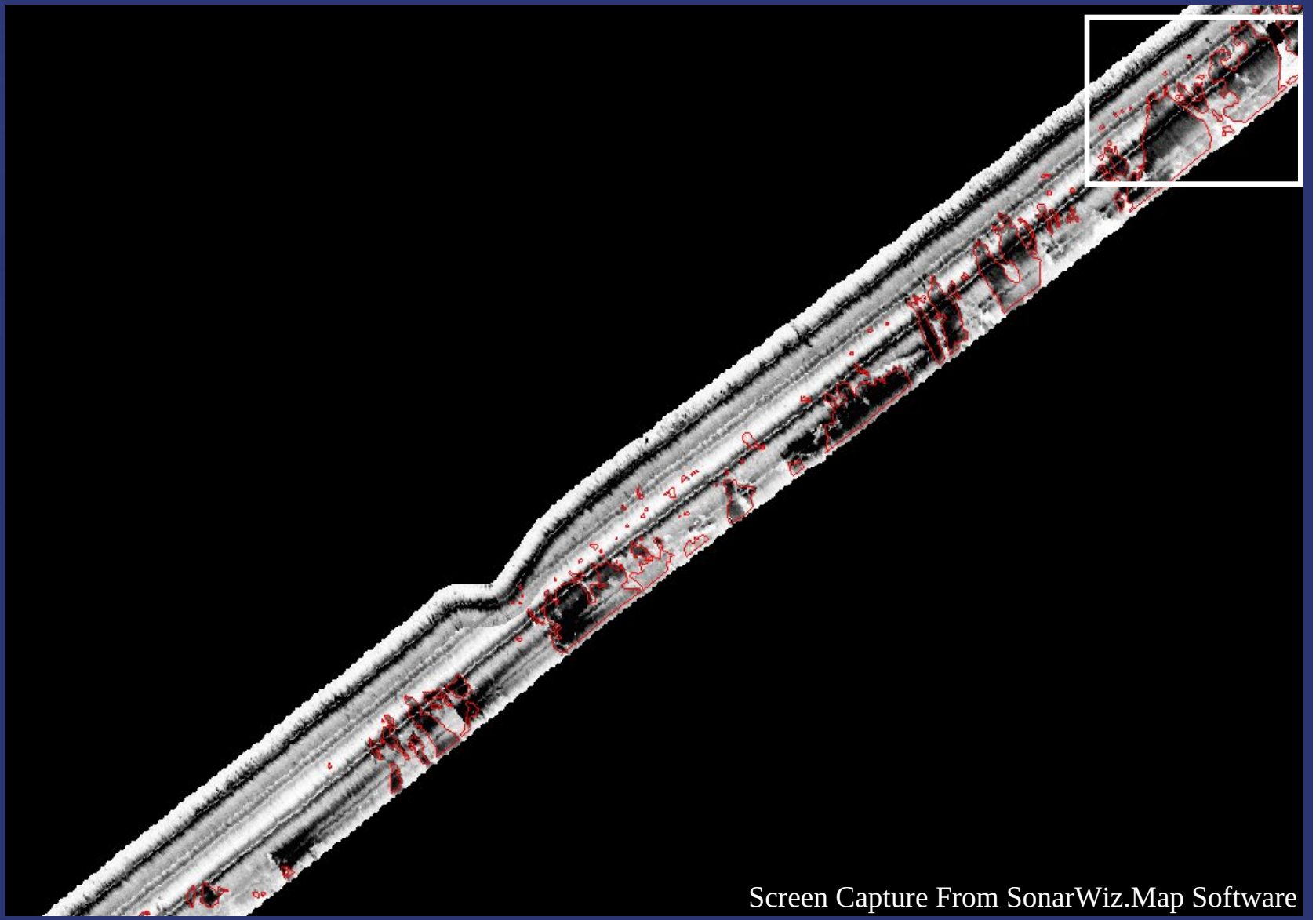
CPE
COASTAL PLANNING & ENGINEERING

Nearshore Sidescan



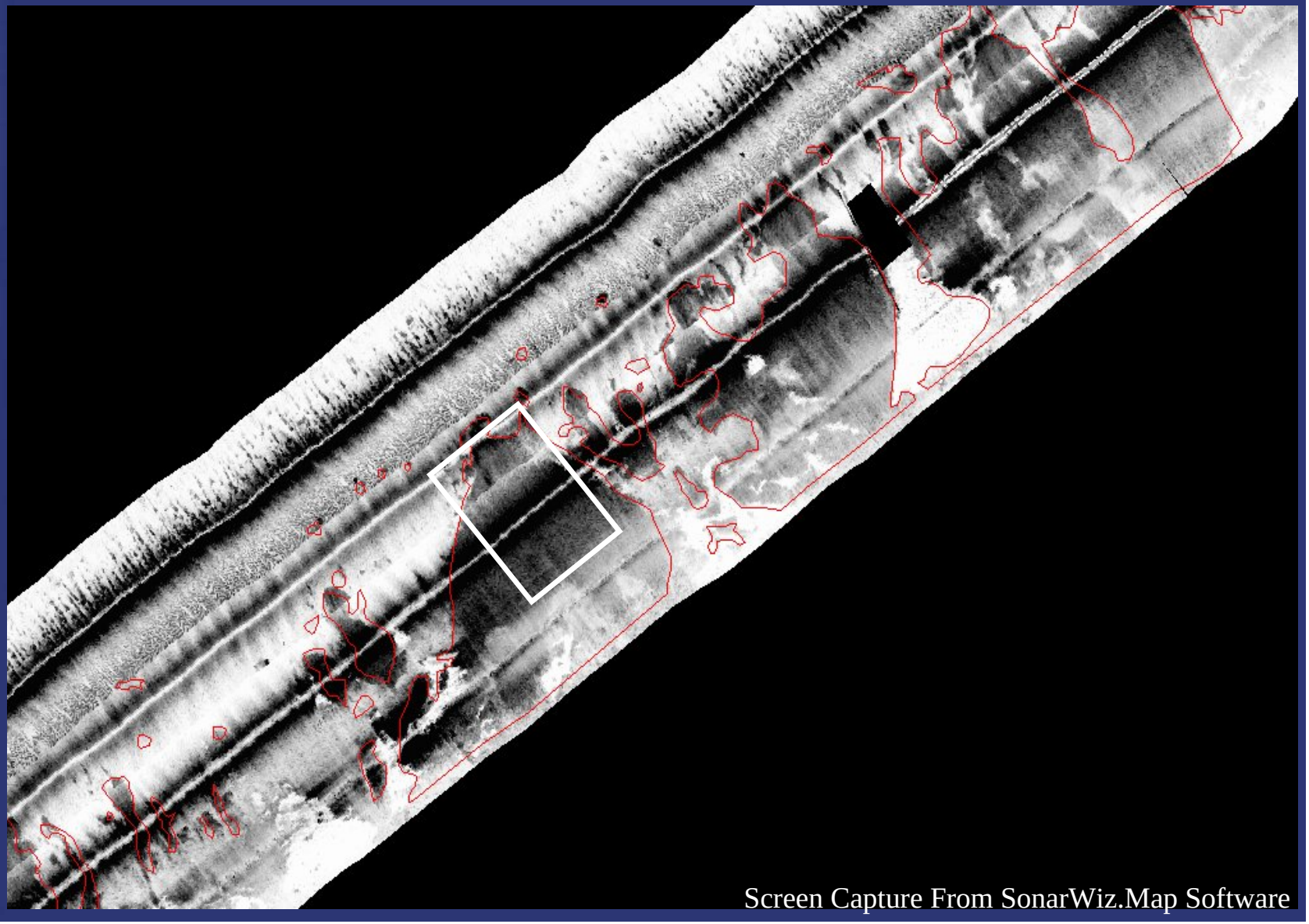
Screen Capture From SonarWiz.Map Software

Nearshore Sidescan



Screen Capture From SonarWiz.Map Software

Nearshore Sidescan (Rippled Areas)

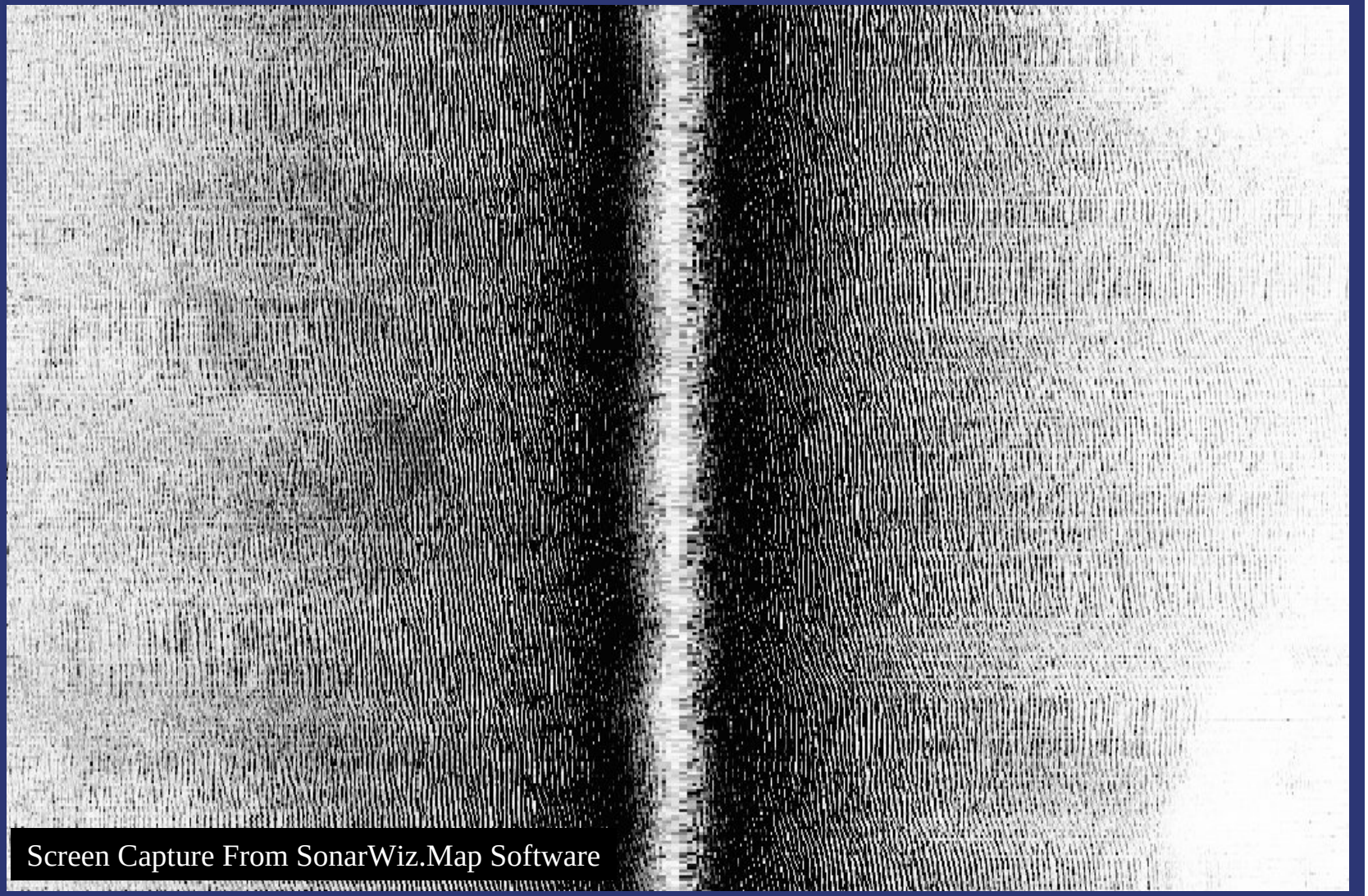


Screen Capture From SonarWiz.Map Software

ANAMAR Environmental Consulting, Inc.

CPE Coastal Planning & Engineering

Nearshore Sidescan (Rippled Areas) Waterfall Image

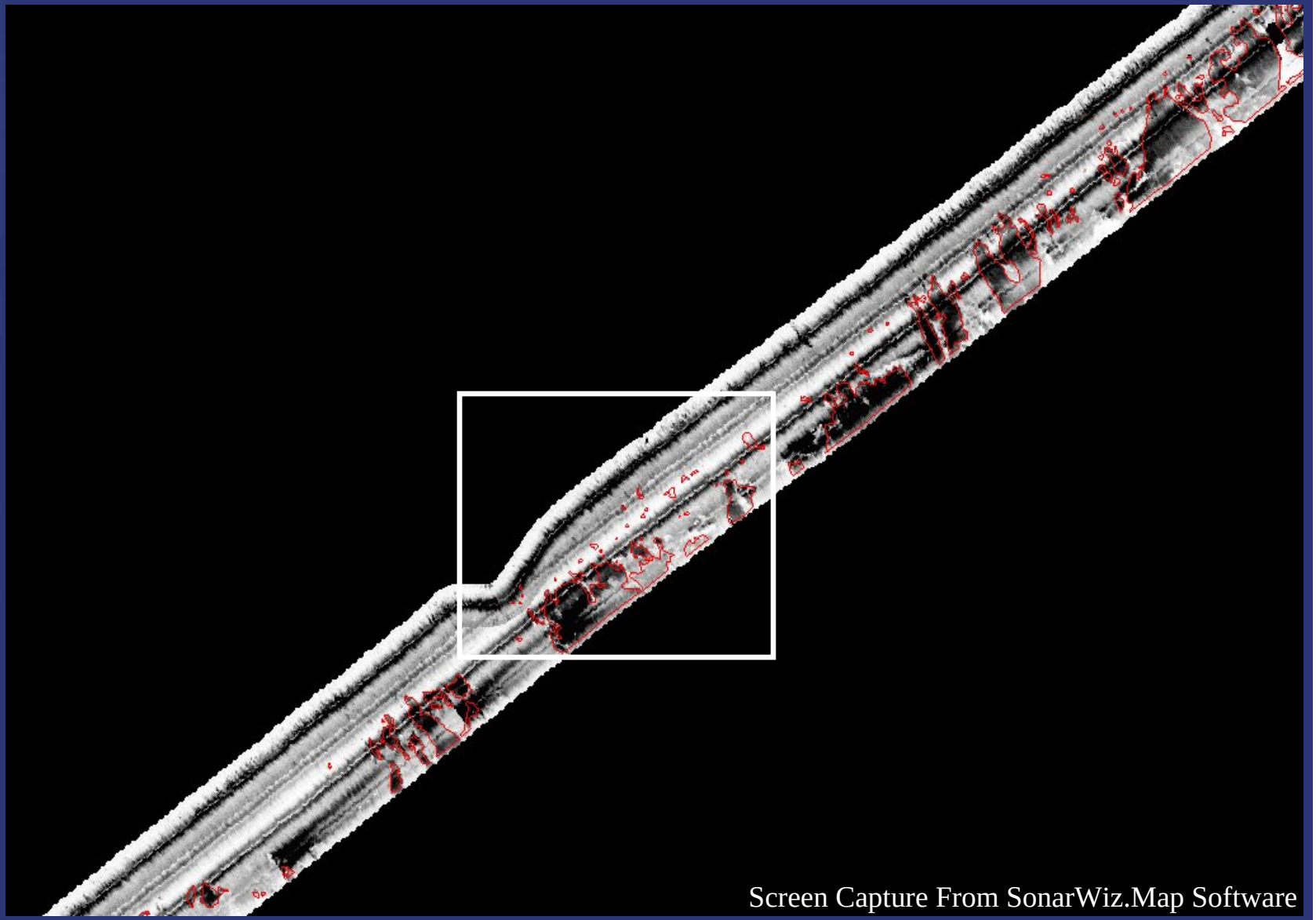


Screen Capture From SonarWiz.Map Software

ANAMAR Environmental Consulting, Inc.

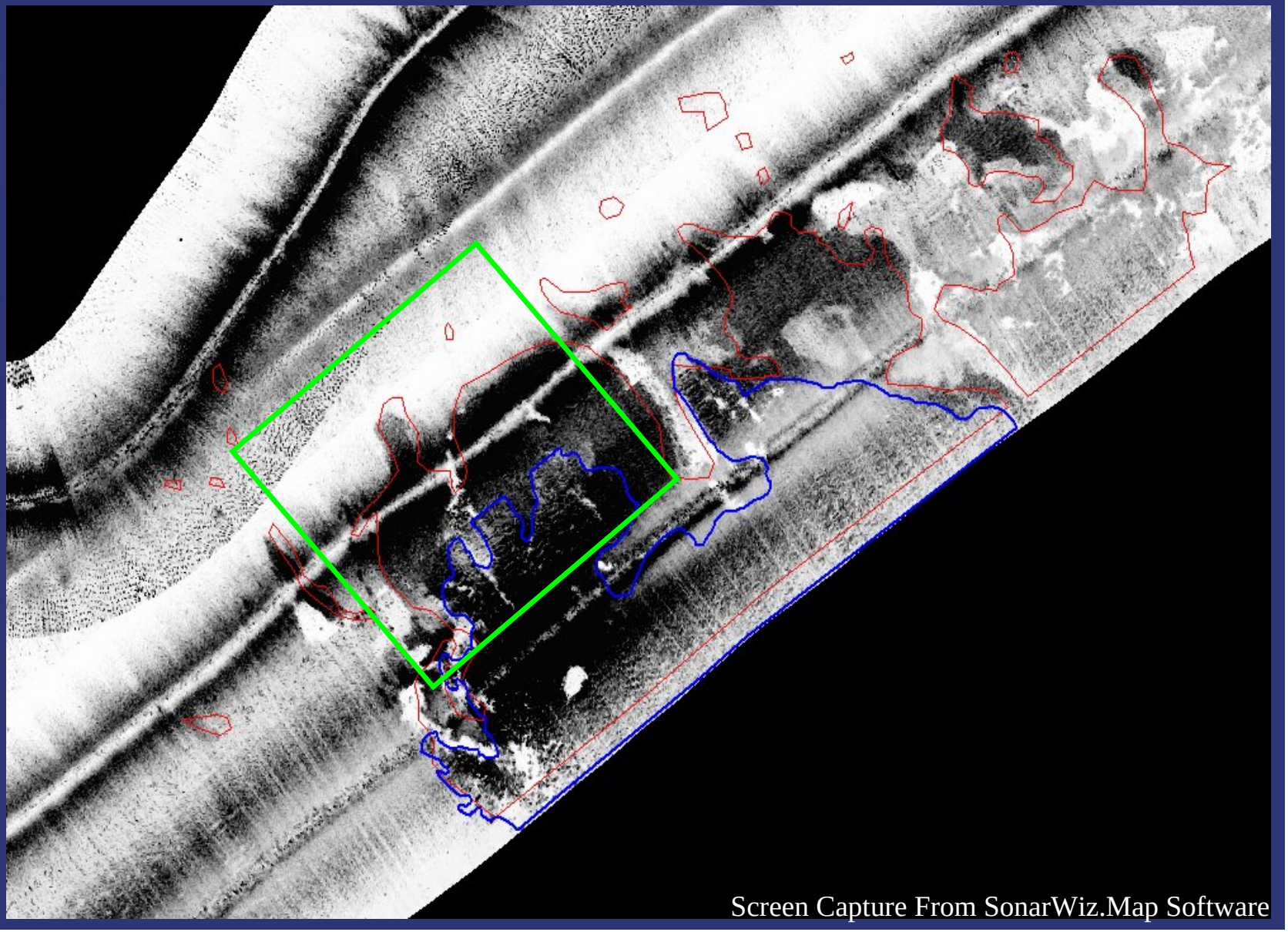
CPE Coastal Planning & Engineering

Nearshore Sidescan



Screen Capture From SonarWiz.Map Software

Nearshore Sidescan (Mixed Areas)

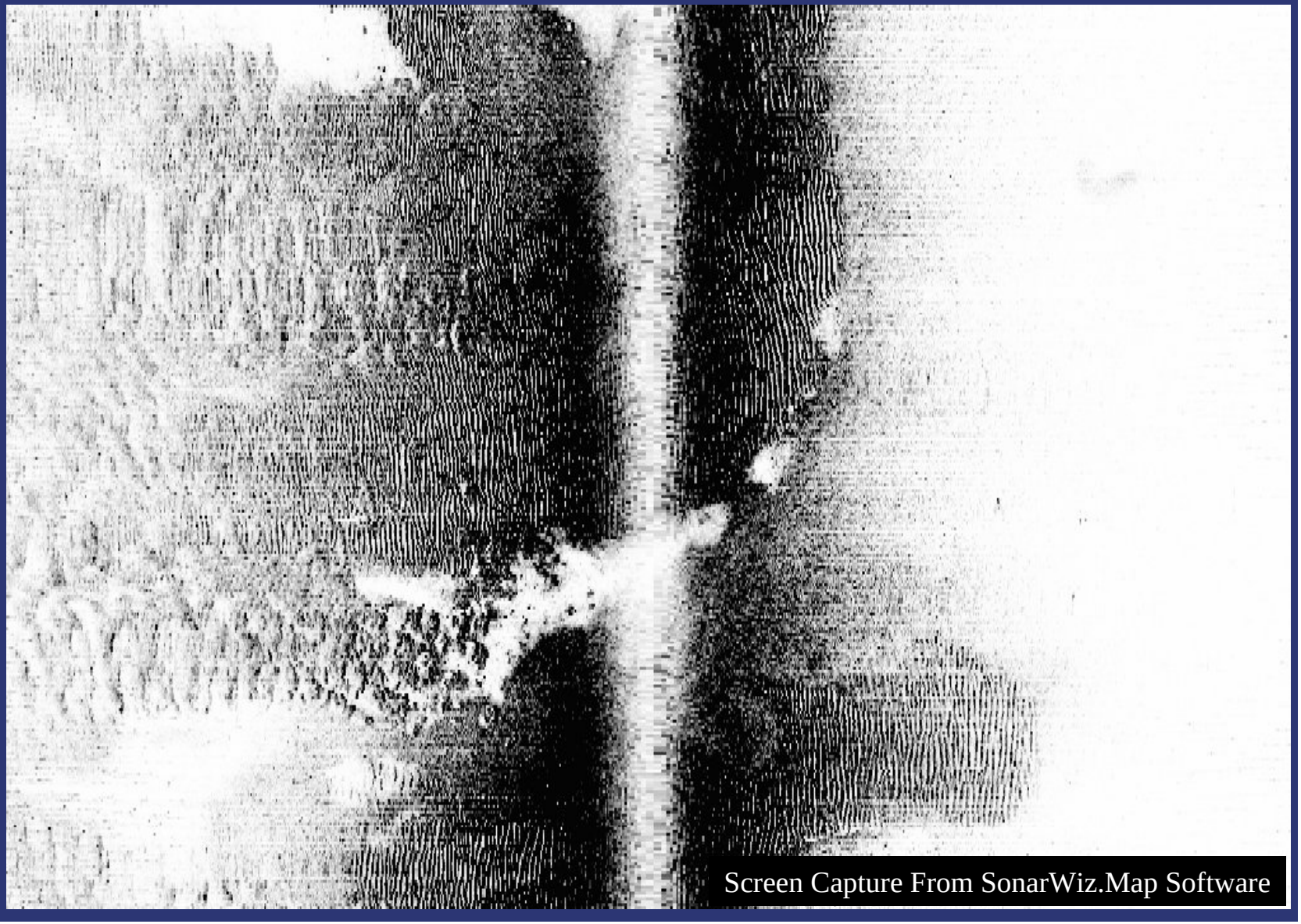


Screen Capture From SonarWiz.Map Software

ANAMAR Environmental Consulting, Inc.

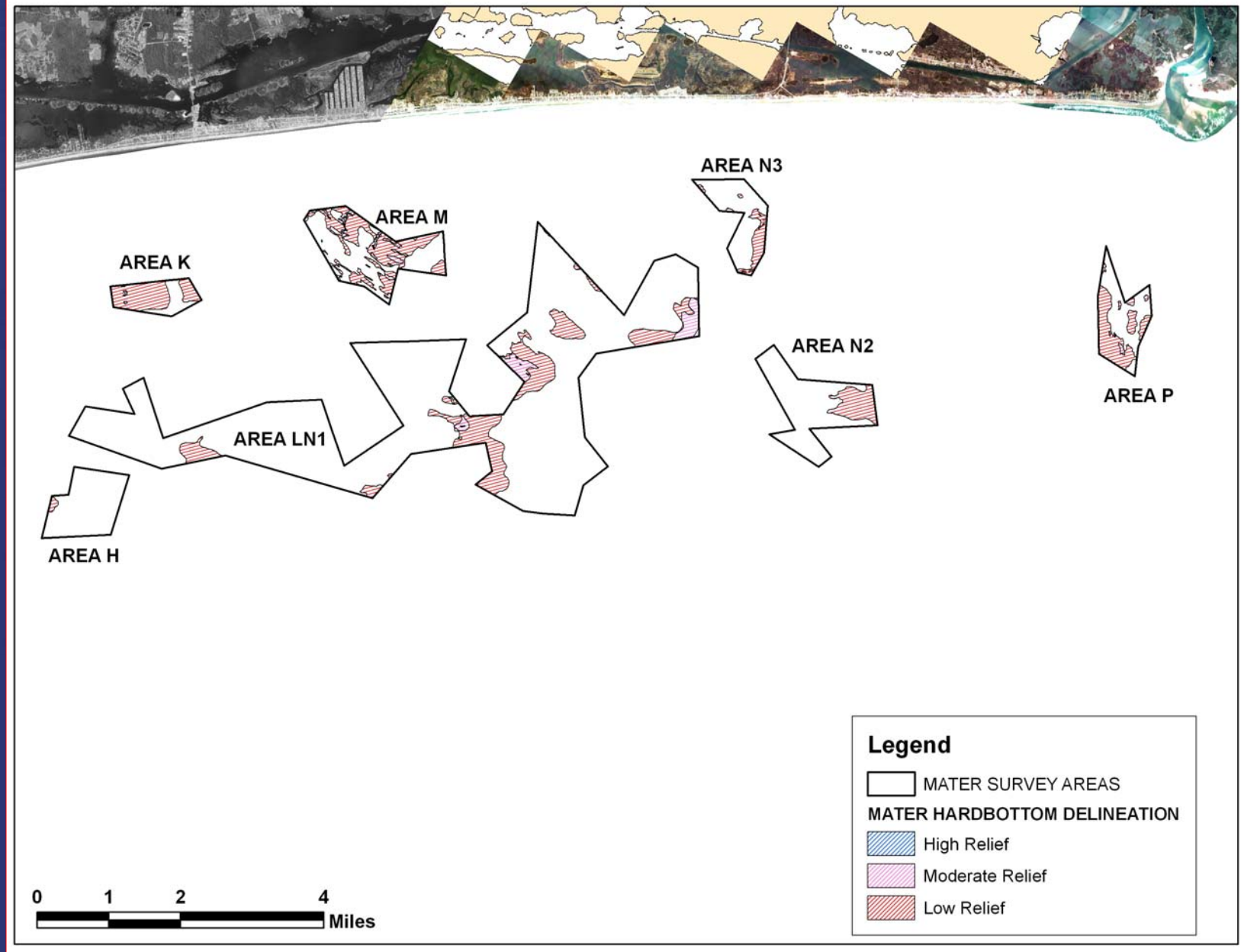
CPE Coastal Planning & Engineering

Nearshore Sidescan (Mixed Areas) Waterfall Image



Screen Capture From SonarWiz.Map Software

Preliminary Sand Areas Surveyed By MATER



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Modified Areas Identified by USACE To Be Investigated

ANAMAR Environmental Consulting, Inc.

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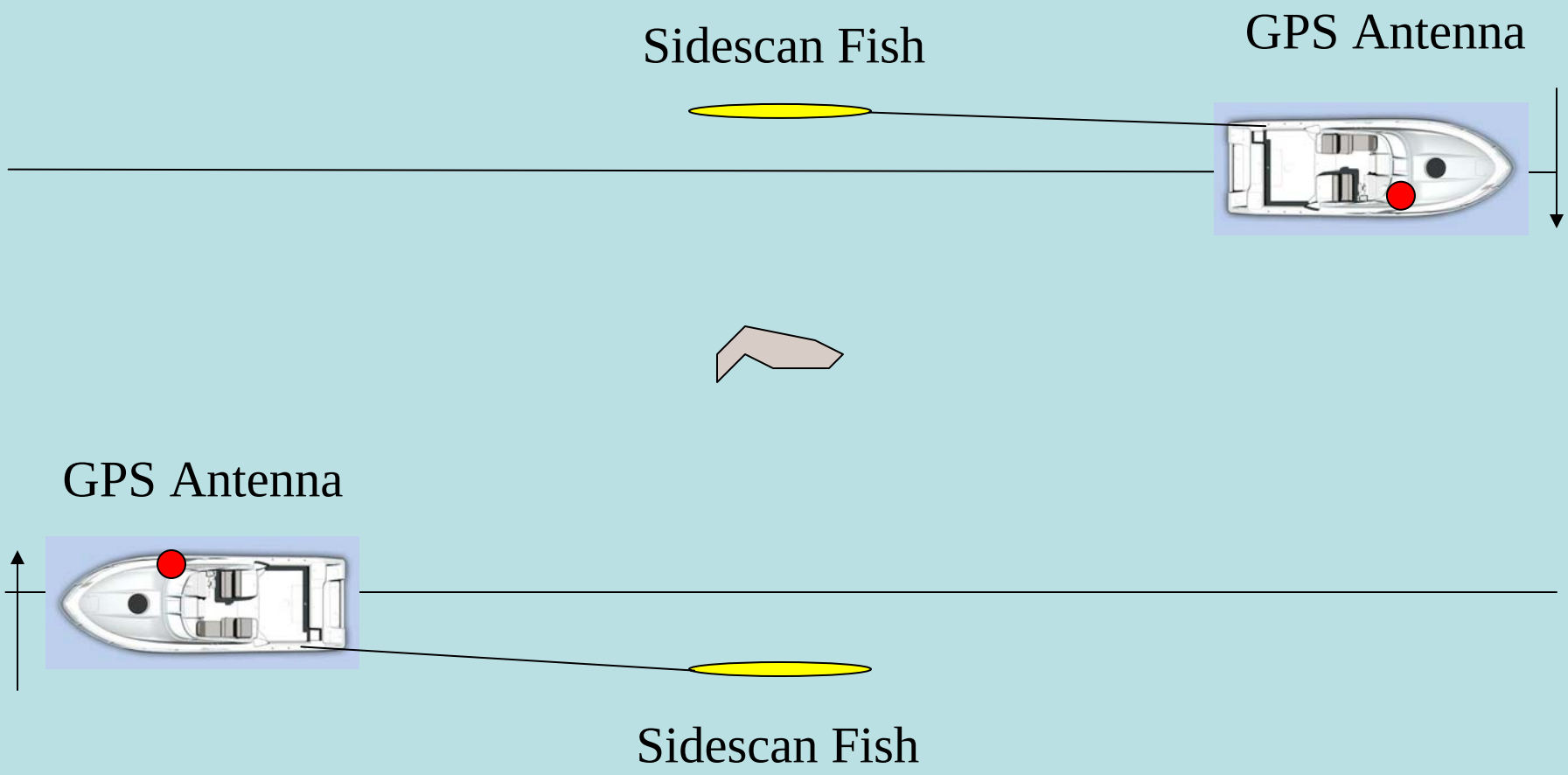
Offset Issue



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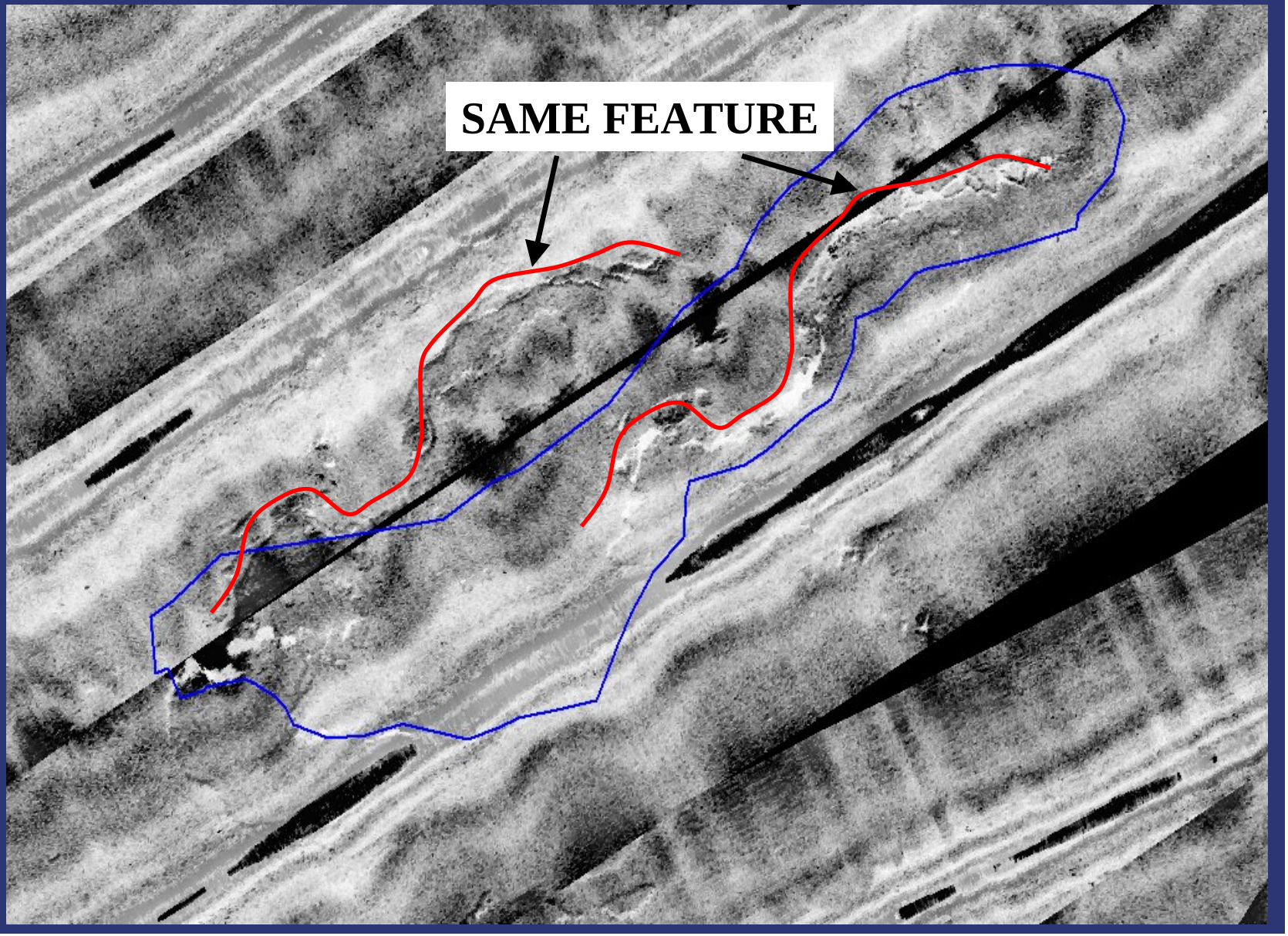
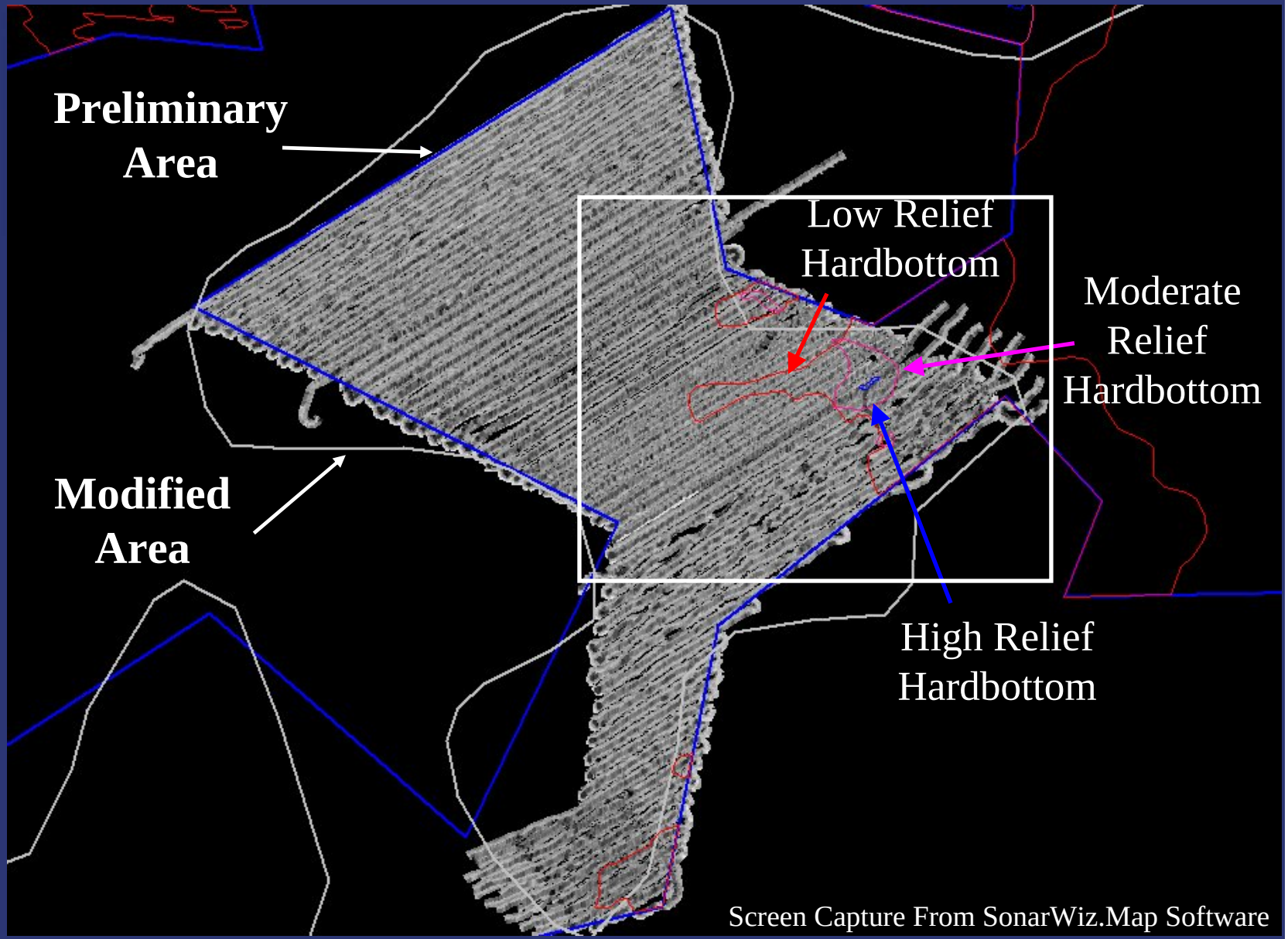
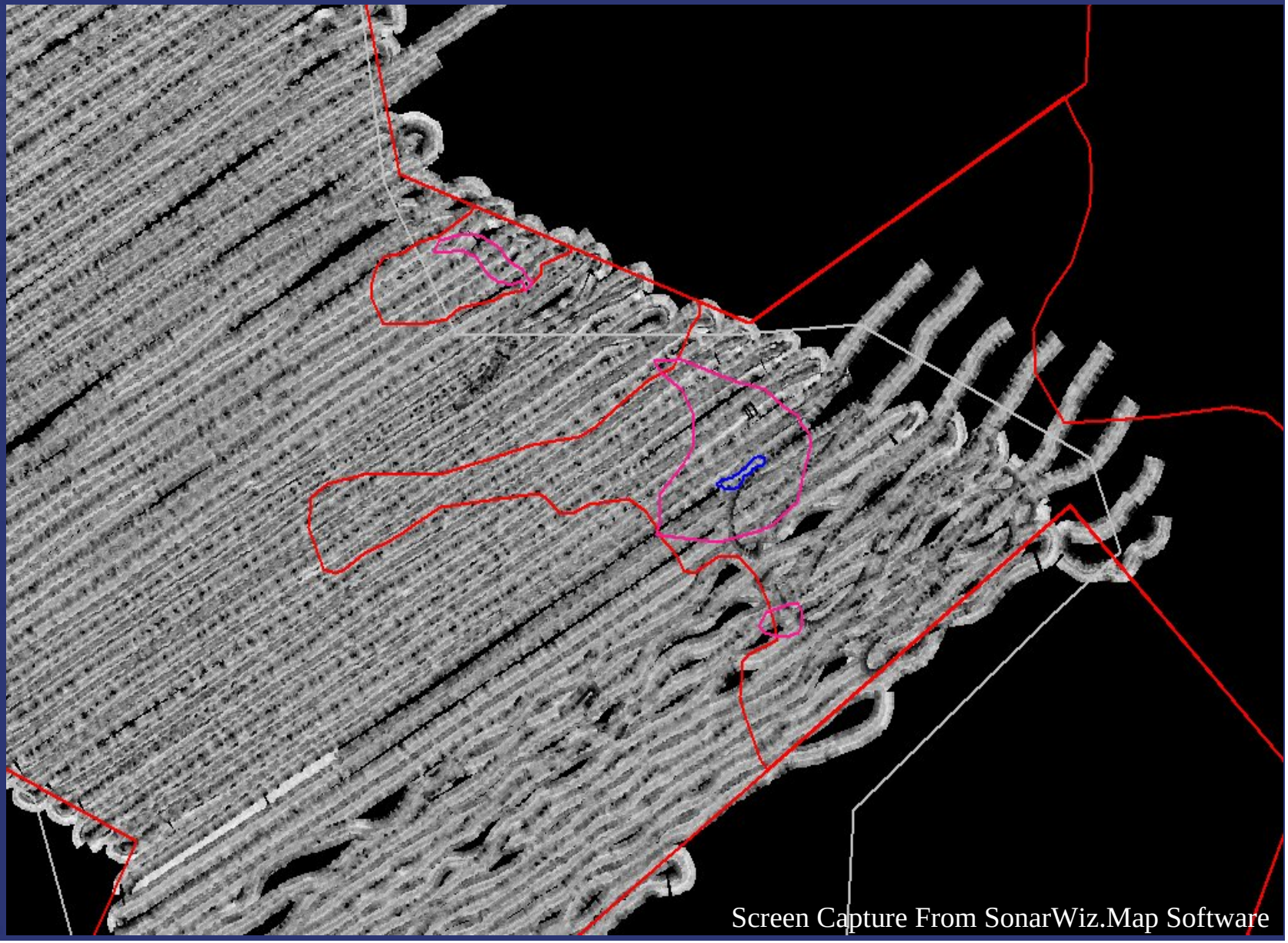


Area L


Preliminary Area
Modified Area
Low Relief Hardbottom
Moderate Relief Hardbottom
High Relief Hardbottom
Screen Capture From SonarWiz.Map Software

Area L: MATER Digitization

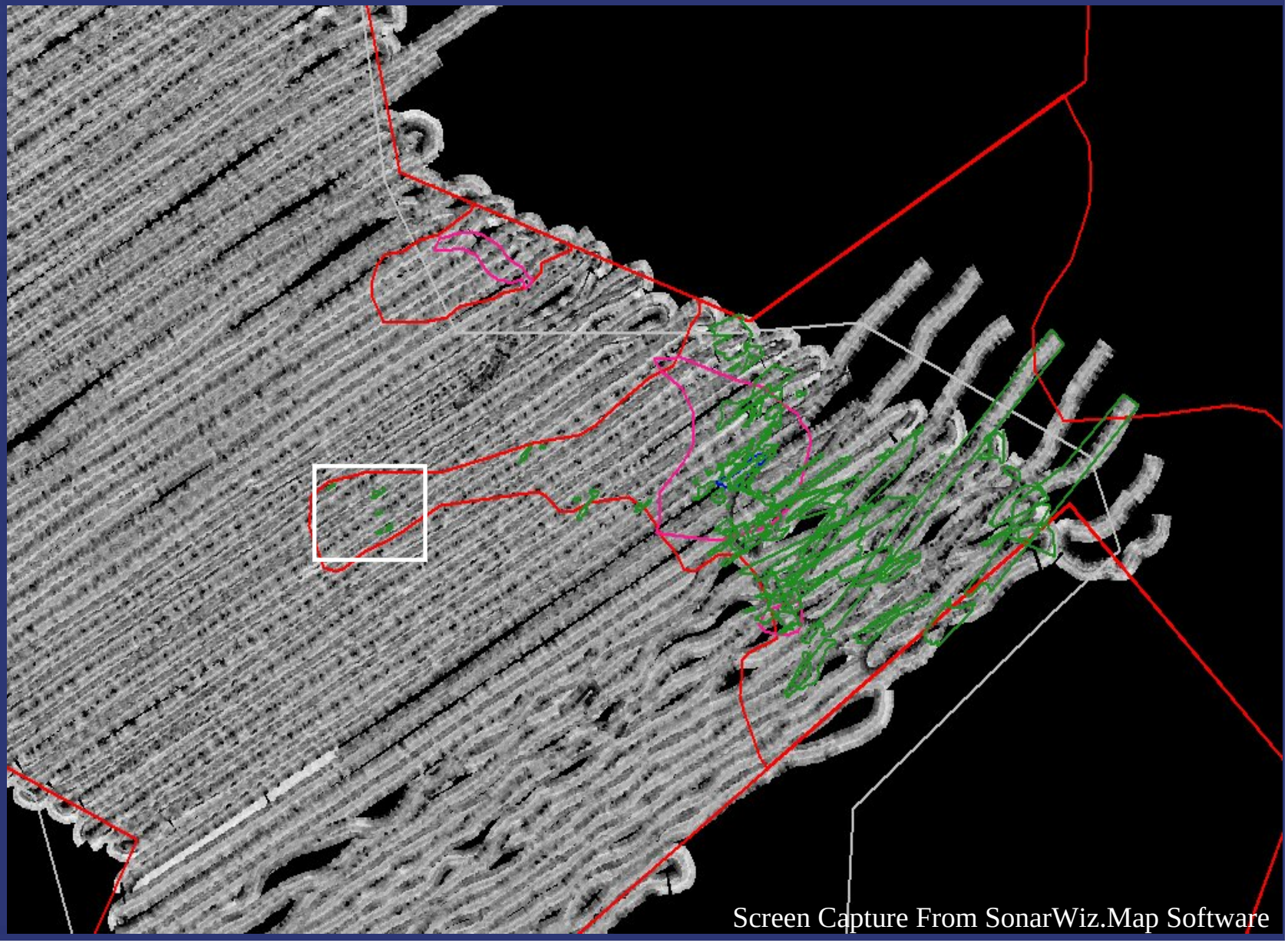


Screen Capture From SonarWiz.Map Software

ANAMAR Environmental Consulting, Inc.

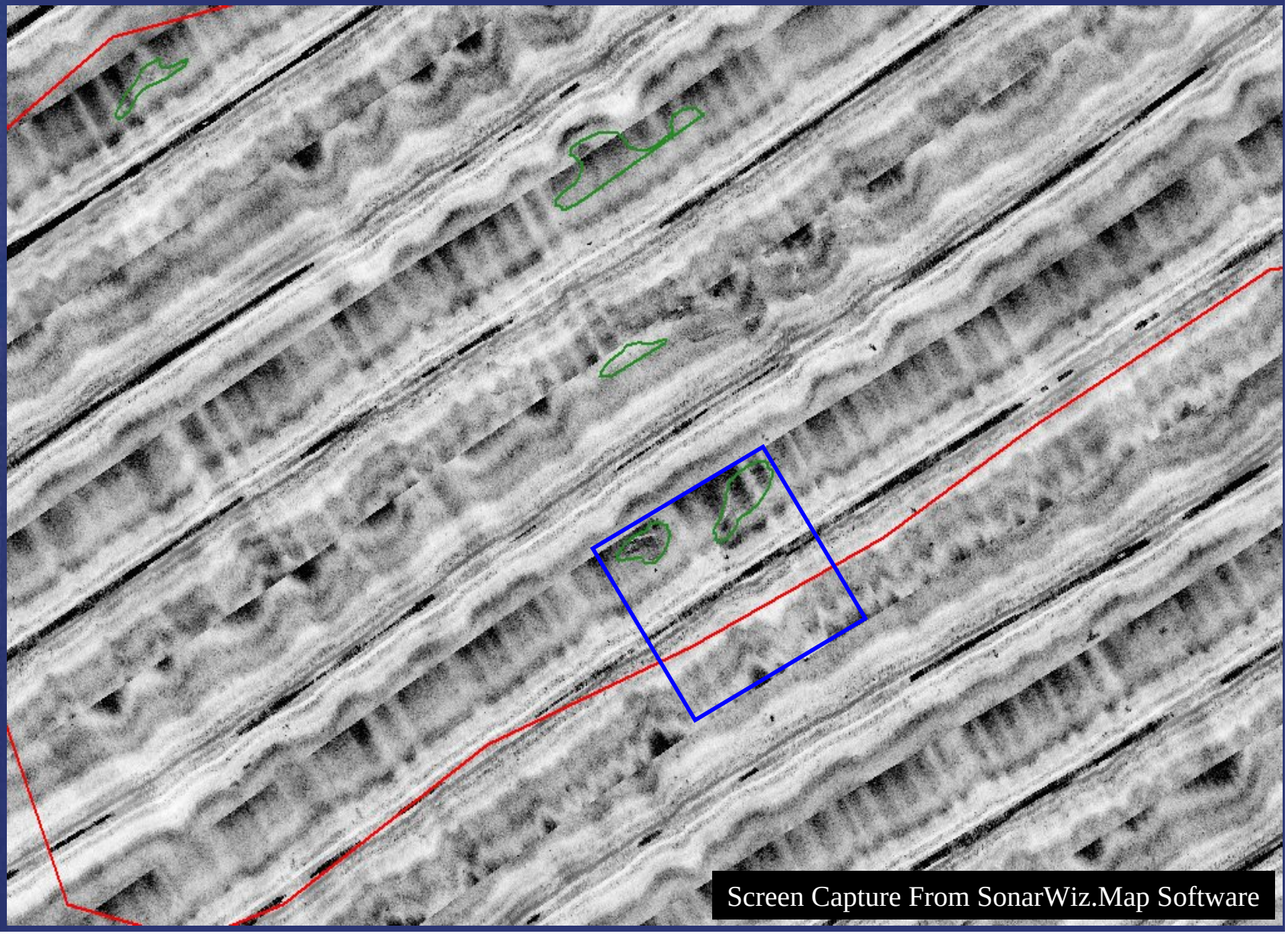
CPE Coastal Planning & Engineering

Area L: CPE Digitization



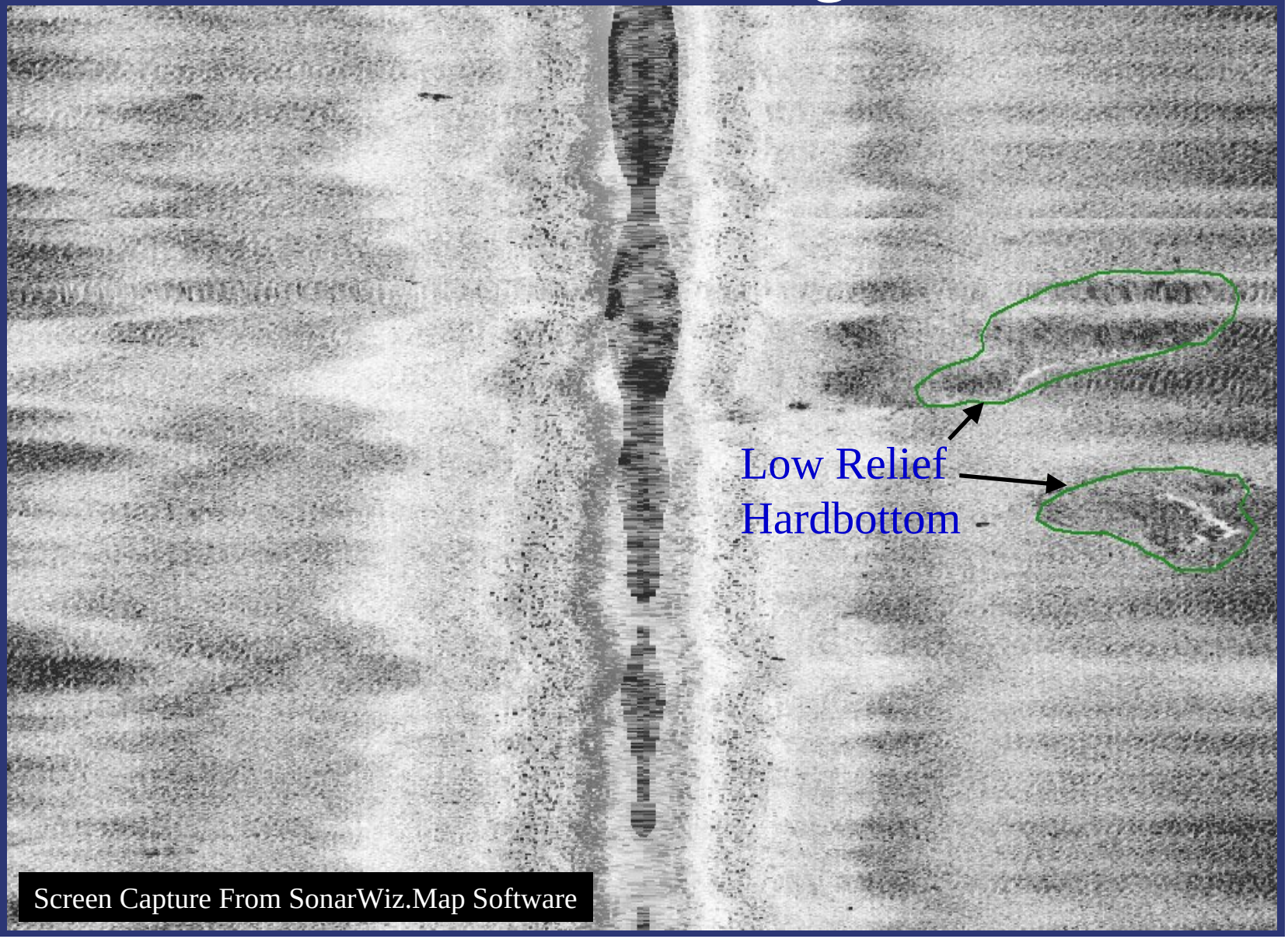
Screen Capture From SonarWiz.Map Software

Area L: Low Relief Hardbottom



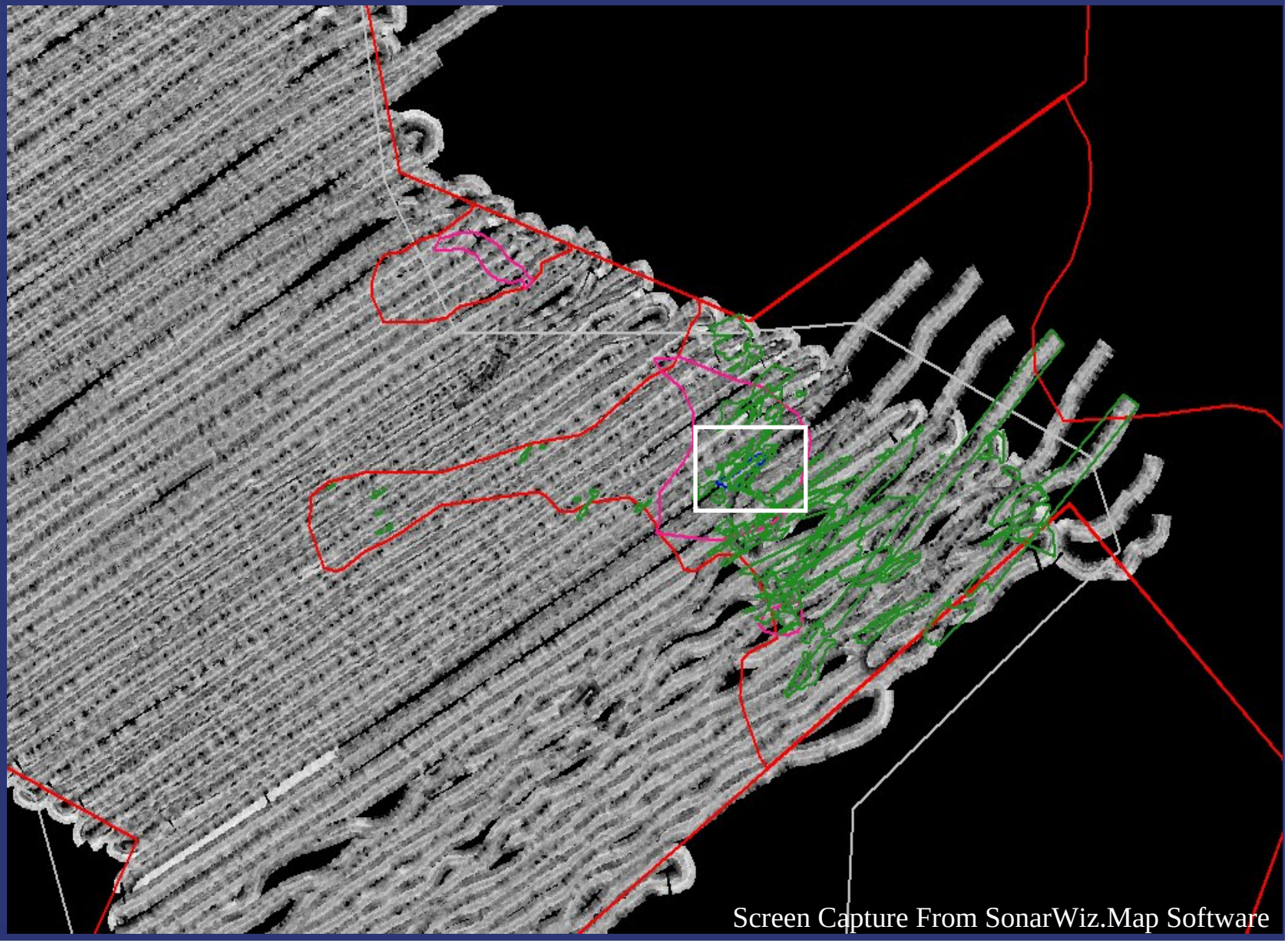
Screen Capture From SonarWiz.Map Software

Area L: Low Relief Hardbottom Waterfall Image



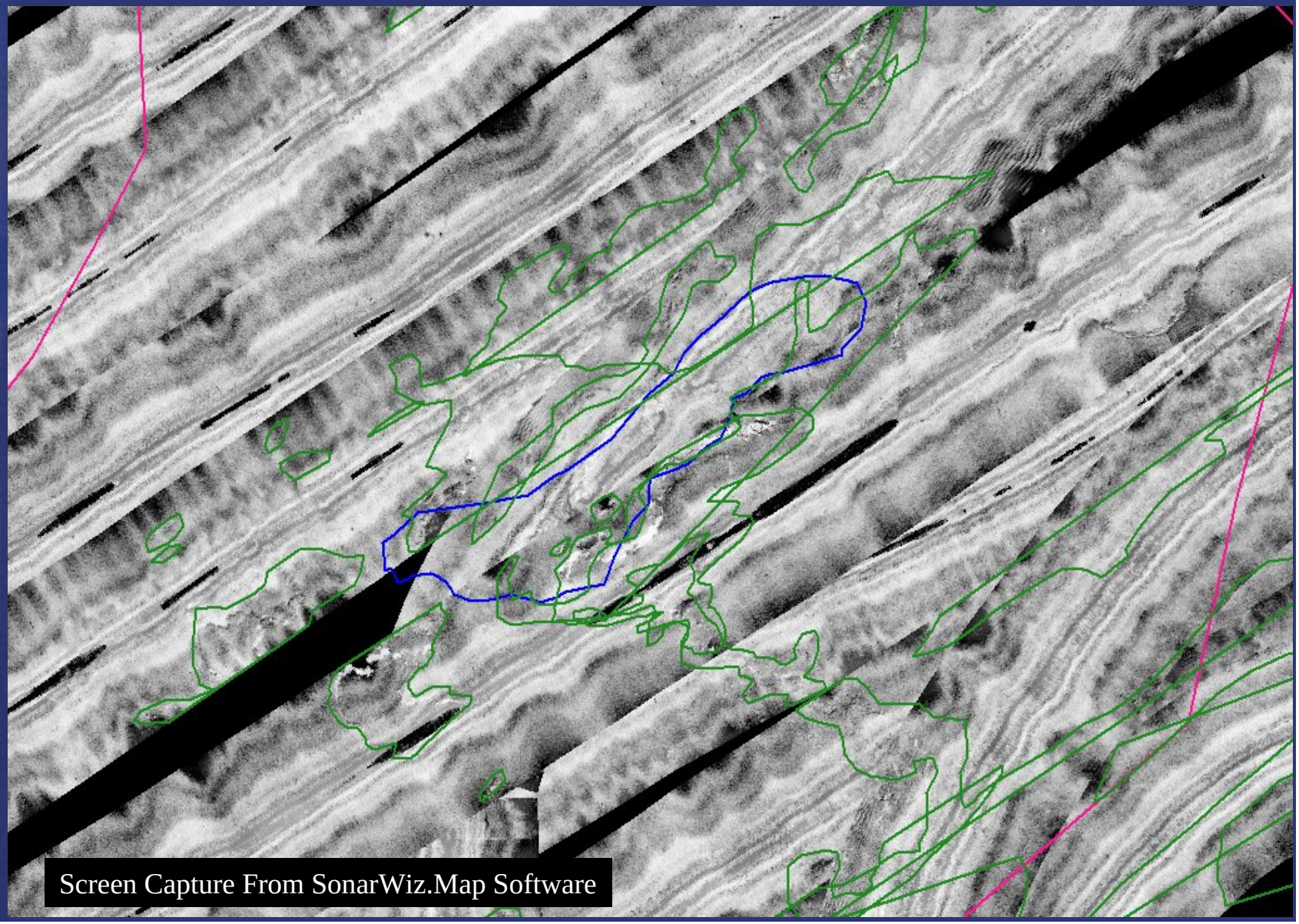
Screen Capture From SonarWiz.Map Software

Area L: CPE Digitization



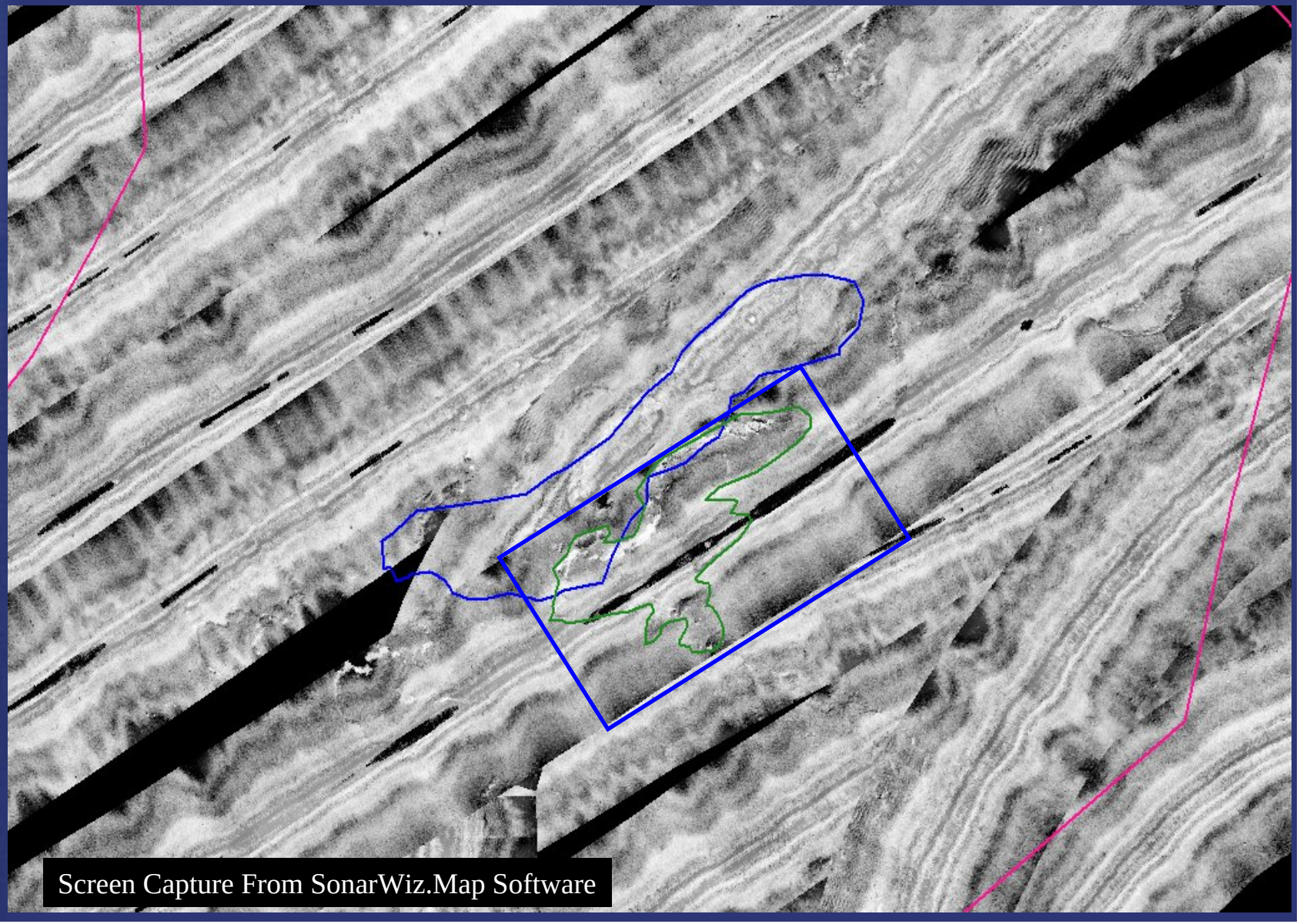
Screen Capture From SonarWiz.Map Software

Area L: High Relief Hardbottom



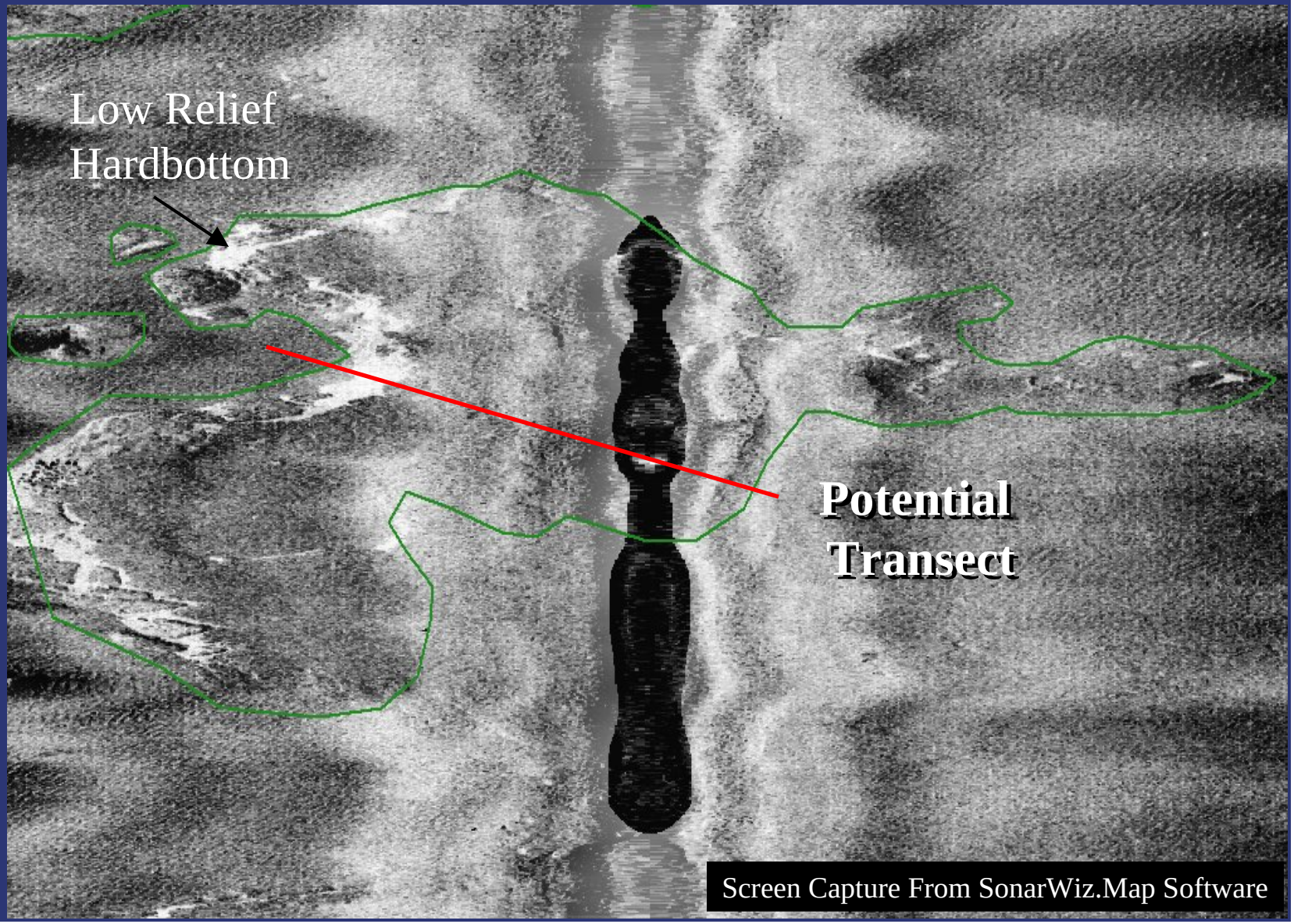
Screen Capture From SonarWiz.Map Software

Area L: High Relief Hardbottom

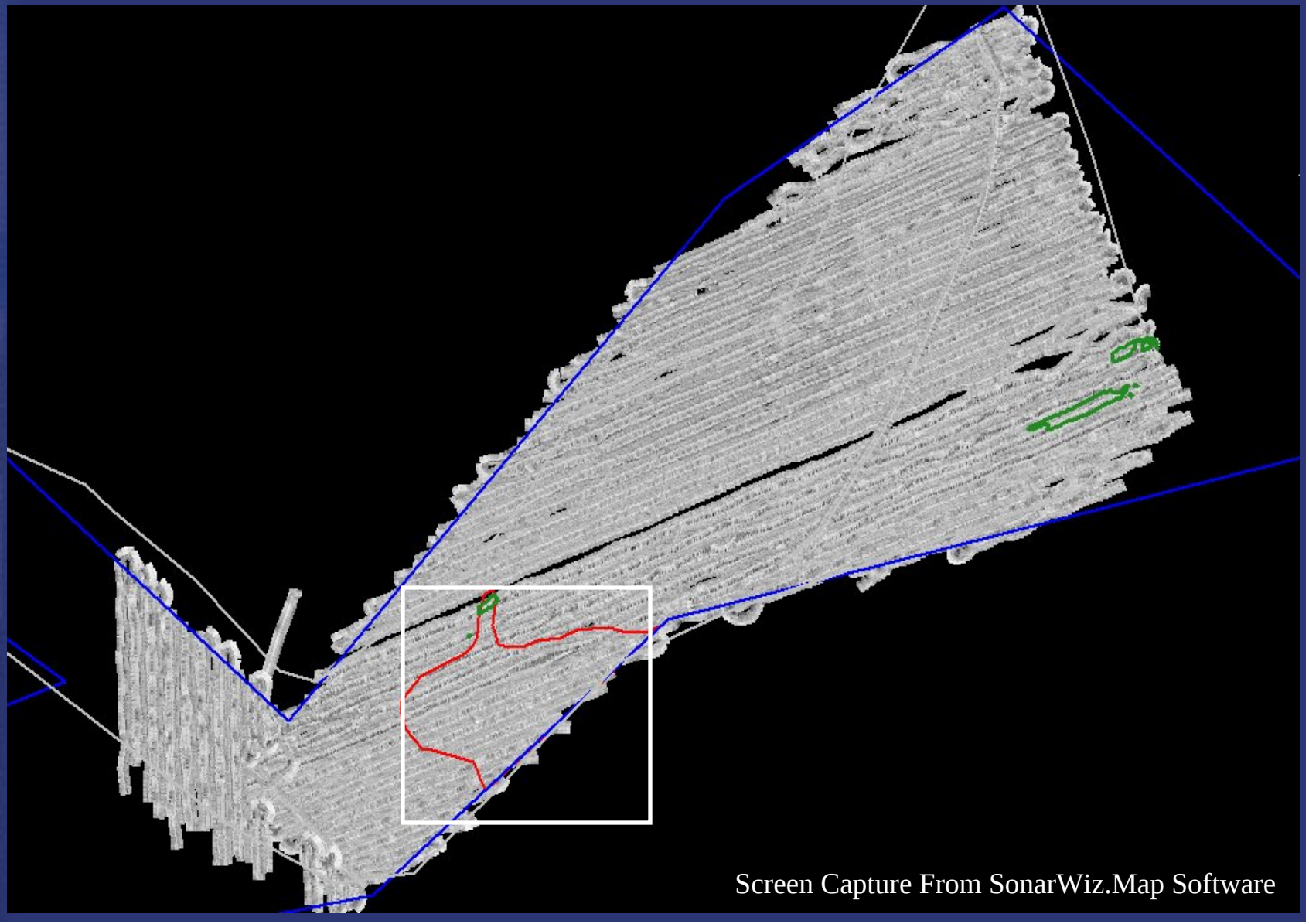


Screen Capture From SonarWiz.Map Software

Area L: High Relief Hardbottom Waterfall Image

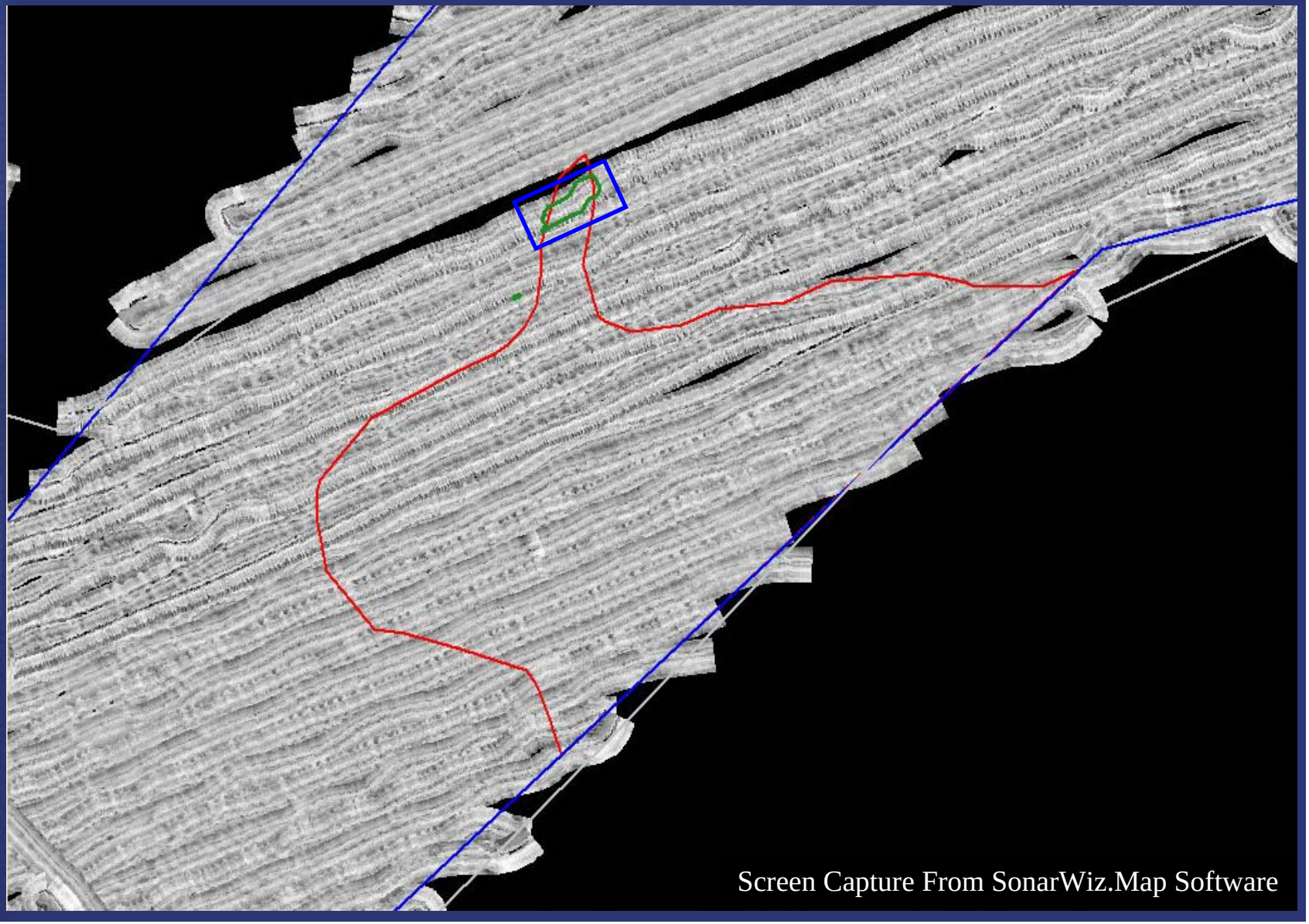


Area J



Screen Capture From SonarWiz.Map Software

Area J: Within MATER Digitized Zone



Screen Capture From SonarWiz.Map Software

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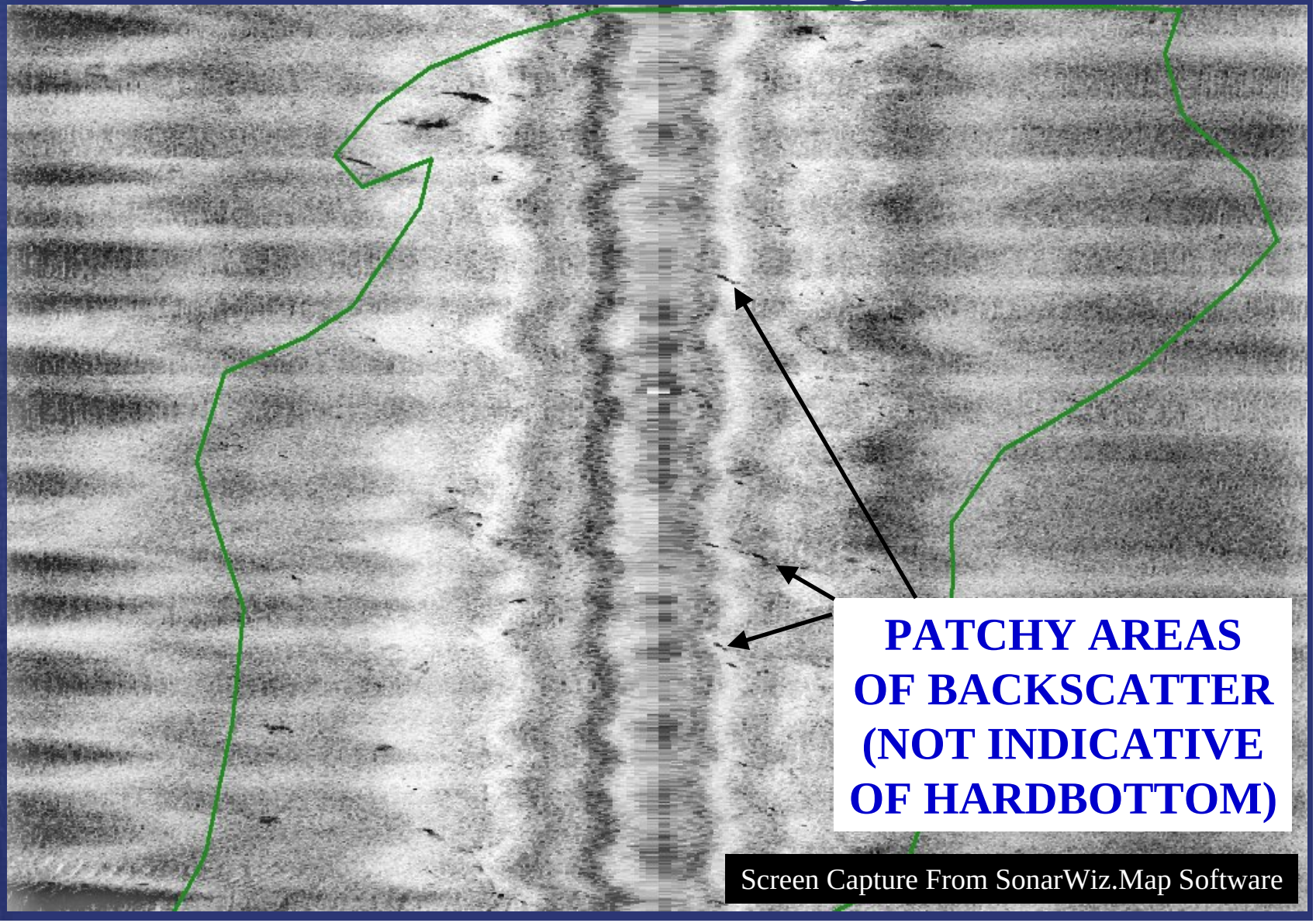
Area J: Within MATER Digitized Zone Waterfall Image



Screen Capture From SonarWiz.Map Software

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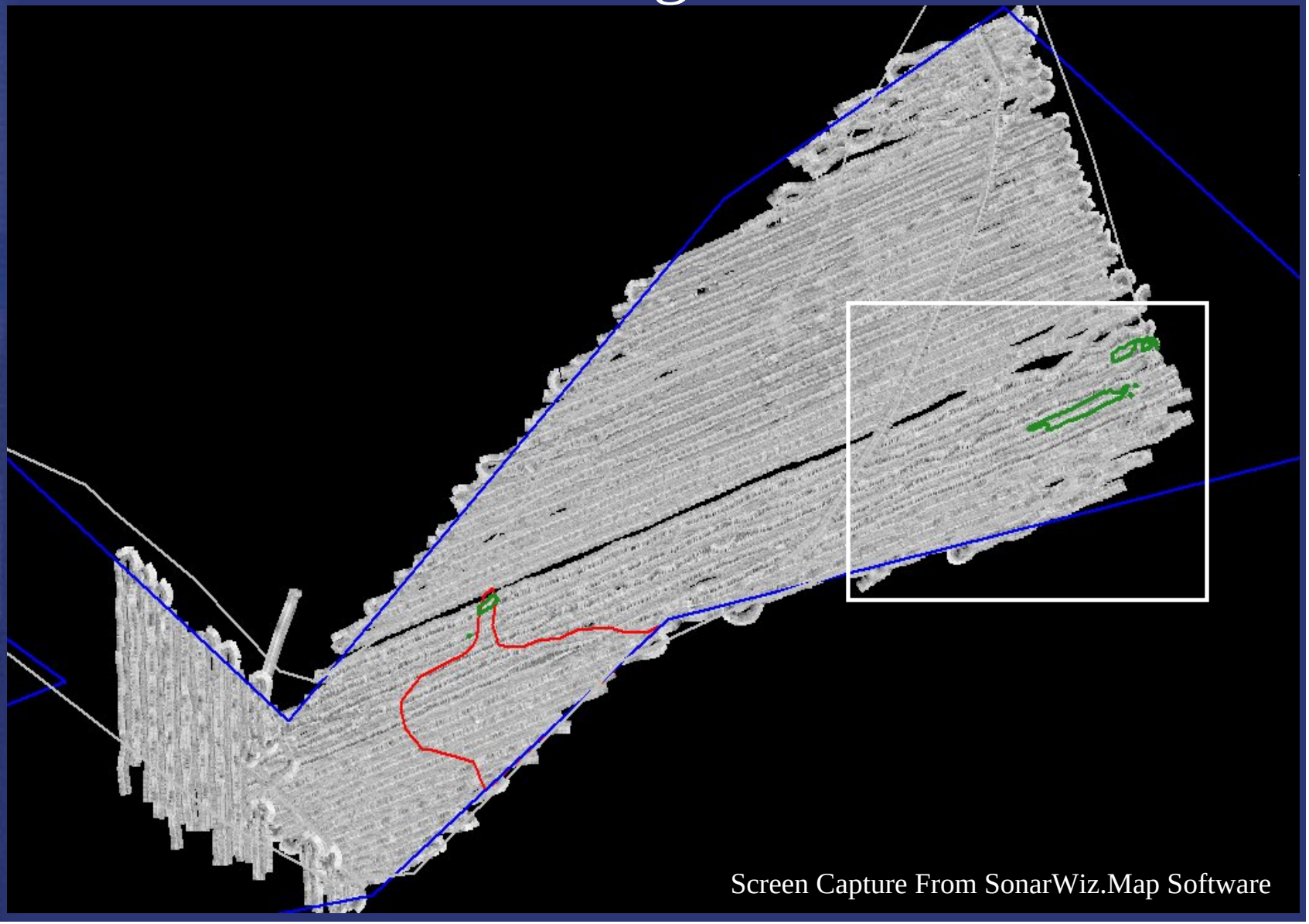
Area J: Potential Hardbottom Outside MATER Digitized Zone



Screen Capture From SonarWiz.Map Software

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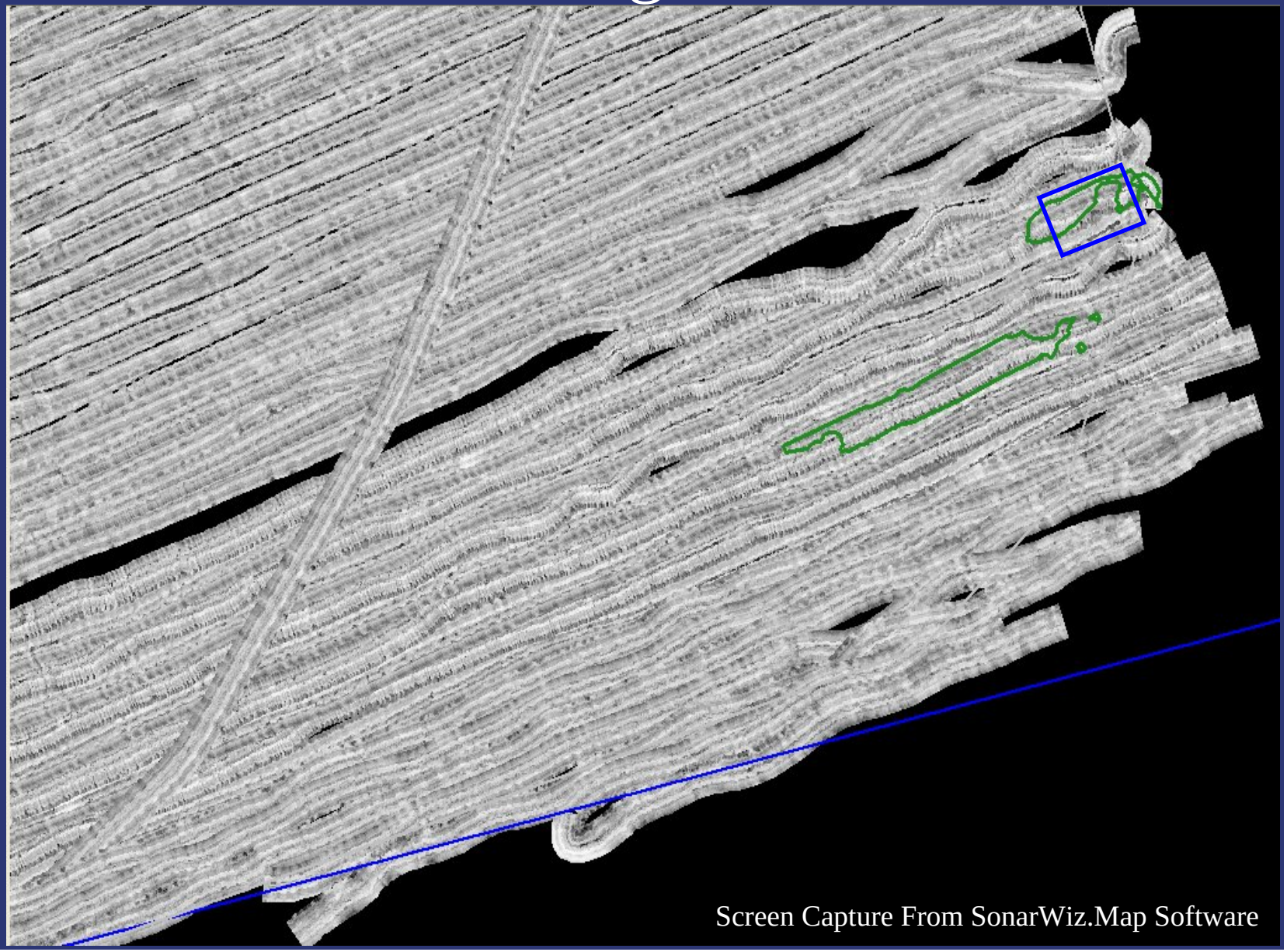
Area J: Potential Hardbottom Outside MATER Digitized Zone



Screen Capture From SonarWiz.Map Software

Area J: Potential Hardbottom Outside MATER Digitized Zone

Screen Capture From SonarWiz.Map Software

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APPENDIX D

ORIGINAL DATA SHEETS (PDF FILES)

1. BEAMR
2. Diver Notes
3. Sediment Log

Key to Personnel Initials in This Appendix

AH, ARH	=	Andrew Hannes
LF	=	Lauren Floyd
JC	=	Jessica Craft
Dan M., DM	=	Dan Morelli

I was tangled

195° Bry.

RUGOSITY = 20.6 or 20.6 (T1)

Project Name SCNTB **Site Name / Transect Name** AH

Date 3/18/08 **Data Collector** AH **Data Entry**

I pulled it

Quad Label: 17 Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	3	Ovrubsda |||	1
Max Sediment Depth (cm)	5		
Sessile Benthos...	**% Cover**	Carijoa	1
Sediment- (circle all: sand shell mud)	70	Carijoa	2
Macroalgae- Fleshy+Calcareous	1		
Turf- algae+cyanobacteria (circle all: g r b)	22		
Encrusting Red Algae	1		
Sponge	2		
Hydroid	2		
Octocoral	0		
Stony Coral	3		
Tunicate	0		
Bare Hard Substrate	0		
other-...			

Total Must = 100%

Quad Label: 15 Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	2	Tida	3
Max Sediment Depth (cm)	1	Carijoa	2
Sessile Benthos...	**% Cover**	Sarg	4
Sediment- (circle all: sand shell mud)	50		
Macroalgae- Fleshy+Calcareous	5		
Turf- algae+cyanobacteria (circle all: g r b)	38		
Encrusting Red Algae			
Sponge	1		
Hydroid	2		
Octocoral	1		
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-... Bry	3		

Total Must = 100%

Quad Label: 13 Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	3	Oirub	1
Max Sediment Depth (cm)	1		
Sessile Benthos...	**% Cover**	Sarg	2
Sediment- (circle all: sand shell mud)	50		
Macroalgae- Fleshy+Calcareous	3	Tida	2
Turf- algae+cyanobacteria (circle all: g r b)	39		
Encrusting Red Algae			
Sponge	1		
Hydroid	2		
Octocoral	1		
Stony Coral	1		
Tunicate	1		
Bare Hard Substrate			
other-... Bry	2		

Total Must = 100%

Quad Label: 11 Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	4	Sarg	2
Max Sediment Depth (cm)	3		
Sessile Benthos...	**% Cover**	Carijoa	1
Sediment- (circle all: sand shell mud)	70		
Macroalgae- Fleshy+Calcareous	3		
Turf- algae+cyanobacteria (circle all: g r b)	18		
Encrusting Red Algae			
Sponge	2		
Hydroid	4		
Octocoral	1		
Stony Coral			
Tunicate	0		
Bare Hard Substrate			
other-... Bry	2		

Total Must = 100%

Standard Abbreviations: and abbreviation formats

Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...

Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl

Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...

Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3

Other... includes: Anemone, Wormrock, Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid,

Titanid
C. irisii
Cliona celata

we should also check running it at 195°

entered 0/31/08

Project Name SCNTB **Site Name / Transect Name** T1 (offshore)

Date 3/18/08 **Data Collector** LF **Data Entry**

Quad Label: Sample Name or #	19	List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	13	Carijoa 1	x 4
Max Sediment Depth (cm)	2		
Sessile Benthos...	**% Cover**	O. robust	1
Sediment- (circle all: sand shell mud)	25	1	(x2)
Macroalgae- Fleshy+Calcareous	5		
Turf- algae+cyanobacteria (circle all: g r b)	49	Sargas	2
Encrusting Red Algae	1		
Sponge	7		
Hydroid	3		
Octocoral	1		
Stony Coral	1		
Tunicate	2		
Bare Hard Substrate	1		
other-... Bryoz	3	spiral	
worm	1		

Total Must = 100%

Quad Label: Sample Name or #	18	List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	5	Titanoid	1
Max Sediment Depth (cm)	4	Carijoa	3
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	83		
Macroalgae- Fleshy+Calcareous	1		
Turf- algae+cyanobacteria (circle all: g r b)	10		
Encrusting Red Algae	1		
Sponge	—		
Hydroid	2		
Octocoral	1		
Stony Coral	—		
Tunicate	—		
Bare Hard Substrate	—		
other-... bryo	1		
worm	1		

Total Must = 100%

do we say HG
+HG ?
Bi Sia Bugs
pink encrusting

Quad Label: Sample Name or #	16	List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	6	Carijoa	4
Max Sediment Depth (cm)	1	"	4
Sessile Benthos...	**% Cover**	"	3
Sediment- (circle all: sand shell mud)	15		
Macroalgae- Fleshy+Calcareous	10	Sargas	7
Turf- algae+cyanobacteria (circle all: g r b)	58	Wrangel	1
Encrusting Red Algae	2		
Sponge	4	O. rob	1
Hydroid	2		
Octocoral	1		
Stony Coral	0		
Tunicate	1		
Bare Hard Substrate	1		
other-... anemone	1	worm	1
bryoz	4		

Total Must = 100%

Quad Label: Sample Name or #	14	List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	4	O. rob	4
Max Sediment Depth (cm)	2	"	1 x3
Sessile Benthos...	**% Cover**	Carij	1
Sediment- (circle all: sand shell mud)	20		
Macroalgae- Fleshy+Calcareous	3		
Turf- algae+cyanobacteria (circle all: g r b)	54	Sargas	1
Encrusting Red Algae	1		
Sponge	4		
Hydroid	3		
Octocoral	1		
Stony Coral	1		
Tunicate	2		
Bare Hard Substrate	2		
other-... bryo	5	worm	✓
anem	1		

Total Must = 100%

Standard Abbreviations: and abbreviation formats
Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Brythamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
Other includes: Anemone, Wormrock, Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid,

Seastar HB relief 47 cm above sand 41 ft
Entered 6/3/08

Project Name SCNTB **Site Name / Transect Name** T1

Date 3/18/08 **Data Collector** LF **Data Entry**

Quad Label: 12 (Sample Name or #)		List macroalgae Genus % / List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	6	O rob	1 x 3
Max Sediment Depth (cm)	2	Cari ju	4
Sessile Benthos...	**% Cover**	"	5
Sediment- (circle all: sand shell mud)	10		
Macroalgae- Fleshy+Calcareous	4		
Turf- algae+cyanobacteria (circle all: g r b)	72	Sargas	3
Encrusting Red Algae	1		
Sponge	1		
Hydroid	1		
Octocoral	1		
Stony Coral	1		
Tunicate	1		
Bare Hard Substrate	1		
other-... bryo	6		
worm	1		

Total Must = 100%

Quad Label: 10 (Sample Name or #)		List macroalgae Genus % / List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	7		
Max Sediment Depth (cm)	2		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	20	Titanid	4
Macroalgae- Fleshy+Calcareous	4		
Turf- algae+cyanobacteria (circle all: g r b)	64	O rob	1
Encrusting Red Algae	1		
Sponge	2		
Hydroid	1	Codium	1
Octocoral	1	Sargas	2
Stony Coral	1		
Tunicate	1		
Bare Hard Substrate	1		
other-... worm	1	bryoz	2
barnacle	1		

Total Must = 100%

Quad Label: 8 (Sample Name or #)		List macroalgae Genus % / List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	3		
Max Sediment Depth (cm)	2		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	80		
Macroalgae- Fleshy+Calcareous	4	Sargas	3
Turf- algae+cyanobacteria (circle all: g r b)	10		
Encrusting Red Algae	1		
Sponge	1		
Hydroid	0		
Octocoral	0		
Stony Coral	0		
Tunicate	0		
Bare Hard Substrate	1		
other-...		bryo 2	
worm	1		

Total Must = 100%

Quad Label: 6 (Sample Name or #)		List macroalgae Genus % / List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	2	Carij	3
Max Sediment Depth (cm)	1	Titanid	3
Sessile Benthos...	**% Cover**	"	1
Sediment- (circle all: sand shell mud)	69		
Macroalgae- Fleshy+Calcareous	1		
Turf- algae+cyanobacteria (circle all: g r b)	20		
Encrusting Red Algae	1		
Sponge	2		
Hydroid	1		
Octocoral	1		
Stony Coral	0		
Tunicate	2		
Bare Hard Substrate	1		
other-... bryo	2		

END AIR

Total Must = 100%

sea spider

Standard Abbreviations: and abbreviation formats
Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
Other- includes: Anemone, Wormrock, Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid,

entered 3/31/08

(FIP)

Project Name SC/NTB **Site Name / Transect Name** A

Date 3/18/08 **Data Collector** AH **Data Entry**

Quad Label: 9 Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	3		
Max Sediment Depth (cm)	2	D. nb. 11	1
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	80	Tidan	1
Macroalgae- Fleshy+Calcareous	4		
Turf- algae+cyanobacteria (circle all: g r b)	7	SCR	2
Encrusting Red Algae		~~Hypnea~~ Gelidia?	
Sponge	2		1
Hydroid	2		
Octocoral	1	~~AH wants to check this~~	
Stony Coral	1		
Tunicate	1		
Bare Hard Substrate			
other-... Bry	2		

Total Must = 100%

Quad Label: Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Finish → roll up tape

Quad Label: 7 Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	3		
Max Sediment Depth (cm)	1		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	40		
Macroalgae- Fleshy+Calcareous	1		
Turf- algae+cyanobacteria (circle all: g r b)	52		
Encrusting Red Algae			
Sponge	3		
Hydroid	2		
Octocoral			
Stony Coral			
Tunicate	1		
Bare Hard Substrate			
other-... bry	1		

Total Must = 100%

Quad Label: Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Standard Abbreviations: and abbreviation formats

Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
Other- includes: Anemone, Wormrock, Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid.

43'   52°   Blk sea bass, sheepshead

Grac, Sarg, Titanoderma? (left margin notes)

Project Name SCNTB **Site Name / Transect Name** T3

Date 3/21/08 **Data Collector** LF **Data Entry** sea star, conch?

Quad Label: 18 (Sample Name or #)		List macroalgae Genus % / List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	8	O rob	1
Max Sediment Depth (cm)	5		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud) — sand circled	10		
Macroalgae- Fleshy+Calcareous	1		
Turf- algae+cyanobacteria (circle all: g r b)	61		
Encrusting Red Algae	1		
Sponge	5		
Hydroid	1		
Octocoral	0		
Stony Coral	1		
Tunicate (blk condo)	16		
Bare Hard Substrate	1		
other-... worm	1		
bryo	2		

Total Must = 100%

Quad Label: 12 (Sample Name or #)		List macroalgae Genus % / List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	0		
Max Sediment Depth (cm)	23		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	100		
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: 10 (Sample Name or #)		List macroalgae Genus % / List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	0		
Max Sediment Depth (cm)	7		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud) — sand circled	97		
Macroalgae- Fleshy+Calcareous	1		
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid	1		
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-... bryo	1		

Total Must = 100%

Quad Label: 6 (Sample Name or #)		List macroalgae Genus % / List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	8	lepto V.	3
Max Sediment Depth (cm)	6		
Sessile Benthos...	**% Cover**	O rob	1
Sediment- (circle all: sand shell mud)	80		
Macroalgae- Fleshy+Calcareous	1		
Turf- algae+cyanobacteria (circle all: g r b)	10		
Encrusting Red Algae	1		
Sponge	2		
Hydroid	1		
Octocoral	1		
Stony Coral	0		
Tunicate	0		
Bare Hard Substrate	1		
other-... bryo	1		
worm	1		

Total Must = 100%

Standard Abbreviations: and abbreviation formats:
Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Brythamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
... Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid,

Project Name SCNTB **Site Name / Transect Name** T3

Date 3/21/08 **Data Collector** LF **Data Entry**

Start HB ledge

Quad Label: 0 Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	14		
Max Sediment Depth (cm)	8		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud) (sand circled)	77		
Macroalgae- Fleshy+Calcareous	1		
Turf- algae+cyanobacteria (circle all: g r b)	15		
Encrusting Red Algae	1		
Sponge	1		
Hydroid	2		
Octocoral	0		
Stony Coral	0		
Tunicate	0		
Bare Hard Substrate	1		
other-... bryo	1		
worm	1		

Total Must = 100%

Quad Label: Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Standard Abbreviations: and abbreviation formats

Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
Other- includes: Anemone, Wormrock, Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid.

Project Name SCATB **Site Name / Transect Name** T3

Date 3/21/08 **Data Collector** JC **Data Entry**

Quad Label: Sample Name or #	18	List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	11		
Max Sediment Depth (cm)	1		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	2		
Macroalgae- Fleshy+Calcareous	2		
Turf- algae+cyanobacteria (circle all: g r b)	83		
Encrusting Red Algae	1		
Sponge	5		
Hydroid			
Octocoral			
Stony Coral			
Tunicate	1		
Bare Hard Substrate			
other-... bryo	5		
worm	1		

Total Must = 100%

Quad Label: Sample Name or #	14	List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	6	Sarg-1	
Max Sediment Depth (cm)	3		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	88		
Macroalgae- Fleshy+Calcareous	2		
Turf- algae+cyanobacteria (circle all: g r b)	9		
Encrusting Red Algae			
Sponge	1		
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-... worm	1		
bryo	3		

Total Must = 100%

Quad Label: Sample Name or #	8	List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	5		
Max Sediment Depth (cm)	5		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	84		
Macroalgae- Fleshy+Calcareous	1		
Turf- algae+cyanobacteria (circle all: g r b)	10		
Encrusting Red Algae			
Sponge	1		
Hydroid	1		
Octocoral			
Stony Coral			
Tunicate	3		
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: Sample Name or #	4	List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	-		
Max Sediment Depth (cm)	8		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	100		
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Standard Abbreviations: and abbreviation formats

Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
Other- includes: Anemone, Wormrock, Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid.

Project Name SCNTB **Site Name / Transect Name** T3

Date 3/21/08 **Data Collector** JC **Data Entry**

Quad Label: 2 **Sample Name or #**		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	4	Titan	3
Max Sediment Depth (cm)	1		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	1		
Macroalgae- Fleshy+Calcareous	1		
Turf- algae+cyanobacteria (circle all: g r b)	87		
Encrusting Red Algae			
Sponge	1		
Hydroid	1		
Octocoral	1		
Stony Coral			
Tunicate	7		
Bare Hard Substrate			
other-... b MO	1		

Total Must = 100%

Quad Label: **Sample Name or #**		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: **Sample Name or #**		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: **Sample Name or #**		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Standard Abbreviations: and abbreviation formats
Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
Other includes: Anemone, Wormrock, Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid.

43 ~~3~~ 1' vis max

Project Name SC/NTB **Site Name / Transect Name** T4

Date 3/21/08 **Data Collector** LF **Data Entry**

2 urchins
sm shell

Quad Label: Sample Name or #	16	List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	22	Carij	3
Max Sediment Depth (cm)	7		2
Sessile Benthos...	**% Cover**		1
Sediment- (circle all: sand shell mud) coarse	18		
Macroalgae- Fleshy+Calcareous	1	Lepto v.	3
Turf- algae+cyanobacteria (circle all: g r b)	70		5
Encrusting Red Algae	1		5
Sponge	1		4
Hydroid	1		1
Octocoral	1		2
Stony Coral	0		11
Tunicate white condo	0		2
Bare Hard Substrate	2	O. robust	1
other-... bryo	3	worm 1	

Total Must = 100%

Quad Label: Sample Name or #	10	List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	9	Titanid.	8
Max Sediment Depth (cm)	1	Lepto v	9, 9
Sessile Benthos...	**% Cover**		15, 8
Sediment- (circle all: sand shell mud)	48		8, 7, 8
Macroalgae- Fleshy+Calcareous	2		7, 6
Turf- algae+cyanobacteria (circle all: g r b)	40		
Encrusting Red Algae	1		
Sponge	1	O. robus	5x1 cm
Hydroid	1		
Octocoral	1	Sargass	1
Stony Coral	0	Caulerp	1
Tunicate blk [illegible]	2		
Bare Hard Substrate	1		
other-... bryo	2		
worm	1		

Total Must = 100%

Quad Label: Sample Name or #	8	List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	7	lepto v	8, 7,
Max Sediment Depth (cm)	8	11	8, 11
Sessile Benthos...	**% Cover**	9	9
Sediment- (circle all: sand shell mud)	46	Carijoa	3, 4
Macroalgae- Fleshy+Calcareous	1	Titanid	1, 2
Turf- algae+cyanobacteria (circle all: g r b)	40		
Encrusting Red Algae	1	O. rob.	2
Sponge	2		
Hydroid	1		
Octocoral	2		
Stony Coral	1		
Tunicate	2		
Bare Hard Substrate	1		
other-... barn	1	worm 1	
bryo	1		

Total Must = 100%

Quad Label: Sample Name or #	2	List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	15	QUAD	2
Max Sediment Depth (cm)	14	100% sand	
Sessile Benthos...	**% Cover**	0 relief	
Sediment- (circle all: sand shell mud)	75	14	~~sm~~
Macroalgae- Fleshy+Calcareous	1		
Turf- algae+cyanobacteria (circle all: g r b)	15	Lepto v	16, 8
Encrusting Red Algae	1		
Sponge Q. U.	1	O. Rob	1, 1
Hydroid	1		
Octocoral	1		
Stony Coral	1		
Tunicate	1		
Bare Hard Substrate	1		
other-... barn	1		
bryo	1		

Total Must = 100%

Standard Abbreviations: and abbreviation formats

Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
[illegible] Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid,

anem.

Project Name SCNTB **Site Name / Transect Name** T4

Date 3/21/08 **Data Collector** JC **Data Entry**

Quad Label: 18 Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	0	L. virg (11)	4
Max Sediment Depth (cm)	9	L. virg	6
Sessile Benthos...	**% Cover**	L. virg (11)	3
Sediment- (circle all: sand shell mud)	100	coarse	
Macroalgae- Fleshy+Calcareous	2	O. rob (11) polyp	1
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-... Bryo	2		
worm	1	anem-1	

Total Must = 100%

Quad Label: 14 Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	15		
Max Sediment Depth (cm)	10		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	84		
Macroalgae- Fleshy+Calcareous	1		
Turf- algae+cyanobacteria (circle all: g r b)	5		
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral	1		
Stony Coral	1		
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: 12 Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	17	Cari pog	4
Max Sediment Depth (cm)	2	L. virg (111)	2
Sessile Benthos...	**% Cover**	L. virg	4
Sediment- (circle all: sand shell mud)	15		
Macroalgae- Fleshy+Calcareous	1	O. rob	10 x 08
Turf- algae+cyanobacteria (circle all: g r b)	74	O. rob (11)	2cm
Encrusting Red Algae			
Sponge	1		
Hydroid			
Octocoral	1		
Stony Coral	1		
Tunicate	1		
Bare Hard Substrate			
other-... bryo	4		
anem	1	worm 1	

Total Must = 100%

Quad Label: 6 Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	0	4m	
Max Sediment Depth (cm)	11	0, 12cm	
Sessile Benthos...	**% Cover**	100% sand	
Sediment- (circle all: sand shell mud)	100		
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Alepto's poking through 6ft to side

Standard Abbreviations: and abbreviation formats

Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
Other includes: Anemone, Wormrock, Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid,

45 Ft. VIS 5-10' 334°

Project Name 3/21/08 **Site Name / Transect Name** 01

Date SCNMB **Data Collector** LF **Data Entry**

Quad Label: Sample Name or # 16		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	0		
Max Sediment Depth (cm)	~~10~~ 9		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	100		
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)		QUAD 14	
Encrusting Red Algae		100% sand,	
Sponge		8 cm	
Hydroid	all 10		
Octocoral	[illegible] AND	Qu. 12	
Stony Coral		rel 11 cm	
Tunicate		sand 7 cm	
Bare Hard Substrate		barn 1	
other-...		bryo 1 turf 8	
		hydro 1 sand 89	

Total Must = 100%

Quad Label: Sample Name or # 10		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	5	0.106	1 x 3
Max Sediment Depth (cm)	5		
Sessile Benthos...	**% Cover**	Lepto V	1 x 2
Sediment- (circle all: sand shell mud)	95		
Macroalgae- Fleshy+Calcareous	—		
Turf- algae+cyanobacteria (circle all: g r b)	2		
Encrusting Red Algae	—	QUAD 6	
Sponge	—	100% Sand	
Hydroid	—	13 cm	
Octocoral	1		
Stony Coral	1		
Tunicate	—	QUAD 4	
Bare Hard Substrate	—	100% sand	
other-... anemone	1	16 cm	

Total Must = 100%

Quad Label: Sample Name or # 2		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	12		
Max Sediment Depth (cm)	1	Seagrass	2
Sessile Benthos...	**% Cover**	Dasya	1
Sediment- (circle all: sand shell mud)	30		
Macroalgae- Fleshy+Calcareous	3		
Turf- algae+cyanobacteria (circle all: g r b)	55	Orobus	1 x 5 cm
Encrusting Red Algae	1		
Sponge	1	"	3
Hydroid	1		
Octocoral	2	Caryo 5, 3, 4	
Stony Coral	1		3, 6
Tunicate			
Bare Hard Substrate	1		
other-... worm	1		
bryo	5		

Total Must = 100%

Quad Label: Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Standard Abbreviations: and abbreviation formats

Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...

Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl

Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...

Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3

Millepora sp. Seagrass Zoanthid

Sargassum
Dasya
Udotea
Gelidium

Dasya

black seabass
arbacias

Project Name SCNTR **Site Name / Transect Name** 01

Date 3/21/08 **Data Collector** JC **Data Entry**

Bugula fans

Quad Label: Sample Name or # 18		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	13	Sarg	8
Max Sediment Depth (cm)	2		
Sessile Benthos...	**% Cover**	Cariaco	5
Sediment- (circle all: sand shell mud)	30		2
Macroalgae- Fleshy+Calcareous	9		3
Turf- algae+cyanobacteria (circle all: g r b)	48		1
Encrusting Red Algae		O.rob	2
Sponge			
Hydroid	3		
Octocoral	1		
Stony Coral	1		
Tunicate	2		
Bare Hard Substrate			
other-... worm	1		
Dry0	5		

Total Must = 100%

stars
Luidia
echinaster

Quad Label: Sample Name or # 8		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	26	Sarg 5	
Max Sediment Depth (cm)	9		
Sessile Benthos...	**% Cover**	Cariaco 5	
Sediment- (circle all: sand shell mud)	12	O.rob 6	
Macroalgae- Fleshy+Calcareous	6	O.rob 6	
Turf- algae+cyanobacteria (circle all: g r b)	41		
Encrusting Red Algae			
Sponge	2		
Hydroid	2		
Octocoral	1		
Stony Coral	1		
Tunicate	4		
Bare Hard Substrate	22		
other-... Dry0 worm	8 1		

Total Must = 100%

Quad Label: Sample Name or # 0		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	8	Cariaco 0	11
Max Sediment Depth (cm)	3	0	3
Sessile Benthos...	**% Cover**	0	8
Sediment- (circle all: sand shell mud)	2		
Macroalgae- Fleshy+Calcareous	1		
Turf- algae+cyanobacteria (circle all: g r b)	89		
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral	2		
Stony Coral			
Tunicate			
Bare Hard Substrate	5	9%	
other-... worm	1		

Total Must = 100%

Tunicates
D. corolla
Eudistoma
unicavus

C. celata

Quad Label: Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Standard Abbreviations and abbreviation formats

Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G.spe: A.cer, A.aga, C.nat, M.ann, M.cav, P.ame, O.dif, S.rad, S.sid, S.bou, S.hya, S.int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3

Bryozoan, Millepora sp., Seagrass, Zoanthid

Project Name SCNTB **Site Name / Transect Name** 03

Date 3/21/06 **Data Collector** NRG **Data Entry**

Quad Label: Sample Name or #	4M	List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	2	Cnat W	2
Max Sediment Depth (cm)	9	"	3
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	70	O.nb W	1
Macroalgae- Fleshy+Calcareous	1		
Turf- algae+cyanobacteria (circle all: g r b)	27		
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral	1		
Stony Coral	1		
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: Sample Name or #	0M	List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	4		
Max Sediment Depth (cm)	2		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	20	Cdium	2
Macroalgae- Fleshy+Calcareous	5	Sarg	2
Turf- algae+cyanobacteria (circle all: g r b)	67	Dasya	1
Encrusting Red Algae			
Sponge	1	O.nb W	1
Hydroid	2		
Octocoral			
Stony Coral	1		
Tunicate	1		
Bare Hard Substrate			
other-... Rock	3		

Total Must = 100%

Quad Label: Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Standard Abbreviations and abbreviation formats

Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
Other- includes: Anemone, Wormrock, Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid.

ScNTB

Project Name 3/20/08 **Site Name / Transect Name** T3 03

Date **Data Collector** ARW **Data Entry**

Quad Label: 16M Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	17		
Max Sediment Depth (cm)	15		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	100		
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: 8M Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	0		
Max Sediment Depth (cm)	14		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	100		
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: 12M Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	3	Carijoa ~~1111~~	2
Max Sediment Depth (cm)	1	1111	1
Sessile Benthos...	**% Cover**	111	3
Sediment- (circle all: sand shell mud)	30		
Macroalgae- Fleshy+Calcareous	12	Sarg	7
Turf- algae+cyanobacteria (circle all: g r b)	45	Geld	3
Encrusting Red Algae	0		
Sponge	1	O. vub	10
Hydroid	2		1
Octocoral	4		
Stony Coral	3		
Tunicate	1		
Bare Hard Substrate			
other-... Bry	2		

Total Must = 100%

Quad Label: 6M Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	0		
Max Sediment Depth (cm)	15		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	100		
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Standard Abbreviations: and abbreviation formats

Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
Other- includes: Anemone/Wormrock, Annelid (excludi...

Project Name SCNTB **Site Name / Transect Name** 03

Date 3/21/08 **Data Collector** JC **Data Entry**

Quad Label: Sample Name or # 18		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	14		
Max Sediment Depth (cm)	8		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	94		
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)	1		
Encrusting Red Algae	2		
Sponge			
Hydroid			
Octocoral	0		
Stony Coral	0		
Tunicate			
Bare Hard Substrate	3		
other-...			

Total Must = 100%

Quad Label: Sample Name or # 14		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	36	Sarg	4
Max Sediment Depth (cm)	3	Carijoa	2
Sessile Benthos...	**% Cover**	JS	8
Sediment- (circle all: sand shell mud)	5	D.vib (II)	9
Macroalgae- Fleshy+Calcareous	5		5
Turf- algae+cyanobacteria (circle all: g r b)	65		4
Encrusting Red Algae	1		2
Sponge	2	(II)	1
Hydroid	2		
Octocoral	2		
Stony Coral	3		
Tunicate	3		
Bare Hard Substrate	1		
other-... worm	1		
bryo	10		

Total Must = 100%

Quad Label: Sample Name or # 10		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	8	Carijoa	7
Max Sediment Depth (cm)	5	D.vib (II)	1
Sessile Benthos...	**% Cover**	Carijoa	4
Sediment- (circle all: sand shell mud)	94		
Macroalgae- Fleshy+Calcareous	1		
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral	1		
Stony Coral	1		
Tunicate			
Bare Hard Substrate	1		
other-... bryo	1		
worm	1		

Total Must = 100%

Quad Label: Sample Name or # 2		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	7	Gelidium	1
Max Sediment Depth (cm)	2	D.vib (II)	1
Sessile Benthos...	**% Cover**	Carijoa (II)	4
Sediment- (circle all: sand shell mud)	8	"	2
Macroalgae- Fleshy+Calcareous	2	"	5
Turf- algae+cyanobacteria (circle all: g r b)	76		
Encrusting Red Algae	1		
Sponge	2		
Hydroid	3		
Octocoral	4		
Stony Coral	1		
Tunicate	1		
Bare Hard Substrate			
other-... worm	1		
bryo	1		

Total Must = 100%

Standard Abbreviations: and abbreviation formats

Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
Other- includes: Anemone, Wormrock, Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid.

18?

Project Name SCNTB **Site Name / Transect Name** 04

Date 3/21/08 **Data Collector** JC **Data Entry**

Quad Label: 9 Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	0		
Max Sediment Depth (cm)	17		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	100	4m= 0 relief	
Macroalgae- Fleshy+Calcareous		100% S	
Turf- algae+cyanobacteria (circle all: g r b)		17cm depth	
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: 7 Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	0		
Max Sediment Depth (cm)	17		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	100		
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: 10 Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	0		
Max Sediment Depth (cm)	14	5m	
Sessile Benthos...	**% Cover**	0 relief	
Sediment- (circle all: sand shell mud)	100	100% S	
Macroalgae- Fleshy+Calcareous		16cm depth	
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae		3m= 0 relief	
Sponge		100% S	
Hydroid		12cm depth	
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: 1m Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	10	Sarg	6
Max Sediment Depth (cm)	6		
Sessile Benthos...	**% Cover**	O-rob (11)	1
Sediment- (circle all: sand shell mud)	5	Cari O q (11)	7
Macroalgae- Fleshy+Calcareous	7	(11)	3
Turf- algae+cyanobacteria (circle all: g r b)	76	(11)	2
Encrusting Red Algae	1	(11)	1
Sponge	1		4
Hydroid	1		
Octocoral	1		
Stony Coral	1		
Tunicate	4		
Bare Hard Substrate	1		
other-... worm	1		
bryo	1		

Total Must = 100%

Standard Abbreviations: and abbreviation formats

Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
Other: ... Anemone/Wormrock, Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid.

1810

Project Name SCNTB **Site Name / Transect Name** 04

Date 3/21/08 **Data Collector** AH **Data Entry**

Quad Label: Sample Name or # 8M		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	0		
Max Sediment Depth (cm)	15		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	100		
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: Sample Name or # 4M		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	0		
Max Sediment Depth (cm)	14		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	100		
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: Sample Name or # 2M		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	7	D, S	2
Max Sediment Depth (cm)	2		1
Sessile Benthos...	**% Cover**	Cor; Jo III	2
Sediment- (circle all: sand shell mud)	50	II	3
Macroalgae- Fleshy+Calcareous	8	III	1
Turf- algae+cyanobacteria (circle all: g r b)	30	L. Lig	49
Encrusting Red Algae			
Sponge	1	Sarg	8
Hydroid	3		
Octocoral	5		
Stony Coral	1		
Tunicate			
Bare Hard Substrate			
other-... Bry	2		

Total Must = 100%

Quad Label: Sample Name or # 0M		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	15	Sarg	4
Max Sediment Depth (cm)	10		
Sessile Benthos...	**% Cover**	Cor; Jo III	2
Sediment- (circle all: sand shell mud)	35		8
Macroalgae- Fleshy+Calcareous	3	III	3
Turf- algae+cyanobacteria (circle all: g r b)	55	L. Lig	10
Encrusting Red Algae			
Sponge	1		
Hydroid	1		
Octocoral	3		
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Standard Abbreviations and abbreviation formats

Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
Other- includes: Anemone, Wormrock, Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid.

Narrow edge of HB w/ dead sm. O. rob & tall Lepto v., then all buried w/ tops of tall Lepto V.'s [illegible] beyond ↓ ephemeral

205°

Project Name SCNTB **Site Name / Transect Name** J2

Date 3/22/08 **Data Collector** LF **Data Entry**

Quad Label: Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	9 m	100% sand	
Max Sediment Depth (cm)		30 cm	
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous	8 m	100% sand	
Turf- algae+cyanobacteria (circle all: g r b)		28 cm	
Encrusting Red Algae			
Sponge			
Hydroid	6 m	100% sand	
Octocoral		23 cm	
Stony Coral			
Tunicate	4 m	99% sand	11 cm
Bare Hard Substrate		1% octo	
other-...		Lepto v.	58 cm
		w gastropods on it	

Total Must = 100%

Dasy [illegible] lower [illegible]

Quad Label: Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge	(X)		
Hydroid	Missing	ZERO	
Octocoral	QUAD	BEAMR-	
Stony Coral	USE	PHOTOS FROM	
Tunicate	START –	Some	
Bare Hard Substrate	relief &	exposed	
other-... HB, lots	of	leptos	
dead small	O.	robustas,	

Total Must = 100%

looks recently buried & exposed

Quad Label: 1 m Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	2	O. rob	3, 2
Max Sediment Depth (cm)	4	on	
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	77		
Macroalgae- Fleshy+Calcareous	0	Titanid	12
Turf- algae+cyanobacteria (circle all: g r b)	12		
Encrusting Red Algae		Lepto V	80, 75
Sponge			90
Hydroid			
Octocoral	8	Lp. lobes	18
Stony Coral	1		
Tunicate	1	2 dead O.	rob
Bare Hard Substrate		on small	HB ~~[illegible]~~
other-... barn	1	were pools	barnacles

Total Must = 100%

Quad Label: Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

8H 1507N 72/05 at [illegible] 01

Standard Abbreviations: and abbreviation formats

Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg…
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex… except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int…
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
[illegible] Annelid (excluding wormrock) Barnacle Bivalve Bryozoan *Millepora* sp., Seagrass, Zoanthid,

Project Name SCNTB **Site Name / Transect Name** J2

Date 3/22/08 **Data Collector** AH **Data Entry**

Quad Label: Sample Name or # 7M		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	0		
Max Sediment Depth (cm)	13		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	100		
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: Sample Name or # 5M		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	0		
Max Sediment Depth (cm)	13		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	100		
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: Sample Name or # 3M		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	0	Living	45
Max Sediment Depth (cm)	10		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	94		
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral	5		
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-... Barn	1		

Total Must = 100%

Quad Label: Sample Name or # 2M		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	0		
Max Sediment Depth (cm)	10		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	100		
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Standard Abbreviations: and abbreviation formats

Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
Other- includes: Anemone, Wormrock, Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid.

gum 8 20 I 2 60 cm ht ledge w/ tons of sea lords 129° Cog Cyp Crypto

Project Name SCNTB **Site Name / Transect Name** L1

Date 24-Mar-08 **Data Collector** LF **Data Entry**

Quad Label: 16 (Sample Name or #)		List macroalgae Genus % / List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	3	Sarg	10
Max Sediment Depth (cm)	1		
Sessile Benthos...	**% Cover**	Telesto	5
Sediment- (circle all: sand shell mud)	20		
Macroalgae- Fleshy+Calcareous	11		
Turf- algae+cyanobacteria (circle all: g r b)	55		
Encrusting Red Algae	2		
Sponge	1		
Hydroid	1		
Octocoral	1		
Stony Coral	0		
Tunicate	1		
Bare Hard Substrate	2		
other-... bryo	5 (fan)		
worm	1		

Total Must = 100%

Quad #4 100% sand 14 cm

Quad Label: 14 (Sample Name or #)		List macroalgae Genus % / List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	2		
Max Sediment Depth (cm)	2		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	25	Sarg	6
Macroalgae- Fleshy+Calcareous	7	Gelidium	1
Turf- algae+cyanobacteria (circle all: g r b)	51		
Encrusting Red Algae	3		
Sponge	1	O.rob	2,1,3
Hydroid	1		
Octocoral	0		
Stony Coral	1		
Tunicate	1		
Bare Hard Substrate	3		
other-... bryo	4	worm	1
barna	2		

Total Must = 100%

Quad Label: 8 (Sample Name or #)		List macroalgae Genus % / List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	32	Telesto	2,6,9,7
Max Sediment Depth (cm)	5		12,5,9
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	15		
Macroalgae- Fleshy+Calcareous	6		
Turf- algae+cyanobacteria (circle all: g r b)	43	O.rob	4,3,1
Encrusting Red Algae	3		2,1,1,1
Sponge	15		
Hydroid	1		
Octocoral	3	Sarg	4
Stony Coral	1	Crypto/lobophora	1
Tunicate	1		
Bare Hard Substrate	2		
other-... anem	1	bryo	8
worm	1		

Total Must = 100%

Quad Label: 10 (Sample Name or #)		List macroalgae Genus % / List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	4	Sargas	1
Max Sediment Depth (cm)	6		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	70	O.rob	1,2
Macroalgae- Fleshy+Calcareous	2		1,1,2
Turf- algae+cyanobacteria (circle all: g r b)	19		
Encrusting Red Algae	1		
Sponge	0		
Hydroid	0		
Octocoral	0		
Stony Coral	1		
Tunicate	0		
Bare Hard Substrate	5		
other-... ~~barnac 2~~			
worm	1	Bryo	1

Total Must = 100%

Standard Abbreviations: and abbreviation formats
Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Brythamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
Other: ... Anemone/Wormrock, Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid

129°

Project Name SCNTB **Site Name / Transect Name** L1

Date 24-Mar-08 **Data Collector** JC **Data Entry**

Quad Label: Sample Name or # 18		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	37	Sarg	4
Max Sediment Depth (cm)	1	Wrong	5
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	3	Cario a 5	4
Macroalgae- Fleshy+Calcareous	40		20
Turf- algae+cyanobacteria (circle all: g r b)	50		5
Encrusting Red Algae	2		6
Sponge	1	Orob 5	1
Hydroid	1		2
Octocoral	3		4
Stony Coral	1		
Tunicate	1		
Bare Hard Substrate	0		
other-... byo	8		
worm	1		

Total Must = 100%

Quad Label: Sample Name or # 14		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	5	Sarg	7
Max Sediment Depth (cm)	2		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	83		
Macroalgae- Fleshy+Calcareous	8		
Turf- algae+cyanobacteria (circle all: g r b)	2		
Encrusting Red Algae	1		
Sponge	1		
Hydroid	1		
Octocoral	2		
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-... worm	1		
byo	3		

Total Must = 100%

Quad Label: Sample Name or # 10		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	7	Sarg	14
Max Sediment Depth (cm)	1		
Sessile Benthos...	**% Cover**	Orob 3	5
Sediment- (circle all: sand shell mud)	15		1
Macroalgae- Fleshy+Calcareous	15	Cariya	4
Turf- algae+cyanobacteria (circle all: g r b)	58		2
Encrusting Red Algae	1	2	1
Sponge	1		
Hydroid	1		
Octocoral	1		
Stony Coral	1		
Tunicate	1		
Bare Hard Substrate	0		
other-... worm	1		
byo	5		

Total Must = 100%

Quad Label: Sample Name or # 6		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	22	Sarg	1
Max Sediment Depth (cm)	4		
Sessile Benthos...	**% Cover**	Orob 5	2
Sediment- (circle all: sand shell mud)	10	3	1
Macroalgae- Fleshy+Calcareous	2	Cario a	6
Turf- algae+cyanobacteria (circle all: g r b)	75	2	2
Encrusting Red Algae	2		3
Sponge	1		1
Hydroid	1		5
Octocoral	2		
Stony Coral	1		
Tunicate	1		
Bare Hard Substrate	1		
other-... byo	3		
worm	1		

Total Must = 100%

Standard Abbreviations: and abbreviation formats

Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
Other: Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid,

Project Name SCNTB **Site Name / Transect Name** L1

Date 3/24/08 **Data Collector** JC **Data Entry**

Quad Label: 2 **Sample Name or #**		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	28	Sars	4
Max Sediment Depth (cm)	8		
Sessile Benthos...	**% Cover**	Carijpa	14
Sediment- (circle all: sand shell mud) [sand circled]	60		6
Macroalgae- Fleshy+Calcareous	5	I IIII	1
Turf- algae+cyanobacteria (circle all: g r b)	14		8
Encrusting Red Algae	0		4
Sponge	5		2
Hydroid	1		
Octocoral	5		
Stony Coral	0		
Tunicate	2		
Bare Hard Substrate	0		
other-... bryo	7		
worm	1		

Total Must = 100%

Quad Label: **Sample Name or #**		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: **Sample Name or #**		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: **Sample Name or #**		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Standard Abbreviations: and abbreviation formats

Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
Other- includes: Anemone, Wormrock, Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid.

168°

Project Name SCNTB **Site Name / Transect Name** 12

Date 3/24/08 **Data Collector** AH **Data Entry**

Quad Label: 18M (Sample Name or #)		List macroalgae Genus % / List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	0		
Max Sediment Depth (cm)	5	Sarg	2
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	98		
Macroalgae- Fleshy+Calcareous	2		
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: 10M (Sample Name or #)		List macroalgae Genus % / List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	3		
Max Sediment Depth (cm)	1		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	10	Sarg	40
Macroalgae- Fleshy+Calcareous	40	Cetdium	8
Turf- algae+cyanobacteria (circle all: g r b)	40		
Encrusting Red Algae	2	O.rub	1
Sponge	1		
Hydroid	1		
Octocoral			
Stony Coral	1		
Tunicate	1		
Bare Hard Substrate			
other-... Anemone	1		
Bry	2		

Total Must = 100%

Quad Label: 14M (Sample Name or #)		List macroalgae Genus % / List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	3	Sarg	1
Max Sediment Depth (cm)	1		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	45		
Macroalgae- Fleshy+Calcareous	2		
Turf- algae+cyanobacteria (circle all: g r b)	49		
Encrusting Red Algae	2		
Sponge	1		
Hydroid	1		
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

2M
Relief = 0
Depth = 15
Sand/shell = 100

Total Must = 100%

Quad Label: 6M (Sample Name or #)		List macroalgae Genus % / List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	34	O.rub |||	6
Max Sediment Depth (cm)	3		7
Sessile Benthos...	**% Cover**			5
Sediment- (circle all: sand shell mud)	5		3
Macroalgae- Fleshy+Calcareous	5	|||	1
Turf- algae+cyanobacteria (circle all: g r b)	70	Caulerpa	11
Encrusting Red Algae	3	Sarg	3
Sponge	3		
Hydroid	6		
Octocoral			
Stony Coral	4		
Tunicate	1		
Bare Hard Substrate			
other-... Bry	3		

Total Must = 100%

Standard Abbreviations: and abbreviation formats
Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
... Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid,

48 ft 20 m trans 168° 0 — 6m — 20

Project Name SCNTB **Site Name / Transect Name** L2

Date 3/24/08 **Data Collector** LF **Data Entry**

Quad Label: Sample Name or # 10		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	0		
Max Sediment Depth (cm)	4	Sarg	5
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	95		
Macroalgae- Fleshy+Calcareous	5		
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: Sample Name or # 12		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	3		
Max Sediment Depth (cm)	1		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	10	Sarg	12
Macroalgae- Fleshy+Calcareous	12		
Turf- algae+cyanobacteria (circle all: g r b)	67		
Encrusting Red Algae	2		
Sponge	2		
Hydroid	1		
Octocoral	0		
Stony Coral	0		
Tunicate	0		
Bare Hard Substrate	2		
other-... Bryo	3		
worm	1		

Total Must = 100%

Quad Label: Sample Name or # 8		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	6	Cariya	3
Max Sediment Depth (cm)	1	Telesto	6,2
Sessile Benthos...	**% Cover**	Sarg as	45
Sediment- (circle all: sand shell mud)	8	Gelidium	1
Macroalgae- Fleshy+Calcareous	47		
Turf- algae+cyanobacteria (circle all: g r b)	28	O. rob	4
Encrusting Red Algae	3		
Sponge	1		
Hydroid	1		
Octocoral	1		
Stony Coral	1		
Tunicate	1		
Bare Hard Substrate	2		
other-... worm	1		
bryo	6		

Total Must = 100%

Quad Label: Sample Name or # 4		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	4	Telesto	6,4,1
Max Sediment Depth (cm)	1	Cariy	3
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	10		
Macroalgae- Fleshy+Calcareous	6	Sarg	5
Turf- algae+cyanobacteria (circle all: g r b)	72		
Encrusting Red Algae	2		
Sponge	1		
Hydroid	1		
Octocoral	1		
Stony Coral	0		
Tunicate	0 1		
Bare Hard Substrate	2		
other-... bryo	3		
worm	1		

Total Must = 100%

Standard Abbreviations and abbreviation formats

Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
Other: Barnacle, Bivalve, Bryozoan, *Millepora* sp, Seagrass, Zoanthid

tran = 15 M 0, 1.5, 13, 14.5, 14, 15, 9, 10.5, 13.5 143° G1 Blk Sculpts

49 Px

Project Name SCNTB **Site Name / Transect Name** **Date** 3/24/08 **Data Collector** LF **Data Entry**

Quad Label: Sample Name or #	12	List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	13	0. rob	28, 14, 12
Max Sediment Depth (cm)	7		2, 1, 1, 1
Sessile Benthos…	**% Cover**		
Sediment- (circle all: sand shell mud)	5		
Macroalgae- Fleshy+Calcareous	4	feather bro	
Turf- algae+cyanobacteria (circle all: g r b)	70	Dasya	3
Encrusting Red Algae	5	Sarg	1
Sponge	2		
Hydroid	1		
Octocoral	0		
Stony Coral	5		
Tunicate	3		
Bare Hard Substrate	2		
other-… anem	1	worm 1	
bryo	1		

Total Must = 100%

Quad Label: Sample Name or #	9	List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	14	0. rob	14, 8, 13, 5
Max Sediment Depth (cm)	5	18, 8, 5, 3	1, 1, 1
Sessile Benthos…	**% Cover**		
Sediment- (circle all: sand shell mud)	4		
Macroalgae- Fleshy+Calcareous	1		
Turf- algae+cyanobacteria (circle all: g r b)	63		
Encrusting Red Algae	4	Halymen	1
Sponge	3		
Hydroid	0		
Octocoral	0		
Stony Coral	10		
Tunicate	10		
Bare Hard Substrate	2		
other-… anem	1	bryo 1	
worm	1		

Total Must = 100%

Quad Label: Sample Name or #	7.5	List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	19	0. rob	5, 8, 10, 2
Max Sediment Depth (cm)	2		1, 1, 1, 1, 1, 4
Sessile Benthos…	**% Cover**		
Sediment- (circle all: sand shell mud)	5		
Macroalgae- Fleshy+Calcareous	4		
Turf- algae+cyanobacteria (circle all: g r b)	70		
Encrusting Red Algae	3	Telesto?	4
Sponge	1	orange/yellow/wh. [illegible]	3
Hydroid	1		
Octocoral	1		
Stony Coral	3	Sarg	1
Tunicate	7	Loboph	2
Bare Hard Substrate	2	Shingles	
other-… anem	1	bryo 1	
worm	1		

Total Must = 100%

Quad Label: Sample Name or #	4.5	List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	7	0. rob	1, 5, 2, 1
Max Sediment Depth (cm)	5		1, 2
Sessile Benthos…	**% Cover**		1, 1, 1, 1
Sediment- (circle all: sand shell mud)	6	Lopto √	4
Macroalgae- Fleshy+Calcareous	4	Telesto	2
Turf- algae+cyanobacteria (circle all: g r b)	69		
Encrusting Red Algae	2		
Sponge	1		
Hydroid	0		
Octocoral	1	Loboph	2
Stony Coral	2	Halym	1
Tunicate	10		
Bare Hard Substrate	2		
other-… wo	1	anem 1	
bryo	1		

Total Must = 100%

Standard Abbreviations: and abbreviation formats
Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg…
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex… except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int…
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
Other: … Anemone, Wormrock, Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid,

Project Name SCNTB **Site Name / Transect Name** G1

Date 3/24/08 **Data Collector** LF **Data Entry**

Quad Label: 1.5 **Sample Name or #**		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	19	O. rob 15,6	
Max Sediment Depth (cm)	5		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand, shell mud)	40		
Macroalgae- Fleshy+Calcareous	2	Lepto ✓	8
Turf- algae+cyanobacteria (circle all: g r b)	44	Telesto	3
Encrusting Red Algae	2		
Sponge	1		
Hydroid	0		
Octocoral	1		
Stony Coral	2	Sarg	1
Tunicate	4	Dasya	1
Bare Hard Substrate	1		
other-... worm	1	bmo	1
anem	1		

Total Must = 100%

Quad Label: **Sample Name or #**		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: **Sample Name or #**		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: **Sample Name or #**		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Standard Abbreviations: and abbreviation formats

Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
Other- includes: Anemone, Wormrock, Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid.

15m/10 = 0, 1.5, 3, 4.5, 6, 7.5, 9, 10.5, 12, 13.5

142° G1 Hal

Project Name SCNTB **Site Name / Transect Name** G1

Date 3/24/08 **Data Collector** JC **Data Entry**

*beautiful up low relief but lots benthos

Quad Label: 13.5 Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	12/13	Sarg	3
Max Sediment Depth (cm)	8/4		
Sessile Benthos...	**% Cover**	L.virg	7
Sediment (circle all: sand shell mud)	90/86	Carijoa	3,4,4
Macroalgae Fleshy+Calcareous	7/4	Telesto orange rings large polyps	14
Turf- algae+cyanobacteria (circle all: g r b)	1/57		
Encrusting Red Algae	3	O.rob (3)	8
Sponge	5		3
Hydroid	1	(2)	5
Octocoral	1	(1)	4
Stony Coral	4		2
Tunicate	15		6
Bare Hard Substrate	1	(2)	1
other-... anemone bryo	1		9
worm	1/1		

Total Must = 100%

Quad Label: 6 Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	13	Sarg	6
Max Sediment Depth (cm)	1	Halym	5
Sessile Benthos...	**% Cover**		
Sediment (circle all: sand shell mud)	5	O.rob	6
Macroalgae Fleshy+Calcareous	8		9
Turf- algae+cyanobacteria (circle all: g r b)	58		7
Encrusting Red Algae	4	Carij	4
Sponge	1	#2x	3
Hydroid	2	#2x	2
Octocoral	1		6
Stony Coral	2	Telesto	10
Tunicate	15		
Bare Hard Substrate	1		
other-... anemone	1		
bryo	1		
worm	1		

Total Must = 100%

Quad Label: 3 Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	15	O.rob - 2 bl, branches	21
Max Sediment Depth (cm)	2		9
Sessile Benthos...	**% Cover**		14
Sediment (circle all: sand shell mud)	18	(2)	3
Macroalgae Fleshy+Calcareous	1	(37)	1
Turf- algae+cyanobacteria (circle all: g r b)	62		2
Encrusting Red Algae	11		
Sponge	1		
Hydroid	0		
Octocoral	1		
Stony Coral	8		
Tunicate	6		
Bare Hard Substrate	1		
other-... worm	1		

Total Must = 100%

Quad Label: 0 Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	3	O.rob #2x	1
Max Sediment Depth (cm)	8		2
Sessile Benthos...	**% Cover**		
Sediment (circle all: sand shell mud)	97		
Macroalgae Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)	1		
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral	1		
Tunicate			
Bare Hard Substrate	1		
other-...			

Total Must = 100%

Standard Abbreviations: and abbreviation formats
Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
... Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid.

0, 1.8, 3.6, 5.4, 7.2, 9.0, 10.8, 12.6, 14.4, 16.2 — 86°

18m / 10 = 1.8

Project Name SCNTR **Site Name / Transect Name** G3

Date 24-Mar-08 **Data Collector** JC **Data Entry** 341

Quad Label: Sample Name or # 16.2		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	14	L.virg	20
Max Sediment Depth (cm)	5	Carijoa	4
Sessile Benthos...	**% Cover**	Teleste (11)	1
Sediment- (circle all: sand shell mud)	20	O.hb (22)	1
Macroalgae- Fleshy+Calcareous	1	(8)	2
Turf- algae+cyanobacteria (circle all: g r b)	69	(42)	3
Encrusting Red Algae	3		
Sponge	3		
Hydroid	0		
Octocoral	1		
Stony Coral	1		
Tunicate	1		
Bare Hard Substrate	1		
other-... anemone	2		
worm	1		

Total Must = 100%

Quad Label: Sample Name or # 15.4		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	10/18	Sarg	4
Max Sediment Depth (cm)	13/5	L.virg	18
Sessile Benthos...	**% Cover**		19
Sediment- (circle all: sand shell mud)	10/25		16
Macroalgae- Fleshy+Calcareous	5		15
Turf- algae+cyanobacteria (circle all: g r b)	41	Teleste	1
Encrusting Red Algae	4	Carijoa	3
Sponge	1	O.hb (15)	18
Hydroid	1		1
Octocoral	2	Teleste	3
Stony Coral	7		
Tunicate	11		
Bare Hard Substrate	1		
other-... byo	1		
worm	1		

Total Must = 100%

Quad Label: Sample Name or # 0		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	11	O.hb	1
Max Sediment Depth (cm)	6	Carijoa	1
Sessile Benthos...	**% Cover**	Titan	3
Sediment- (circle all: sand shell mud)	92		
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)	5		
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral	1		
Stony Coral	1		
Tunicate			
Bare Hard Substrate			
other-... worm	1		

Total Must = 100%

Quad Label: Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Standard Abbreviations: and abbreviation formats

Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
Other- includes: Anemone, Wormrock, Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid.

0, 1.8, 3.6, 5.4, 7.2, 9.0, 10.8, 12.6, 14.4, 16.0

86°

Project Name SC/NTB **Site Name / Transect Name** G3

Date 3/24/08 **Data Collector** LF **Data Entry**

Quad Label: 14.4 Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	2	G. rub ll	2
Max Sediment Depth (cm)	12		1
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	98	L. virg	9
Macroalgae- Fleshy+Calcareous			7
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral	1		
Stony Coral	1		
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: 10.8 Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	0		
Max Sediment Depth (cm)	13		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	100		
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: 12.6 Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	0		
Max Sediment Depth (cm)	14		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	100		
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: 9.0 Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	0		
Max Sediment Depth (cm)	7		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	100		
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Standard Abbreviations: and abbreviation formats

Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
Other- includes: Anemone, Wormrock, Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid.

Project Name SCNTB **Site Name / Transect Name** G3

Date 3/24/08 **Data Collector** AH **Data Entry**

Quad Label: Sample Name or # 3.6		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	0		
Max Sediment Depth (cm)	8		
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)	100		
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: Sample Name or # 1.8		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)	8	L. vinq	11
Max Sediment Depth (cm)	6	11	10
Sessile Benthos...	**% Cover**		5
Sediment- (circle all: sand shell mud)	65		16
Macroalgae- Fleshy+Calcareous	9		8
Turf- algae+cyanobacteria (circle all: g r b)	20	D. lac	1
Encrusting Red Algae	1	Dasya	4
Sponge	1	Sarg	4
Hydroid			
Octocoral	2		
Stony Coral	1		
Tunicate	1		
Bare Hard Substrate			
other-...			

Total Must = 100%

Quad Label: Sample Name or #		List macroalgae Genus % List every coral colony ~and coral condition(s)	% cover or max size (cm)
Max Relief (cm)			
Max Sediment Depth (cm)			
Sessile Benthos...	**% Cover**		
Sediment- (circle all: sand shell mud)			
Macroalgae- Fleshy+Calcareous			
Turf- algae+cyanobacteria (circle all: g r b)			
Encrusting Red Algae			
Sponge			
Hydroid			
Octocoral			
Stony Coral			
Tunicate			
Bare Hard Substrate			
other-...			

Total Must = 100%

Standard Abbreviations and abbreviation formats

Macroalgae: Pool to Genus = Genu or Genus: Avra, Bryopsis, Bryothamnion, Caul, Codi, Dasya, Dasycladus, Grac, Hali, Hypn, Sarg...
Octocoral: Genus of each colony = Genu: Gorg, Lept, Plex... except Pseudopterogorgia=Pspt, Plexaurella=Plla, Pseudoplexaura=Pspl
Stony Coral: Genus species of each colony = G spe: A cer, A aga, C nat, M ann, M cav, P ame, O dif, S rad, S sid, S bou, S hya, S int...
Coral condition: W=white disease(s), O=other disease(s), B=bleaching, Coral Stress Index # 0 1 2 3
Other, includes: Anemone, Wormrock, Annelid (excluding wormrock), Barnacle, Bivalve, Bryozoan, *Millepora* sp., Seagrass, Zoanthid

ANAMAR

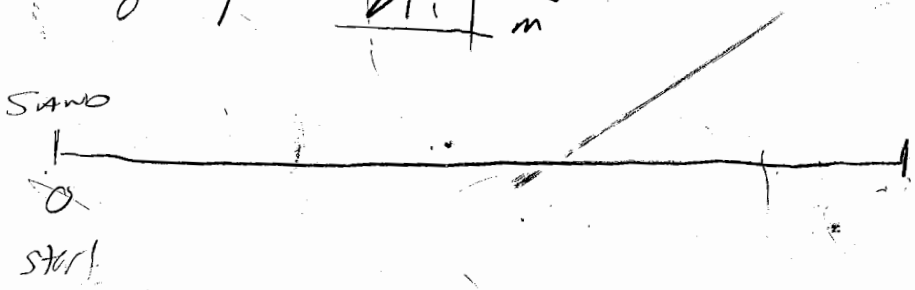
195°

Date: 3/18/08

Site: T1

Dan M,

Rugosity = 21.4 m



Notes

0m – 2.4m Low relief hard bottom (~4 cm relief)

2.4 m – Scarp out to 35 cm high hard bottom

16.5 m feature. At this edge were ~20 Sea Bass. Under ledge were 2 colonies of Leptogorgia virgulata. Surface is rich w/ fleshy algae, Arbacia, Bryozoans, sponges, hydroids, (Codium & Sargassum) surface bar, occasional sand patches where I saw 1 sand dollar & 1 sea star.

16.5 m – 26 m Shallow sand < 2cm over hard substrate, occasional bryozoans, Codium & sargassum → fleshy algae, sponges, ophiuroids of hard bottom that protrude above sand. Saw 1 burrowing anemone at 19.5 m. Also present were hydroids

(Asterias forbesi)
SM. Ochre sea star @ 16.5 m
3 sheepshead at 2 m
1 non-sheepshead weighed barrel Fish - poss. Scup

Lots of these

← Spotted Pinfish

Lg Asterias @ 4 m
forbesi

Site Name: NS9 Heading: 247° 5/18/2008

LF

Sed. depth: 21 cm

Bag # 1.

Notes: coarse sand w/ hash

Vis = 2 ft

depth 20'

temp 55° F

Fix 1 = fine sand, soft
no shell
- sed sample bag #2

Site Name: NS8 Heading 61° LF

Sed Depth: 24 cm

Bag #4

fine soft sand no shell

Fix #1 coarse sand/shell hash/bits of Oculina

Bag #6

Round backscatter anomaly

Site NS6 Heading 197°

LF

Sed depth 23 cm

fine soft sand, Bag #5

depth 20'

VIS 23'

Fix 1 = coarse sand/shell hash, sand dollars

Bag #3, sparse rocks ~1 ft long

@tube worm some fist-size rocks, no attached w/shell Aubs #8, just loose in coarse sand

Fix 2 = transition back to fine sand

3/18/08

LF

Site : NS 5

Heading : 46°

Sed depth : 17cm

Depth = 24'
VIS = 2'

coarse sed/shell hash

oculina frags (same as before)

lost sed bag?

Nadia collected sed in pocket — looks same as last site

sparse cobble
unattached rock (collected one) w/dead oculina recruits & barnacles

---

AH

Site: NS 11
Heading: 47°

Depth : 24 ft
Vis : 6 ft

sed depth = 26

Bag # = 9

Notes : fine sed/

Coarse material w/ muds Bag # = 7 * Bouy pull 1
-sed depth = 15cm

back to fine sediment
-sed depth = 28cm * Bouy pull 2

910-251-4589

3/23/08 NEARSHORE

AH, JC

Site: NS7 Heading: 50°

Depth: 23

Vis: 6 inches

Sed depth: 20

Notes: Sand/fine – Buoy pull in shell/hash, coarse sed.

Sample bag #: 3, 15 2nd sed sample = #12

Site: NS4 Heading: 200°

Depth 20

Vis = 4 inches Bag # 14

Sed depth = 11

Notes – fine sediment, no transition

Site: NS 3 Heading: 37°

Depth 22 Bag # 13, 16

Vis 4 inches ↓ coarse ↓ fine

Sed depth 12cm

coarse shell hash → fine sed

sed depth –

Two Potential HB sites (seaward of 23')

AH JC

NS 10 Heading: 227°

Depth 30

Vis 6 inches

HB
~6 inch relief

urchin

Sed depth	Bag #
5 cm	unmarked

NS 12 Heading: 92°

~~Notes~~

depth 30

vis 4 inches

Sed depths	Bag #
25	17

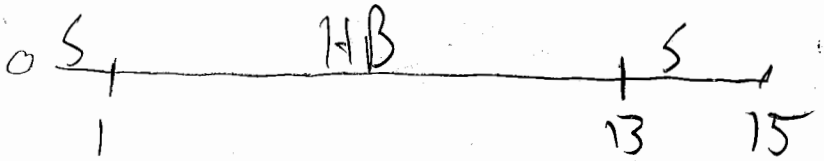
Notes: Shell hash/hard bottom → fine sediment

3/24/08 OFFSHORE

Site: G1 143°

AH

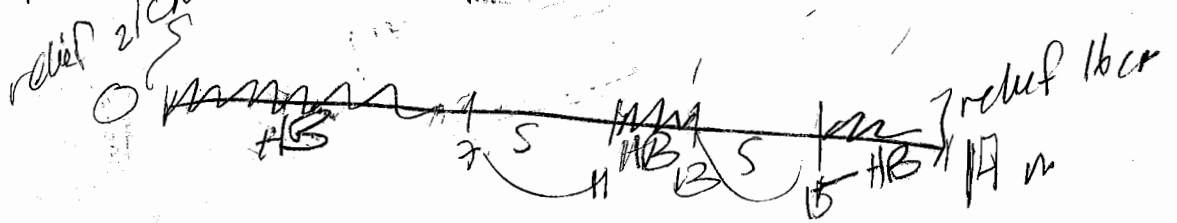
Depth: 49



Rugosity = 15.2 m

Site: G3 Heading: 86°

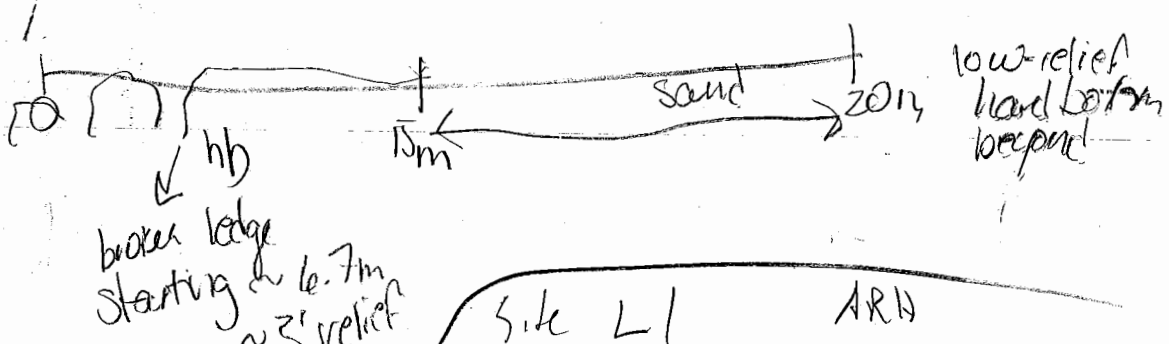
Depth: Rugosity = 17.3



Site L[illegible] 168° (20m)

JC

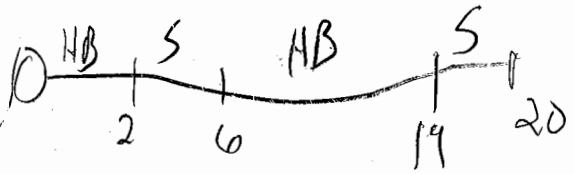
Large ledge. Lots fish: black seabass, porgies, sheepshead, spottail pinfish



Site L1 ARN

Rugosity =

Rugosity: 20.6 M
Large Platform 0.5M relief.



3/21/08 43°

DM T4

0 20

RELIEF: 20, 45

0-6.9 sand 1:1 Leptogorgia virgulata x2

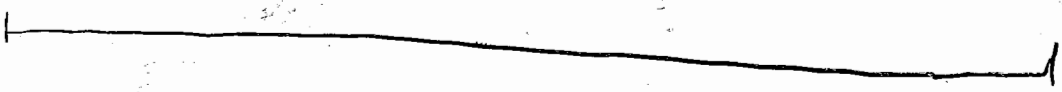
6.9-15.1 Hardbottom with sand overlain <1cm
Leptogorgia v., [illegible], Sargassum, Codium,
Sponges, bryozoans Arbacia p.
1 Sea Bass,

15.1-16.3 Coarse Sand & shell hash

16.3-20 Hardbottom 10cm relief over sand
Bryozoa, Codium, Leptogorgia v.

3/20/08

DM T3



HB
Sand
deeper 1 cm
longer 0.5 m

Relief = 20.35 M

0 SOND

0.2 - 9cm scarp to Hard bottom to 3M

0.8 Luidia

3M - 6M SAND over Hard bottom

6M - 20M Hard bottom

Sparse sargassum, some sponges, bryozoans, 2 sea fans & 1 other octocoral

SAW 3 Black Sea Bass

3/21/08 DM 0-3 347°

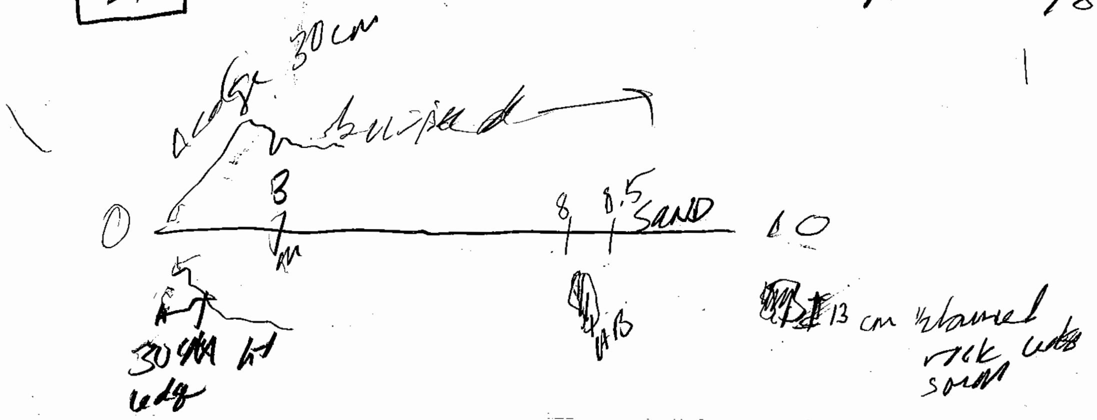
0 ———————————————— 20

Relief = 20.2 M

0 – 4.2 hard bottom
4.2 – 10.4 Sand
10.4 – 14.2 Hard
14.2 – 19.5 Sand
19.5 – 20 Hard

~30 cm Relief max

LF 04 181°



lots of
cavejon
L. rubes
L. pm02
L. slug

rub
10.3

0-1 3/21/08 DM 334°

0 ——————————————— 20

Relief = 20.5 M

0-4 m Hard bottom with overlay of sand < 1 cm
sponges, white octocoral, sargassum, Black sea bass, Barbacia, Asterias,
@ 1.7 m @ 30 cm scarp exists

4-7.3 sand

7.3-10.1 Hard bottom w/sponges, algae, Arbacia, bryozoans

10.1-17.2 sand

17.2-20 Hard bottom, max relief 20 cm, Lobsters

SCNTB 3/22/08

JC

Site: J2 (J. Craft)

↳ only very small patch of hb around 0m

Rugosity = 10:3

Leptos poking through sand out to 4m (14cm thick)

max depth 4m

Site: J1

1 drop on fine sand
sample bag #10

Rugosity

SEDIMENT SAMPLES 3/23/08

LF/AH/JC

SITE NAME	BAG #	NOTES
NS 7	15	fine sand (landed on it)
	~~15~~ 12	coarse sand/shell hash (bag opened, lost a lot)
		→ Fix 1 = start coarse Fix 2 = end coarse/back to sand
NS 4	14	fine sand — no transitions
↳ Circular backscatter anomaly		
NS 3	13	coarse/shell hash (landed in it)
	16	fine (Fix = 1)
NS10	unmarked bag	fine, found around the Hardbottom
NS12	17	coarse/shell hash
		Fix 1 = transition to fine sand

LF | JC | AH

SEDIMENT SAMPLES

SITE NAME	BAG #	NOTES
NS9	1	on feature - coarse sand / shell
NS9	2	off feature - fine (fix 1)
NS8	4	off feature - fine
NS8	6	on feature - coarse (fix 2)
NS10	5	off feature - fine
NS10	3	on feature - coarse fix @ beginning + end of feature
NS5	8	no transdons, fines were lost, not suitable for sieve anal.
NS11	9	fine sed - at weight
NS11	7	coarse sed w/ mud (sed ridges, mud troughs)

APPENDIX E

FIELD LOGS

1. Daily Control Reports
2. Boat Safety Checklists
3. Dive Safety Checklists
4. Dive Logs

Daily Control Reports

Daily Control Reports

ANAMAR
Environmental Consulting, Inc.

Daily Quality Control Report

PROJECT: W912HN-08-C-0003 Surf City / North Topsail

This report will contain a description of the work performed, samples collected, general conditions, corrective actions taken, departures from the sampling plans, and any other notes or comments needed that will document the day's activities.

ANAMAR Environmental Consulting, Inc.
2106 NW 67th Place, Suite 5
Gainesville, FL 32653
(352) 377-5770 FAX (352) 378-1500

Name: Nadia Lombardero
Date: ~~March 3, 2008~~ 03/17/08

Samples Collected: N/A

Notes, Comments: Arrived to dock @ 0700. Had brief meeting with Captain Campeau. We checked weather and called rough weather (winds from NE) - no diving in the AM. Will wait until PM to make an afternoon call. After reviewing the weather data from the closest buoys (19 knots NNE gusting to 23 knots while the offshore buoy indicated 6 feet waves offshore) the captain gave his final determination and we called off the field day by 1130 after all equipment was checked and set-up.

Refer to electronic daily report for full weather information

ANAMAR
Environmental Consulting, Inc.

Daily Quality Control Report

PROJECT: SCNTB HB Characterization - W912HN-08-C-0009

This report will contain a description of the work performed, samples collected, general conditions, corrective actions taken, departures from the sampling plans, and any other notes or comments needed that will document the day's activities.

ANAMAR Environmental Consulting, Inc.
2106 NW 67th Place, Suite 5
Gainesville, FL 32653
(352) 377-5770 FAX (352) 378-1500

Name: Nadia Lombardero
Date: 3/18/08

Samples Collected: See below

Notes, Comments: Arrived to dock @ 0730, otherwise there will not be enough penetrating light to dive and see.

0650 EDT, Winds E 11.7 kts gust to 15.5. Air Temp - 57.3°F. Dew Pt 43. BP 1029.7. Water Temp 57.2. Wave Ht. 2.6ft Wave Dom Pe. 4sec

Left Marina at 0835. Sea state at NR Inlet 2-3ft

First site → NS9 - (The following sites were surveyed in order:
NS8
NS6
NS5
NS11

Nearshore conditions worsened, rendering further nearshore work impossible. Divers moved work offshore.

Site surveyed offshore: T1

Finished offshore work and returned to boat dock by 1700.

Refer to electronic daily report for full weather information and for details of each dive.

ANAMAR
Environmental Consulting, Inc.

Daily Quality Control Report

PROJECT: W912HN-08-C-0009 Surf City / North Topsail

This report will contain a description of the work performed, samples collected, general conditions, corrective actions taken, departures from the sampling plans, and any other notes or comments needed that will document the day's activities.

ANAMAR Environmental Consulting, Inc.
2106 NW 67th Place, Suite 5
Gainesville, FL 32653
(352) 377-5770 FAX (352) 378-1500

Name: Nadia Lombardero
Date: 03/19/08 and 03/20/08

Samples Collected: N/A

Notes, Comments: Contacted Captain both days at 0630 to confirm weather forecast and buoy information. Electronic copies of forecast are included with this Daily Report. Captain and crew agreed to call these weather days. Winds were coming from wrong directions, wave height was too high, and very importantly, surface current was too fast for a safe SCUBA operation.

ANAMAR
Environmental Consulting, Inc.

Daily Quality Control Report

PROJECT: W912HN-08-C-0009 Surf City / North Topsail

This report will contain a description of the work performed, samples collected, general conditions, corrective actions taken, departures from the sampling plans, and any other notes or comments needed that will document the day's activities.

ANAMAR Environmental Consulting, Inc.
2106 NW 67th Place, Suite 5
Gainesville, FL 32653
(352) 377-5770 FAX (352) 378-1500

Name: Nadia Lombardo
Date: 5/21/08

Samples Collected: N/A

Notes, Comments: Meet at dock @ 0715 to unload tanks, left dock @ 0740. Seas 1-2 feet NW wind 5-10 winds headed towards T to continue transect. (T3) followed by T4, then O1, O3, and O4.

Returned to dock @ 1840, cleaned-up gear, filled Tanks. Finished @ 2030

Contacted Aquatic Safari to finalize plans for Saturday as they were the stand-by ~~pier~~ boat for project. Unfortunately they retracted their availability. Called Scuba Pro for another boat, but they weren't available. The UNCW Captains found us a replacement boat, Captain Tom Collins, boat's name Spirit.

Weather for next day appeared unpredictable. Decided to get up at 0600

ANAMAR
Environmental Consulting, Inc.

Daily Quality Control Report

PROJECT: W912HN-08-C-0009 Surf City / North Topsail

This report will contain a description of the work performed, samples collected, general conditions, corrective actions taken, departures from the sampling plans, and any other notes or comments needed that will document the day's activities.

ANAMAR Environmental Consulting, Inc.
2106 NW 67th Place, Suite 5
Gainesville, FL 32653
(352) 377-5770 FAX (352) 378-1500

Name: Nadia Lombardero
Date: 03/22/08

Samples Collected: ~~N/A~~ NC Collected a sediment sample @ J1 - all sand site
(Note: e-mail request from Murray to receive copies of logs.-)
Murray.Degnan@usace.army.mil

Notes, Comments: Contacted captain Ch/Kris (replacement vessel for weekend work) at 0600. Captain & diving crew made determination to dive and contacted COE inspector at 0630. Requested 0830 meeting time @ dock. Crew (ANAMAR) picked up 17 SUBA cylinders. Crew (CPE) arrived ahead of time @ dock to start transfering equipment from R/V Seawhawk. Both crews prepared equipment and were ready by 0830. COE inspector Murray was delayed, he arrived @ 0915. ANAMAR's lead diver gave a daily safety meeting, the Captain instructed all passangers regarding vessel safety rules. Left dock aprox @ 10.00

Weather was about SW ~ 10 knots, Seas 3-4 and building through the day.

Dive team surveyed station J2 (Ken's suggestion after reviewing sidescan data). Divers found small covered ledge. Lauren's drysuit flooded at second dive J1. We are experiencing problems with the weight of the additional 30 cf tanks. the BC's are not designed for the extra lopsided weight. We belive that the heavy hanging tanks (while seating on gunnel waiting to enter the site) are creating undue stress on the BC's and are stretching and pulling the dry suit seals. (I will write COE DQR and explain why the 30 cf tank is not only unnecessary for scientific diving operations at shallow depths (<50ft) but they are a hazard.) One engine in boat failed and Captain decided to head back, seas were also building. Arrived @ dock @ 1530

Side note

Finished cleaning equipment & filling tanks @ 1645

ANAMAR
Environmental Consulting, Inc.

Daily Quality Control Report

PROJECT: W912HN-08-C-0009 Surf City / North Topsail

This report will contain a description of the work performed, samples collected, general conditions, corrective actions taken, departures from the sampling plans, and any other notes or comments needed that will document the day's activities.

ANAMAR Environmental Consulting, Inc.
2106 NW 67th Place, Suite 5
Gainesville, FL 32653
(352) 377-5770 FAX (352) 378-1500

Name: Nadia Lombardero
Date: 03/23/08

Samples Collected: N/A

Notes, Comments: Monitored weather through AM. there was a small craft advisory until 11 AM. meet @ dock @ 12:30. After brief meetings (safety, boat, diving) headed towards the last nearshore sites. Winds around 10-15 Knots, small swells (2-3 feet), fairly fast current. Monitored carefully through day.
NL ~~Offshore~~ Inshore visibility was poor. Sedimentation had suspended from last week's storms and strong winds.
Finished the 3 nearshore stations → all sand → no need for transects. In lieu of transects we did two more bounce dives beyond the -23 contour line. The dives were to find hard bottom but the water was too turbid to conduct a BEAMR survey.
Seas building up while finished last inshore site. Headed back to the dock and cleaned gear. Exchange tanks, finished leaving dive shop @ 2000.

C:\Documents and Settings\Nadia\Local Settings\Temporary Internet Files\Content.Outlook\5XK3COK5\Field Paperwork Kit.xlsDQCR

ANAMAR
Environmental Consulting, Inc.

Daily Quality Control Report

PROJECT: W912-ATN-08-C-0009 Surf City / North Topsail

This report will contain a description of the work performed, samples collected, general conditions, corrective actions taken, departures from the sampling plans, and any other notes or comments needed that will document the day's activities.

ANAMAR Environmental Consulting, Inc.
2106 NW 67th Place, Suite 5
Gainesville, FL 32653
(352) 377-5770 FAX (352) 378-1500

Name: Nadia Lombardero
Date: 3/24/08

Samples Collected: N/A

Notes, Comments: Called COE inspector & boat Captain @ 06:00. Decision from night before was confirmed. Travel to dock to install equipment at 07:00. COE inspector arrived @ 07:30. Had boat briefing and headed to the last 4 offshore stations. G & L. Weather was a little problematic, 15-20 Knot winds 2-4 feet waves, fast current. made a determination to dive but monitor very carefully. After first dive weather improved. made a decision to finish all stations if possible. Were successful and finished! Returned to dock at 1800. Returned tanks and clear gear. Finished @ 1945.

Boat Safety Checklists

Boat Safety Checklists

SAFETY CHECKLIST FOR LAUNCHES, MOTORBOATS AND SKIFFS

Contract # and title or Organization:

W912HN-08-C-0009 USCOE Willmington Surf City/N. Topsail

Contractor or Operator:	Subcontractor:
ANAMAR	CPE
Name of equipment: RV SEAHAWK Date of inspection: 3/17/08	Superintendent or inspector: Scott ~~Gare~~ AIKEN

This checklist references EM 385 1-1, revised 3 November 2003	Yes	No	N/A
1. Is a qualified crew person assigned to assist with deck duties under the following circumstances: (19.C.01) a. When extended trips(more than 2 hours) are made from the work site? b. When conditions of navigation make it hazardous for an operator to leave the wheel while underway? c. When operations other than tying-in require the handling of lines? d. When operating at night or in inclement weather? e. When towing?	✓ ✓ ✓ ✓		
2. Are all motorboats, launches and skiffs posted with the number of passengers and weight they can carry? (19.C.02)			✓
3. Is there a PFD available for each passenger and crewmember? (19.C.02)	✓		
4. Do all launches and motorboats that are less than 26 feet in length have at least one 1A-10B:C fire extinguisher on board? (19.C.03)			✓
5. Do all launches and motorboats that are 26 feet or more in length have at least 2 1A-10B:C fire extinguishers on board? (19.C.03)	✓		
6. Do all launches and motorboats that have gasoline or liquid petroleum gas power plants or equipment in cabins, compartments, or confined spaces have built-in automatic CO2 or other equally effective type of fire extinguishing system? (19.C.03)			✓
7. Are all launches and motorboats equipped with "kill (dead man) switches"? (19.C.02(d))	✓		

SAD Form 1437b-R Previous editions may be used for contract submittals prior to Nov 03.
Reference: EM 385-1-1, 3 November 2003 edition.

	Yes	No	N/A
8. Have all motorboat operators completed the following training? a. A boating safety course meeting the USCG Auxiliary, National Associate of Safety Boating Law Administrators (NASBLA), or equivalent; and b. Motorboat handling training, based on the type of boats they will operate, provided by qualified instructors (in-house or other). c. Operators must pass a written and operational test d. Current USCG licensed personnel are exempt from the boating safety training, but they shall complete the written exam and operational test. (19.C.05)	✓		
7. Remarks: (Enter actions taken for "no" answers.)			
Contractor inspector signature 3/17/08	✓		
Contractor QC/safety officer/project manager signature 3/17/08	✓		

SAD Form 1437b-R Previous editions may be used for contract submittals prior to Nov 03.
Reference: EM 385-1-1, 3 November 2003 edition.

SAFETY CHECKLIST FOR LAUNCHES, MOTORBOATS AND SKIFFS

Contract # and title or Organization: W912HN-08-C-0009 Surf City / North Topsail	
Contractor or Operator: Tom Collins / Spearit Seawhawk - 29 foot Cabin	Subcontractor: to ANAMAR CPE
Name of equipment: Seawhawk - 29 foot Cabin Date of inspection: 03/22/08	Superintendent or inspector: Murray Degnan

This checklist references EM 385 1-1, revised 3 November 2003	Yes	No	N/A
1. Is a qualified crew person assigned to assist with deck duties under the following circumstances: (19.C.01) a. When extended trips(more than 2 hours) are made from the work site? b. When conditions of navigation make it hazardous for an operator to leave the wheel while underway? c. When operations other than tying-in require the handling of lines? d. When operating at night or in inclement weather? e. When towing?	✓		
2. Are all motorboats, launches and skiffs posted with the number of passengers and weight they can carry? (19.C.02)	✓		
3. Is there a PFD available for each passenger and crewmember? (19.C.02)	✓		
4. Do all launches and motorboats that are less than 26 feet in length have at least one 1A-10B:C fire extinguisher on board? (19.C.03)	N/A ✓		
5. Do all launches and motorboats that are 26 feet or more in length have at least 2 1A-10B:C fire extinguishers on board? (19.C.03)	✓		
6. Do all launches and motorboats that have gasoline or liquid petroleum gas power plants or equipment in cabins, compartments, or confined spaces have built-in automatic CO2 or other equally effective type of fire extinguishing system? (19.C.03)	N/A		
7. Are all launches and motorboats equipped with "kill (dead man) switches"? (19.C.02(d))	✓		

SAD Form 1437b-R Previous editions may be used for contract submittals prior to Nov 03.
Reference: EM 385-1-1, 3 November 2003 edition.

	Yes	No	N/A
8. Have all motorboat operators completed the following training? a. A boating safety course meeting the USCG Auxiliary, National Associate of Safety Boating Law Administrators (NASBLA), or equivalent; and b. Motorboat handling training, based on the type of boats they will operate, provided by qualified instructors (in-house or other). c. Operators must pass a written and operational test d. Current USCG licensed personnel are exempt from the boating safety training, but they shall complete the written exam and operational test. (19.C.05)	✓		
7. Remarks: (Enter actions taken for "no" answers.)			
Contractor inspector signature Yadira Sandoval	✓		
Contractor QC/safety officer/project manager signature Yadira Sandoval	✓		

SAD Form 1437b-R Previous editions may be used for contract submittals prior to Nov 03.
Reference: EM 385-1-1, 3 November 2003 edition.

Dive Safety Checklists

APPENDIX 4
DIVING SAFETY AND PLANNING CHECKLIST

A. IDENTIFY AND ANALYZE POTENTIAL HAZARDS

✓ **Natural Hazards:**

1. Atmospheric:
   - ✓ Exposure of personnel to extreme conditions
   - ✓ Adverse exposure of equipment and supplies to elements
   - ✓ Delays or disruptions caused by weather
2. Surface:
   - ✓ Sea sickness
   - ✓ Water entry and exit
   - ✓ Handling of heavy equipment in rough seas
   - ✓ Maintaining location in tides and currents
   - N/A Ice, flotsam, kelp, and petroleum in the water
   - ✓ Delays or disruption caused by sea state
3. Underwater and Bottom:
   - ✓ Depth which exceeds diving limits or limits of available equipment
   - ✓ Exposure to cold temperatures
   - ✓ Dangerous marine life
   - ✓ Tides and currents
   - ✓ Limited visibility
   - ✓ Bottom obstructions
   - N/A Ice (underwater pressure ridges, loss of entry hole, loss of orientation, etc.)
   - N/A Dangerous bottom conditions (mud, drop-offs, etc.)

✓ **On-Site Hazards:**

- ✓ Local marine traffic or other conflicting naval operations
- N/A Other conflicting commercial operations
- N/A High-powered active sonar
- N/A Radiation, contamination, and other pollution (chemical, sewer outfalls, etc.)

✓ **Mission Hazards:**

- ✓ Decompression sickness
- ✓ Communications problems
- ✓ Drowning
- ✓ Other trauma (injuries)

✓ **Object Hazards:**

- N/A Entrapment and entanglement
- N/A Shifting or working of object
- N/A Explosives or other ordnance

B. SELECT EQUIPMENT, PERSONNEL, AND EMERGENCY PROCEDURES

✓ **Diving Personnel:**

1. ✓ Assign a complete and properly qualified Diving Team.
2. ✓ Assign the right person to the right task.
3. ✓ Verify that each member of the Diving Team is properly trained and qualified for the equipment and depths involved.

4. Determine that each diver is physically fit to dive, paying attention to the following:
   - general condition and any evidence of fatigue
   - record of last medical exam
   - ears and sinuses
   - severe cold or flu
   - use of stimulants or intoxicants
5. Observe divers for emotional readiness to dive:
   - motivation and professional attitude
   - stability (no noticeably unusual or erratic behavior)

Diving Equipment:

1. Verify that diving gear chosen and diving techniques are adequate and authorized for mission and particular task.
2. Verify that equipment and diving technique are proper for depth involved.
3. Verify that life support equipment has been tested and approved for use.
4. Determine that all necessary support equipment and tools are readily available and are the best for accomplishing the job efficiently and safely.
5. Determine that all related support equipment such as winches, boats, cranes, floats, etc. are operable, safe, and under control of trained personnel.
6. Check that all diving equipment has been properly maintained (with appropriate records) and is in full operating condition.

Emergency Equipment:

1. Obtain suitable communication equipment with sufficient capacity to reach outside help.
2. Check all communications for proper operation.
3. Verify that a recompression chamber is ready for use if required.
4. Verify that a completely stocked first aid kit is at hand.
5. Verify that emergency oxygen is available, that the cylinder is full, and that the unit is operational, including all masks, valves, and resuscitator.
6. Verify that emergency transportation is either standing by or on immediate call.

Emergency Procedures:

1. Know how to obtain medical assistance immediately.
2. For each potential emergency situation, assign specific tasks to the diving team and support personnel.
3. Complete and post Emergency Assistance Checklist and ensure that all personnel are familiar with it.
4. Verify that an up-to-date copy of the U.S. Navy Decompression Tables is available.
5. Ensure that all divers, boat crews, and other support personnel understand all diver hand signals.
6. Predetermine distress signals and call-signs.
7. Ensure that all divers have removed anything from their mouths on which they might choke during a dive (gum, dentures, tobacco).

✓ 8. Thoroughly drill all personnel in emergency procedures, with particular attention to cross-training; drills should include:

Emergency recompression	Rapid undressing
Fire	First aid
Rapid dressing	Embolism
Restoration of breathing	Drowning
Electric shock	Blowup
Entrapment	Lost diver

C. ESTABLISH SAFE DIVING OPERATIONAL PROCEDURES

✓ **Planning, Organization, and Coordination Activities:**

✓ 1. Ensure that other means of accomplishing mission have been considered before deciding to use divers.
✓ 2. Ensure that contingency planning has been conducted.
✓ 3. Carefully state goals and tasks of each mission and develop a flexible plan of operations (dive plan).
✓ 4. Completely brief the diving team and support personnel.
✓ 5. Designate a diving supervisor to be in charge of the mission.
✓ 6. Designate a recordkeeper/timekeeper as needed and verify that (s)he understands the associated duties and responsibilities.
✓ 7. Determine the exact depth of the dive site.
✓ 8. Verify existence of and adequate supply of compressed gas available for all planned diving plus an adequate reserve for emergencies.
✓ 9. Ensure that no operations or actions on the part of the dive team, support personnel, technicians, boat crew, etc. take place without the knowledge of and the approval of the diving supervisor.
✓ 10. Make all efforts at all phases to minimize bottom time. Water depth and the condition of the diver, rather than the amount of work to be done, shall govern the diver's bottom time.
✓ 11. Ensure that current decompression tables are on hand and are used in all planning and scheduling of diving operations.
✓ 12. Instruct all divers and support personnel not to cut any lines until approved by the diving supervisor.
✓ 13. Ensure that ship, boat, or diving craft is securely moored and in position to permit the safest and most efficient operations.
N/A 14. Verify that when surface-supplied technique is being used the ship, boat, or diving craft has at least a two-point moor.
N/A 15. Ensure that when SCUBA operations are being conducted in hazardous conditions a boat can be quickly cast off and moved to a diver in distress.

✓ **Diving Safety Procedures and Safety Measures:**

✓ 1. Ensure that each diver checks his/her own equipment in addition to checks made by tenders, technicians, or other support personnel.
✓ 2. Designate a standby diver, if required, for diving operations; the standby diver should be dressed to the necessary level and ready to enter the water if needed.
✓ 3. Assign buddy divers, when required, for all SCUBA operations.
N/A 4. Take precautions to prevent divers from being fouled on the bottom; if work is conducted inside a wreck or other structure, assign a team of divers to accomplish the task; one diver enters the wreck while the other tends the first diver's lines from point of entry.

N/A 5. Use safety procedures as outlined in relevant OSHA publications for all underwater cutting and welding operations.

N/A 6. Brief all divers and deck personnel on the planned decompression schedules for each particular dive; check provisions for decompressing the diver.

✓ 7. Verify that ship, boat, or diving craft is displaying proper signals, flags, day shapes, or lights to indicate diving operations are in progress (consult publications governing international or inland rules, international/inland local signals, and Navy communications instructions).

✓ 8. Ensure that protection against harmful marine life has been provided.

✓ 9. Ensure that the divers' air supply has been obtained from an inspected source and that air purity meets or exceeds CGA Grade E for air diving and Modified CGA Grade E for nitrox diving.

✓ 10. Thoroughly brief boat crew.

✓ 11. Verify that proper safety and operational equipment is aboard small diving boats or craft.

✓ **Notification of Start of Diving Operations:**

✓ 1. Notify the Diving Officer

✓ 2. Notify the Diving Supervisor

N/A 3. If diving on a large vessel notify the bridge to ensure that ship's personnel will not turn the propeller or thrusters, get underway, activate sonar or other electronics, drop heavy items overboard, shift the moor, activate sea discharges or suctions, operate bow or stern-planes or rudder, or operate vents or torpedo shutters.

✓ 4. Notify other interested parties

[signature] 8/17/08

APPENDIX 3
SCUBA DIVING OPERATIONS PRE-DIVE CHECKLIST

A. Basic Preparation:

- ✓ 1. Verify that proper signals indicating that underwater operations are being conducted are displayed correctly.
- ✓ 2. Ensure that all personnel concerned, or in the vicinity, are informed of diving operations.
- ✓ 3. Verify that diving system components are certified.

B. Equipment Protection:

- ✓ 1. Assemble all members of the diving team, support personnel, and boat crew for a pre-dive briefing.
- ✓ 2. Assemble and lay out all dive equipment, including primary equipment and standby spares and all accessory equipment and tools, for diver (or standby diver).
- ✓ 3. Check all equipment for superficial wear, tears, dents, distortion, or other deficiencies.
- ___ 4. Check all masks, regulators, buoyancy-control devices, hoses, straps, and weight system components for damage.
- N/A 5. If tethered system is used, check harnesses and strength members for wear or damage.

C. General Equipment:

- ✓ 1. Check that all accessory equipment (tools, lights, special systems, spares, etc.) is on site and in working order; in testing lights, tests should be conducted with lights submerged in water and extinguished before removal to prevent overheating and failure.
- ✓ 2. Attach diving ladder.

D. Diving Equipment:

- ✓ 1. Check that scuba cylinders contain suitable primary and back-up air supplies to completely service all divers throughout all phases of the planned operation and that the air source is verified in terms of purity supply pressure.
- ✓ 2. Ensure that qualified personnel are available to operate and stand watch on the dive system according to scientific or commercial diving standards.
- ✓ 3. Attach reserve gas supply to cylinders if necessary, attach BCDs and regulators to cylinders, and set up reserve block as required.

E. Activate the Air Supply and Test System in Accordance with Approved Operating Procedures

- ✓ 1. Gas Supply and Regulators:
  - ✓ a. Verify that cylinder pressure gauges on primary and reserve gas supplies are functional; check all manifolds and valves for operation
  - ✓ b. Pressurize regulators, ensure that primary gas supply is sufficient for diving operation; check hoses and regulators for leaks
  - N/A c. Check emergency or reserve gas supply; verify that the reserve supply is sufficient for diving operation; verify that hoses are free from leaks; verify that the EGR valve is turned off after function checkE 3.

F. Buoyancy Control Devices:

- ✓ 1. Ensure that BCDs are free from damage and that all valves function properly.
- ✓ 2. Ensure that redundant gas supply, if required, is present and functional.

G. Final Preparations:

- ✓ 1. Verify that all necessary records, logs, and timesheets are on the diving station.
- ✓ 2. Check that appropriate decompression tables are readily at hand.
- ✓ 3. Place the dressing bench in position, reasonably close to the diving ladder to minimize diver travel.

Joshua Saulsbury 3/24/08

APPENDIX 3
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✓ Linda Lombardo March 23, 2008

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Ysolda Fernandez 3/22/08

APPENDIX 3
SCUBA DIVING OPERATIONS PRE-DIVE CHECKLIST

A. Basic Preparation:

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B. Equipment Protection:

✓ 1. Assemble all members of the diving team, support personnel, and boat crew for a pre-dive briefing.

✓ 2. Assemble and lay out all dive equipment, including primary equipment and standby spares and all accessory equipment and tools, for diver (or standby diver).

✓ 3. Check all equipment for superficial wear, tears, dents, distortion, or other deficiencies.

✓ 4. Check all masks, regulators, buoyancy-control devices, hoses, straps, and weight system components for damage.

N/A 5. If tethered system is used, check harnesses and strength members for wear or damage.

C. General Equipment:

N/A 1. Check that all accessory equipment (tools, lights, special systems, spares, etc.) is on site and in working order; in testing lights, tests should be conducted with lights submerged in water and extinguished before removal to prevent overheating and failure.

✓ 2. Attach diving ladder.

D. Diving Equipment:

✓ 1. Check that scuba cylinders contain suitable primary and back-up air supplies to completely service all divers throughout all phases of the planned operation and that the air source is verified in terms of purity supply pressure.

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G. Final Preparations:

✓ 1. Verify that all necessary records, logs, and timesheets are on the diving station.

✓ 2. Check that appropriate decompression tables are readily at hand.

N/A 3. Place the dressing bench in position, reasonably close to the diving ladder to minimize diver travel.

3/18/08

APPENDIX 3
SCUBA DIVING OPERATIONS PRE-DIVE CHECKLIST

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✓ 2. Assemble and lay out all dive equipment, including primary equipment and standby spares and all accessory equipment and tools, for diver (or standby diver).
✓ 3. Check all equipment for superficial wear, tears, dents, distortion, or other deficiencies.
✓ 4. Check all masks, regulators, buoyancy-control devices, hoses, straps, and weight system components for damage.
N/A 5. If tethered system is used, check harnesses and strength members for wear or damage.

C. General Equipment:

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✓ 2. Attach diving ladder.

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✓ 2. Check that appropriate decompression tables are readily at hand.
N/A 3. Place the dressing bench in position, reasonably close to the diving ladder to minimize diver travel.

3/21/08 3/21/08

Dive Logs

EVENT: N Topsail / Surf City	SITE SUPERVISOR: Nadia Lombardero (NL)
DATE: 03/18/08	DIVING SUPERVISOR: Dan Marelli (DM)
LOCATION & DIVE OPERATOR: Seahawk - Gerry Compleau	SAFETY DIVER: NL / DM / Lauren Floyd
WEATHER/SEA CONDITIONS: Winds 11-15, Waves 2-3 feet	TIMEKEEPER: NL / DM / Ken Willson / Christy Smith.

		Dive #1	Site: NS9 / NS6 / NS11								Dive #2	Site: NS8 / NS5					
DIVER'S NAME	INITIAL RG	START CYL. (PSIG)	START TIME (24 HR)	END TIME (24 HR)	END CYL. (PSIG)	DIVE TIME (MIN)	MAX. DEPTH (FT)	FINAL RG	SURFACE INTERVAL (MIN)		START CYL. (PSIG)	START TIME (24 HR)	END TIME (24 HR)	END CYL. (PSIG)	DIVE TIME (MIN)	MAX. DEPTH (FT)	FINAL RG
1 Dan Marelli	-	3000	0952	1009	2000	17	22	A	27	A	2000	1038	1049	1600	11	22	B
2 Lauren Floyd	-	3000	0952	1009	2300	17	22	A	27	A	2300	1038	1049	1800	11	22	B
3 Andrew Hanners	-	2800	0952	1009	2000	17	22	A	27	A	2000	1038	1049	1600	11	22	B
4																	
5																	
6																	
1 Dan Marelli	B	1600	1109	1125	900	16	25	C	99	B	3000	1304	1323	2000	19	24	D
2 Lauren Floyd	B	1800	1109	1125	1400	16	25	C	43	C	1400	1208	1234	500	26	21	D
3 Andrew Hanners	B	1300	1109	1125	750	16	25	C	99	B	3200	1304	1323	2200	19	24	D
4																	
5																	
6																	
1 Nadia Lombardero	-	2980	1208	1234	1554	26	21	B									
2 Jessica Craft	-	2900	1208	1234	1500	26	21	B	30	B	1600	1304	1323	500	19	24	C
3																	
4																	
5																	
6																	
1 Dan Marelli	C	3100	1523	1620	100	57	44	J									
2 Andrew Hanners	C	3100	1523	1620	300	57	44	J									
3 Lauren Floyd	B	2900	1523	1620	550	57	44	I									
4																	
5																	
6																	

Comments

EVENT:	North Topsail / Surfcity	SITE SUPERVISOR:	Nadia Lombardero (NL)
DATE:	3/21/08	DIVING SUPERVISOR:	Dan Marelli (DM) & NL
LOCATION & DIVE OPERATOR:	Seaubank / Gerry Compeau	SAFETY DIVER:	DM / NL / Lauren Floyd
WEATHER/SEA CONDITIONS	Sunny/clear NW 5-10kts, 2-3' waves	TIMEKEEPER:	DM / NL / Christy Smith / Kenneth Sm

1/

DIVER'S NAME		INITIAL RG	Dive #1 START CYL. (PSIG)	Site: T3/01 START TIME (24 HR)	END TIME (24 HR)	END CYL. (PSIG)	DIVE TIME (MIN)	MAX. DEPTH (FT)	FINAL RG	SURFACE INTERVAL (MIN)	RG	Dive #2 START CYL. (PSIG)	Site: T4/03 START TIME (24 HR)	END TIME (24 HR)	END CYL. (PSIG)	DIVE TIME (MIN)	MAX. DEPTH (FT)	FINAL RG
1	Dan Marelli	–	2800	0846	0918	~~300~~ 200	~~32~~ 29	44	D	74	D	3100	1032	1110	1300	33	43	I
2	Lauren Floyd	–	2700	0846	0918	1200	32	44	D	↓	D	2764	1032	↓	1300	↓	↓	↓
3	Andrew Hannes	–	3000	0846	0918	1200	32	44	D	↓	D	3000	1032	↓	1000	↓	↓	↓
4	Jessica Craft	–	2700	0846	0918	700	32 ↓	44	D	↓	D	3000	1032	↓	1000	↓	↓	↓
5																		
6																		
1	DM	G	3100	1258	1313	1100	29	44	K	108	G	2800	1501	1524	1300	18	43	K
2	LF	↓	2900	↓	↓	1500	↓	↓	K	↓	G	1500	↓	1524	630	18	↓	K
3	AH	↓	3200	↓	↓	1400	↓	↓	K	↓	G	3000	↓	1534	1500	~~28~~ 33	↓	L
4	JC	↓	2800	↓	↓	900	↓	↓	K	↓	G	3000	↓	1534	1100	~~28~~ 33	↓	L
5																		
6																		
1	LF 1:50	G	~~29~~ 2800	1728	1756	1580	28	47										
2	AH 1:50	G	3000	1726	1756	1400	28	47										
3	JC 1:50	G	3000	1726	1756	1000	28	47										
4																		
5																		
6																		
1																		
2																		
3																		
4																		
5																		
6																		

Comments

1:36
1313
136
14:49

14:50
50
15:00
1:36
16:36
50
17:26

1:50
15:34
16:60
5:56

16:34
12:24 @ 05:24 pm

1313
1188
1:48

EVENT:	Surf City / North Topsail	SITE SUPERVISOR:	Nadia Lombardero (NL)
DATE:	3/22/08	DIVING SUPERVISOR:	Nadia Lombardero
LOCATION & DIVE OPERATOR:	Tom Collins / Spearfish	SAFETY DIVER:	Lauren Floyd / Ken Wilson (KW)
WEATHER/SEA CONDITIONS	SW ≈ 10, Seas 3-4	TIMEKEEPER:	(NL) / KW

		Dive #1	Site: J2							Dive #2	Site: J1					
DIVER'S NAME	INITIAL RG	START CYL. (PSIG)	START TIME (24 HR)	END TIME (24 HR)	END CYL. (PSIG)	DIVE TIME (MIN)	MAX. DEPTH (FT)	FINAL RG	SURFACE INTERVAL (MIN)	START CYL. (PSIG)	START TIME (24 HR)	END TIME (24 HR)	END CYL. (PSIG)	DIVE TIME (MIN)	MAX. DEPTH (FT)	FINAL RG
1 Lauren	–	3100	1116	1148	1600	25	48	E	1:12 D	1600	1300	1314	1000	8	47	G
2 Andrew	–	3200	↓	↓	1400	↓	↓	E	1:12 D	1400	1300	1314	500	8	47	G
3 Jessica	–	3000	↓	↓	1400	↓	↓	E	–	—	—	—	—	—	—	
4																
5																
6																
1 (Lauren)	Increment weather and one engine (out of 2) malfunctioning — decided to head back after finishing J site															
2 Andrew																
3 Jessica																
4																
5																
6																
1																
2																
3																
4																
5																
6																
1																
2																
3																
4																
5																
6																

Comments

EVENT:	Surf City / North Topsail Beach Renourishment	SITE SUPERVISOR:	Nadia Lombardero (NL)
DATE:	03/23/08	DIVING SUPERVISOR:	Nadia Lombardero
LOCATION & DIVE OPERATOR:	Tom Collins / Spearit	SAFETY DIVER:	Lauren Floyd / LF
WEATHER/SEA CONDITIONS	Waited until winds calmed in the PM*	TIMEKEEPER:	NL / LF

		Dive #1	Site: NS7 / NS3 / NS12							Dive #2	Site: NS4 / NS10					
DIVER'S NAME	INITIAL RG	START CYL. (PSIG)	START TIME (24 HR)	END TIME (24 HR)	END CYL. (PSIG)	DIVE TIME (MIN)	MAX. DEPTH (FT)	FINAL RG	SURFACE INTERVAL (MIN)	START CYL. (PSIG)	START TIME (24 HR)	END TIME (24 HR)	END CYL. (PSIG)	DIVE TIME (MIN)	MAX. DEPTH (FT)	FINAL RG
1 Jessica	–	3000	1411	1431	2200	20	23	C	40 C	2200	1510	1522	1500	11	20	E
2 Andrew	–	3200	1411	1431	2200	20	23	C	40 C	2200	1510	1522	1800	11	20	E
3																
4																
5																
6																
1 Jessica	E	1500	1539	1550	1100	11	21	D H	37 D G	3000	1627	1699	2500	12	30	J
2 Andrew	E	1800	1539	1550	1500	11	21	D H	37 D G	3000	1627	1639	2500	12	30	J
3																
4																
5																
6																
1 Jessica		2500	1701	1717	1500	16	30									
2 Andrew		2500	1701	1717	1900	16	30									
3																
4																
5																
6																
1																
2																
3																
4																
5																
6																

Comments 05:17

* See daily report

EVENT:	Surf City - Topsail Beach Nourishment	SITE SUPERVISOR:	Nadia Lombardero (NL)
DATE:	03/24/08	DIVING SUPERVISOR:	Nadia Lombardero
LOCATION & DIVE OPERATOR:	Capt Gerry Compeau	SAFETY DIVER:	Lauren Floyd (LF) and NL
WEATHER/SEA CONDITIONS	N 15K winds, seas 2-4,	TIMEKEEPER:	NL and Ken Wilson

		Dive #1	Site: L1							Dive #2	Site:					
DIVER'S NAME	INITIAL RG	START CYL. (PSIG)	START TIME (24 HR)	END TIME (24 HR)	END CYL. (PSIG)	DIVE TIME (MIN)	MAX. DEPTH (FT)	FINAL RG	SURFACE INTERVAL (MIN)	START CYL. (PSIG)	START TIME (24 HR)	END TIME (24 HR)	END CYL. (PSIG)	DIVE TIME (MIN)	MAX. DEPTH (FT)	FINAL RG
1 Lauren	-	2800	09:37	10:16	1100	32	~~32~~ 48	F	1:11 D	2900	1127	1202	1200	28	48	H
2 Jessica	-	2900	↓	↓	900	↓	48	F	1:11 D	3000	↓	↓ NL 1200	↓	↓	↓	H
3 Andrew	-	3000	↓	↓	750	↓	48	F	1:11 D	3200	↓	↓	1200	↓	↓	H
4																
5																
6																
1 Lauren	E	3000	1352	1426	1500	27	48	J	2:03 F	3000	1629	1702	1400	26	46	J
2 Jessica	E	3000	↓	↓	1200	↓		J	↓ F	3000	1629	1702	1300	↓	↓	J
3 Andrew	E	3000	↓	↓	1500	↓		J	↓ F	3200	1629	1702	1500	↓	↓	J
4																
5																
6																
1																
2																
3																
4																
5																
6																
1																
2																
3																
4																
5																
6																

Comments

1:11

12:02
1:42
13:44

12:02
13:52
1:42

14:26
1:47
16:13

15:26
47
16:13 = 1:13

1629
1426
2:03

34
2:03

1:42

353 - 284
= 195

APPENDIX F

NEARSHORE SAMPLE DESCRIPTIONS AND CLASSIFICATIONS

Sample Description/Classification	
Project Name: Surf City/Top Sail Hardbottom Survey	**Project #:** 07-0009
Date: 4/14/2008	**Analyst:** Jim McCullough

Sample ID:	NS3/#13
USCS Class:	GP

Description:

Sandy Shell Hash.

- poorly graded, fine to coarse grained sand with 2 mm to 2 cm broken shells and gravel
- very few large shells

Sample ID:	NS3/#16
USCS Class:	SW

Description:

Well sorted, light grey, fine to very fine grained sand with very few (<1%) very small (1-2 mm) shell fragments.

Sample ID:	NS4/#14
USCS Class:	SW

Description:

Well graded, light grey fine sand with few (~1%) shell fragments (2 mm - 1 cm).

Sample ID:	NS5
USCS Class:	GP *

Description:

Poorly graded shell fragments, broken shells and rocks.

- Shell fragments 2 mm to 3 cm
- Broken shells up to 9 cm
- Rocks from 1 cm to 5 cm

* Note that sample may not be representative of area due to it being collected in a BCD pocket due to lost bag - field descriptions say fines were probably lost.

Sample ID:	NS6/#3
USCS Class:	GP

Description:

Moderately graded shell hash with coarse grained sand.

- Few (~2%) small (1 cm - 3 cm rocks)
- Most shell hash <1 cm, few 1-3 cm

Sample ID:	NS6/#5
USCS Class:	SW

Description:

Well graded, light grey fine to very fine sand.

- Few (~1%) small shell fragments (1-3 mm)

Sample ID:	NS7/#12
USCS Class:	GP

Description:

Poorly graded shell hash/coarse sand.

- Few rocks (0.5-2 cm)
- Shells range from 2 mm to 2 cm

Sample ID:	NS7/#15
USCS Class:	SW

Description:

Well graded fine to very fine light grey sand with very few (<1%) small (1-3 mm) shell fragments.

Sample ID:	NS8/#4
USCS Class:	SW

Description:

Well graded light to medium grey fine sand, very few (<1%) small shell fragments (2 mm - 1 cm).

Sample ID:	NS8/#6
USCS Class:	GP

Description:

Poorly graded shell hash/coarse sand with few complete bivalve shells (3-5 cm) and well rounded rocks (2-3 cm).

Sample ID:	NS9/#1
USCS Class:	GP

Description:

Very poorly graded shell/shell hash/sand.

- Shell fragments range from 1 mm to 6 cm (most from 3 mm to 1 cm)
- Rocks (<5%) range from 0.5 to 4 cm
-Sand (40-50%) ranges from very fine to coarse

Sample ID:	NS9/#2
USCS Class:	SW

Description:

Well graded light grey fine sand with few (<1%) small (1-5 mm) shell fragments.

Sample ID:	NS10
USCS Class:	SW

Description:

Moderately well sorted, olive grey fine sand with few (2-3%) small shell fragments (2-4 mm).

Sample ID:	NS11/#7
USCS Class:	GP

Description:

Poorly sorted shell hash/sand with few rocks (1-3%, 0.5-3 cm).

- Shell fragments range from ~3 mm to 2.5 cm
- Sand ranges from fine to coarse grain

Sample ID:	NS11/#9 *
USCS Class:	SW

Description:

Moderately well sorted light to medium grey fine sand with few (1-2%) shell fragments (2 mm to 5 mm).

* Note that there were 2 containers labeled NS11/#9, each were visually very similar/identical.

Sample ID:	NS12/#17
USCS Class:	GP

Description:

Very poorly graded shell hash/sand/rocks.

- Rocks (~5%) range from <1 cm to 7 cm
- Shell fragments (~50%) range from 2 mm to 4 cm
- Sand (40-50%) ranges from fine to coarse

APPENDIX G

NEARSHORE DIVE LOCATION MAPS WITH SIDESCAN DATA

NEARSHORE DIVE STATION NS3
SURF CITY/ NORTH TOPSAIL BEACH, N.C.
SHORE PROTECTION PROJECT
HARDBOTTOM RESOURCE CONFIRMATION AND CHARACTERIZATION STUDY

LEGEND

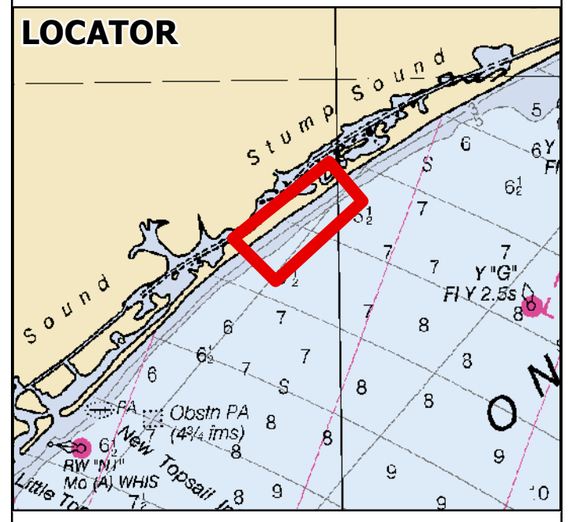
- Dive Location
- USACE Depth of Closure 23ft
- Geodynamics Areas to Investigate

N
W E
S

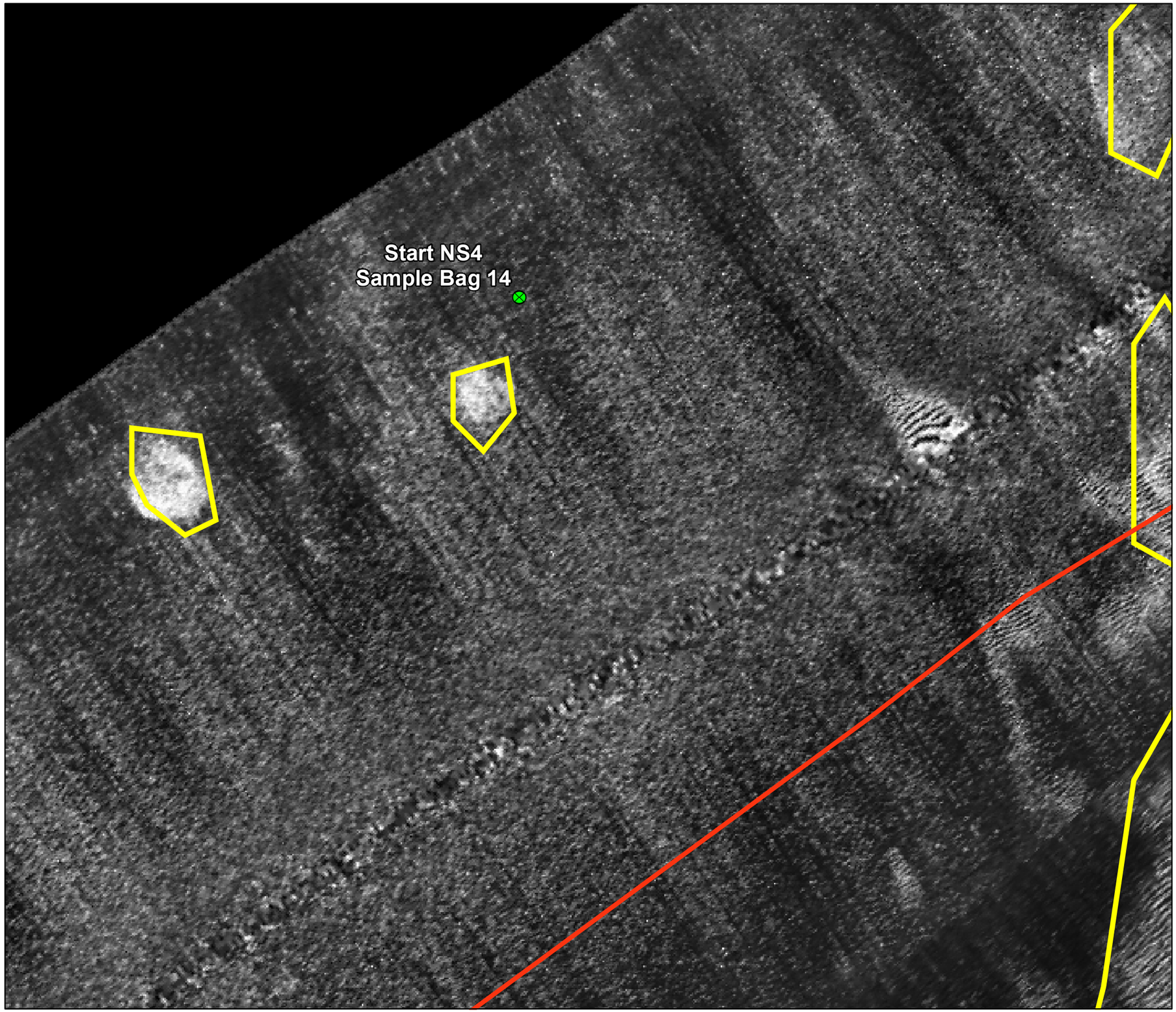
Feet
0 20 40

1 inch equals 20 feet

LOCATOR



DISCLAIMER: This map and/or digital data is for planning purposes only and should not be used to determine the precise location of any feature
Lengths approximate and GIS-derived. Data provided as-is.
22MAY08. ns3.mxd.
Data sources: Geodynamics, CPE, USACE.



NEARSHORE DIVE STATION NS4
SURF CITY/ NORTH TOPSAIL BEACH, N.C.
SHORE PROTECTION PROJECT
HARDBOTTOM RESOURCE CONFIRMATION AND CHARACTERIZATION STUDY

LEGEND

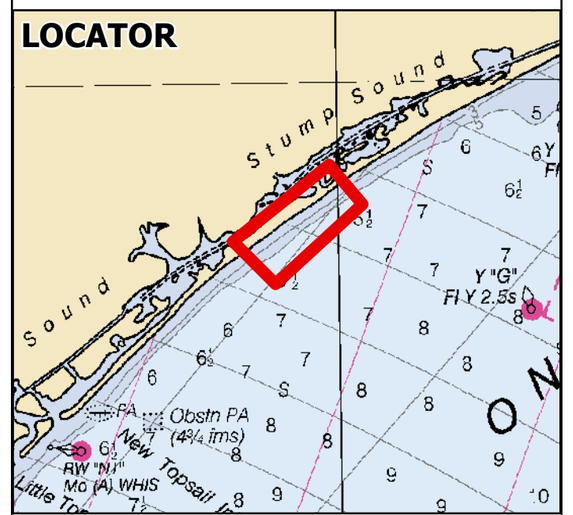
- Dive Location
- USACE Depth of Closure 23ft
- Geodynamics Areas to Investigate

N
W E
S

Feet
0 30 60

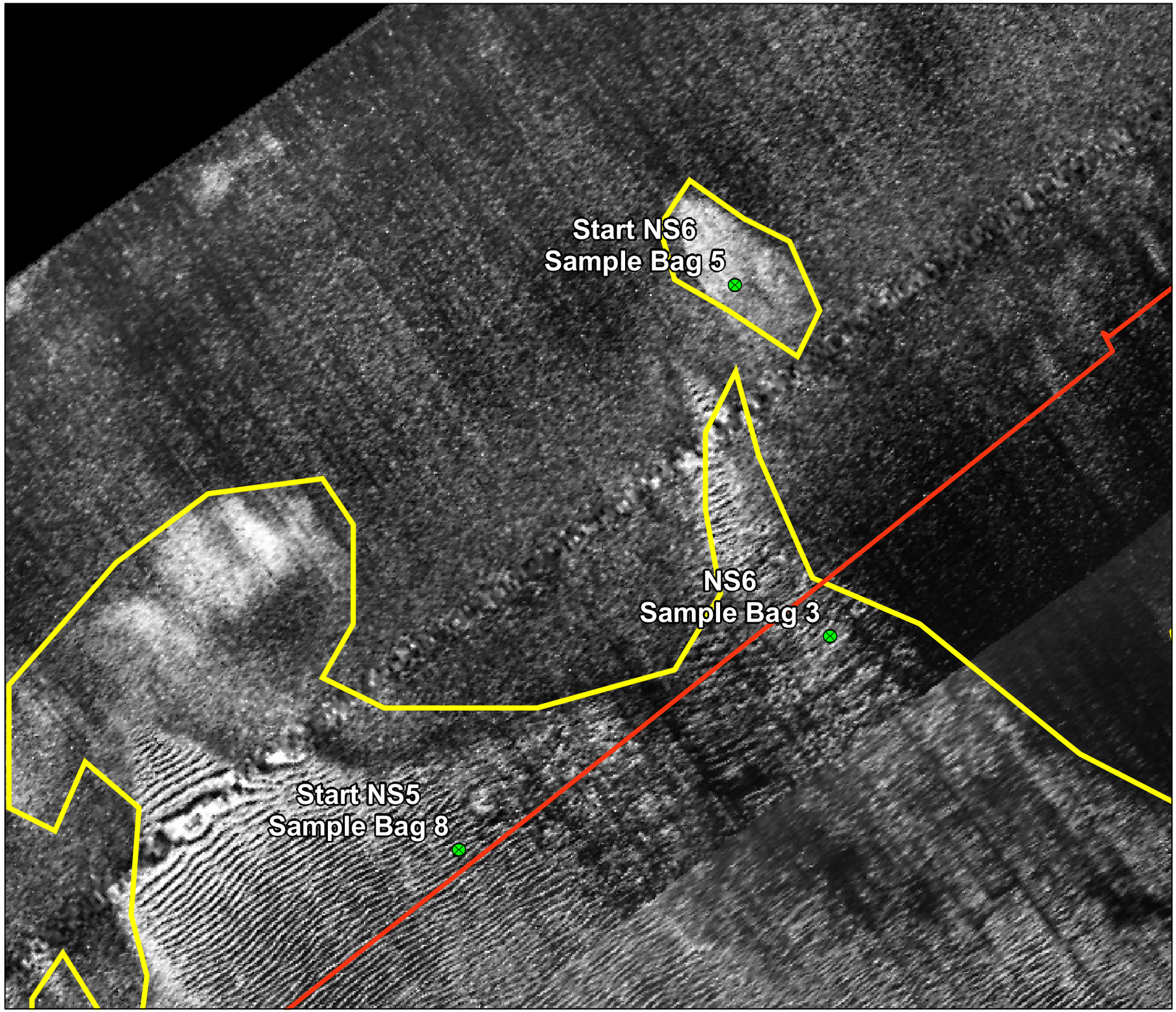
1 inch equals 30 feet

LOCATOR



DISCLAIMER: This map and/or digital data is for planning purposes only and should not be used to determine the precise location of any feature
Lengths approximate and GIS-derived. Data provided as-is.
22MAY08. ns4.mxd.
Data sources: Geodynamics, CPE, USACE.

NEARSHORE DIVE STATIONS NS5 AND NS6
SURF CITY/ NORTH TOPSAIL BEACH, N.C.
SHORE PROTECTION PROJECT
HARDBOTTOM RESOURCE CONFIRMATION AND CHARACTERIZATION STUDY



LEGEND

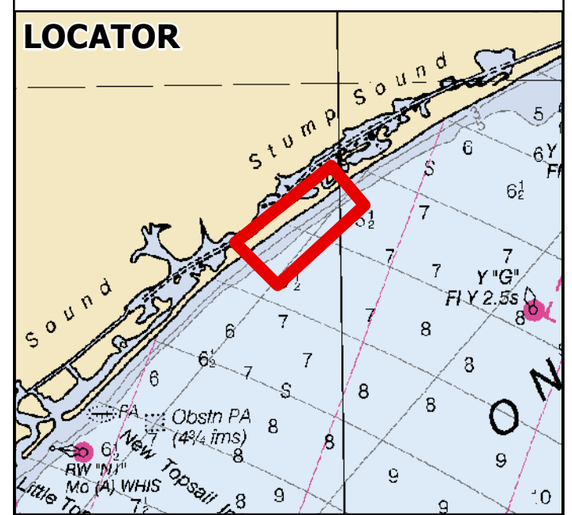
- Dive Location
- USACE Depth of Closure 23ft
- Geodynamics Areas to Investigate

N
W E
S

Feet
0 30 60

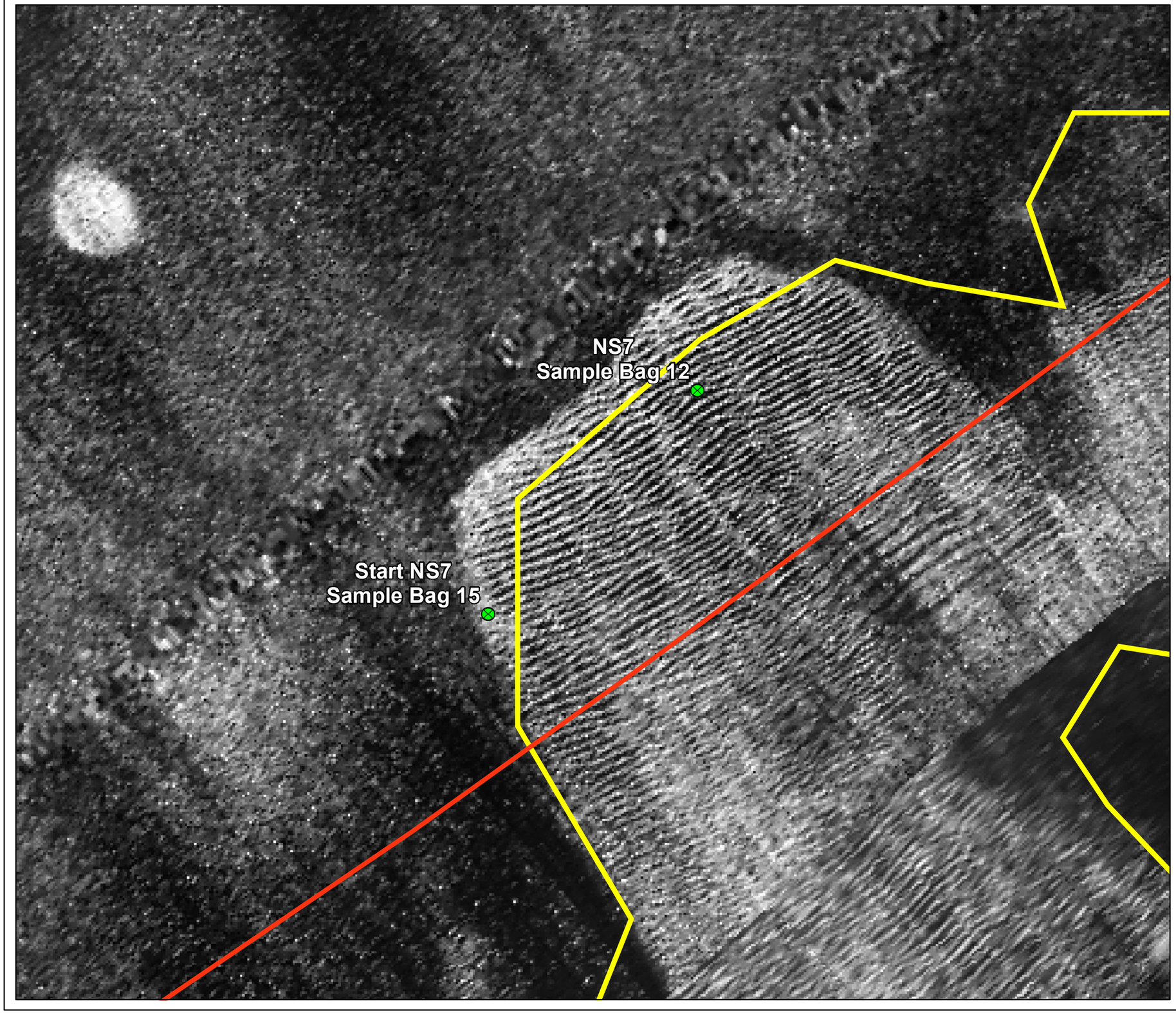
1 inch equals 30 feet

LOCATOR



DISCLAIMER: This map and/or digital data is for planning purposes only and should not be used to determine the precise location of any feature
Lengths approximate and GIS-derived. Data provided as-is.
22MAY08. ns5-6.mxd.
Data sources: Geodynamics, CPE, USACE.

NEARSHORE DIVE STATION NS7
SURF CITY/ NORTH TOPSAIL BEACH, N.C.
SHORE PROTECTION PROJECT
HARDBOTTOM RESOURCE CONFIRMATION AND CHARACTERIZATION STUDY



LEGEND

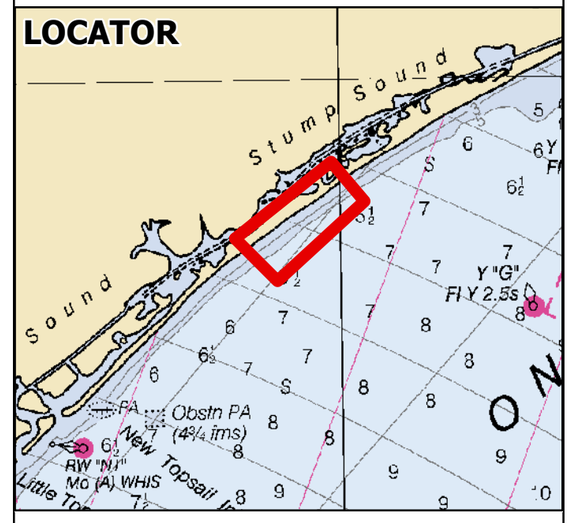
- Dive Location
- USACE Depth of Closure 23ft
- Geodynamics Areas to Investigate

N
W E
S

Feet
0 20 40

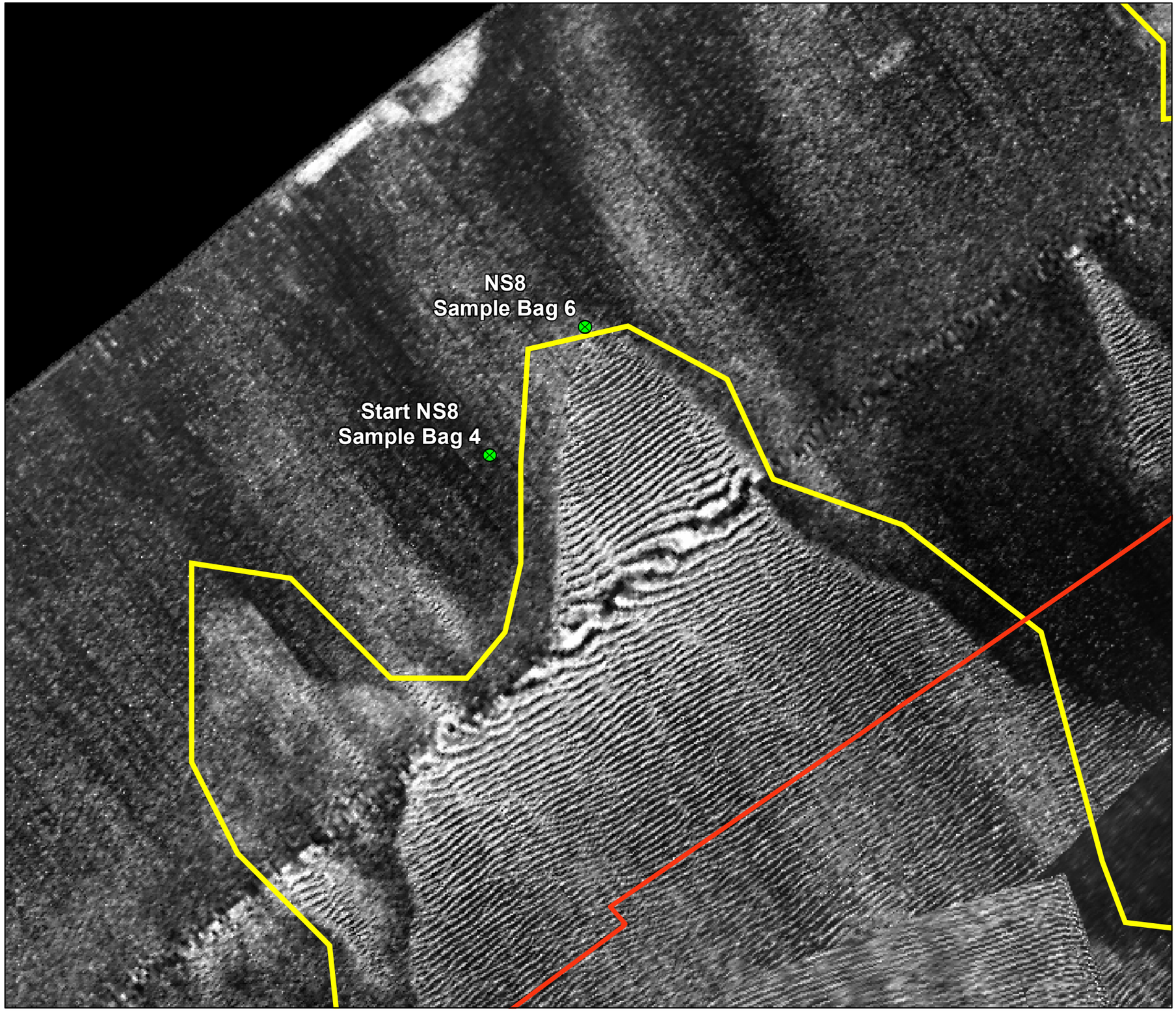
1 inch equals 20 feet

LOCATOR



DISCLAIMER: This map and/or digital data is for planning purposes only and should not be used to determine the precise location of any feature
Lengths approximate and GIS-derived. Data provided as-is.
22MAY08. ns7.mxd.
Data sources: Geodynamics, CPE, USACE.

NEARSHORE DIVE STATION NS8
SURF CITY/ NORTH TOPSAIL BEACH, N.C.
SHORE PROTECTION PROJECT
HARDBOTTOM RESOURCE CONFIRMATION AND CHARACTERIZATION STUDY



LEGEND

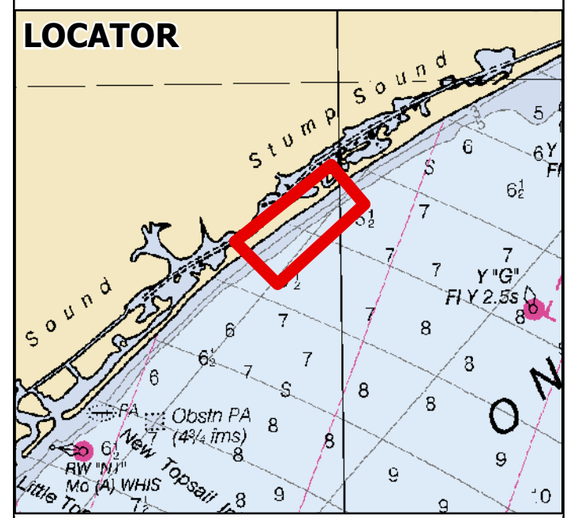
- Dive Location
- USACE Depth of Closure 23ft
- Geodynamics Areas to Investigate

N
W E
S

Feet
0 30 60

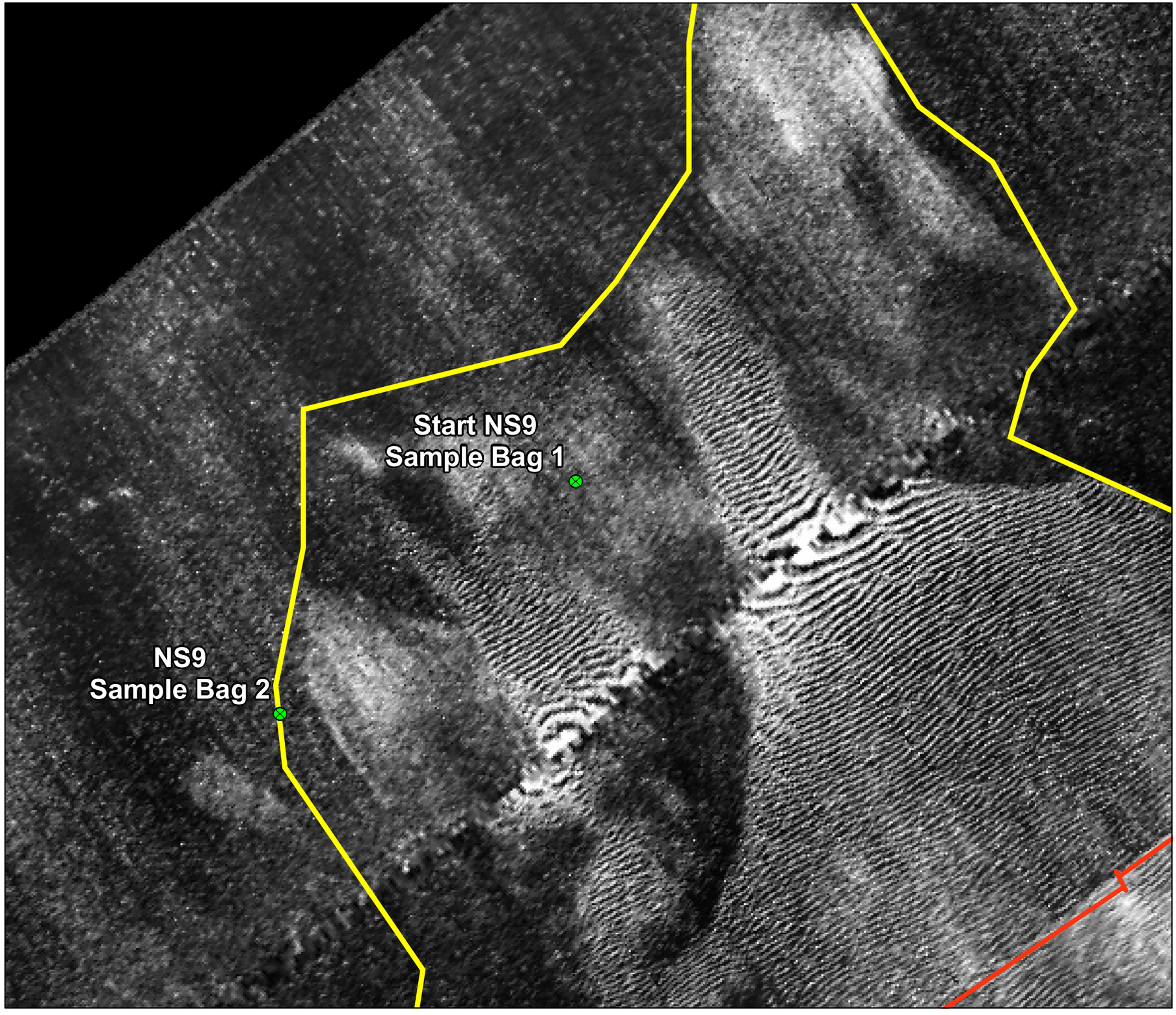
1 inch equals 30 feet

LOCATOR



DISCLAIMER: This map and/or digital data is for planning purposes only and should not be used to determine the precise location of any feature
Lengths approximate and GIS-derived. Data provided as-is.
22MAY08. ns8.mxd.
Data sources: Geodynamics, CPE, USACE.

NEARSHORE DIVE STATION NS9
SURF CITY/ NORTH TOPSAIL BEACH, N.C.
SHORE PROTECTION PROJECT
HARDBOTTOM RESOURCE CONFIRMATION AND CHARACTERIZATION STUDY



LEGEND

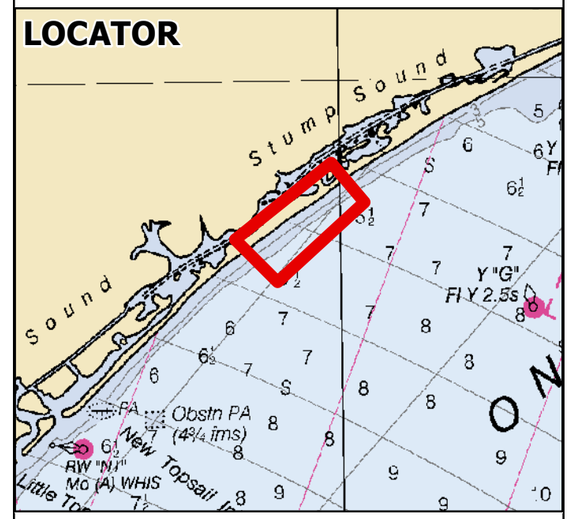
- Dive Location
- USACE Depth of Closure 23ft
- Geodynamics Areas to Investigate

N
W E
S

Feet
0 25 50

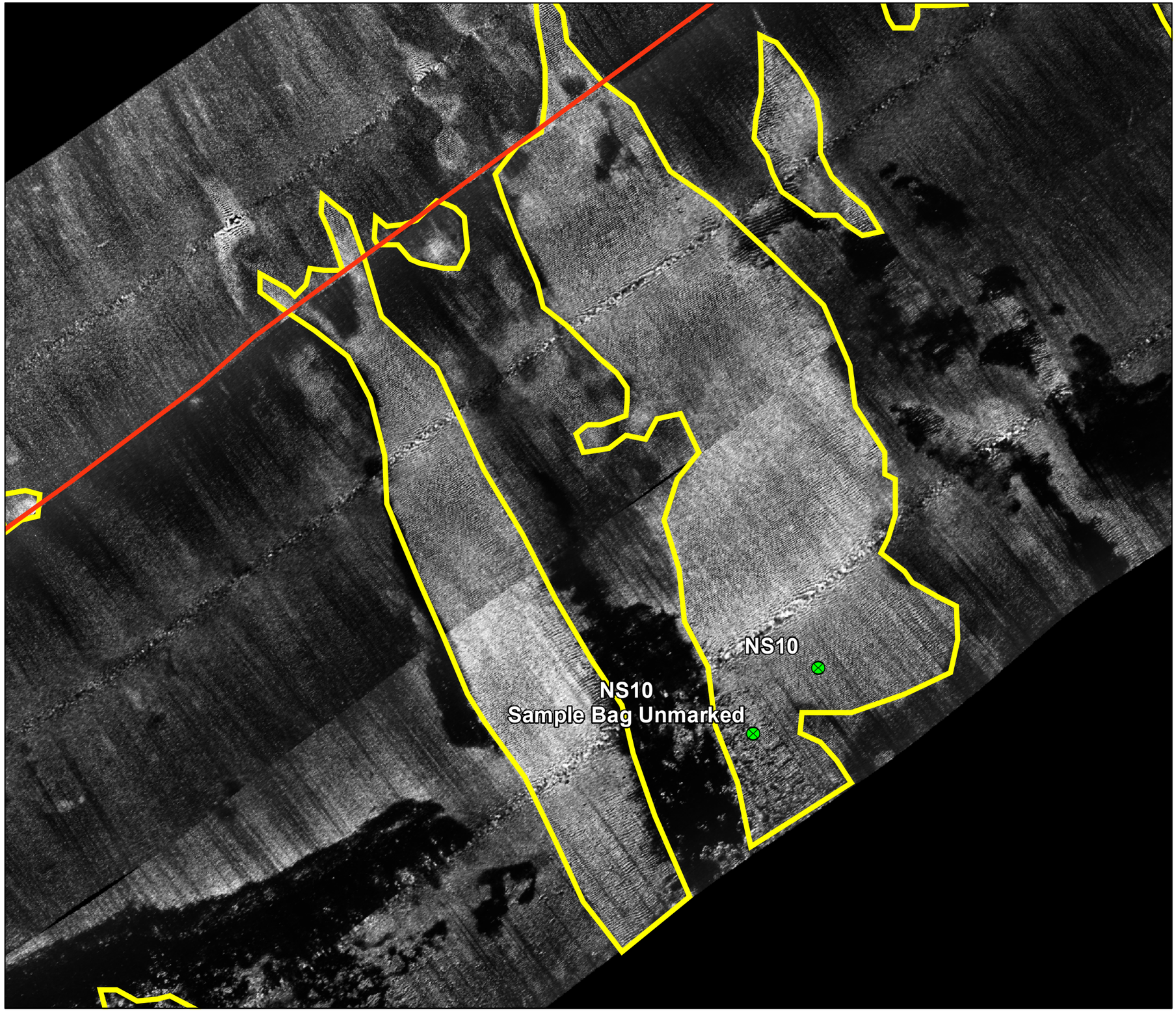
1 inch equals 25 feet

LOCATOR



DISCLAIMER: This map and/or digital data is for planning purposes only and should not be used to determine the precise location of any feature
Lengths approximate and GIS-derived. Data provided as-is.
22MAY08. ns9.mxd.
Data sources: Geodynamics, CPE, USACE.

NEARSHORE DIVE STATION NS10
SURF CITY/ NORTH TOPSAIL BEACH, N.C.
SHORE PROTECTION PROJECT
HARDBOTTOM RESOURCE CONFIRMATION AND CHARACTERIZATION STUDY



LEGEND

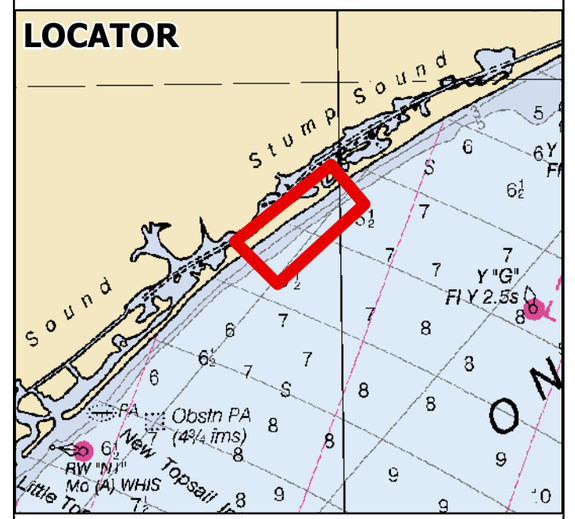
- Dive Location
- USACE Depth of Closure 23ft
- Geodynamics Areas to Investigate

N
W E
S

Feet
0 100 200

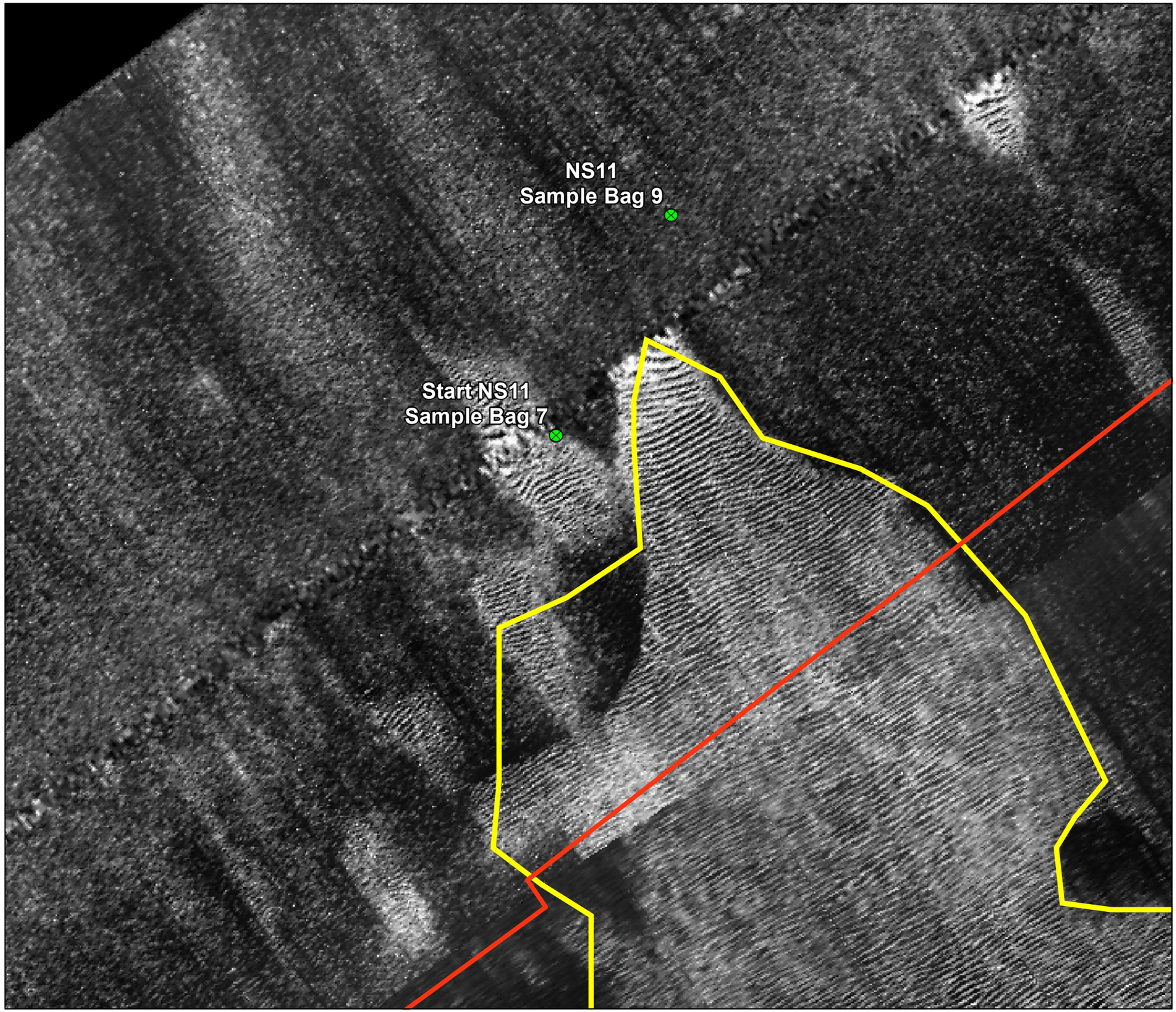
1 inch equals 100 feet

LOCATOR



DISCLAIMER: This map and/or digital data is for planning purposes only and should not be used to determine the precise location of any feature
Lengths approximate and GIS-derived. Data provided as-is.
22MAY08. ns10.mxd.
Data sources: Geodynamics, CPE, USACE.

NEARSHORE DIVE STATION NS11
SURF CITY/ NORTH TOPSAIL BEACH, N.C.
SHORE PROTECTION PROJECT
HARDBOTTOM RESOURCE CONFIRMATION AND CHARACTERIZATION STUDY



LEGEND

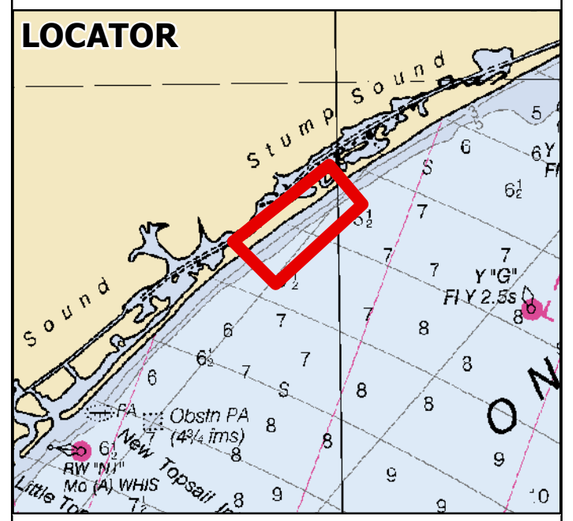
- Dive Location
- USACE Depth of Closure 23ft
- Geodynamics Areas to Investigate

N
W E
S

Feet
0 30 60

1 inch equals 30 feet

LOCATOR



DISCLAIMER: This map and/or digital data is for planning purposes only and should not be used to determine the precise location of any feature
Lengths approximate and GIS-derived. Data provided as-is.
22MAY08. ns11.mxd.
Data sources: Geodynamics, CPE, USACE.

NEARSHORE DIVE STATION NS12
SURF CITY/ NORTH TOPSAIL BEACH, N.C.
SHORE PROTECTION PROJECT
HARDBOTTOM RESOURCE CONFIRMATION AND CHARACTERIZATION STUDY

LEGEND

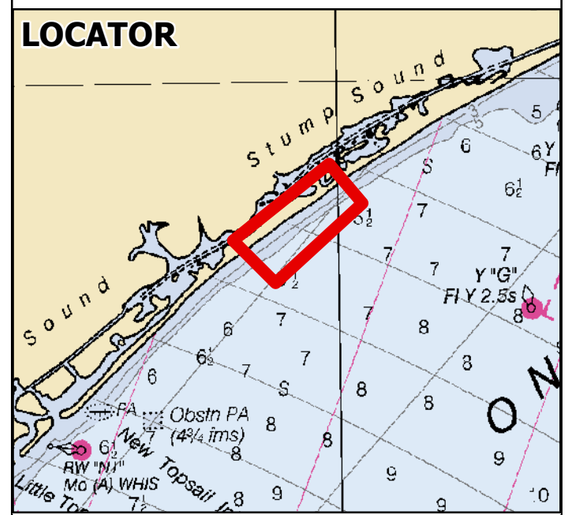
- Dive Location
- USACE Depth of Closure 23ft
- Geodynamics Areas to Investigate

N
W E
S

Feet
0 40 80

1 inch equals 40 feet

LOCATOR



DISCLAIMER: This map and/or digital data is for planning purposes only and should not be used to determine the precise location of any feature
Lengths approximate and GIS-derived. Data provided as-is.
22MAY08. ns12.mxd.
Data sources: Geodynamics, CPE, USACE.

APPENDIX H

SPECIES LIST AND PHOTOGRAPHS

APPENDIX H
SPECIES LIST AND PHOTOGRAPHS

	Species	Common Name
INVERTEBRATES		
SPONGES	*Cliona celata**	Boring sponge
	Unidentified gray sponge (Possibly *Ircinia* sp.)*	
	Several unidentified species*	
HYDROIDS	Several unidentified species	
BRYOZOANS	*Bugula turrita**	Spiral-tufted bryozoan
	Hippopodina feegeensis	Pearly orange encrusting bryozoan
	Unidentified fan bryozoans*	
ANEMONES	Cerianthid anemone*	Tube-dwelling anemone
	Several unidentified species*	
SCLERACTINIAN CORAL	*Oculina sp.**	Ivory tree coral
OCTOCORAL	*Leptogorgia hebes**	Regal sea fan
	*Leptogorgia virgulata**	Colorful sea whip
	Telestaceans (*Carijoa riisei* and/or *Telesto sp.)**	Telestos
	*Titanideum frauenfeldii**	Brilliant sea fingers
MOLLUSCS	*Fasciolaria tulipa*	Tulip snail
	Simnia sp.*	Simnia
ECHINODERMS		
Urchins	*Arbacia punctulata**	Common Arbacia urchin
	*Lytechinus variegatus**	Variegated urchin
Sea Stars	*Astropecten articulatus**	Beaded sea star
	*Asterias forbesii**	Forbe's sea star
	*Echinaster sp.**	Orange-ridged sea star
	*Luidia alternata**	Banded sea star
Sea Cucumbers	Unidentified sea cucumber*	
ARTHROPODS	*Anoplodactylus lentus*	Lentel sea spider
	Various hermit crabs	
	Balanus sp.	Barnacles
TUNICATES	*Botryllus/Botrylloides* spp.*	Flat/row/geometric encrusting tunicates
	*Distaplia corolla**	Button tunicate
	Eudistoma spp.	Condominium tunicates
	Several unidentified species*	
VERTEBRATES		
FISH	*Archosargus probatocephalus**	Sheepshead
	*Centropristis striatus**	Black sea bass
	*Diplodon holbrookii**	Spottail pinfish
PLANTS		
MACROALGAE	*Caulerpa*	green alga
	*Codium**	Dead man's fingers
	Cryptonemia	red alga
	*Dasya**	red alga
	Gelidiella	red alga
	Gelidium	red alga
	*Halymenia**	red alga
	*Lobophora**	Encrusting fan-leaf alga
	*Sargassum**	Sargassum weed
	Wrangelia	red alga
	Encrusting Red Algae	

*Photographs of specimens shown below

INVERTEBRATES

SPONGES

Cliona celata

Unidentified gray sponge (possibly *Ircinia* sp.)

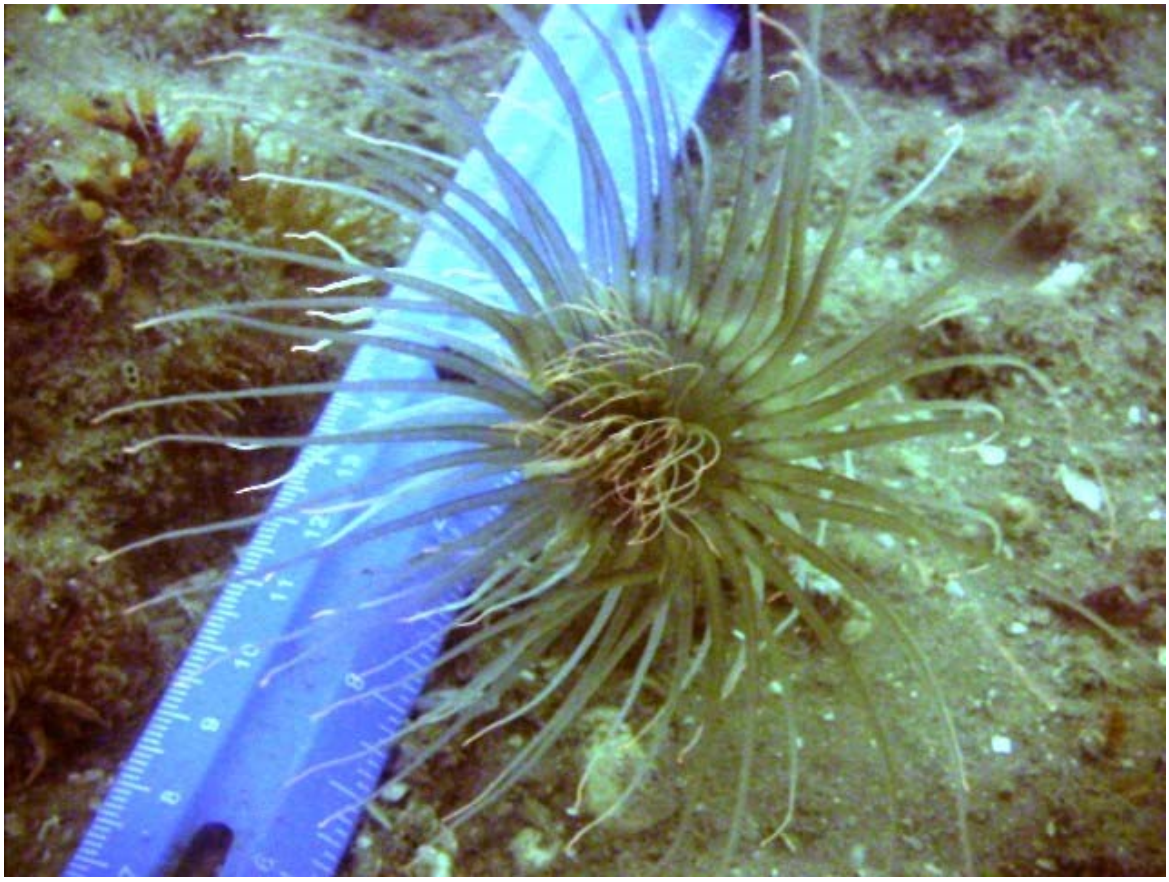
Several unidentified species:

BRYOZOANS

Bugula turrita

Unidentified fan bryozoan

ANEMONES



Cerianthid anemone

Several unidentified species:

Unidentified anemone 1

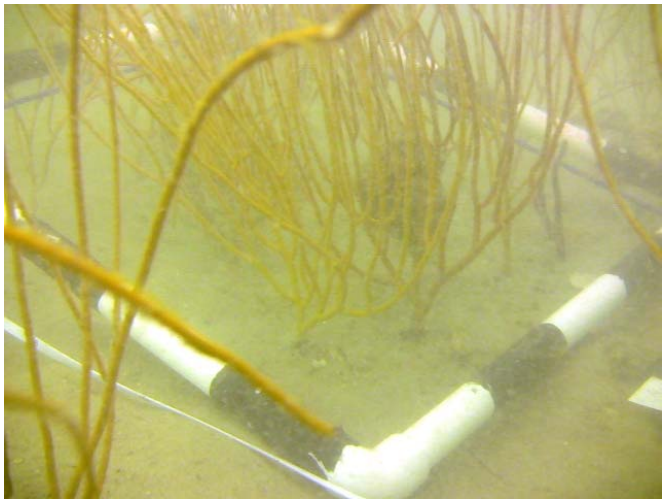
Unidentified anemone 2

SCLERACTINIAN CORAL


Oculina sp.

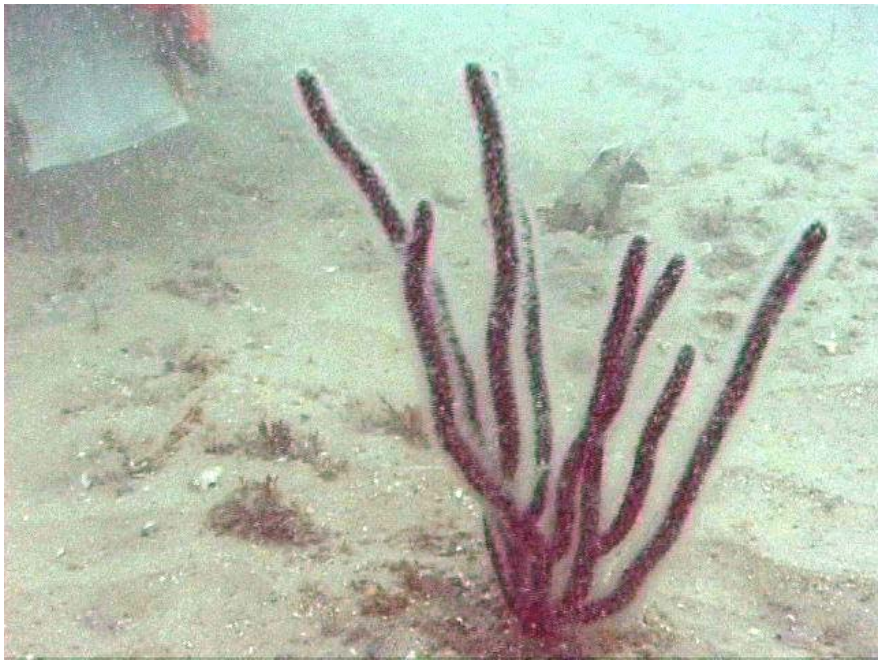
OCTOCORAL

Leptogorgia hebes



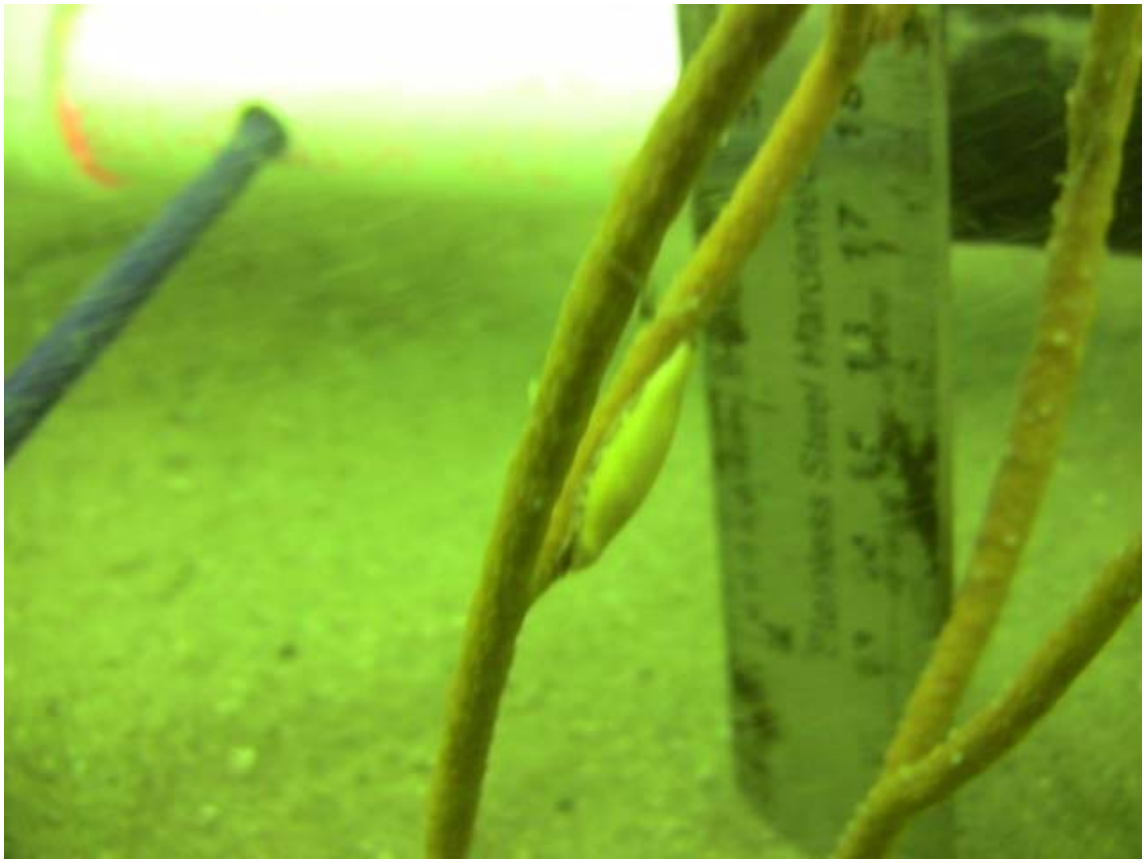
Leptogorgia virgulata

Telestaceans (Possibly *Telesto* sp. *o*r *Carijoa* sp.)



Titanideum frauenfeldii

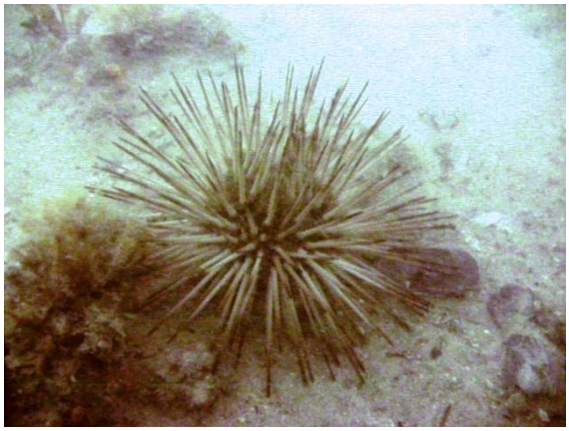
MOLLUSCS



Simnia sp.

ECHINODERMS

URCHINS:



Arbacia punctulata

Lytechinus variegatus

SEA STARS:

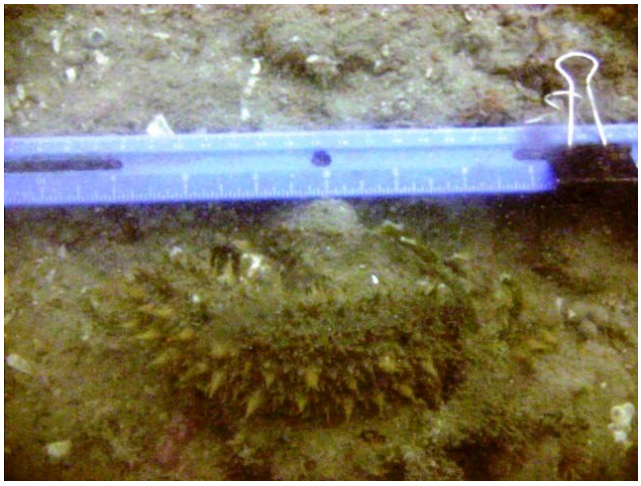
Astropecten articulatus

Asterias forbesii

Echinaster sp.

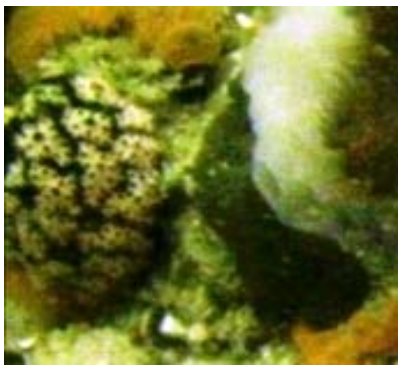
Luidia alternata

SEA CUCUMBERS:

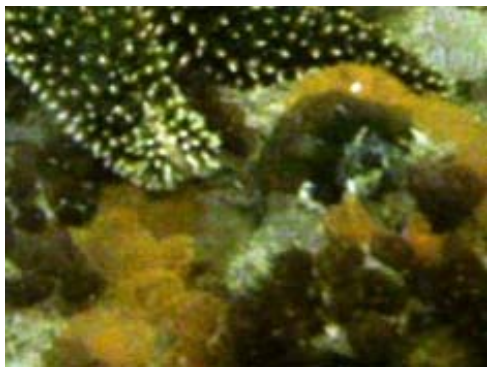


Unidentified sea cucumber

TUNICATES



Botryllus/Botrylloides spp.



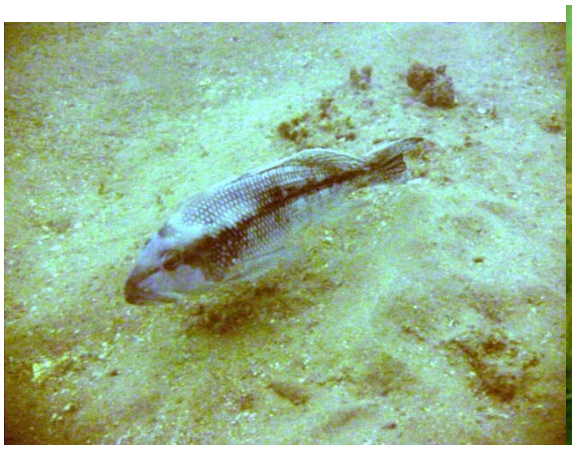
Distaplia corolla

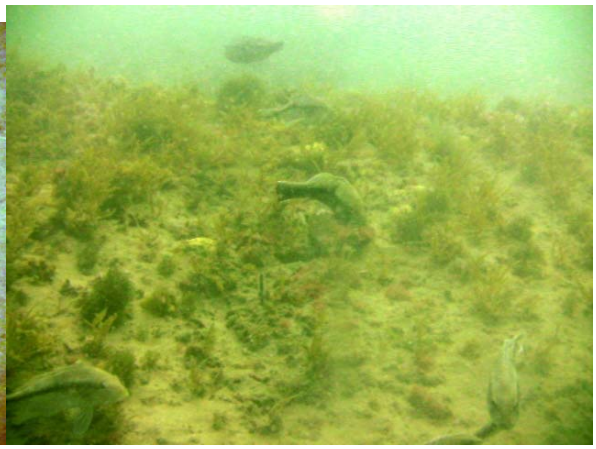
Eudistoma spp.

Several unidentified tunicates.

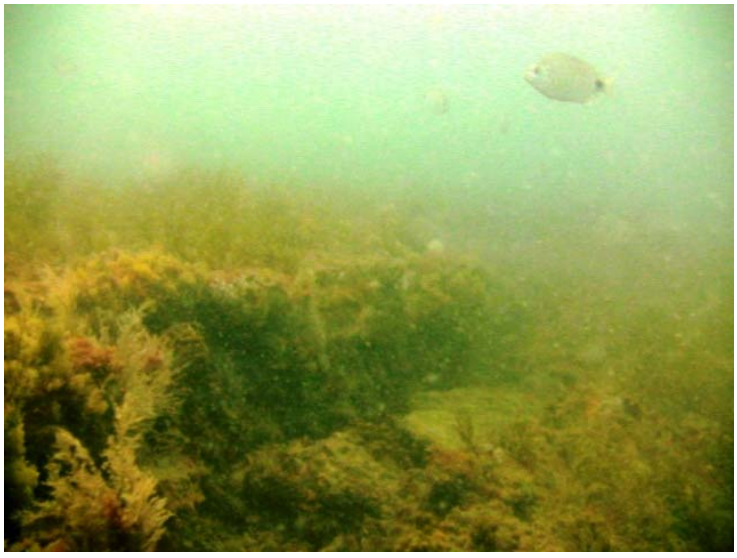
FISH

Archosargus probatacephalus (Sheepshead)



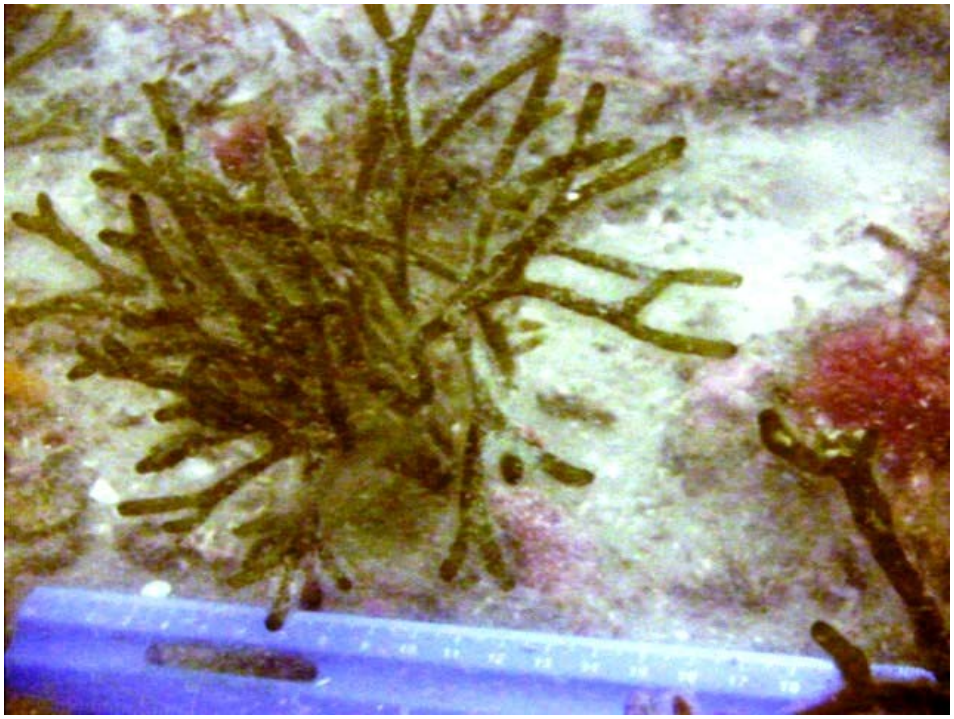


Centropristis striatus (Black seabass)



Diplodon holbrookii (Spottail pinfish)

MACROALGAE

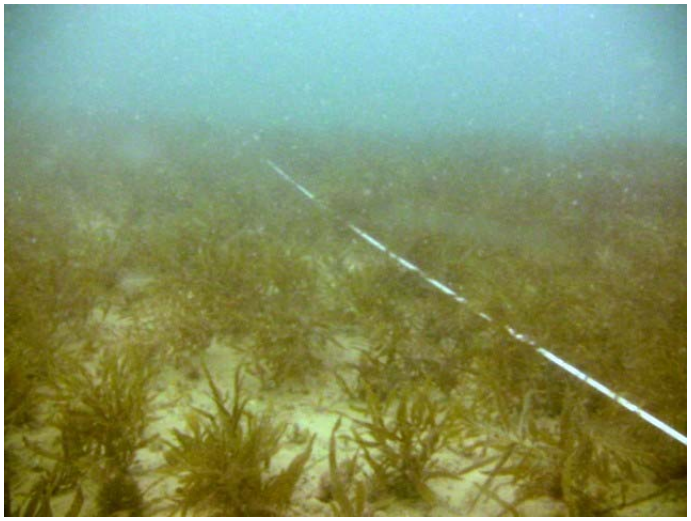


Codium sp.

Dasya sp.

Halymenia

Lobophora sp.



Sargassum sp.