

# **TECHNICAL ADVICE SECTION**

**Approach for Sand Searches On the Northeast Florida Atlantic Coast**

## 1.1 METHODOLOGICAL APPROACH FOR SAND SEARCHES ON THE NORTHEAST COAST OF FLORIDA

Offshore sand resources along the northeast coast of Florida occur in six main depositional settings: (1) sand flats on the inner shelf, (2) ebb-tidal deltas on the inner shelf, (3) sand waves on the middle shelf, (4) shoals on the middle shelf, (5) banks on the middle shelf and (6) sand ridges on the outer shelf. The northeast coast of Florida lies on the Atlantic and Gulf Coast Physiographic Province (Walker and Coleman, 1987). The seaward side of the study area contains a portion of the Atlantic continental shelf. Almost all of it is covered by a surficial sand sheet (Hollister, 1985). The shelf is also characterized by fields of linear, northeast-trending sand ridges (Duane *et al.*, 1972). These ridges are typically less than 10 m thick and contain medium grained, well-sorted sand that is similar to sand along the present shoreline.

Searches for beach quality sand in sand flats or in sand ridges should be based on investigations that follow a logical progression of steps. Sand search procedures developed, for example, by Finkl, Khalil and Andrews (1997), Benedet *et al.* (2004), Finkl and Khalil (2005) and Finkl *et al.* (2006) follow strategic sand search protocols that are widely accepted in the industry. The three-phased protocol suggests that, in areas where bathymetrically positive features (e.g. sand ridges, bars, and shoals) occur, reconnaissance investigations should concentrate on bathymetric data (preferably recently obtained) and reconnaissance sand samples (Phase I), followed by jet probes (Phase II) and finally seismic reflection (sub-bottom) profiles and vibracores (Phase III).

A logical sequence of offshore sand searches targeting sand resources along the northeast coast of Florida should approximate the following steps. These suggested procedures can be adapted to individual survey requirements, but they nevertheless provide a basic framework for sequencing steps in a logical cost-effective progression.

### 1.1.1 Review of Historical Data

Using the ROSS database, the investigator should download historical datasets containing seabed relief information, descriptions of geotechnical data (vibracores, jet probes, and grain size data) and geophysical data (sidescan sonar and seismic reflection profiles) to identify initial target areas for more detailed investigation. The gray scale shaded relief image available from ROSS should be used to identify offshore morphosedimentary features (sand flats, ebb tidal deltas, sand waves, sand shoals, and sand ridges) occurring near a project area. The geotechnical and geophysical layers should then be turned on to see if available sediment data overlie morphosedimentary features of interest. This data may provide initial information regarding deposit thickness and sediment textural properties. After target areas are identified and data availability checked, the investigator can design a reconnaissance survey plan.

### 1.1.2 Reconnaissance Survey Plan

The reconnaissance survey plan should focus on obtaining better definition of seafloor geomorphology and morphosedimentary properties. Commonly, a few (more than five) morphosedimentary features are selected on the basis of the Phase 1 analyses. This list of

potential sand targets is typically then narrowed down to one or two features for more detailed field investigations that may define final borrow areas.

The bathymetric data that is used to define the morphosedimentary features of interest in Phase 1 will most likely consist of historical NOAA-NOS data that may be several decades old. Because morphosedimentary features tend to be modified by tidal currents and wave action, an updated bathymetric survey is required to determine whether seafloor features have changed shape or migrated over time. A reconnaissance seismic reflection profile survey can be conducted simultaneously with the bathymetric survey to determine sediment thickness. Bathymetric data and seismic records (obtained from chirp systems such as the Edgetech 512i) can be used to determine sediment thickness and the results displayed in an isopachous map. Undesirable materials such as rubble layers or fine-grained sediments can normally be identified in seismic records if calibration data (*i.e.* historical vibracores) is available. Line spacing in reconnaissance surveys depends on the survey area, but generally ranges from 1000 to 2000 feet.

Traditionally, sand quality and thickness are investigated during preliminary sampling surveys using surface grab samples and jet probes. Because vibracores are more expensive and time-consuming, they are usually reserved for the detailed phases of offshore investigation after the search area has been narrowed to target areas using other methods.

Sand quality and thickness may be investigated during preliminary sampling surveys using surface samples, jet probes or widely spaced vibracores. Surface grab samples can be deceiving because they only sample the upper few inches of seafloor sediment (generally sediment transported by modern processes) and do not show the characteristics of deeper lying sediments. Jet probes are a cost-effective method to estimate sediment thickness and sediment quality in deeper layers. Because sediment samples extracted from jet probes are disturbed by the water jet, silt content may be underestimated.

One important consideration of sediment variability is that sand quality on the surface, as indicated by surface samples and widely spaced jet probes may not always be the most effective procedure to select morphosedimentary features for further investigation during reconnaissance efforts. It may be found, for example, that relict sediments underlying the feature surface contain cleaner sandy sediments (e.g. fewer shell and rubble fragments) than surface sediments. This occurs because modern sedimentation processes that are linked to the upper layers of sedimentation on a sand ridge, for example, may be significantly different from relict sedimentation processes that formed the ridge. Evidence of relict processes is normally found in deeper subsurface layers that have been unaffected by subsequent events. Thus, it is suggested that during reconnaissance investigations of offshore morphosedimentary features on the northeast Florida Atlantic coast, at least one undisturbed sample (vibracore) be acquired to supplement jet probe and surface sample data for each morphosedimentary feature that is under investigation. The purpose of this suggestion is to provide better insight into the nature of sediments comprising the core of the feature under study.

Reconnaissance sampling plans should be designed to target the crests or divides of the main morphosedimentary features. Spacing between samples will, thus, vary depending

on the size of the area under investigation, the total volume targeted, and the project budget.

### 1.1.3 Detailed Survey Plan and Preliminary Borrow Area Design

Following analysis of the data collected during Phase II, a plan to conduct detailed investigations over a smaller area should be prepared. Detailed investigation plans should strive to obtain enough information to define sand quality for specific quantities and to map the vertical and horizontal continuity of sand layers. This level of investigation also provides sufficient information to identify layers or zones of undesirable sediments that should be avoided during borrow area design. The detailed investigations usually consist of detailed bathymetry, sidescan sonar and seismic reflection profile surveys on 200 to 300 foot grids with vibracores obtained on 1,000 foot centers. Analysis of the information obtained in detailed surveys permits the preliminary design of offshore borrows area and the mapping of surface features (*i.e.* environmental resources, and possible obstructions to dredging) that occur in or near the borrow. Tools that assist in the visualization of deposit morphology, sediment thickness and general characteristics of the borrow include geological cross-sections and fence diagrams, three-dimensional isopach maps and bathymetric charts, color-coded interpretation of seismic records, etc.

Although these detailed investigations allow for preliminary borrow area design, they are usually adequate to meet final engineering requirements of complete borrow area design. It must be appreciated that the characteristics of sand resources, even in geologically well known sites, are still subject to interpretive errors that are linked to the spatial and temporal variability of natural environments.

### 1.1.4 Cultural Resource Investigations

Detailed geophysical investigations are required to determine whether cultural resources occur within the boundary limits of a proposed borrow. Geophysical surveys are usually conducted on a grid with tracklines spaced 30 m (98 feet) apart (note: cultural resource surveys are conducted on metric grids). The cultural resource surveys generally consist of magnetometer, sidescan sonar and seismic reflection profile surveys. Because these investigations must be conducted at 30 m intervals, other geophysical Phase III investigations are generally conducted along multiple trackline spacings at 60 m (196 feet) and 90 m (292 feet). These multiple spaced grids are spaced so that cultural resource investigations can make sure of data from Phase III by nesting additional tracklines between lines of prior Phase III geophysical surveys. It is desirable that the cultural resource investigations be conducted using the same type of geophysical equipment deployed in the previous Phase III geophysical surveys. In this way, borrow area design can be refined using the additional (cultural resource) data obtained, making for efficient use of separate surveys. Presence of cultural resources (*i.e.* shipwrecks, large cultural artifacts, etc.) requires redelineation of the borrow area design to avoid disturbing the mapped features. The addition of 200-foot no-dredge buffers around the cultural resource feature satisfies this requirement. The margins of the borrow area (when the cultural resource feature occurs near the borders of the borrow) may also be modified to meet cultural resource requirements.

### 1.1.5 Borrow Area Impact Analysis (Environmental Investigation and Numerical Modeling)

Data from Phases III and IV may also be used to map sensitive environmental resources (*e.g.* hardbottoms) occurring near the proposed borrow site. If sensitive environmental resources occur near the proposed dredge site, the borrow area design is modified.

In addition to cultural resources and the consideration of environmental impacts, there is a need to evaluate whether the proposed borrow sites will adversely affect the nearshore wave climate to cause additional erosion of adjacent beaches. This evaluation is preferably accomplished by using a range of numerical models that simulate wave transformation over the borrow sites. These models can also simulate wave-induced currents, sediment transport, shoreline change and variation in beach morphology. Several wave models evaluate borrow area impacts on nearshore wave climates. In order to properly evaluate borrow area impact on nearshore waves, spectral wave models that incorporate most of the relevant physical processes of wave transformation (*e.g.* wave refraction, bottom friction and to a lesser extent diffraction) are recommended. Even though proposed borrows may induce changes in the nearshore wave climate, these changes may not necessarily cause additional erosion of adjacent beaches. To evaluate whether the impacts of borrow areas on nearshore waves is significant in terms of beach erosion and deposition patterns, shoreline change models or beach morphology change models can be used.

These models can be either empirical (*i.e.* sediment transport is calculated based on the output of a wave transformation model that feeds empirical sediment transport formulas) or process-based (output from a wave transformation model is used to calculate wave-induced currents and these are in turn used to calculate bed-load and suspended load sediment transport). Simulations are run for scenarios with and without the proposed dredging. By comparing the with/without dredging scenarios, the investigator can evaluate the impact of dredging on the beach deposition and erosion patterns. If numerical modeling indicates that significant undesirable impacts are expected on adjacent beaches due to borrow area dredging, borrow area design modifications may be required.

### 1.1.6 Final Borrow Area Design

Final borrow area designs, plans and specifications are prepared when all concerns regarding sediment quality, cultural resource potential, environmental impacts, and physical considerations are addressed. Due to implementation of no-dredge buffers that reduce negative impacts from dredging, the final shape and cut depths may differ significantly from the design prepared at the end of Phase III.