Assessment of Beach Renourishment Resources on the Inner Shelf Off Folly Beach and Edisto Island, South Carolina

by:

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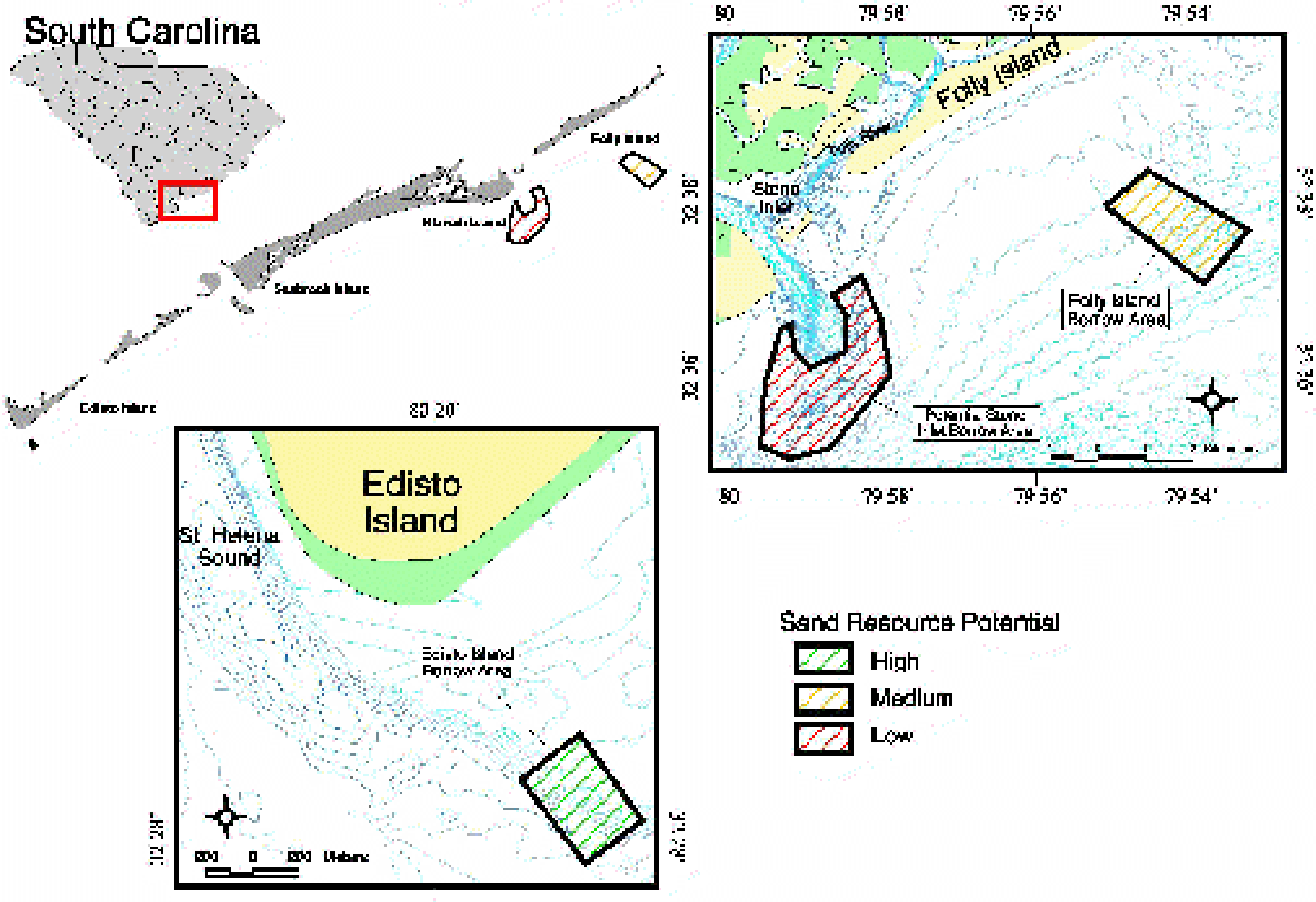

submitted to:
Minerals Management Service
Office of International Activities and Mineral Resources
381 Elden Street
Herndon, VA 22070

August, 1998

South Carolina Task Force on Offshore Resources
a cooperative program with the State of South Carolina
and the
Minerals Management Service

Final Report

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Executive Summary

An extensive collection of seismic reflection profiles, surficial sediment grabs and vibracores were collected and analyzed to assess offshore sand resources potential on the inner shelf off Folly Beach and Edisto Island, South Carolina. Quaternary sediments form a seaward thinning wedge in the region and extensive outcrops of Tertiary deposits exist seaward of 6 kilometers from the coast.

Folly Beach Area

A body of beach-compatible sand exists on the inner shelf off of Folly Beach from three to six kilometers offshore of the north central portion of the island. This site was originally identified by Gayes and Donovan-Ealy (1995) and it is the most accessible and highest resource potential site for use in future nourishment at Folly Beach. Shoreface-connected ridge-like structures on the northern flank of the Stono Inlet ebb tidal delta, and many sites sampled on the ebb tidal delta complex proper, appear to contain sediments that are too fine-grained and with overfill ratios too high to be usable as a beach nourishment source for Folly Beach. Localized areas of beach-compatible sands are likely to exist within the delta complex but were not identified by surficial sediment samples or vibracores collected.

Edisto Island Area

The sand resource potential on the inner shelf offshore of Edisto Island is very poor. Tertiary deposits exist at or within a meter of the sea floor over much of the inner shelf and are very fine-grained. Surficial sediment on the shelf is high in fines and none of the samples collected produced acceptable R_A values. No significant incised channels or local thickenings of Quaternary sediment were found in seismic profiles.

Sand within the massive ebb tidal delta shoals at Edisto Inlet was used for the 1995 nourishment of southern Edisto Island. That borrow area infilled rapidly with sand and may represent a reusable resource (Van Dolah et al., 1998). Samples collected seaward of the 1995 borrow site suggest that beach-compatible sands extend further offshore on the shoal. There is significant variability in sand quality on the shoal. This variability appears to increase near the base of the shoal and at deeper horizons within the shoal complex. The shoal crest has the highest sand resource potential for the Edisto Island.

Introduction

The South Carolina Task Force on Offshore Resources and Critical Habitats was established through funding from the Minerals Management Service INTERMAR program to compile sand, mineral, and hardbottom resource data for the inner continental shelf of South Carolina. The objective of the Task Force is to facilitate the efficient use of the state's resources while ensuring such use will incorporate environmentally sound planning. The Task Force was designed to be a five-year program to compile and update a database relative to program goals and undertake new studies to document sand, mineral and hard-bottom resources that exist on the state's coastal ocean shelf from the shoreline to 16 kilometers (10 miles) offshore where existing data is limited.

Previous Task Force Activities

The goal of the first year of the Task Force was to assemble the existing biological and geological information and identify areas where additional sand resource information was needed. That effort was presented in a combined Task Force Final Report in April of 1994 (Van Dolah et al., 1994).

The main goal of the second year of the Task Force was to assemble the Year I database into a GIS system and begin a phased field study gathering relevant information to assess beach renourishment resources off areas of the South Carolina coast which are in need of these resources and for which existing data is inadequate. These efforts were submitted as separate reports. The Center for Marine and Wetland Studies submitted a Final Report assessing the inner shelf sand resources near Folly Beach, South Carolina in August of 1995 (Gayes and Donovan-Ealy, 1995) and The Marine Resources Research Institute at SC DNR submitted a Final Report on the GIS analysis of the database (Van Dolah et al., 1994a). A report on the shoreline migration rates and sediment budgets based on beach profile data for the Seabrook, Kiawah and Folly Islands was completed by Katuna et al. (1995). Copies of these reports are available through SC DNR and through the worldwide web via the Minerals Management Service INTERMAR homepage (www.mms.gov/intermar/marine/ac.htm).

The South Carolina Task Force on Offshore Resources and Critical Habitats-Year III

The goal and specific associated tasks of the third year of the program were to:

1. Continue the phased mapping effort to delineate potential sand resources in the offshore zone near erosional beaches in the state. This phase was to expand the previous reconnaissance survey of the Folly Beach area and to initiate a reconnaissance of the inner shelf near Edisto Island, South Carolina and
2. To complete a resurvey of the bathymetry and surficial sediment characteristics of previously used borrow areas in the state.

This report documents the contributions of the Center for Marine and Wetland Studies at Coastal Carolina University to the Task Force's Year III efforts. The CMWS had responsibilities to: collect additional vibracores from offshore of Folly Beach, South Carolina and to conduct a reconnaissance survey of sand resources offshore of Edisto Island, South Carolina. Results from the study of the previously used borrow areas at Edisto Island, Hunting Island, Seabrook Island and Hilton Head, South Carolina are presented in a separate report (Van Dolah et. al, 1998).

PHASED MAPPING EFFORTS

Previous Work

Folly Beach

Folly Beach has historically experienced active coastal erosion. The island is a site of a recent beach nourishment project which was completed in 1993. Ebersole et. al (1995) reported a 4% loss of the nourished beach in the first year after emplacement. Katuna et. al (1995) reported that a 41% loss of the volume placed above -5.0 feet NGVD occurred during the first two years of the project. Figure 1 shows the total sand volume change within the entire area of the active beach profile from 1993 to 1996 based on long profile data (Gayes, unpublished data). While the assessment of the performance of the project is subject to the specific criteria being evaluated (amount of subaerial beach remaining, total volume in the active beach profile, storm damage mitigation) the project is now in the fifth year since the fill was placed on the beach. The original design called for a 50-year project life supported by eight-year renourishment intervals (USACE, 1991). The first renourishment of the site on the original schedule would occur in the year 2001. An emergency renourishment has already occurred (1998) along the southernmost reach of Folly Island where a small county park has experienced an extreme erosional event associated with the re-alignment of the northern marginal flood channel of Stono Inlet.

The sand source that was used for the 1993 nourishment was located behind Stono Inlet in the Folly River. That borrow site and the post-dredging recovery are documented in Van Dolah et. al (1998). While the Folly River borrow area has been actively infilling, the site may no longer be available for future renourishment at Folly Beach due to the COBRA zone restrictions (US Fish and Wildlife Service-COBRA, 1994).

As a result of the anticipated renourishment needs and potential elimination of the original borrow area in the future, there is an interest in finding alternative sand resources for the Folly Beach area. A preliminary search for potential offshore sand sources was

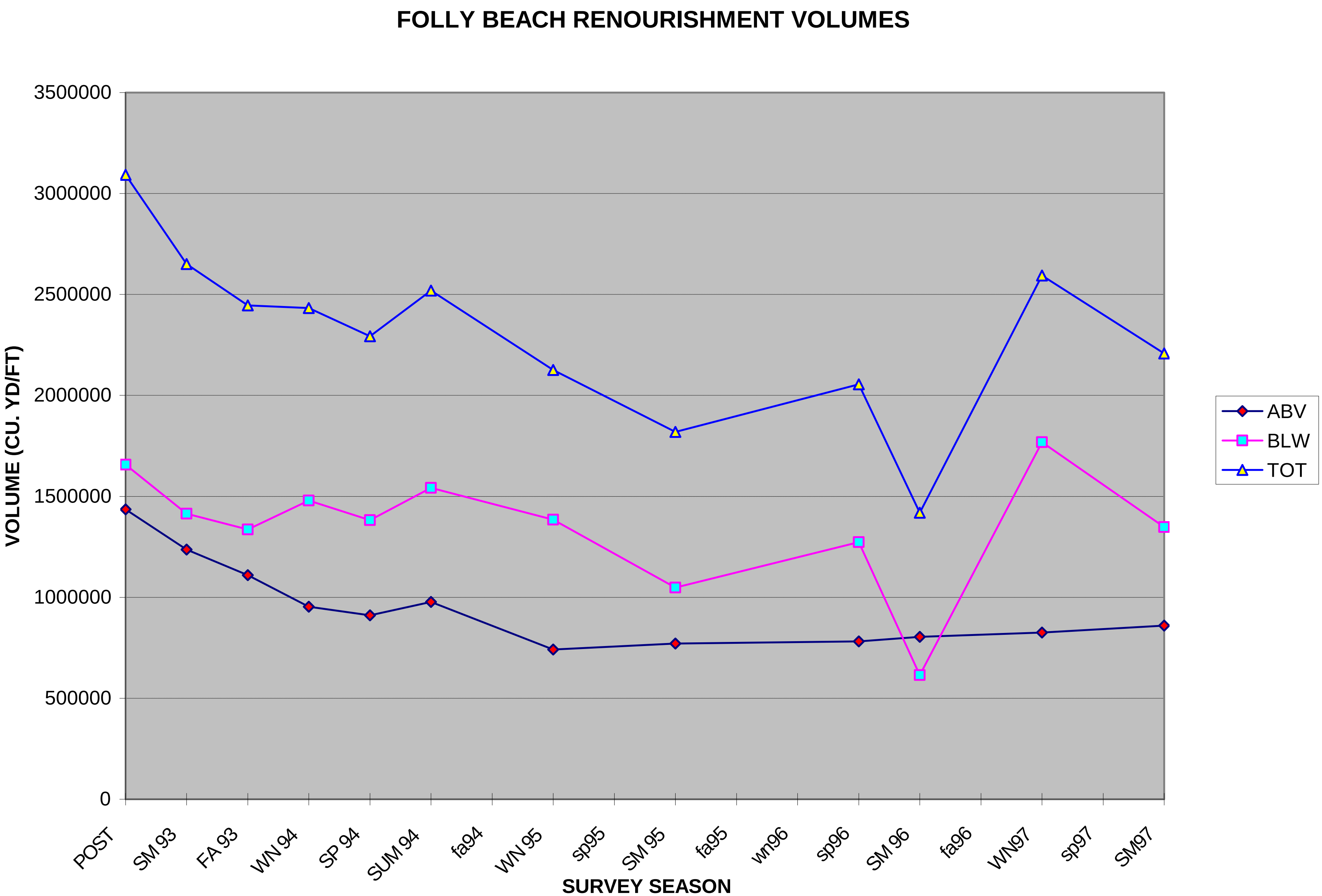


Figure 1. Volume of Nourishment Sands on Folly Beach, South Carolina by season, total, above and below 0' NGVD.

undertaken in Year II of the South Carolina Intermar Task Force and reported in Gayes and Donovan-Ealy (1995). That study identified a potential sand body on the inner shelf offshore of the northern third of the island. The potential sand body was projected to contain approximately 700,000 cubic yards of beach compatible sand. Figure 2 shows a side scan sonar mosaic of the inner shelf off Folly Beach constructed by Gayes et. al (1997) and Swift et. al (1997) that documents the spatial continuity of several surficial sedimentary units on the inner shelf off Folly Beach. The mosaic covers the area occupied by the sand body originally defined by Gayes and Donovan-Ealy (1995) using seismic reflection profiles and vibracore data. The potential sand resource identified in the 1995 study is delineated on the mosaic image. The lighter tones represent high backscatter of the sonar from the bottom and are areas of medium to coarse shelly sands existing within a field of linear rippled scour depressions on the inner shelf. The intervening darker tones on this image (low backscatter) are areas with fine-grained well-sorted sand at the sea floor. The sand reserve previously identified exists at the terminus of a broad shore perpendicular linear rippled scour depression off the north central coast of Folly Beach. This area is just south of an area of chronic erosion problems, locally known as “the Washout”, where the island is very narrow and main road is protected by a revetment

The ebb tidal delta at Stono Inlet at the southern end of Folly Beach represents an additional and potentially massive reserve of sand for Folly Beach. Similar ebb tidal delta shoals have been used as sand sources for renourishment projects elsewhere in South Carolina at Edisto, Hilton Head and Seabrook Islands (Van Dolah et al., 1998). The SC Task Force on Offshore Resources established as a Year III program objective to gather additional data offshore of Folly Beach, particularly in the areas southwest and northeast of the Year II study area.

Edisto Island

Edisto Island has also been the site of erosional problems and previous beach renourishment projects in 1954 and 1995 (CSE-Baird, 1996, Van Dolah, et. al, 1998). The trend of historical erosion on the island was determined from: 1) USCGS charts for the period between 1855 through 1955, 2) CERC/NOS historical shoreline change maps

Sediment Grab and Vibracore Locations over '95 Folly Island 100 KHz Side-Scan Mosaic

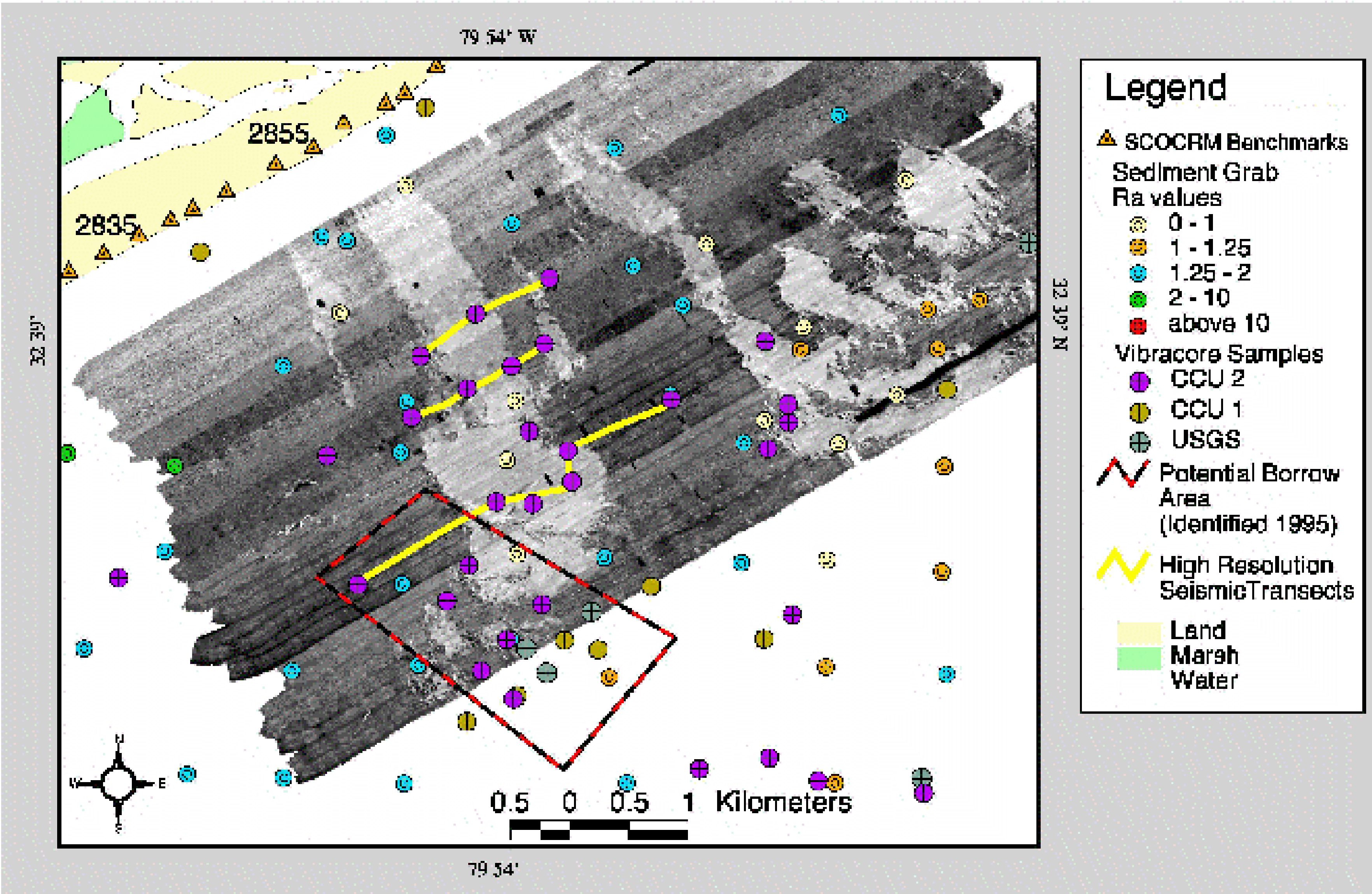


Figure 2. Sediment sample and vibracore locations superimposed on 1995 side scan sonar mosaic. Sample numbers and textural data are provided in Figures 7, 13 and 15 and Appendicies 1, 2 and 3.

for the period between 1920 and 1983 and 3) analysis of aerial photographs from the period between 1954 and 1989 by USACE(1969) and CSE (1992). Those studies reported that the southern part of the island was relatively stable or accretional and that the rates of erosion increased to the north. The greatest historical rates of erosion are found on the northern end of the island within Edisto Beach State Park (CSE, 1992), which was nourished in 1954.

The 1995 nourishment project placed 157,835 cubic yards on the southern portion of the island (CSE-Baird, 1996). The borrow site for that project was located within an enormous shoal area on the northern flank of the ebb tidal delta of Edisto Inlet. Van Dolah et. al (1998) documented a very rapid recovery of this borrow area with predominately beach-compatible sands suggesting this shoal area may be a large and potentially reusable reserve of beach sand resources to Edisto Beach.

Large sand shoals exist within the tidal inlet systems at both ends of the island and may represent a potentially large nourishment sand resource for the island. There is concern over potential limitation of the use of those resources due to COBRA regulations. In addition, location of potential sand sources closer to the middle of the island would also be advantageous. As a result, the South Carolina Task Force on Offshore Resources targeted the inner shelf off Edisto Island as a site for a reconnaissance assessment of potential sand resources as part of Year Three activities.

Methods

Seismic reflection profiles, vibracores and surficial sediment samples were collected at both the Folly Beach and Edisto Island sites to further assess potential beach resources on the inner shelf. While the present study was to provide a very modest reconnaissance data set to infer sand resource potential particular in the offshore areas to the three-mile limit, a larger USGS/SC Sea Grant supported study collected similar types of data (seismic reflection profiles, side scan sonar mosaics and vibracores) in the region during the study period (Gayes, et. al, 1997, Harris et. al, 1997, Swift et al., 1997). The geophysical and geological data collected through the USGS/Cooperative study have been incorporated here to augment the INTERMAR Folly and Edisto area data sets and affect a more comprehensive sand resource assessment.

Along much of the South Carolina coast the Quaternary sections are relatively thin to absent, except within individual incised paleochannels or large ebb tidal delta complexes. In this section of the coast, a priority was initially placed on defining paleochannel systems extending across the inner shelf as potential sand resources as those settings have been successfully used elsewhere in the state (Myrtle Beach, North Myrtle Beach and Surfside/Garden City) as nourishment sand sources. In addition, there was also a priority to define areas of relatively thick surficial Quaternary sediment deposits. Localized thick Quaternary deposits, such as those found in tidal deltas and nearshore shoals, have been used for nourishment projects in South Carolina (Hilton Head, Edisto Island). In the study areas, isopach maps of surficial sediment thickness were constructed from the seismic data for the Folly Beach inner shelf to allow a spatial projection of sand resources. The sediment thickness maps were augmented by vibracore and surficial sediment data, which provided a quantitative assessment of sand quality, to produce sand resource potential maps of the inner shelf off of both Folly Beach and Edisto Island.

Seismic Reflection Profiling

A total of 1400 line kilometers of high resolution seismic reflection profiles were collected for sand resource assessment of the Folly Beach and Edisto Island sites**.** Offshore of Folly Beach a total of 1200 line kilometers was collected and an additional 190 line kilometers of seismic trackline was collected off of Edisto Island. Tracklines for each dataset are shown in Figures 3 and 4. Seismic data were collected on board the Coastal Carolina University vessel R/V Coastal II and the National Oceanic and Atmospheric Administration Ship FERREL. A series of seismic reflection profiles were collected by the USGS-St. Petersburg in the study area. These profiles have been incorporated into the dataset and interpretations of the inner shelf stratigraphy off Folly Beach and Edisto Island, SC. That seismic reflection profile data set was collected on board the R/V Gilbert in 1995 and 1996.

The CMWS Geopulse high resolution seismic reflection profiling system was used for the collection of the CCU data. The system was triggered every 0.65 seconds at 100 Joules. The return signal was filtered through a Krone Hite Hi-Pass/Lo-Pass filter and the maximum frequency range sampled was 300-10000 hz under optimum sea state

Seismic Trackline Locations off Folly Island

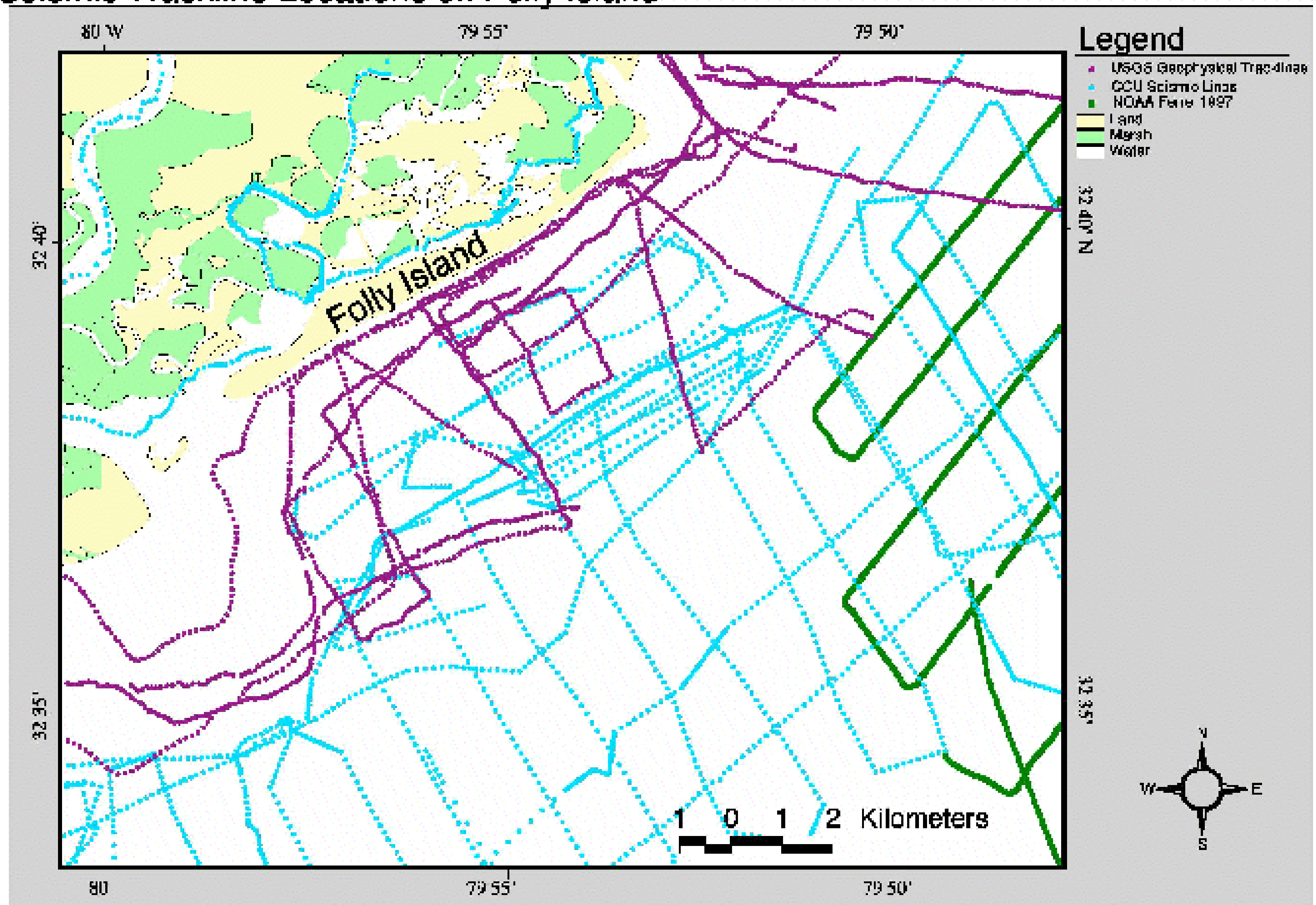


Figure 3. Trackline map for high resolution seismic reflection profiles collected on the inner shelf off Folly Island, South Carolina.

Seismic Trackline Locations off Edisto Island

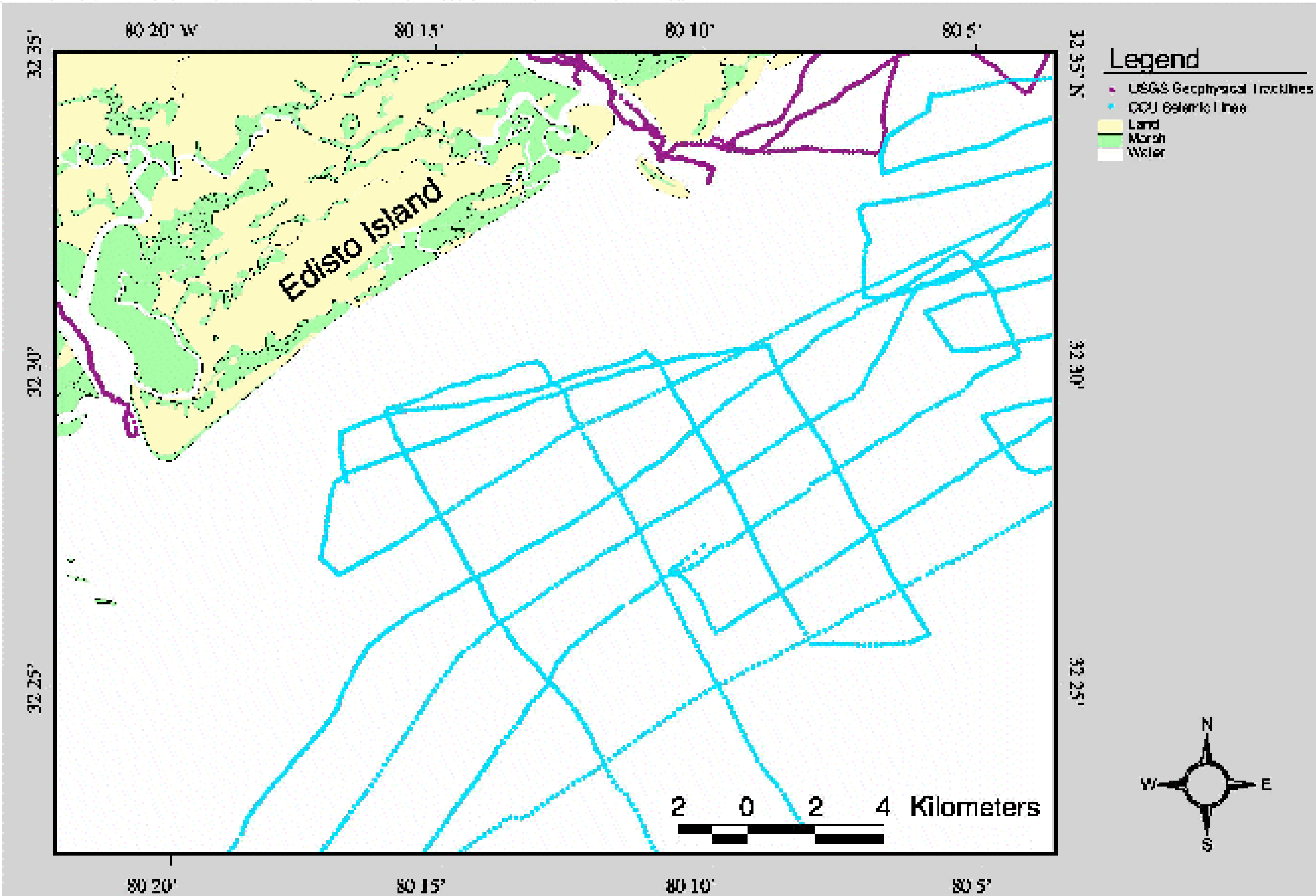


Figure 4. Trackline map for high resolution seismic reflection profiles collected on the inner shelf off Edisto Island, South Carolina.

but more typically was 400-8000 hz. Minimum resolution of this system is 0.5 meters. The data was collected as an analog record on an EPC 1650s recorder.

The U.S. Geological Survey data was collected using a Huntec transducer and a Delph Elix digital acquisition system. Processed hard copy records of that data were provided by the USGS and were used in the interpretation here. Differential Global Positioning System (DGPS) was used for navigation for both systems.

Vibracores

Seventy-seven vibracores were collected in the study area and incorporated into this project. Core locations off the Folly Beach (54 cores) and Edisto Island (23 cores) areas are shown in Figures 5 and 6. These cores were collected using the CMWS electric vibracore rig deployed from the NOAA Ship FERREL and additional short vibracores were collected using a standard marsh vibracore system deployed from the NOAA Ship FERREL's launch or the CCU R/V Coastal II. The core series from the INTERMAR Year II report (Gayes and Donovan-Ealy, 1995) are also shown in the compiled data base.

The U.S. Geological Survey collected a series of vibracores in the area on board the R/V Gilbert. That data has also been made available to this project to help assess sand resource potential. The USGS cores were collected using a compressed air driven vibracore.

All three rigs used 3 inch diameter aluminum pipe vibrated into the sediment and DGPS for navigation. Core locations were selected from preliminary analysis of seismic data to sample major regional seismic reflectors and sand deposits. Cores were recovered, cut into 1.5 meter sections, labeled, capped and sealed for transit on ship. All of the cores were shipped back to CCU where they were split, photographed, visually described and sampled for sediment textural analyses. Standard sieve analysis was conducted to determine the following textural parameters: mean size (mm), % gravel-sand-silt-clay, sorting, skewness and kurtosis values. Carbonate fractions were removed by dilute acid to determine percent carbonate and the grain size moments were determined for the non-carbonate fractions.

Vibracore Locations off Folly Island

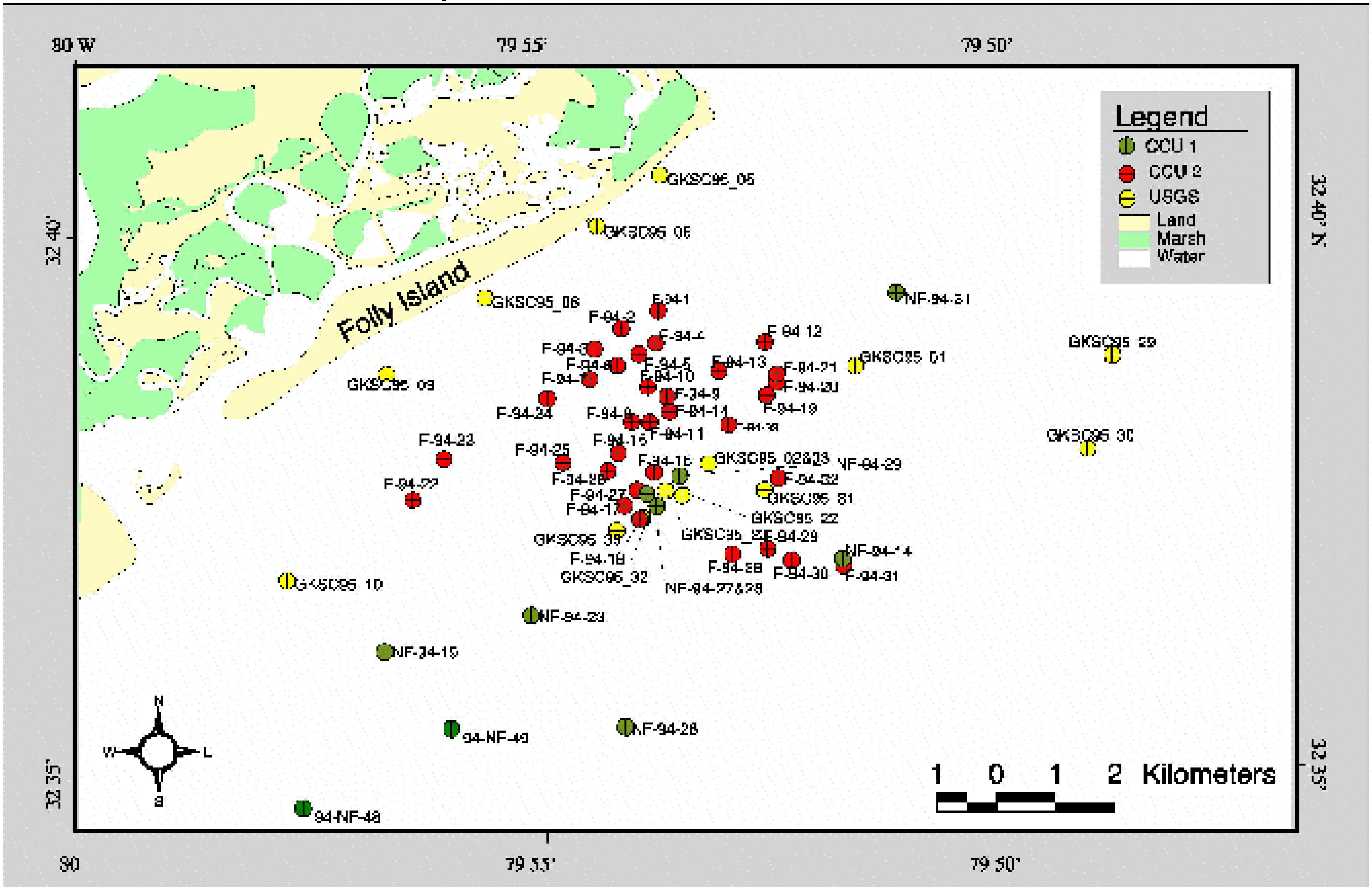


Figure 5. Location of vibracores collected on the inner shelf off Folly Island, South Carolina.

Vibracore Locations off Edisto Island

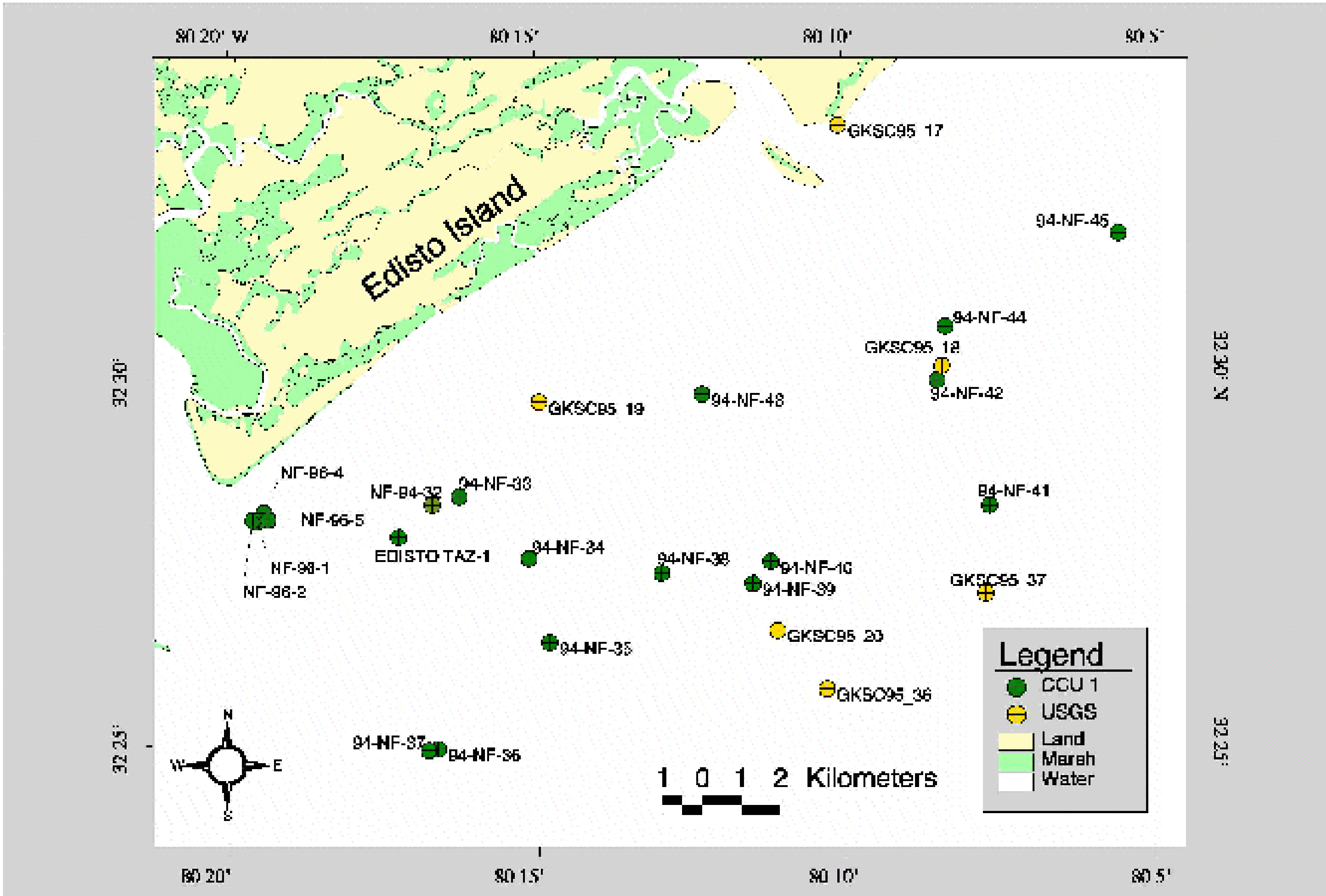


Figure 6. Location of vibracores collected on the inner shelf off Edisto Island, South Carolina.

Surficial Sediment Sampling

A total of 153 surficial sediment samples were collected in the study area to help further define regional surficial sediment textural trends. Surficial sediment sample locations for the Folly Beach (121 grab samples) and Edisto Island (32 grab samples) areas are shown in Figures 7 and 8. Samples were collected using a modified Young grab from Coastal Carolina's R/V Coastal II, the NOAA Ship FERREL and the FERREL's launch. Surficial sediment sample locations were sited to broadly characterize surficial conditions and to quantify surficial sediment characteristics in key sites based on seismic, bathymetry and side scan sonar data (provided by a separate study). DGPS was used for navigation. Samples were processed by standard sieve techniques to provide mean size (mm), % gravel-sand-silt-clay, sorting, skewness and kurtosis values for the bulk and non-carbonate fractions.

RESULTS

FOLLY BEACH STUDY AREA

Seismic Reflection Data.

Figure 9 shows an interpreted section for two shore parallel seismic lines in the Folly Beach study area. These sections defined the nature of the shallow stratigraphy in the vicinity of Folly Beach. In general, Tertiary age deposits (Marks Head and Ashley Formations) are gently inclined up towards the southwest offshore of Folly Beach. Tertiary deposits are directly exposed on the inner shelf of the region. Figure 10 shows the pattern of exposure at the sea floor or existence of Tertiary deposits in the very shallow subsurface in the region (Harris, 1998). Extensive fields of Tertiary outcrop are apparent offshore of Folly Beach and Edisto Island and within deep scours of the tidal creeks and inlets in the area. These outcrops become more prevalent further than 5 kilometers from the coast and sand resource potential in these areas is poor.

A variable thickness of Quaternary age sediments overlie the Tertiary deposits, and in general form a seaward-thinning wedge, from the beach to approximately 5 kilometers from the beach. These deposits are thickest within a series of paleochannels incised into the Marks Head Formation (Figure 11). In addition, substantial Quaternary

Folly Island Grab Sample Locations

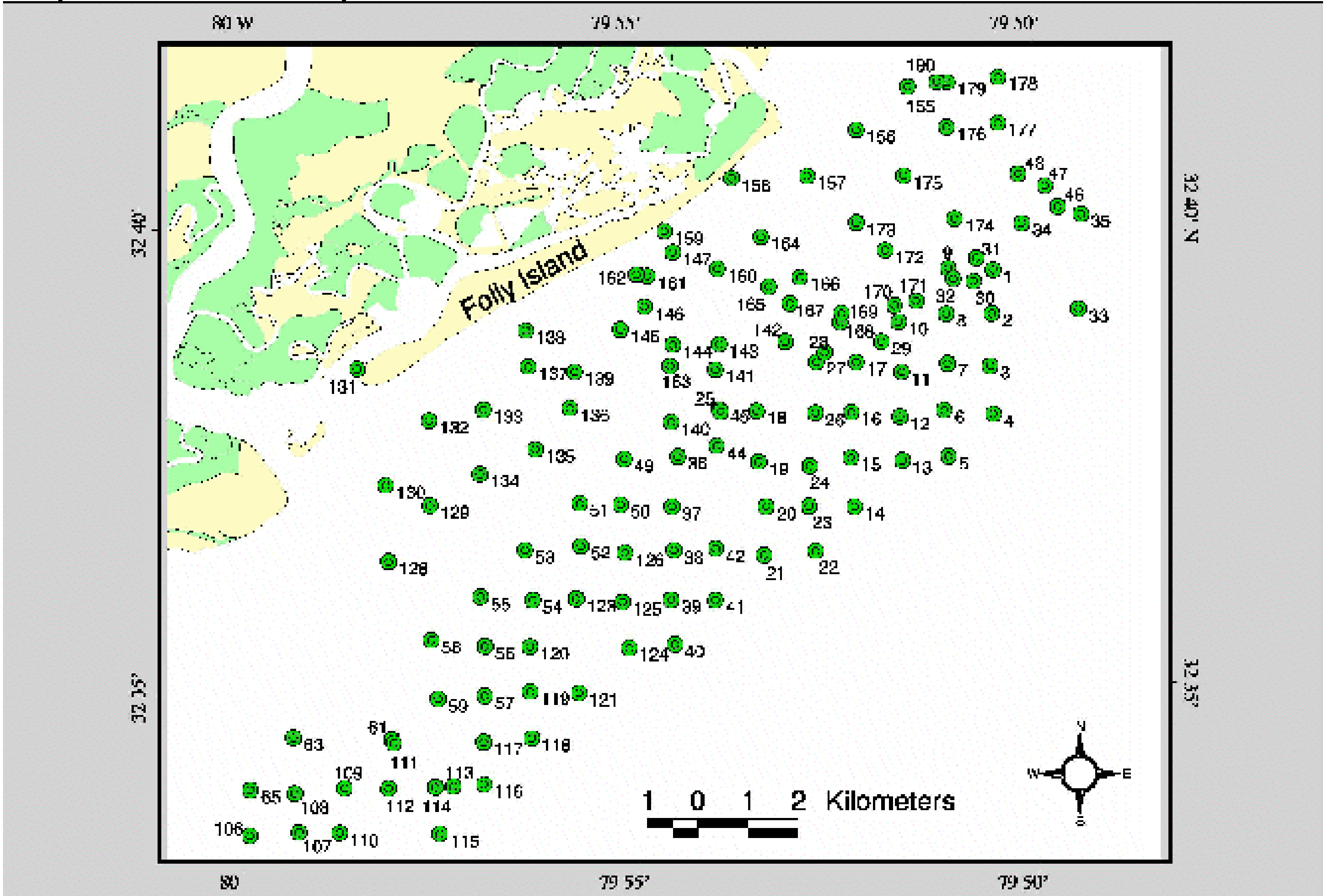


Figure 7. Surficial sediment sample location map for the inner shelf off Folly Island, South Carolina. Sediment texural parameters are provided in Appendix 1.

Edisto Island Grab Sample Locations

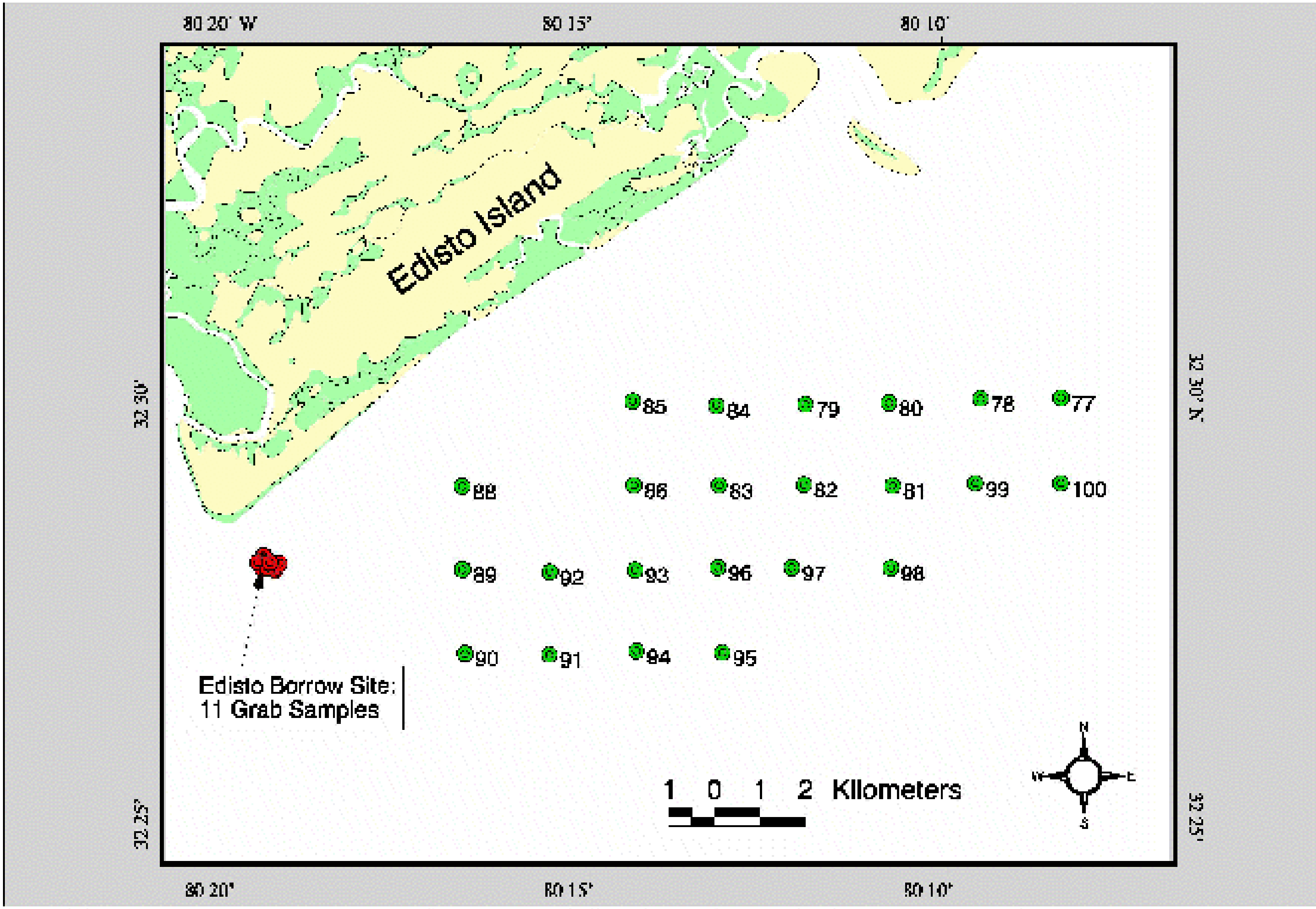


Figure 8. Surficial sediment sample location map for the inner shelf off Edisto Island, South Carolina. Sediment textural parameters are provided in Appendix 1.

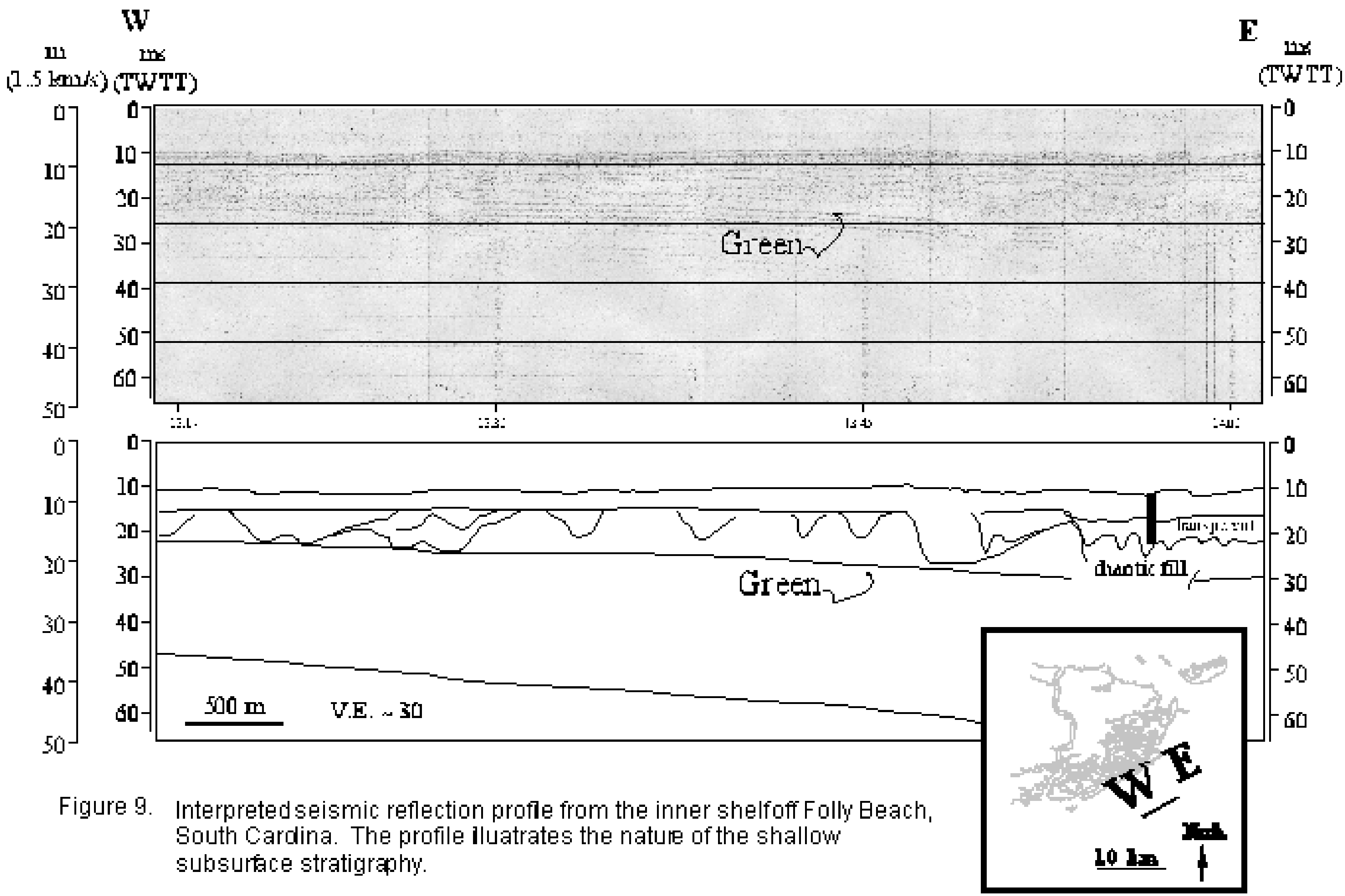


Figure 9. Interpreted seismic reflection profile from the inner shelf off Folly Beach, South Carolina. The profile illuatrates the nature of the shallow subsurface stratigraphy.

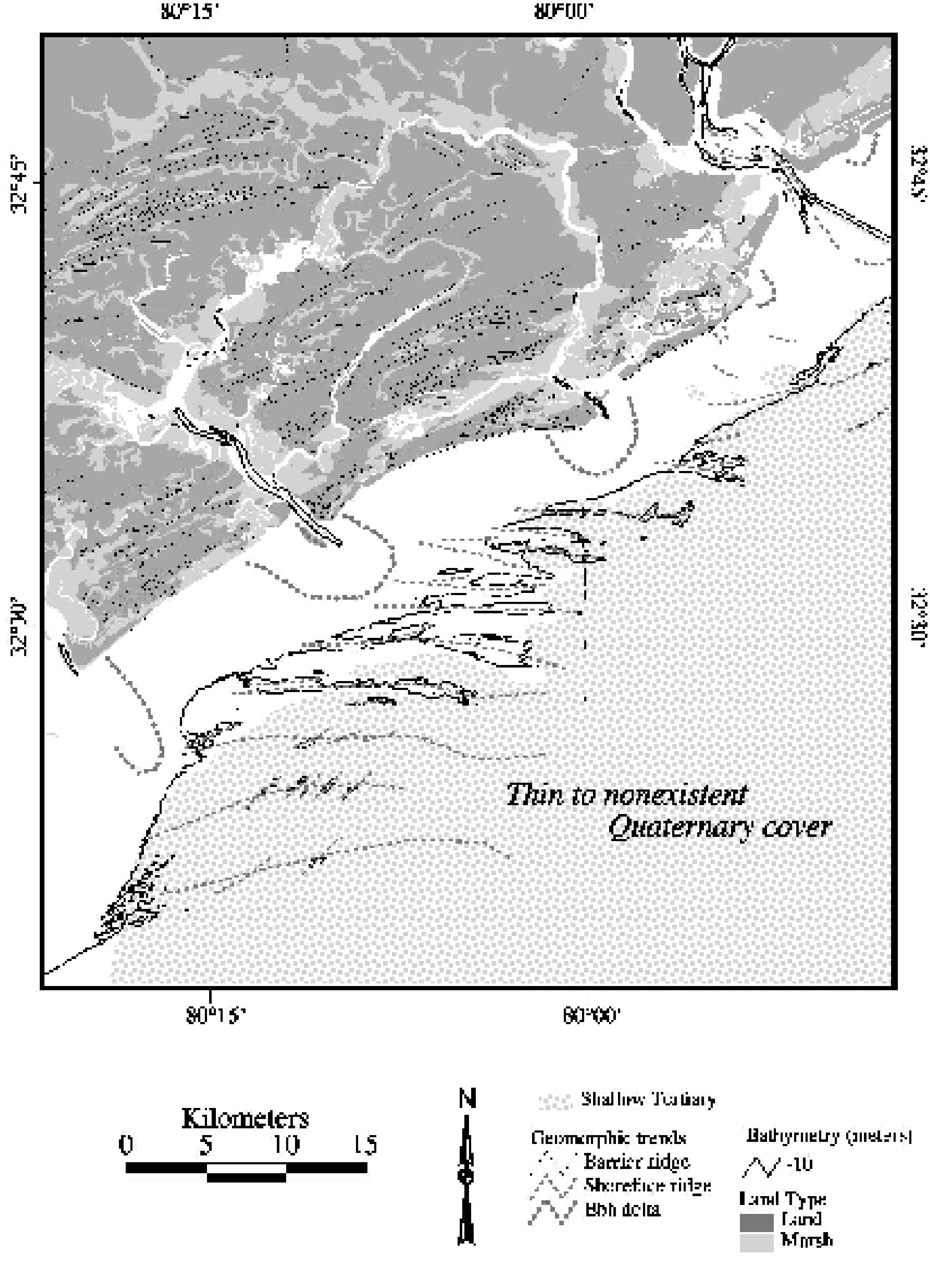


Figure 10. Map defining the limit of Quaternary sediment and abundant Tertiary outcrop on the innershelf off Charleston, South Carolina.

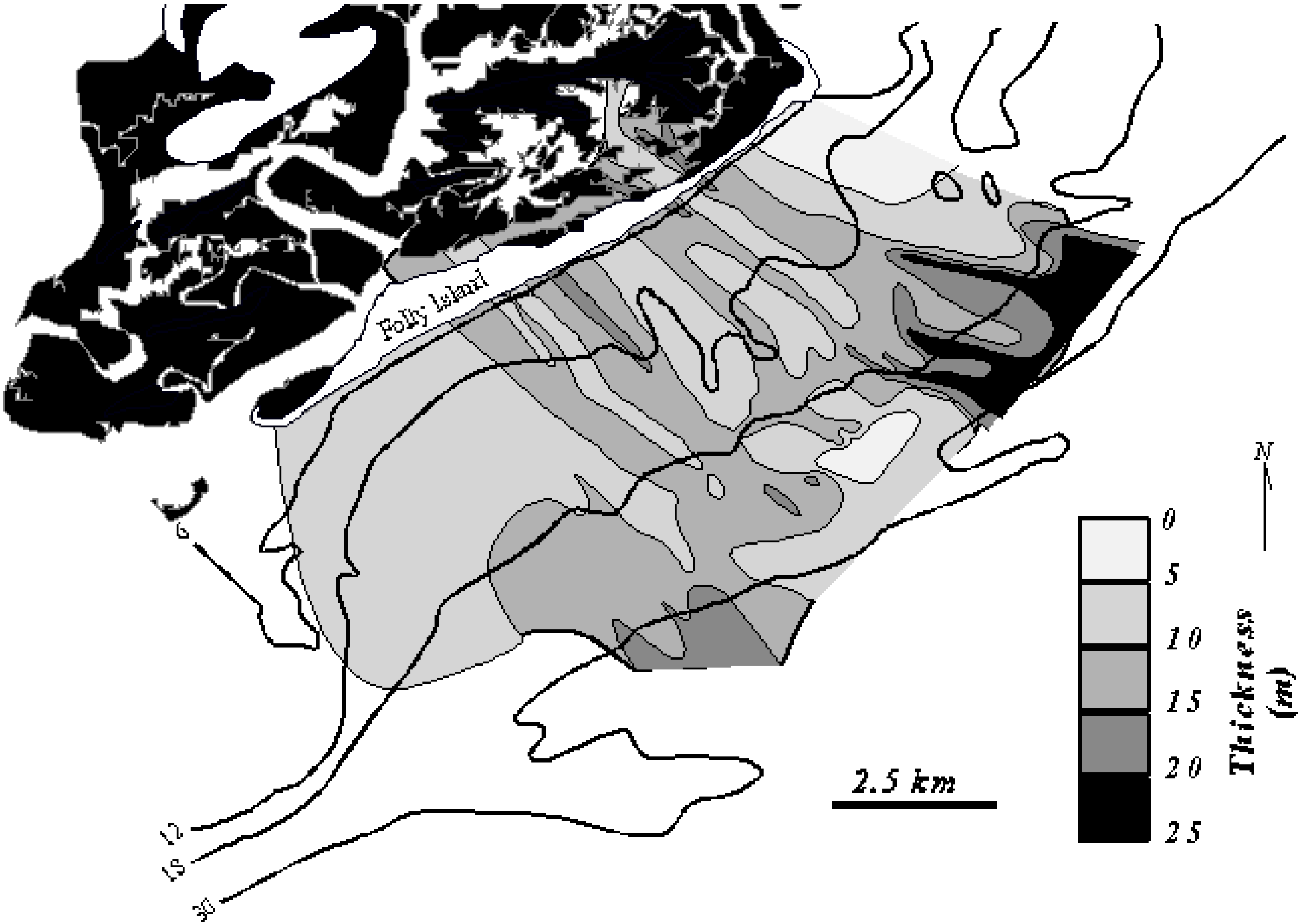


Figure 11. This isopach (thickness) map of Quarternary deposits indicates the presence of a Tertiary high spot beneath the shoreface Thickness deposits to the northeast fill a Holocene paleovalley. Small incisions to the southeast of the Tertiary high are filled with paleochannel materials. Bathymetric contours in feet below mean sea level.

deposits exist within the large ebb tidal deltas found along the coast such as Stono Inlet. The paleochannels offshore of Folly Beach trend offshore to the southeast and appear to be progressively younger in relative age towards the south. A strong planar regional reflector is definable in the seismic data that truncates the paleochannels and older deposits across the region. This surface is inferred to be the Holocene ravinement and overlying sediments are typically 1 to 4 meters thick within 5 kilometers of the beach.

Figure 2 shows a side scan sonar mosaic constructed off of the Folly Beach area which shows surficial sediment characteristics in the region. A series of coarser grained sediment bodies (lighter tones and higher backscatter values) can be seen in this image. These features cut across the trend and position of the paleochannels and represent surficial sediment deposits. A large shore-perpendicular, high backscatter area seen on the shoreface and inner shelf off of the north-central Folly Beach has been proposed as a potential conduit of nearshore sands to the inner shelf off of Folly Beach (Gayes et al., 1997). The sand body identified in INTERMAR Year 2 studies (Gayes and Donovan-Ealy, 1995) lies at the distal end of this feature. The sediments in this deposit have strong textural and shape affinities to sands from the modern beach and surf zone as well as the nourishment project borrow area (Nelson et al., 1995). Seismic profiles (Figure 12) across the sand body indicate the sediments are not shallow or exposed paleochannel sands but are localized lenses of beach quality sand above the ravinement surface. It is possible these are locally-preserved paleoshoreline sands or may be a localized site of deposition of beach and nearshore sands at the base of the large, linear rippled scour depression that extends from the site to the modern surf zone (Gayes et al., 1997, Swift et al., 1997).

SURFICIAL SEDIMENT SAMPLES

Figure 7 shows the sample numbers and locations for all surficial sediment samples collected offshore of Folly Beach by this and other recent studies. Sample locations and full textural parameters for each sample are provided in Appendix 1. Native beach sands on the beach prior to the 1993 nourishment project were characterized by a mean grain size of 2.55 phi (0.17 mm) and sorting values of 0.5

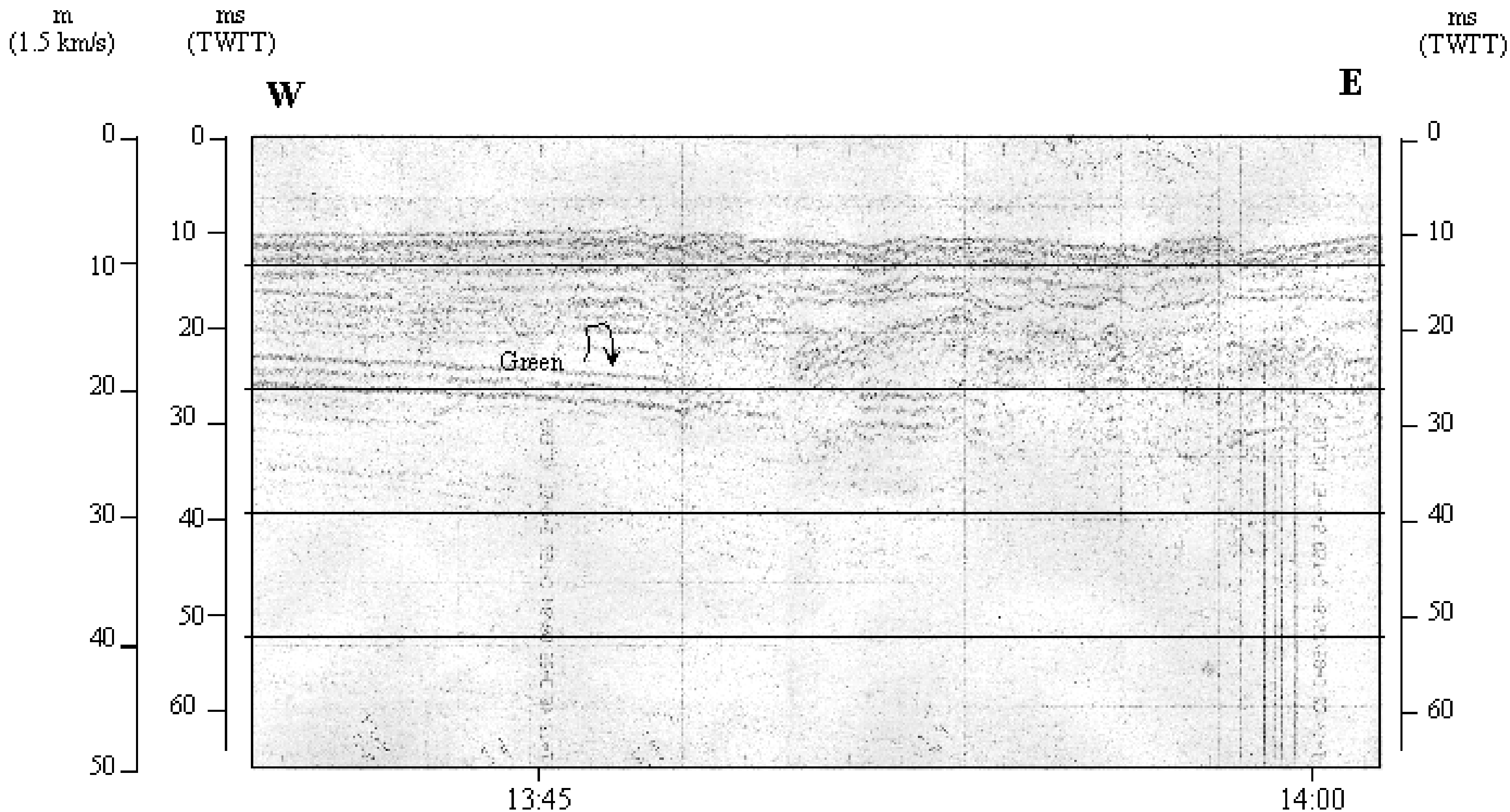


Figure 12. Representative seismicreflection profile from thesand resource study on the inner shelf off north central Folly Beach, South Carolina.

(USACE, 1991). Figure 13 shows the mean grain size (mm) for the 1995 series of sediment samples offshore of Folly Beach. In general, the surficial sands are finer grained than the native beach all along the inner shelf off Folly Beach.

Overfill Ratios-R_A (James, 1975) are a standard parameter used to assess the suitability of a sand resource for use as a beach fill. The values project the percentage of sediment that could be expected to be lost during the sorting and reworking of the fill as the borrow area sands are reworked by the waves and currents of the beach system. This provides a measure of the amount of additional sands, overfill, that would be required to be placed in a project to effect a given design volume to remain after sorting occurs.

These ratios were calculated for each surficial sediment sample using the native beach mean and sorting values that existed before the 1993 nourishment (USACE, 1991). The sample locations on Figure 13 are coded to identify spatial concentrations of beach quality sand. The R_A parameters used in the calculation for each of the surficial sediment samples offshore of Folly Beach are shown in Appendix II. Figure 14 provides the RA nomogram of James (1975) and key for the coding of R_A values for sample locations provided in Figure 13.

Overfill Ratio values between 1.0 and 1.25 are generally proposed to be acceptable for use as nourishment sands in the area (CSC, 1992). Along most of the shoreface and inner shelf to three kilometers offshore mean grain size is characteristically less than the native beach and R_A values of surficial sediment exceeded 1.25. These sands would generally make poor beach sand resources. Surficial sediment samples collected on and around the inshore portion of the Stono Inlet ebb tidal delta also were found to be finer grained than the native beach with high R_A values and generally unacceptable as a sand resource.

Two zones of potential beach quality sand exist based on surficial sediment samples. The first is the within the area defined by Gayes and Donovan-Ealy (1995). The second is a coast parallel band of low RA value sand located from 3 to 6 kilometers from the beach along the coast. Many of the sands in the 3-6 kilometer zone exist in areas of relatively thin sediment cover and are also composed of high weight-percent coarse shell fragments. Both of these characteristics limit the potential of using these sands for nourishment applications on Folly Beach.

Folly Island Grab Sample Mean Grain Size and Ra Values

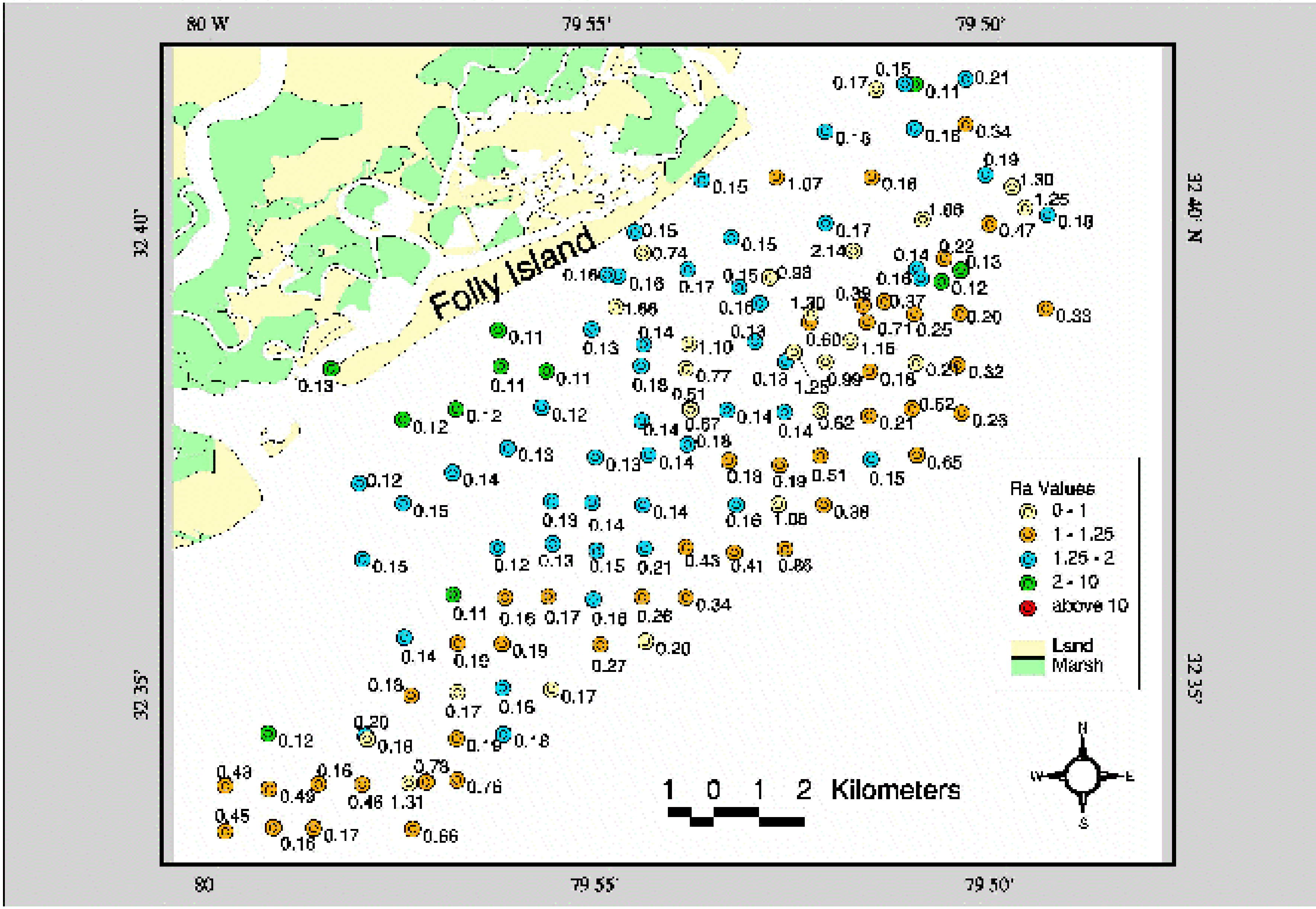


Figure 13. Surficial sediment sample mean grain size (mm) and Ra values (overfill ratio) for the inner shelf off Folly Island, South Carolina. (Color Coding Explained in Figure 14.)

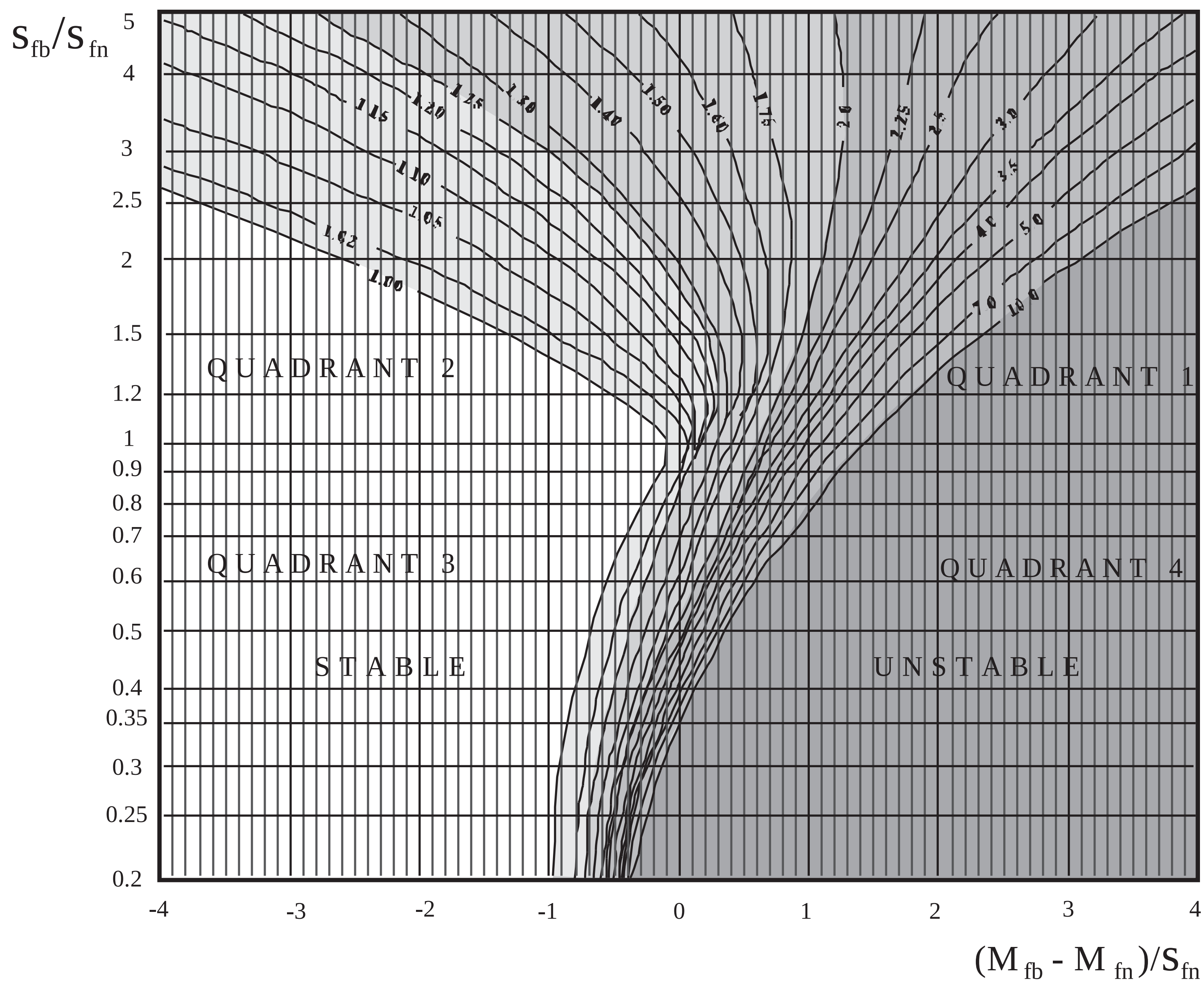


Figure 14: Nomogram used to determine overfill ratio Ra (modified after James (1975). showing Nourishment Quality Coding Used in Figures 13 and 18. Overfill ratios greater than 1.25 are generally considered unstable and unsuitable as beach fill material.

Figure 15 shows the spatial distribution of percent silt and clay as well as the percent carbonate of the samples. The trend in percent fines follows the mean grain size data. Within three kilometers of the beach, surficial sediments are typically higher in percent fines but few samples exceed 10% silt and clay.

VIBRACORE DATA.

A total of 54 vibracores have been compiled from the inner shelf of Folly Beach in the last several years. Most of these were collected and reported as part of the Year II effort (Gayes and Donovan-Ealy, 1995). Additional cores were collected for this study and core descriptions and associated sediment analyses are provided in Appendix III.

In general, core data corresponded well with seismic interpretations and reflecting horizons correlated with changes is sediment characteristics seen in cores. The shallow subsurface (upper 2 meters) of the inner shelf (to 5 kilometers offshore) of Folly Beach is typically underlain by very fine sands that are similar to the surficial sediment characteristic of the low backscatter areas on the side scan sonar mosiac. Sediment textural parameters for sections of the Folly Beach inner shelf vibracore series are provided in Table I

Sand Resource Potential on the Inner Shelf off Folly Beach, SC.

Two areas exist on the inner shelf in the vicinity of Folly Beach, South Carolina that may provide significant quantities of lower R_A value sands. The first is within the zone originally identified by Gayes and Donovan-Ealy (1995). This sand body exists at the seaward terminus of a large and active (Gayes et al., 1997; Swift et. al, 1997) linear rippled scour depression and in a region where the high back scatter sediment of the linear rippled scour depression is overlain by 1- 3 meters of beach compatible sediment **(**Figure 2). Additional vibracores in this area also yielded acceptable R_A values (NF-94-28 and 29). This deposit coarsens and increases in shell fragments as it thins offshore. It is likely to be a less consistent and un-useable resource beyond the three mile limit. As the Quaternary sequence has been eroded away at the base of the shoreface (7-8 meters deep) the paleochannel deposits north of the 1995 resource area exist closer to the

Folly Island Grab Sample Data

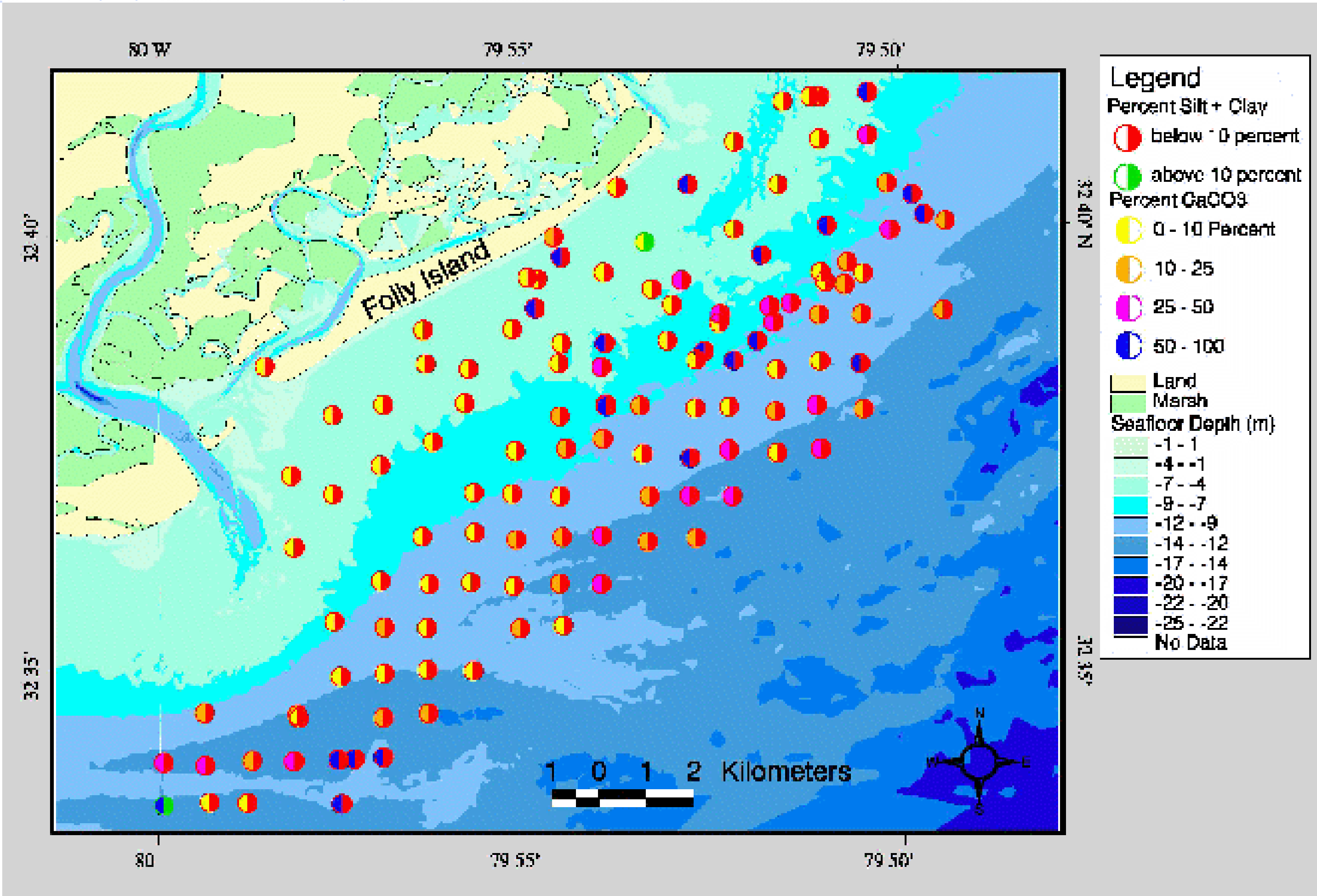


Figure 15. Percent silt/clay and percent carbonate values for surficial sediment samples from the inner shelf off Folly Island, South Carolina.

Table 1. Textural parameters of sediments by interval, for vibracore samples (NF94-14, 19, 23,and 26-29) off Folly and (32) Edisto Islands in June and August 1994. Skewness and kurtosis values are provided for each bulk sample.

Folly Island Vibracores

Core ID / Tot. Core Length	Core ID	Latitude	Longitude	% Gravel	% Sand	% Silt/Clay	% CaCO3	Mean Grain Size (mm)	Sorting	Skewness	Kurtosis
NF94-14 / 2.10m	0-29cm	32.61616	-79.86316	4.53	93.52	1.95	20.68	0.27	1.22	-1.21	5.88
	29-51cm			2.35	93.51	4.14	19.64	0.23	1.19	-0.83	6.11
	51-71cm			2.07	92.49	5.45	22.56	0.19	1.14	-0.99	7.35
	95-112cm			37.78	60.41	1.81	53.51	1.24	1.77	0.54	2.92
	112-131cm			44.19	52.63	3.18	69.28	1.18	1.92	0.78	2.96
NF94-19 / 2.00m	0-43cm	32.6025	-79.9463	0.25	82.22	17.53	24.84	0.10	0.94	-0.11	5.46
	43-77cm			0.13	57.08	42.79	0.00	0.07	1.20	-0.62	3.01
	77-121cm			0.00	67.05	32.95	32.36	0.09	1.20	0.10	2.07
	121-158cm			0.15	45.10	54.74	62.10	0.06	1.14	-1.07	4.04
	158-200cm			0.84	86.21	12.95	20.56	0.14	1.13	-0.25	5.28
NF94-23 / 1.97m	0-30cm	32.608	-79.9197	0.53	70.62	28.84	45.19	0.90	1.17	-0.52	4.60
NF94-26 / 1.89m	0-28cm	32.6216	-79.9028	3.33	95.13	1.54	14.05	0.19	1.14	-1.80	7.37
	28-34cm			15.90	82.06	2.04	42.23	0.46	1.72	-0.37	2.48
	35-55cm			7.18	91.47	1.35	20.42	0.22	1.48	-1.65	5.18
	61-189cm			1.19	91.64	7.17	16.95	0.128	0.974	-1.398	10.46

Table 1. continued

Folly Island Vibracores

Core ID / Tot. Core Length	Core ID	Latitude	Longitude	% Gravel	% Sand	% Silt/Clay	% CaCO3	Mean Grain Size (mm)	Sorting	Skewness	Kurtosis
NF94-27 / 1.56m	0-44cm	32.6245	-79.8967	0.81	97.88	1.31	10.20	0.18	0.83	-1.41	9.17
	44-77cm			2.88	95.15	1.97	15.79	0.19	1.16	-1.75	7.47
	77-156cm			0.37	95.21	4.41	12.65	0.13	0.72	-0.69	13.22
NF94-28 / 1.11m	0-20cm	32.62636	-79.89853	6.40	92.83	0.77	22.24	0.33	1.36	-0.79	3.75
	21-40cm			2.57	92.60	4.83	18.19	0.18	1.22	-1.09	5.88
	43-111cm			0.13	96.01	3.87	10.57	0.14	0.70	0.24	8.38
NF94-29 / 1.85	1-24cm	32.62911	-79.89265	1.55	95.13	3.32	13.64	0.15	1.07	-1.45	8.09
	28-51cm			0.28	91.15	8.57	17.46	0.14	0.96	-0.02	5.20
	52-163cm			1.00	95.90	3.10	11.08	0.16	0.88	-1.42	12.18
	163-1.85			18.25	77.77	3.98	37.56	0.33	2.07	-0.78	2.39

Edisto Island Vibracore

Core ID / Tot. Core Length	Core ID	Latitude	Longitude	% Gravel	% Sand	% Silt/Clay	% CaCO3	Mean Grain Size (mm)	Sorting	Skewness	Kurtosis
NF94-32 / 105cm	1-33cm	32.47156	-79.27903	26.40	66.27	7.33	49.30	0.51	2.39	-0.06	1.74
	33-69cm			2.11	95.49	2.40	12.63	0.15	0.96	-2.84	16.86
	69-94cm			1.53	95.24	3.24	19.03	0.18	1.11	-0.94	5.49
	94-105cm			3.94	94.53	1.52	19.17	0.26	1.26	-0.98	4.82

surface. Cores into these channels show them to be predominately mud filled (GKSC95-29 and 30) and a poor beach nourishment resource.

The second area of potential sand resource is within the significant Quaternary deposits of the large ebb tidal delta complex of Stono Inlet and a small shoreface connected ridge field on the northern flank of the delta. The shoal complex itself represents a massive volume of sediment. The seismic reflection profiles show the shoal complex to be approximately 6 meters in thickness sediment with a relatively complicated internal stratigraphy. The shoal complex overlies a strong, regionally-coherent reflector interpreted as the top of the Ashley Formation. There is evidence of extensive multiple cut and fills within the shoal. These are represented as successive lenses of sediment with prograding internal reflectors documenting active infilling of small channels within the ebb delta environment. A broad zone of acoustically transparent sediment exists in the very shallow subsurface (<2 meters) as indicated on the seismic profile from the delta shown in Figure 16. Such transparent fills in seismic profiles are typically very fine or muddy sediments and are likely to be similar in character to the mud-filled channels cored offshore of the northern third of the island.

All surficial sediment samples on the inshore portion of the ebb delta (Sample #'s 53,55, 58, 61, 63, 111, 114, 117, 128-135) produced unacceptably high R_A values (Figure 13 and Appendix II) as did several sites further offshore (Sample #'s 40, 57, 118, 119, 121). A band of acceptable RA value surficial sediment (Sample #'s 39, 41, 54, 56, 59, 65, 106, 107, 108, 109, 112, 113, 116, 117, 120, 123, 124) exists on the outer Stono Delta. Many of these samples, however, have high percentages of coarse shell hash (> 20 wt.%-sample #'s 39, 41, 65, 106, 108, 116), which limits the compatibility with the native beach at Folly Beach.

Vibracores in the vicinity of the shoal also show variable and potentially limited sand resource potential. Several cores (NF-94-19, NF-94-23, 94-NF-26; Appendix III) showed significant silty-clay units within a meter of the surface across the delta complex and the surficial sands within the cores have unacceptably high R_A values. The overfill ratios are provided for core sediment samples in Table 2. One core (USGS-GKSC95) recovered 2.26 meters of very fine to fine sand from the inshore portion of the Stono Ebb Delta (Appendix III). Grain size data are not available from that core. The

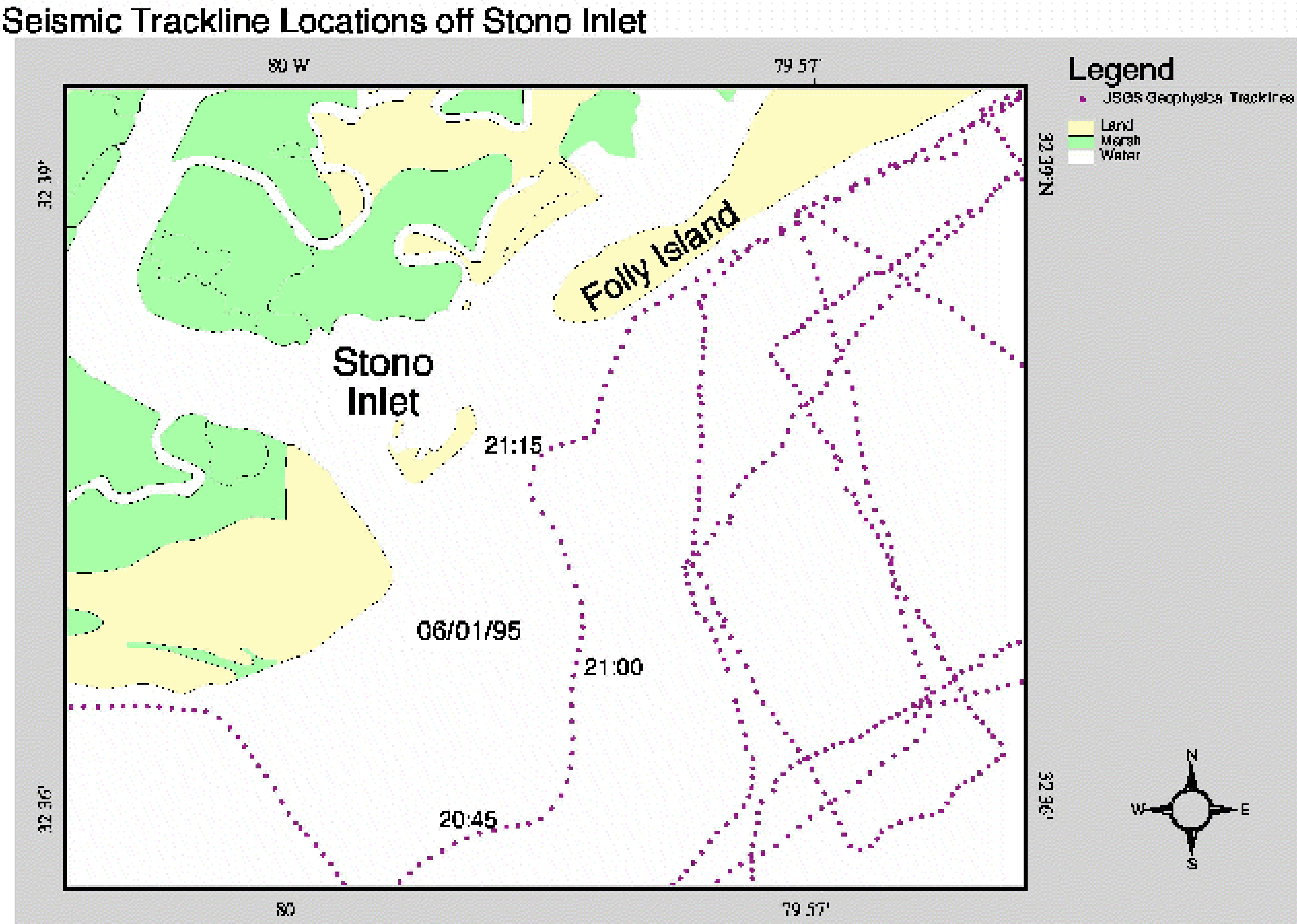


Figure 16(b). Seismic reflection profile location map for Stono Inlet

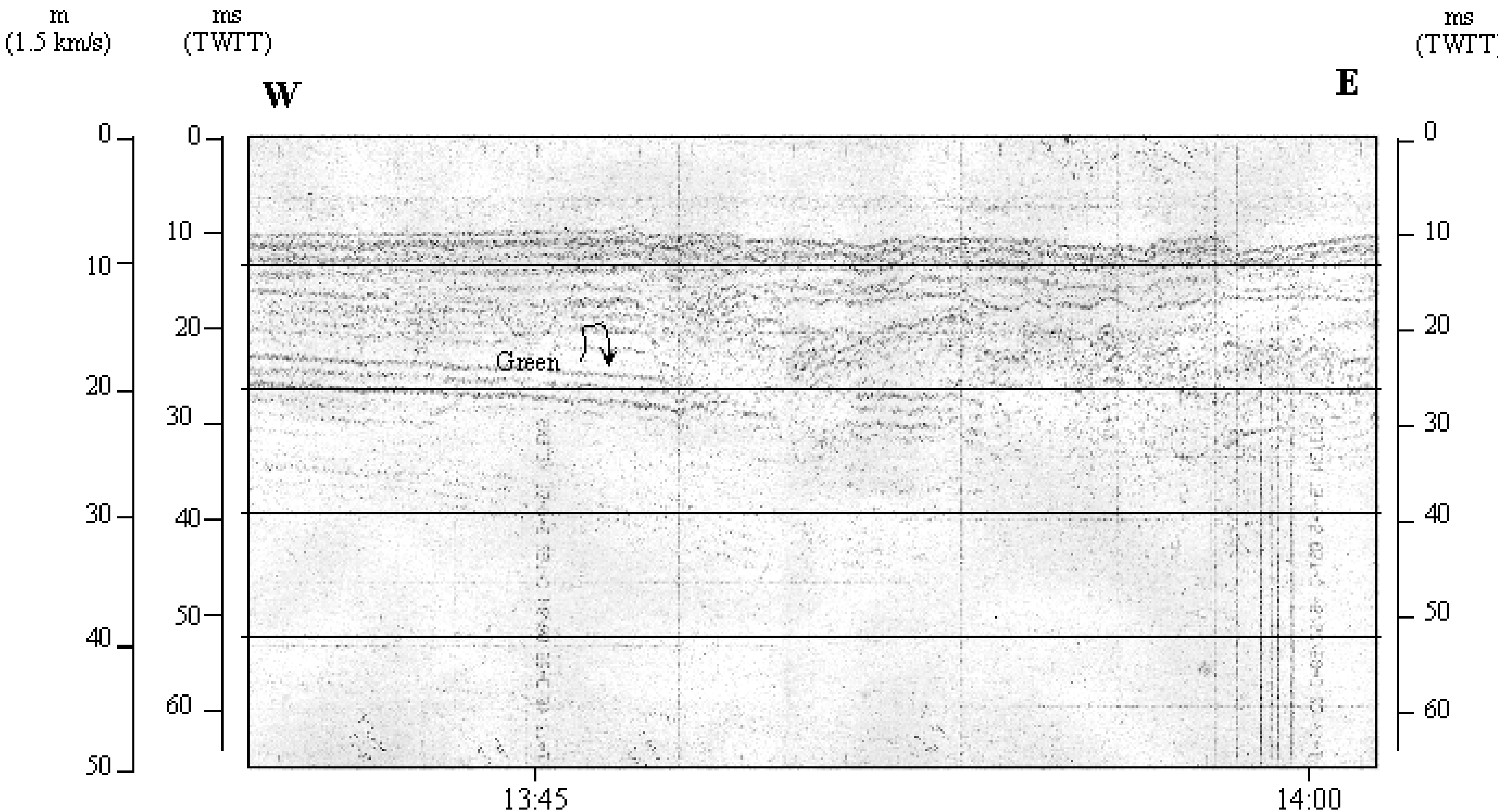


Figure 12. Representative seismicreflection profile from thesand resource study on the inner shelf off north central Folly Beach, South Carolina.

Table 2. R_A Values for vibracore samples off Folly and Edisto Islands

Sample ID	M_b	$Sort_b$	M_b-M_n/$Sort_l$	$sort_b/sort_n$	R_A
Folly					
NF-94-14	1.053	1.152	-3.01	2.30	1
NF-94-19	3.485	0.880	1.86	1.76	3.5
NF-94-23	3.475	1.165	1.84	2.33	2.6
NF-94-26	2.626	1.040	0.14	2.08	1.3
NF-94-27	2.678	0.846	0.24	1.69	1.35
NF-94-28	2.459	0.886	-0.19	1.77	1.11
NF-94-29	2.472	1.033	-0.17	2.07	1.21

Sample ID	M_b	$Sort_b$	M_b-M_n/$Sort_l$	$sort_b/sort_n$	R_A
Edisto					
NF-94-32	2.143	1.525	0.74	1.35	1.75

*M_b and $Sort_b$ calculated from weighted averages for MGS and sorting over variable length cores.

M = Mean Grain Size
b = Borrow site
n = Native Sand

Folly
M_n = 2.556
$sort_n$ = 0.5

Edisto
M_n = 1.3
$sort_n$ = 1.133

core increased in mud laminae below 1.45 meters which is approaching a near-surface, acoustically-transparent unit that is prevalent in the seismic data in this vicinity. This would suggest a relatively limited resource potential but would require extensive vibracoring to define acceptable reserves within the delta complex.

The target for Core NF-94-26 was a bathymetric high that appears to be of similar dimensions and orientation as classic shoreface connected ridge structures commonly found in similar settings (the base of the shoreface). Such sand bodies have been targeted for beach nourishment sand resources elsewhere along the U.S. east coast. That core yielded an unacceptably high R_A but possessed fewer mud units than adjacent cores. The sediment from that core was found to be too fine grained and had too high an overfill ratio for use as a beach nourishment resource (Table 2).

The variability of the shoal and probability of significant muddy sequences within the shoal complex, defined by seismic records, vibracores and poor R_A values of surficial sediment samples, suggest the beach nourishment sand potential of the ebb tidal delta may be limited. It is probable that significant sand deposits do exist in the shoals but they are not likely to be spatially extensive nor homogeneous. Use of the ebb delta as a sand resource would require a very detailed site specific survey and incorporate COBRA zone considerations in the siting of any potential borrow area on the shoal.

The principal beach nourishment sand resource potential offshore of Folly Beach is the site proposed by Gayes and Donovan-Ealy (1995;outlined in Figure 2) which is estimated to contain 700,00 to 1,000,000 cubic yards of beach compatible sand. The alternative site would be reoccupation of the previous borrow area within the Stono River which has been infilling with sands since the 1993 dredging took place (Van Dolah et al., 1998). This site is restricted by COBRA zone regulations. Dredging of channels within Stono Inlet may also have undesirable ancillary effects on inlet processes and morphology. The deposits offshore of the active inshore inlet area produced poor R_A values within a highly variable stratigraphy. Collectively, this extensive groundtruthing of sand quality and consideration of effects on the ephemeral shoals within the inlet (such as Skimmer Flat and Bird Key) as well as the adjacent beaches on Folly Beach within the zone heavily influenced by the inlet (Folly Beach County Park area) is required before the ebb tidal delta resources could be utilized.

EDISTO ISLAND STUDY AREA

Seismic Reflection Data

A regional reconnaissance seismic reflection grid was established to assess the offshore sand resource potential at Edisto Island (Figure 4). As was the case offshore of Folly Beach, the inner shelf offshore of Edito Island is characterized by a seaward thinning wedge of Quaternary sediments (Figure10). A typical interpreted seismic reflection section of the Edisto inner shelf is shown in Figure 17. The Tertiary deposits in this area form an undulating surface that generally exists very close to or at the sea floor. No significant paleochannels are seen to incise the Tertiary strata and no significant thicknesses of Quaternary age sediments are seen in the seismic data from the inner shelf offshore of Edisto Island.

Surficial Sediment Samples

The location of surficial sediment samples collected on the inner shelf off Edisto Island are provided in Figure 8. Figure 18 shows the mean grain size and R_A overfill ratios for the Edisto inner shelf samples. Figure 19 shows the percent silt and clay and percent carbonate for the Edisto Island inner shelf surficial sediment samples. The full grain size distributions for these samples are provided in Appendix IV. The composite mean grain size of 24 surficial sediment samples of the native beach in 1991 was 0.41 mm (CSE, 1992). None of the surficial sediment samples collected on the Edisto inner shelf exceeded the mean beach grain size. Overfill ratios (R_A) are also all greater than commonly accepted limits. These parameters all characterize the surficial sands near the three mile limit as very poor sand resources for use in beach nourishment application at Edisto Island.

Vibracores

Twenty-three vibracores were collected on the Edisto inner shelf to help assess sand resource potential offshore of Edisto Island. These cores also document a very thin Quaternary section and several fine grained Tertiary units within one meter of the sea

Edisto Island Grab Sample Mean Grain Size and Ra Values

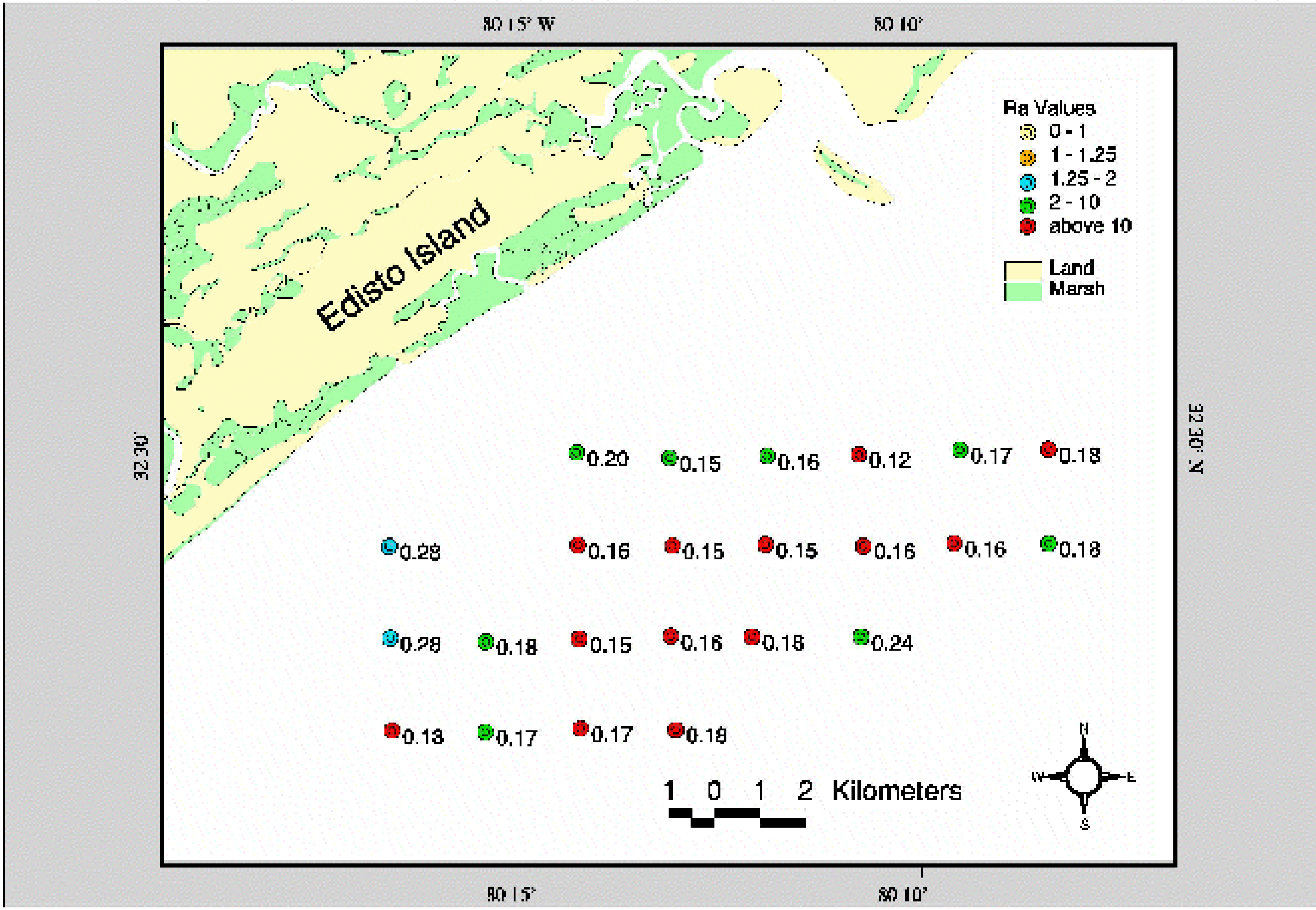


Figure 18. Surficial sediment sample mean grain size (mm) and Ra values (overfill ratio) for the inner shelf off Edisto Island, South Carolina. (Color Coding Explained in Figure 14.)

Edisto Island Grab Sample Data

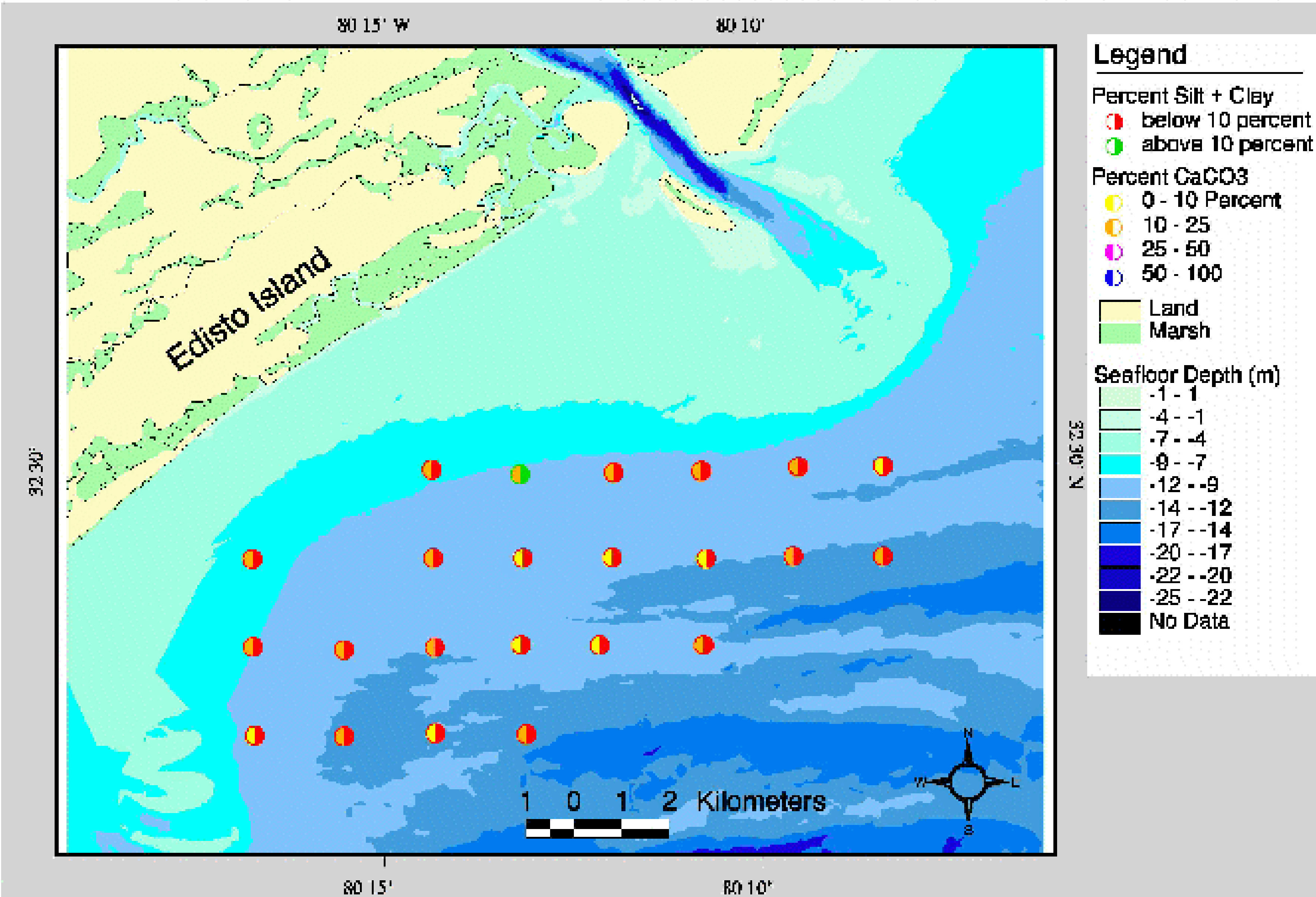


Figure 19. Percent silt/clay and percent carbonate values for surficial sediment samples from the inner shelf off Edisto Island, South Carolina.

floor on the inner shelf off Edisto Island. Core descriptions are provided in Appendix III for the offshore Edisto area vibracores.

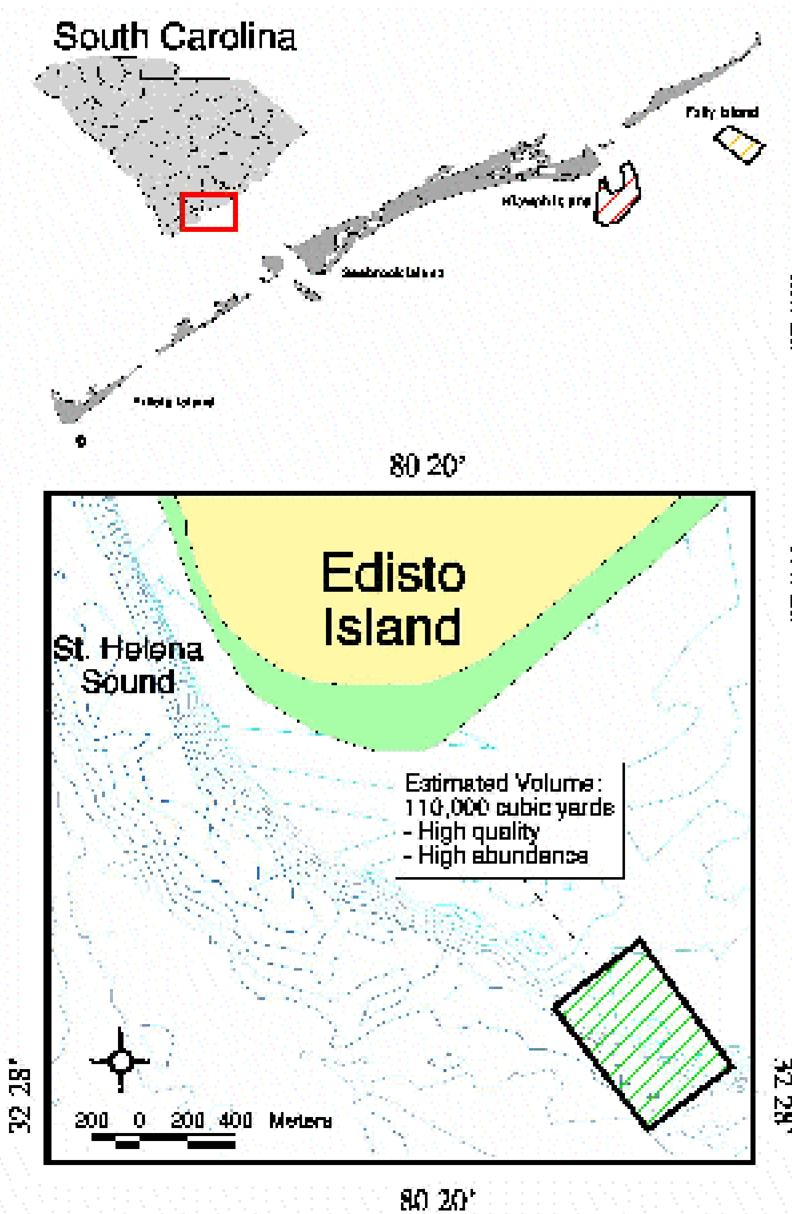
Sand Resource Potential of near the Three Mile Limit off Edisto Island, South Carolina

In general, the sand resource potential of the inner shelf near the federal/state jurisdictional boundary is very poor for use in beach nourishment applications. The surficial sediment deposits are very thin and fine-grained Tertiary deposits are common near the modern sea floor. No significant channels or shoals exist on the inner shelf off Edisto Island. The thin Quaternary section was typically fine grained compared to the modern beach fill and would not be expected to be stable if put on the beaches.

Because the poor sand resource potential offshore of Edisto Island, additional samples were collected in and around a small borrow area on a shoal within the ebb tidal delta complex of South Edisto River Inlet to St. Helena Sound. This shoal area was used as a borrow area for a nourishment project in 1995. The recovery of that borrow area is documented by a separate report of the SC Task Force (Van Dolah et al., 1998). Figure 20 shows the mean grain size, weight percent carbonate and weight percent silt/clay data for the 1996 short vibracore and surficial sediment samples collected in the borrow area used for the 1995 nourishment project (Van Dolah et al., 1998). In general, these cores possess sands with mean grain sizes comparable with the modern beach at Edisto Island. R_A values for the Edisto ebb shoal area all possess acceptable overfill ratios except for one sample (EDBS-03) (Table 2). As a result, this large shoal complex is the most promising resource for the Edisto Island. It is also a setting where the borrow area has rapidly infilled with material similar to the native sands (Van Dolah et al., 1998). There are, however, sporadic fine-grained horizons and lenses within the shoal complex particularly near the base of the shoal which may locally yield sediment incompatible with the native beach. This appears to be more problematic deeper within and around the shoal.

A paucity of potential beach nourishment resources exists on the inner shelf off Edisto Island. Based on the general regional survey, no significant depositional sites or volumes of sand exist on the inner shelf off Edisto Island. The inshore portion of the

Sand Resource Potential For Borrow Areas Off Folly and Edisto Islands



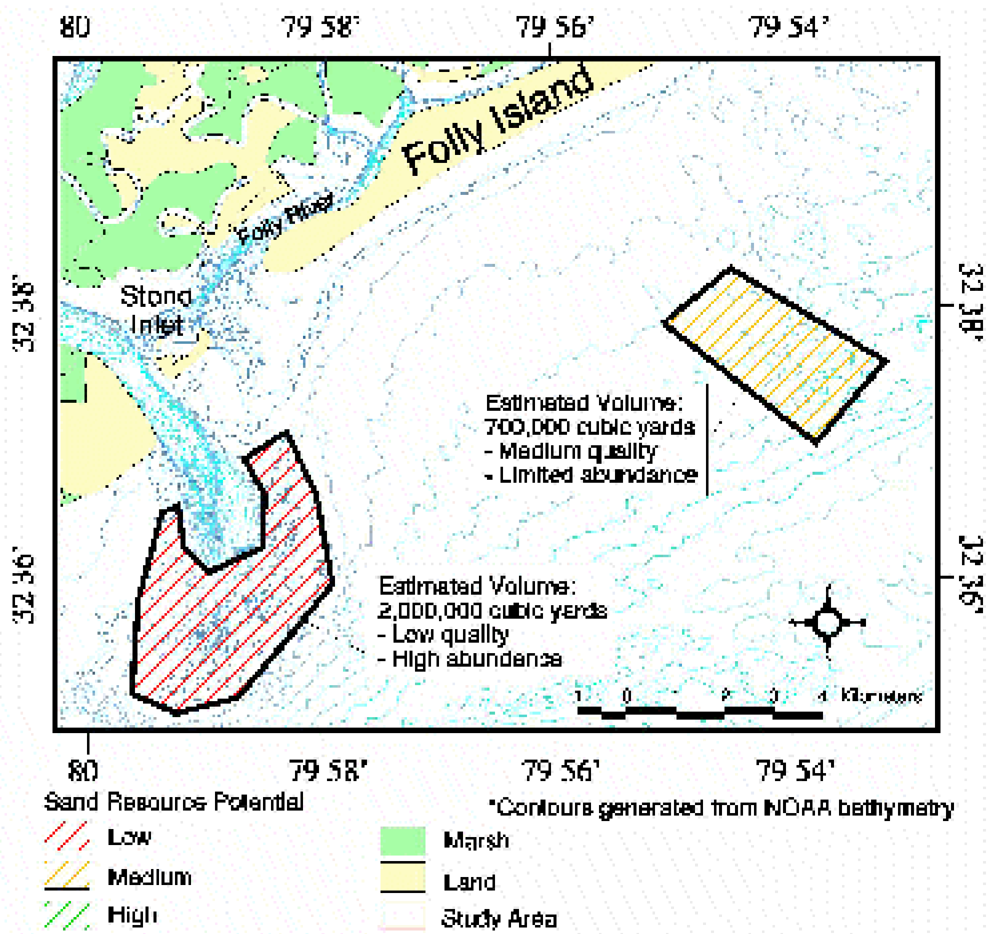


Figure 20. Sand Resource Potential (SRP) maps for Folly and Edisto Islands. Volumes and quality assesments are based upon seismic reflection, vibracores and surficial sediment data (provided in appendicies I and II.) High SRP denotes areas of abundant beach quality sand in close proximity to areas of reccuring nourishment need. Medium SRP denotes areas of limited volumes of beach compatible or abundant volumes of marginally compatible nourishment sand reserves. Low quality designation reflects abundant volumes of sediment available but little beach quality sand observed.

large ebb tidal shoals off Edisto Inlet have been used recently as a sand source for a small nourishment project on Edisto Island. Grab samples and limited short vibracores collected both within and slightly seaward of the previously used borrow site at Edisto Inlet recovered beach compatible sand. As at Stono Inlet, there was some variability in sand quality but expansion of the 1995 borrow site is the most likely source of beach compatible sands available for nourishment purposes to Edisto Island. Potential limitations on the use of these sites by COBRA or state environmental regulations would require seeking a potential sand source well offshore of the three-mile limit in this area.

Bibliography

CSC, 1992, Edisto Beach Nourishment Project: Geotechnical studies, bathymetry and beach surveys, wave modeling studies:prepared for the South Carolina Dept. of Parks Recreation and Tourism and the Town of Edisto Island, 120p.

Ebersole, B.A., Neilans, P.J. and Dowd, M.W., , Beach-fill performance at Folly Beach, South Carolina (1 year after construction) and evaluation of design methods, Shore and Beach, v. , p. 1-26.

Gayes, P.T. and Donovan-Ealy, P., 1995, Assessment of beach renourishment resources near Folly beach, South Carolina: Final Report of the South Carolina Task Force on Offshore Resources to the Minerals Management Service Office of International Activities and Mineral Resources, 186 p.

Katuna, M.P., Blythe, R.B., Moeller, M.E. and Williams, B.P., 1995, Study of Shoreline Migration Rates and Sediment Budgets for Seabrook, Kiawah and Folly Islands, South Carolina: Final Report of the South Carolina Task Force on Offshore Resources to the Minerals Management Service Office of International Activities and Mineral Resources, 102 p.

Nelson, D.D. Donovan-Ealy, P. Gayes, P.T., Eikenberry, 1995, A., beach and nearshore sand transport revealed by size and fourier grain shape analysis, Folly Beach, S.C.; Programs with Abstracts, Annual Meeting of the Geological Society of America, v. 27, n 6, A-64.

U.S. Army Corps of Engineers, 1991, General Design Memorandum: Folly Beach, South Carolina Shore Protection Project, US Army Corps of Engineers, Charleston District, Charleston, S.C., p. 51 + appendices

Van Dolah, R.F., Colgan, M.W., Devoe, M.R., Donovan-Ealy, P., Gayes, P.T., Katuna, M.P. and Padgett., S., 1994, An evaluation of sand, mineral and hardbottom resources on the coastal ocean shelf off South Carolina: Final Report of the South Carolina Task Force on Offshore Resources to the Minerals Management Service Office of International Activities and Mineral Resources, 235 p.

Van Dolah, R.F., Martone, R.M., Lynch, A.E., Levinsen, M.V., Wendt, P.H., Whitaker, D.J. and Andersen, W.D., 1994, Environmental Evaluation of the Folly Beach Nourishment Project; SC-DNR Final Report submitted to the USACE,100p.

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APPENDIX I:

Textural parameters of surficial sediments samples off Folly and Edisto Islands in November, 1995.
Skewness and kurtosis values are provided for each bulk sample.

Folly Island Samples

Sample ID	Latitude	Longitude	% Gravel	% Sand	% Silt/Clay	% CaCO3	Mean Grain Size (mm)	Sorting	Skewness	Kurtosis
NF1195-1	32.65800	-79.84117	0.58	97.35	2.07	8.54	0.13	0.71	-2.14	17.20
2	32.65017	-79.84150	2.99	95.38	1.63	16.06	0.20	1.19	-1.54	6.47
3	32.64083	-79.84200	21.49	77.88	0.63	51.83	0.32	1.48	-0.09	2.59
4	32.63217	-79.84133	1.87	97.89	0.23	11.11	0.26	0.78	-1.98	11.09
5	32.62467	-79.85100	25.25	74.43	0.32	43.84	0.65	1.87	-0.40	1.86
6	32.63300	-79.85183	9.99	89.92	0.08	37.31	0.53	1.31	-0.67	2.80
7	32.64133	-79.85100	0.23	99.40	0.38	5.89	0.21	0.69	-0.92	7.25
8	32.65017	-79.85117	4.58	95.21	0.21	18.15	0.25	1.20	-1.83	6.41
9	32.65833	-79.85067	0.97	97.36	1.68	6.63	0.14	0.76	-3.13	24.50
10	32.64883	-79.86133	11.91	87.44	0.65	28.31	0.71	1.43	0.28	3.51
11	32.63983	-79.86083	0.41	99.08	0.51	5.59	0.18	0.74	-1.61	9.29
12	32.63183	-79.86117	3.02	96.45	0.53	14.37	0.21	1.14	-1.75	6.23
13	32.62400	-79.86083	0.49	98.48	1.03	9.68	0.15	0.75	-2.07	12.38
14	32.61583	-79.87100	13.91	85.55	0.54	37.46	0.38	1.67	-1.03	3.02
15	32.62467	-79.87167	13.49	86.46	0.05	32.01	0.51	1.45	-0.79	2.86
16	32.63283	-79.87150	8.49	91.40	0.11	4.36	0.62	1.08	-0.65	4.81
17	32.64167	-79.87033	23.00	76.77	0.23	54.12	0.99	1.31	-0.12	2.84
18	32.63317	-79.89150	1.97	95.83	2.19	11.01	0.15	0.99	-2.60	13.76
19	32.62400	-79.89117	1.56	97.54	0.90	8.38	0.18	0.91	-2.24	12.77
20	32.61600	-79.88967	2.77	93.09	4.14	16.37	0.16	1.19	-1.75	7.80
21	32.60733	-79.89016	16.75	82.96	0.29	38.17	0.41	1.76	-0.69	2.12
22	32.60800	-79.87933	16.93	83.07	0.00	37.38	0.86	1.26	-0.71	3.26
23	32.61600	-79.88067	27.82	72.18	0.00	52.25	1.08	1.42	-0.17	2.44
24	32.62316	-79.88033	2.16	97.49	0.35	8.02	0.19	0.89	-3.04	15.96
25	32.63317	-79.89917	5.27	94.16	0.57	0.00	0.51	1.02	-0.66	6.35

Sample ID	Latitude	Longitude	% Gravel	% Sand	% Silt/Clay	% CaCO3	Mean Grain Size (mm)	Sorting	Skewness	Kurtosis
NF1195-26	32.63267	-79.87917	0.57	96.84	2.59	9.41	0.14	0.75	-1.63	13.32
27	32.64183	-79.87883	0.68	98.58	0.74	4.98	0.13	0.61	-4.10	35.05
28	32.64350	-79.87700	31.73	68.16	0.11	55.32	1.25	1.33	-0.12	2.46
29	32.64533	-79.86500	23.50	76.50	0.00	65.90	1.15	1.12	0.24	3.01
30	32.65600	-79.84533	0.46	95.99	3.56	14.30	0.12	0.75	-2.07	16.16
31	32.66017	-79.84467	3.78	95.56	0.66	14.04	0.22	1.11	-2.11	8.74
32	32.65650	-79.84967	1.44	97.45	1.11	8.41	0.16	0.83	-2.85	16.68
33	32.65083	-79.82317	10.78	87.84	1.38	21.78	0.33	1.67	-1.24	4.08
34	32.66633	-79.83500	20.90	78.07	1.04	37.31	0.47	2.03	-0.54	2.03
35	32.66783	-79.82250	6.54	89.62	3.84	21.75	0.18	1.60	-1.44	4.62
36	32.62517	-79.90833	2.30	91.10	6.59	14.48	0.15	1.12	-1.97	11.78
37	32.61617	-79.90967	1.32	96.87	1.82	7.56	0.14	0.82	-3.18	21.90
38	32.60833	-79.90933	4.84	92.84	2.32	18.66	0.21	1.37	-1.55	5.69
39	32.59950	-79.91000	7.06	92.26	0.68	22.63	0.26	1.43	-1.53	4.75
40	32.59150	-79.90933	0.44	99.34	0.22	8.62	0.20	0.61	-2.25	14.31
41	32.59933	-79.90067	7.81	91.98	0.21	30.07	0.34	1.40	-1.33	4.34
42	32.60850	-79.90050	9.00	88.78	2.22	36.02	0.43	1.62	-0.06	2.35
44	32.62700	-79.90000	1.50	95.27	3.23	11.31	0.18	1.07	-1.22	6.95
45	32.63350	-79.89933	14.54	85.20	0.27	43.26	0.67	1.30	-0.80	3.53
46	32.66917	-79.82733	35.49	64.32	0.19	75.63	1.25	1.45	0.30	2.44
47	32.67300	-79.83000	33.01	66.74	0.26	61.96	1.31	1.37	0.37	3.02

Sample ID	Latitude	Longitude	% Gravel	% Sand	% Silt/Clay	% CaCO3	Mean Grain Size (mm)	Sorting	Skewness	Kurtosis
NF1195-48	32.67517	-79.83567	4.24	94.33	1.43	15.45	0.20	1.22	-2.03	8.35
49	32.62483	-79.91967	0.27	97.48	2.25	6.47	0.13	0.66	-1.35	13.38
50	32.61667	-79.92050	0.93	97.21	1.86	6.71	0.14	0.75	-3.14	23.88
51	32.61700	-79.92917	1.43	94.84	3.73	8.53	0.13	0.89	-2.40	15.62
52	32.60933	-79.92900	0.73	97.02	2.24	8.06	0.13	0.70	-2.58	21.12
53	32.60867	-79.94083	1.94	93.62	4.44	9.07	0.12	0.96	-3.09	19.34
54	32.59967	-79.93933	0.74	98.03	1.23	10.09	0.16	0.76	-2.44	17.63
55	32.60033	-79.95033	0.19	93.91	5.91	6.96	0.11	0.67	-0.22	13.09
56	32.59150	-79.94950	1.25	92.55	6.20	12.60	0.19	1.06	-0.36	7.03
57	32.58267	-79.94967	0.15	99.39	0.46	5.82	0.17	0.51	-1.92	18.14
58	32.59267	-79.96083	0.28	99.25	0.48	4.70	0.14	0.55	-2.24	19.94
59	32.58217	-79.95950	1.81	94.96	3.23	9.56	0.18	0.96	-1.85	12.39
61	32.57500	-79.96933	4.50	94.05	1.44	15.98	0.20	1.25	-1.99	7.95
63	32.57550	-79.99017	0.10	96.30	3.60	10.67	0.12	0.58	0.11	13.81
65	32.56617	-79.99933	11.97	84.63	3.39	47.04	0.43	1.70	0.00	2.56
106	32.55800	-79.99950	15.23	68.26	16.51	63.54	0.45	2.13	0.46	2.57
107	32.55850	-79.98917	0.13	99.68	0.18	5.60	0.16	0.43	-2.52	24.91
108	32.56550	-79.99000	13.68	86.17	0.15	46.03	0.49	1.48	-0.68	2.66
109	32.56633	-79.97950	0.05	98.93	1.02	11.81	0.16	0.46	-0.35	18.43
110	32.55833	-79.98067	0.09	99.66	0.24	5.87	0.17	0.42	-1.56	20.01
111	32.57433	-79.96900	0.19	99.65	0.16	5.67	0.18	0.43	-2.50	26.98

Sample ID	Latitude	Longitude	% Gravel	% Sand	% Silt/Clay	% CaCO3	Mean Grain Size (mm)	Sorting	Skewness	Kurtosis
NF1195-112	32.56617	-79.97017	9.42	86.18	4.40	43.62	0.46	1.56	0.22	3.36
113	32.56650	-79.95650	24.69	75.08	0.23	58.27	0.78	1.65	-0.18	2.11
114	32.56633	-79.96017	35.80	63.87	0.32	81.34	1.31	1.34	0.68	3.44
115	32.55800	-79.95950	22.14	77.71	0.15	52.32	0.66	1.65	-0.68	2.21
116	32.56683	-79.95000	21.42	78.36	0.22	61.90	0.76	1.53	-0.14	2.12
117	32.57433	-79.95000	3.73	95.71	0.56	15.43	0.19	1.16	-2.61	10.15
118	32.57500	-79.93983	4.16	94.79	1.05	12.58	0.18	1.17	-2.91	12.30
119	32.58333	-79.94000	0.17	99.78	0.05	6.31	0.16	0.42	-3.99	40.95
120	32.59133	-79.94000	0.79	98.88	0.34	8.01	0.19	0.71	-2.39	13.64
121	32.58300	-79.92967	0.11	99.41	0.48	5.97	0.17	0.86	-1.29	20.10
123	32.59983	-79.93000	0.92	98.20	0.87	10.11	0.17	0.76	-2.35	13.40
124	32.59100	-79.91900	1.81	98.19	0.00	16.41	0.27	0.91	-1.64	7.27
125	32.59917	-79.92033	0.88	98.43	0.68	10.18	0.16	0.81	-2.73	13.68
126	32.60800	-79.91967	1.09	96.93	1.99	11.97	0.15	0.86	-2.46	14.70
128	32.60683	-79.96967	0.14	99.04	0.82	4.04	0.15	0.52	-1.65	19.95
129	32.61683	-79.96083	0.93	96.52	2.55	8.81	0.15	0.91	-1.81	10.16
130	32.62050	-79.97017	0.23	93.99	5.78	5.91	0.13	0.69	0.02	12.69
131	32.64133	-79.97600	0.12	97.60	2.28	6.65	0.13	0.53	-0.45	21.21
132	32.63200	-79.96083	0.08	97.66	2.25	6.07	0.12	0.53	-0.68	15.92
133	32.63383	-79.94933	0.35	99.54	0.12	6.53	0.12	0.59	-4.04	33.12

Sample ID	Latitude	Longitude	% Gravel	% Sand	% Silt/Clay	% CaCO3	Mean Grain Size (mm)	Sorting	Skewness	Kurtosis
NF1195-134	32.62233	-79.95017	2.5	96.23	1.27	9.95	0.14	1.02	-3.31	16.74
135	32.62667	-79.93833	1.18	95.52	3.30	7.52	0.13	0.87	-2.19	14.31
136	32.63400	-79.93100	0.55	95.44	4.01	6.56	0.12	0.75	-1.66	15.48
137	32.64150	-79.93967	0.18	92.57	7.25	5.80	0.11	0.71	0.03	10.89
138	32.64800	-79.94017	0.00	93.87	6.13	5.02	0.11	0.63	0.89	7.35
139	32.64050	-79.93000	0.41	94.21	5.38	6.37	0.11	0.71	-1.21	14.72
140	32.63133	-79.90967	1.62	96.81	1.57	12.73	0.14	0.87	-3.45	21.53
141	32.64067	-79.90017	11.73	88.09	0.17	39.11	0.77	1.07	-0.49	4.30
142	32.64550	-79.88533	1.75	96.32	1.94	5.79	0.13	0.86	-3.76	25.22
143	32.64517	-79.89933	31.39	67.14	1.47	68.86	1.10	1.52	0.60	3.70
144	32.64517	-79.90917	1.52	96.90	1.58	6.36	0.14	0.83	-3.34	21.57
145	32.64800	-79.92017	1.26	96.79	1.95	6.28	0.13	0.80	-3.33	23.40
146	32.65200	-79.91500	45.12	53.97	0.92	79.33	1.66	1.29	1.06	5.71
147	32.66167	-79.90900	9.76	90.21	0.03	62.80	0.74	1.12	-0.36	3.77
155	32.69083	-79.85883	0.13	99.27	0.61	3.74	0.17	0.53	-0.80	13.43
156	32.68333	-79.86983	3.43	95.04	1.54	9.95	0.18	1.11	-2.47	11.39
157	32.67517	-79.88033	31.90	67.67	0.43	68.29	1.08	1.47	0.38	2.56
158	32.67483	-79.89633	0.12	99.46	0.42	8.49	0.15	0.43	-1.58	21.61
159	32.66550	-79.91067	0.73	92.73	6.54	12.76	0.15	0.96	-0.81	8.91
160	32.65867	-79.89950	3.04	95.64	1.32	10.08	0.17	1.05	-2.73	12.63

Sample ID	Latitude	Longitude	% Gravel	% Sand	% Silt/Clay	% CaCO3	Mean Grain Size (mm)	Sorting	Skewness	Kurtosis
NF1195-161	32.65750	-79.91433	1.23	97.92	0.85	7.21	0.16	0.79	-3.31	21.45
162	32.65783	-79.91667	2.77	93.32	3.92	9.03	0.16	1.07	-2.29	12.30
163	32.64133	-79.90967	6.99	91.29	1.72	7.00	0.18	1.65	-1.59	4.34
164	32.66433	-79.89017	0.03	88.10	11.86	6.87	0.15	1.00	0.77	4.56
165	32.65533	-79.88867	1.09	97.51	1.40	6.91	0.15	0.76	-3.38	24.56
166	32.65700	-79.88200	20.15	79.13	0.71	45.80	0.98	1.27	0.29	4.14
167	32.65233	-79.88417	3.52	95.63	0.85	9.68	0.16	1.10	-2.90	12.62
168	32.64883	-79.87367	16.74	74.68	8.58	6.28	0.60	1.95	0.58	3.00
169	32.65050	-79.87333	19.32	80.46	0.22	36.18	1.30	0.91	0.51	6.45
170	32.65183	-79.86217	11.51	88.47	0.02	31.81	0.39	1.56	-0.94	2.88
171	32.65250	-79.85750	5.50	94.42	0.08	28.22	0.37	1.21	-0.88	3.42
172	32.66167	-79.86400	55.71	44.20	0.09	81.31	2.14	1.18	0.75	3.75
173	32.66667	-79.87000	2.53	96.97	0.49	7.47	0.17	0.93	-3.17	15.83
174	32.66717	-79.84917	59.53	39.84	0.64	84.17	1.87	1.47	1.18	4.24
175	32.67500	-79.86000	0.71	98.67	0.62	6.57	0.16	0.70	-2.59	16.23
176	32.68367	-79.85067	1.79	96.79	1.42	6.79	0.16	0.93	-2.97	17.88
177	32.68433	-79.83983	5.96	94.11	0.19	28.01	0.40	1.09	-1.34	5.30
178	32.69250	-79.83967	2.35	96.08	1.56	82.87	0.21	1.55	-0.83	2.47
179	32.69167	-79.85050	0.88	91.74	7.37	10.80	0.11	1.23	-1.61	6.00
180	32.69167	-79.85267	0.96	98.48	0.55	5.64	0.15	0.72	-3.54	24.62

Edisto Island Samples

Sample ID	Latitude	Longitude	% Gravel	% Sand	% Silt/Clay	% CaCO3	Mean Grain Size (mm)	Sorting	Skewness	Kurtosis
NF1195-77	32.50017	-80.13917	0.79	98.48	0.73	9.63	0.18	0.69	-2.68	18.12
78	32.50017	-80.15800	2.31	94.93	2.76	12.35	0.17	1.07	-1.77	8.45
79	32.49933	-80.19900	4.51	91.42	4.07	20.60	0.16	1.29	-2.26	9.70
80	32.49950	-80.17950	0.33	91.10	8.57	13.19	0.12	0.85	-0.65	9.13
81	32.48300	-80.17867	0.19	99.23	0.58	9.49	0.16	0.52	-2.56	21.59
82	32.48333	-80.19950	0.34	98.90	0.76	9.10	0.15	0.54	-3.07	29.77
83	32.48333	-80.21933	0.21	98.90	0.89	9.03	0.15	0.51	-2.12	28.87
84	32.49917	-80.21983	5.38	84.88	9.74	21.69	0.15	1.54	-1.71	6.58
85	32.50017	-80.23950	4.10	90.97	4.93	20.77	0.20	1.52	-1.12	4.38
86	32.48350	-80.23933	1.25	97.76	0.99	11.69	0.17	0.91	-2.20	10.35
88	32.48350	-80.27950	7.55	89.56	2.89	20.56	0.28	1.61	-0.91	3.46
89	32.46700	-80.27950	9.96	87.95	2.09	21.95	0.28	1.71	-1.01	3.23
90	32.45033	-80.27917	0.15	98.30	1.55	6.04	0.13	0.62	-1.70	15.00
91	32.45000	-80.25933	1.58	93.00	5.42	17.24	0.17	1.11	-1.25	7.98
92	32.46633	-80.25917	3.45	89.60	6.95	17.86	0.18	1.33	-1.35	6.60
93	32.46667	-80.23917	0.65	98.32	1.03	11.54	0.15	0.63	-2.84	21.13
94	32.45050	-80.23900	0.35	98.36	1.28	9.90	0.17	0.65	-1.84	16.26
95	32.45017	-80.21883	0.72	98.96	0.32	10.78	0.18	0.74	-2.43	12.45
96	32.46700	-80.21983	0.10	99.54	0.36	6.99	0.16	0.45	-1.86	23.83
97	32.46683	-80.20250	0.00	99.90	0.10	10.07	0.18	0.47	-1.50	10.65
98	32.46667	-80.17933	2.32	97.36	0.32	17.64	0.24	0.91	-2.10	8.71
99	32.48333	-80.15933	0.42	99.45	0.14	14.08	0.16	0.59	-3.81	24.34
100	32.48317	-80.13933	3.21	96.39	0.40	13.68	0.18	1.05	-3.13	13.60

APPENDIX II.

R_A Values for Suficial Sediment Grabs off Folly Island

Sample ID	M_b	$Sort_b$	M_b-M_n/$Sort_n$	$sort_b$/$sort_n$	R_A
NF1195-1	2.915	0.705	0.72	1.41	5
2	2.316	1.185	-0.48	2.37	1.23
3	0.323	1.48	-4.47	2.96	1.02
4	1.94	0.779	-1.23	1.56	1.03
5	0.611	1.871	-3.89	3.74	1.07
6	0.93	1.308	-3.25	2.62	1.04
7	2.269	0.689	-0.57	1.38	0.94
8	2.005	1.199	-1.10	2.40	1.16
9	2.821	0.758	0.53	1.52	1.41
10	0.488	1.429	-4.14	2.86	1.02
11	2.468	0.738	-0.18	1.48	1.06
12	2.241	1.14	-0.63	2.28	1.2
13	2.693	0.754	0.27	1.51	1.3
14	1.401	1.666	-2.31	3.33	1.14
15	0.967	1.449	-3.18	2.90	1.05
16	0.684	1.078	-3.74	2.16	0.95
17	0.017	1.313	-5.08	2.63	0.94
18	2.785	0.992	0.46	1.98	1.6
19	2.49	0.913	-0.13	1.83	1.22
20	2.632	1.191	0.15	2.38	1.4
21	1.29	1.756	-2.53	3.51	1.15
22	0.224	1.258	-4.66	2.52	1.01
23	-0.108	1.417	-5.33	2.83	1
24	2.393	0.887	-0.33	1.77	1.1
25	0.97	1.023	-3.17	2.05	0.99
26	2.836	0.746	0.56	1.49	1.49
27	2.89	0.61	0.67	1.22	1.61
28	-0.322	1.326	-5.76	2.65	0.93
29	-0.202	1.122	-5.52	2.24	0.93
30	3.074	0.752	1.04	1.50	2.1
31	2.199	1.113	-0.71	2.23	1.14
32	2.645	0.834	0.18	1.67	1.3
33	1.588	1.669	-1.94	3.34	1.17
34	1.101	2.026	-2.91	4.05	1.16
35	2.439	1.596	-0.23	3.19	1.42
36	2.772	1.119	0.43	2.24	1.5
37	2.808	0.815	0.50	1.63	1.45
38	2.245	1.369	-0.62	2.74	1.3
39	1.937	1.428	-1.24	2.86	1.21
40	2.31	0.606	-0.49	1.21	0.94
41	1.541	1.398	-2.03	2.80	1.12
42	1.227	1.618	-2.66	3.24	1.13

M = Mean Grain Size
b = Borrow site
n = Native Sand
M_n = 2.556
$sort_n$ = 0.5

Sample ID	M_b	$Sort_b$	M_b-M_n/$Sort_n$	$sort_b$/$sort_n$	R_A
44	2.481	1.067	-0.15	2.13	1.26
45	0.586	1.298	-3.94	2.60	1
46	-0.318	1.447	-5.75	2.89	0.94
47	-0.384	1.372	-5.88	2.74	0.93
48	2.358	1.215	-0.40	2.43	1.3
49	2.916	0.66	0.72	1.32	1.64
50	2.868	0.752	0.62	1.50	1.55
51	2.943	0.894	0.77	1.79	1.62
52	2.942	0.702	0.77	1.40	1.75
53	3.054	0.957	1.00	1.91	1.8
54	2.663	0.757	0.21	1.51	1.25
55	3.127	0.672	1.14	1.34	2.55
56	2.387	1.056	-0.34	2.11	1.21
57	2.545	0.513	-0.02	1.03	0.95
58	2.841	0.545	0.57	1.09	1.75
59	2.479	0.962	-0.15	1.92	1.24
61	2.308	1.254	-0.50	2.51	1.27
63	3.075	0.576	1.04	1.15	3
65	1.228	1.703	-2.66	3.41	1.12
106	1.159	2.126	-2.79	4.25	1.2
107	2.613	0.428	0.11	0.86	1.17
108	1.024	1.482	-3.06	2.96	1.06
109	2.634	0.462	0.16	0.92	1.1
110	2.548	0.418	-0.02	0.84	1.06
111	2.478	0.434	-0.16	0.87	0.99
112	1.117	1.56	-2.88	3.12	1.07
113	0.353	1.645	-4.41	3.29	1.03
114	-0.385	1.339	-5.88	2.68	1
115	0.589	1.651	-3.93	3.30	1.03
116	0.387	1.528	-4.34	3.06	1.03
117	2.418	1.162	-0.28	2.32	1.25
118	2.439	1.167	-0.23	2.33	1.26
119	2.657	0.421	0.20	0.84	1.41
120	2.417	0.711	-0.28	1.42	1.05
121	2.517	0.464	-0.08	0.93	1
123	2.549	0.764	-0.01	1.53	1.21
124	1.876	0.912	-1.36	1.82	1.04
125	2.639	0.805	0.17	1.61	1.27
126	2.766	0.864	0.42	1.73	1.42
128	2.767	0.516	0.42	1.03	1.41
129	2.766	0.906	0.42	1.81	1.43
130	2.985	0.687	0.86	1.37	2

M = Mean Grain Size
b = Borrow site
n = Native Sand
M_n = 2.556
$sort_n$ = 0.5

Sample ID	M_b	$Sort_b$	M_{b}-M_n/$Sort_l$	$sort_b/sort_n$	R_A
131	2.963	0.526	0.81	1.05	2.6
132	3.077	0.533	1.04	1.07	4.1
133	3.032	0.587	0.95	1.17	2.6
134	2.832	1.024	0.55	2.05	1.52
135	2.899	0.873	0.69	1.75	1.6
136	3.04	0.745	0.97	1.49	2
137	3.13	0.707	1.15	1.41	2.5
138	3.156	0.629	1.20	1.26	4
139	3.162	0.708	1.21	1.42	3.6
140	2.886	0.865	0.66	1.73	1.6
141	0.379	1.066	-4.35	2.13	0.94
142	2.892	0.859	0.67	1.72	1.61
143	-0.138	1.519	-5.39	3.04	1
144	2.79	0.83	0.47	1.66	1.45
145	2.907	0.796	0.70	1.59	1.61
146	-0.729	1.293	-6.57	2.59	0.94
147	0.431	1.122	-4.25	2.24	0.92
155	2.532	0.532	-0.05	1.06	1
156	2.478	1.108	-0.16	2.22	1.3
157	-0.105	1.47	-2.17	2.94	1.1
158	2.772	0.431	0.43	0.86	1.76
159	2.722	0.956	0.33	1.91	1.36
160	2.579	1.045	0.05	2.09	1.31
161	2.673	0.788	0.23	1.58	1.35
162	2.621	1.068	0.13	2.14	1.35
163	2.499	1.648	-0.11	3.30	1.45
164	2.743	1	0.37	2.00	1.45
165	2.753	0.764	0.39	1.53	1.4
166	0.027	1.271	-5.06	2.54	0.95
167	2.603	1.104	0.09	2.21	1.36
168	0.731	1.954	-3.65	3.91	1.09
169	-0.378	0.925	-5.87	1.85	0.9
170	1.356	1.563	-2.40	3.13	1.11
171	1.438	1.214	-2.24	2.43	1.05
172	-1.096	1.179	-7.30	2.36	0.9
173	2.584	0.931	0.06	1.86	1.3
174	-0.899	1.469	-6.91	2.94	0.92
175	2.64	0.703	0.17	1.41	1.22
176	2.68	0.934	0.25	1.87	1.32
177	1.331	1.091	-2.45	2.18	1.02
178	2.224	1.548	-0.66	3.10	1.32
179	3.178	1.233	1.24	2.47	2.1
180	2.771	0.716	0.43	1.43	1.38

M = Mean Grain Size
b = Borrow site
n = Native Sand
M_n = 2.556
$sort_n$ = 0.5

R_A Values for Suficial Sediment Grabs off Edisto Island

Sample ID	M_b	$Sort_b$	M_b-M_n/$Sort_n$	$sort_b$/$sort_n$	R_A
NF1195-77	2.495	0.69	1.05	0.61	10.2
78	2.524	1.07	1.08	0.94	6.7
79	2.673	1.29	1.21	1.14	6.7
80	3.119	0.85	1.61	0.75	11
81	2.63	0.52	1.17	0.46	11
82	2.718	0.54	1.25	0.48	11.5
83	2.748	0.51	1.28	0.45	11.6
84	2.767	1.54	1.29	1.36	4
85	2.343	1.52	0.92	1.34	2.25
86	2.591	0.91	1.14	0.80	10
88	1.829	1.61	0.47	1.42	1.39
89	1.832	1.71	0.47	1.51	1.4
90	1.782	0.62	0.43	0.55	5.1
91	2.582	1.11	1.13	0.98	3
92	2.506	1.33	1.06	1.18	11.5
93	2.738	0.63	1.27	0.56	11.2
94	2.552	0.65	1.11	0.57	10.5
95	2.472	0.74	1.03	0.65	13
96	2.649	0.45	1.19	0.39	12.2
97	2.449	0.47	1.01	0.41	13
98	2.059	0.91	0.67	0.80	5
99	2.619	0.59	1.16	0.52	12
100	2.463	1.05	1.03	0.93	5

M = Mean Grain Size
b = Borrow site
n = Native Sand
M_n = 1.3
$sort_n$ = 1.133

R_A Values for Suficial Sediment Grabs from Edisto Island Borrow Site

Sample ID	M_b	$Sort_b$	M_b-M_n/$Sort_n$	$sort_b$/$sort_n$	R_A
EDBS-01	0.176	1.804	-0.99	1.59	1.02
EDOFF-01	0.93	0.694	-0.33	0.61	1.02
EDBS-02	1.292	1.58	-0.01	1.39	1.05
EDBS-03	2.005	0.875	0.62	0.77	3.6
EDBS-04	-0.326	1.741	-1.44	1.54	1
EDBS-05	1.452	0.803	0.13	0.71	1.02
EDBS-06	0.502	1.056	-0.70	0.93	0.95
EDOFF-02	0.417	0.976	-0.78	0.86	0.95
EDOFF-03	-0.38	1.188	-1.48	1.05	0.94
EDOFF-04	0.325	1.003	-0.86	0.89	0.95
EDOFF-05	0.28	0.714	-0.90	0.63	0.94

Appendix III:

Appendix III contains individual core logs for each of the vibracores displayed in figures 5 and 6.

This Appendix is available upon request.