

*Sand Needs Assessment and Data Gap Identification on the
Atlantic Coast of Florida*

**Division of Water Resource Management
Florida Department of Environmental Protection**

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Executive Summary

The search for beach-compatible sand was initially a relatively uncomplicated task. As the number of beach restoration and nourishment activities grew, the search for sand became more complex as the distance from shore and water depths increased, and environmental factors, including the role of sediment characteristics, became more stringent. This complexity also led to the recognition that achieving an understanding of the geology of an area is a major key to identifying potential sand sources. In an effort to create a single repository for offshore sand source information with respect to beach nourishment activities, the Florida Department of Environmental Protection (FDEP) created and maintains the Regional Offshore Sand Source Inventory (ROSSI).

In recent years, the FDEP has increased its collaboration with the U.S. Army Corps of Engineers (USACE) and the Bureau of Ocean Energy Management (BOEM) to identify sand sources for beach nourishment activities. Sand sources are recognized as a finite resource that must be managed efficiently. To that end, the FDEP and the BOEM (specifically the Marine Minerals Program [MMP] of the BOEM) entered into a cooperative agreement (MC1400004) to identify sand sources offshore of Florida's Atlantic Coast and identify the needs for additional research. This document is intended to address Item F of that agreement which requires submittal of:

“...a map and technical report providing an assessment of sand resources and prioritized data gap areas to be studied for future geophysical and geological surveys based on the potential need for sand and gravel resources for Florida beaches. Incorporation of data layers into data portals as agreed to by the FDEP and BOEM.”

Included in this document is such an assessment and prioritization. County by county maps are provided that illustrate the location of the potential, proposed, permitted, expended, proven, and unverified borrow areas and existing vibracores and sub-bottom profile data. Also shown on those maps are areas where future investigations should be conducted to collect vibracores and/or sub-bottom profiles to increase the level of confidence in a borrow area in order to change its classification from unverified to potential.

FDEP and BOEM share Geographic Information System (GIS) data coverages from ROSSI and the BOEM MMP. These data coverages are updated and shared between the agencies on a regular basis, and are available on the ROSSI website at <http://rossi.urs-tally.com/>. The ROSSI website has also been registered on Data.gov.

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Introduction

The loss of sand from Florida's beaches and coastal systems is a serious problem which affects not only the coastal system, but also the economic livelihood of Florida's coastal communities. Beach erosion is a chronic problem in Florida. It is influenced by natural coastal processes, sea-level rise, storms, and inlet management (Clark, 1993). Florida has 409.9 miles (659.7 kilometers [km]) of critically eroded sandy shoreline statewide (Florida Department of Environmental Protection, 2015). Traditional sources of readily-available beach restoration quality sand resources proximal to the beaches along southeast Florida for nourishment and restoration projects have been expended (Ousley *et al.* 2014). Identifying offshore sand resources suitable for future beach restoration projects is now critical to sustaining Florida's beaches.

The search for offshore sand was initially a relatively straightforward task. Shore-face connected and isolated shoals (e.g., Cape Canaveral Shoals, Brevard County; Capron Shoal, Ft. Pierce), lying in water depths generally less than 30 feet (9.1 meters), were easily identified on the basis of their distinct geomorphology. As the need for sand for restoration and nourishment grew, deposits were often identified further from the project and in deeper water, increasing cost due to increased hauling distances. As the distance from shore grew, the sedimentary character of the deposits changed compared to the shore-face connected shoals due to natural processes that both formed and reworked these deposits. As these deposits are relict features which formed several thousand years ago and can be as much as 20 miles (32.2 km) from the project area (e.g., Brevard County's South Reach Shore Protection Project), confirmation of suitability for beach placement required more in-depth field and laboratory investigations. Initial volume estimates were also subject to revision after the details of sedimentology and stratigraphy were determined.

More sophisticated methods of continental shelf sand resource investigations off the east coast of the United States were initiated early on under the US Army Corps of Engineers (USACE) program of Inner Continental Shelf Sediment and Structure (ICONS) studies. Four of those ICONS studies were conducted off the east coast of Florida. Duane and Meisburger (1969), Meisburger and Duane (1971) Field and Duane (1974), and Meisburger and Field (1975), investigated the sediments of the inner continental shelf off the east coast of Florida from the Georgia-Florida state line to Miami. These studies set the stage for all subsequent offshore work in the region. Meisburger and Field (1975), in particular, established the nomenclature still used for the shoals lying offshore from Cape Canaveral to the Florida/Georgia border.

The search for offshore borrow areas has continued to move further offshore and field investigations now routinely include surveys of both surface and sub-surface features. Successful offshore sand searches are now commonly accomplished through the use of multidisciplinary teams capable of designing and implementing investigations which will detect sand resources that do not necessarily display a distinctive geomorphology or must be identified using sub-bottom profiler surveys. Such multidisciplinary teams may include professional geologists, professional engineers, and professional surveyors with experience in Florida's coastal systems, as well as marine archeologists knowledgeable of Florida's history.

Present day sand searches often extend offshore beyond Florida state waters into the federal waters of the Outer Continental Shelf (OCS), and are conducted seaward out to water depths approaching 100 feet (30.5 meters). Potential borrow areas may not be present as distinct bathymetric features, but instead as subtle sub-bottom features. Such features are identifiable via the analysis of geophysical data for the presence of distinct internal sedimentary structures. Investigations typically require the use of bathymetric, sub-bottom profile, magnetometer, sidescan surveys, and the collection of vibracores. To ensure compatibility with the project beach and a sufficient volume of recoverable material, a denser data set must now be acquired from the potential borrow area.

Beach erosion being a constant concern in Florida, the shore protection measure of choice has been, and continues to be, the periodic placement of sand along the beach. Beach-compatible sand is becoming harder to locate in state waters off the Atlantic coast of Florida. To address this burgeoning need, the Bureau of Ocean Energy Management (BOEM) of the United States Department of the Interior and the Florida Department of Environmental Protection (FDEP) entered into a cooperative agreement (MC1400004) to investigate the available restoration-quality sand resources offshore of the eastern coast of Florida. Its purpose is to locate and characterize both the areal extent and volume of beach restoration quality sand resources offshore of Florida's east coast which are available for beach nourishment. This document is intended to address Item F of that agreement:

“F. A map and technical report providing an assessment of sand resources and prioritized data gap areas to be studied for future geophysical and geological surveys based on the potential need for sand and gravel resources for Florida beaches. Incorporation of data layers into data portals as agreed to by the FDEP and BOEM.”

Two types of sub-bottom profiler data were examined for this study, “chirp” and “boomer” data. Chirp systems generate a broad band of frequencies. Boomer systems generate a narrower band.

The chirp data were typically collected using EdgeTech 512i sub-bottom profiler systems. The chirp data were collected within the past ten years and are of higher resolution, albeit with lower penetration, than the boomer data. These data sets comprise surveys of relatively small areas with fairly tight grid density of east-west trending lines crossed by north-south trending tie lines. The most notable exception to this was a survey conducted in 2007 by FDEP for the Central and Northeast Atlantic Coast Reconnaissance Offshore Sand Search. It was conducted within state waters using a widely spaced zig-zag grid of alternating east-west and northwest-southeast transects from the Georgia-Florida border in Nassau County through Martin County (URS and Coastal Planning & Engineering, Inc., 2007a; URS and Coastal Planning & Engineering, Inc., 2007b).

The boomer data surveys, with one exception, were collected in multiple surveys by the Florida Geological Survey (FGS) in cooperation with the United States Geological Survey (USGS). The earliest of these geophysical surveys were conducted in 1996. Collection and processing of these data continued, on a more or less yearly basis, until 2005. These surveys were part of multi-year studies, funded by the Department of the Interior's Minerals Management Service (now BOEM), that ultimately included surveying in federal waters out to approximately 18 nautical miles (33.3 km) off the northeast and central east coast of Florida. They were comprised of widely spaced grids of east-west lines, at approximately one nautical mile (1.9 km) or 0.5 nautical mile (0.93 km) spacing, crossed by north-south trending tie lines. These data are the most extensive in areal coverage. The single exception to this were data collected in one small tightly-gridded survey. Those data were collected by the USGS in waters spanning the boundary between state and federal waters offshore of northern St. Johns County over a feature known as Crescent Beach Spring. All of these boomer survey data were collected in what is now an obsolete format. When converted to a usable format the utility of these data is somewhat compromised. In addition, in some cases conversion of the data to a usable format cannot be achieved. Future work in support of beach nourishment projects would utilize chirp data, rather than boomer data, because of the higher resolution of the chirp data.

The geologic data in the region consisted of vibracores and grab samples collected in both state and federal waters. These vibracores and grab samples were typically collected as part of sand searches for specific projects. As such, they typically targeted areas of bathymetric highs proximal to the projects in question to allow for shorter hauling and/or pumping distances during construction.

Methods

Sediment needs were determined by using a series of sources, including the USACE-FDEP Southeast Florida Sediment Assessment and Needs Determination (SAND) study report (Ousley *et al.* 2014) the FDEP's Strategic Beach Management Plan (SBMP) (Florida Department of Environmental Protection, 2016), and the authors' institutional knowledge of both beach restoration/nourishment projects and data-collection efforts throughout the waters offshore of the state of Florida. Sediment needs are based on project performance and updated planning reports for federal and non-federal beach nourishment projects using offshore sediment sources. The FDEP SBMP includes information by coastal region regarding past beach restoration/nourishment projects, current projects, and future studies and projects, including whether or not a 15-year supply of compatible sand has been identified to complete the beach nourishment projects. The SBMP can be found on the FDEP website at <http://www.dep.state.fl.us/beaches/publications/index.htm#SBMP>.

Data gaps exist between sand search areas in both the geological and geophysical data. These data gaps were identified, on a county by county basis, within the available geological and geophysical data sets. Data gaps are identified by looking at the data available for a given area in the Regional Offshore Sand Source Inventory (ROSSI) Map Viewer and determining where additional data are needed to identify sources of beach-compatible sand for projects in the area, or where additional data would provide more confidence in the sedimentary character of the potential borrow area. The authors' institutional knowledge of ongoing and/or upcoming sand source investigations is also included in the determination and prioritization of data gaps. There are areas where small amounts of data exist that suggest those areas do not contain beach-compatible sand. In those areas, additional data collection would not be justifiable at this time. However; data gaps may be identified where minimal amounts of data exist that suggest those areas may contain beach-compatible sand. The majority of the data gaps identified are areas where insufficient geological and geophysical data have been collected, but that bathymetric data and knowledge of the surrounding areas suggest beach-compatible sand may exist and may be dredgeable. Due to the limits of conventional dredging technology readily available in the United States at this time, offshore areas deeper than about 90 feet (27.4 meters) are not considered.

Based on previous needs assessment, it was determined that sand needs south of Cape Canaveral and, in particular, south of Martin County are highest priority. Lacking reserves proximal to the beaches of southern Palm Beach and Broward and Miami/Dade counties, it was determined that resources in federal waters offshore of Martin and St. Lucie counties were likely to be the most viable offshore alternative

sources. Thus specific attention was paid to identifying and addressing data gaps offshore of those counties during the SAND study. Knowledge of current projects and available compatible sand in the project area was a factor in prioritizing data gaps and recommending future work along the entire Atlantic coast of Florida.

Results

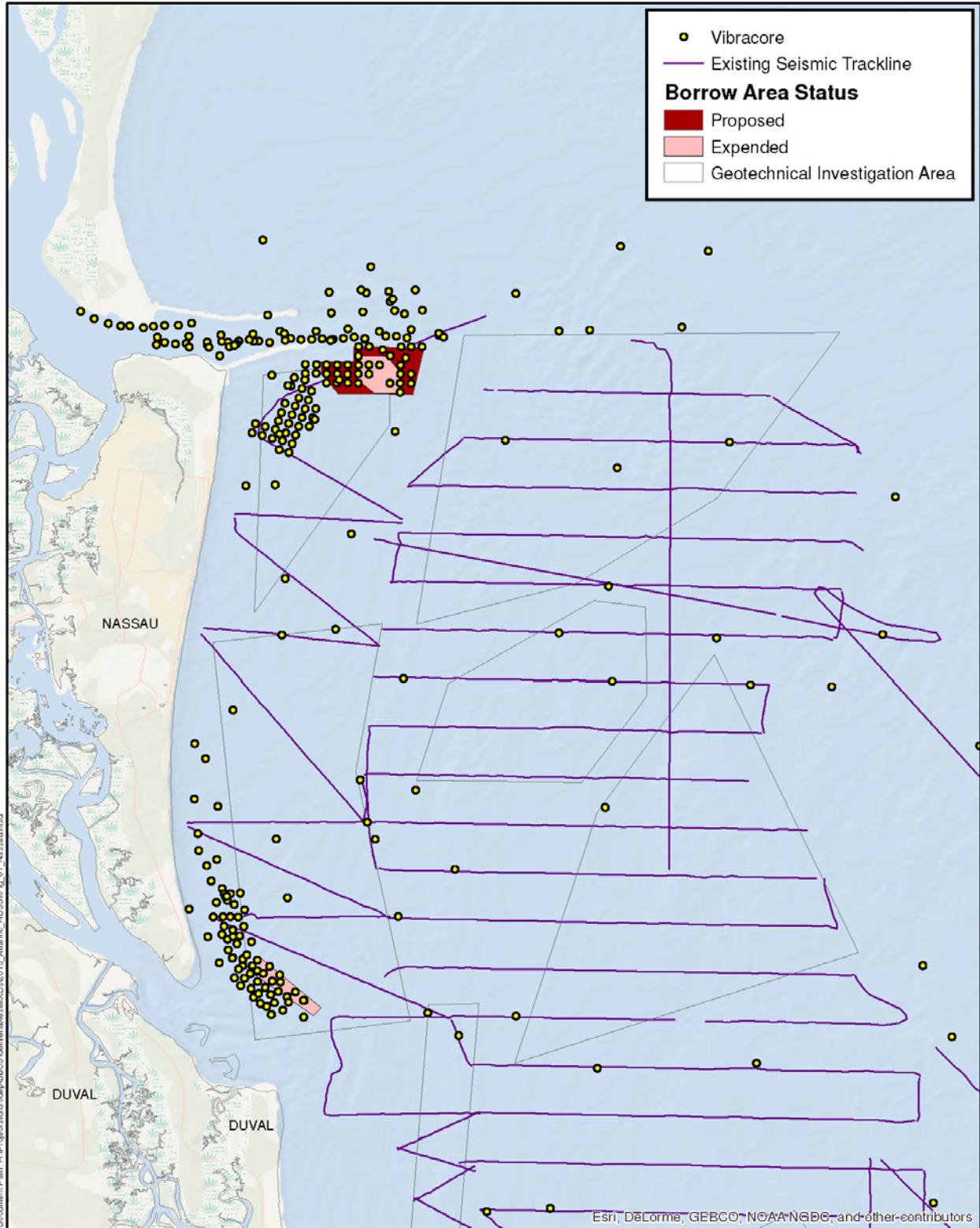
Data gaps are identified by looking at the data available for a given area in the ROSSI Map Viewer and determining where additional data are needed to identify sources of beach-compatible sand for projects in the area. Figures 1 through 12 were created to illustrate the data coverage offshore of the Atlantic coast of Florida. From these coverages, available data could be clearly seen and data gaps identified. Where data gaps exist, locations for the collection of sub-bottom profile (seismic) data and vibracores were noted on the figures. These locations, explained in more detail in the Data Gaps section, represent areas where additional information would lead to greater geologic understanding of the area in an effort to identify potential sand resources. While data (vibracores and/or seismic data) do exist in these areas, future work would be conducted in order to increase the level of confidence in the sediment characteristics of the possible sand resource. It should be noted, as additional data become available, the data gaps may change or even cease to exist. In particular, geological and geophysical data collected under the Broad Area Agreement are not presently available. This dataset may cause the recommendations within this document intended to address data gaps to become partially outdated. Therefore, the ROSSI database, local project sponsors, and permitting agencies should be consulted before work within these data gaps is initiated. The ROSSI database and MapViewer can be found at <http://rossi.urs-tally.com/>.

An assessment of sand needs was made by compiling information from a number of sources. These sources will be discussed along with sand needs for the next 15 years. Fifteen years is the current statutorily allowed duration of a State of Florida Joint Coastal Permit for beach restoration/nourishment.

Data Gaps:

No additional geological or geophysical data are recommended to be collected offshore of Nassau and Duval counties at this time. These counties are shown as Figures 1 and 2, respectively.

St. Johns County is shown in Figure 3 with two areas delineated for proposed future investigations. While data (vibracores and seismic data) do exist in these areas, future work would be conducted in order to



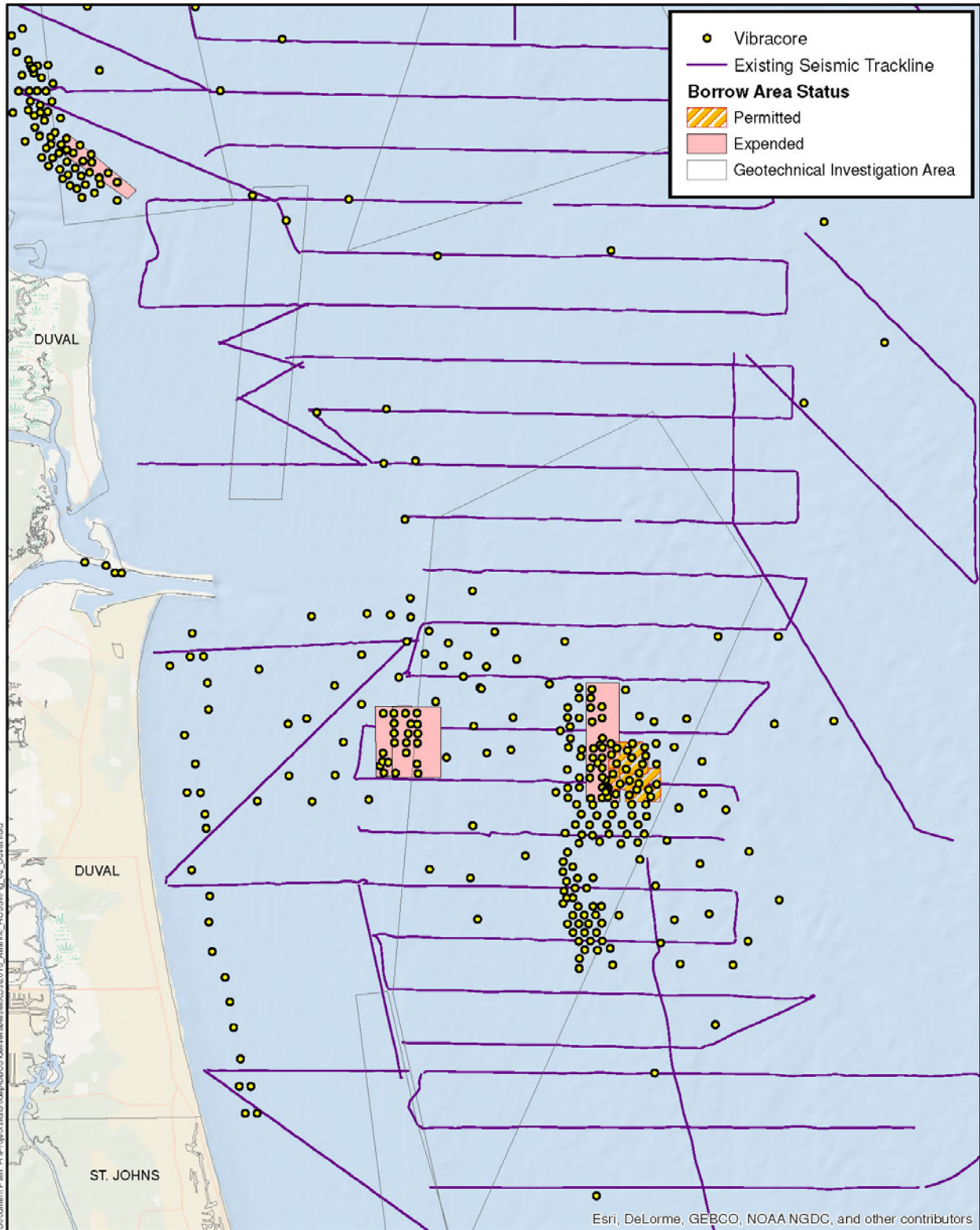
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Figure 1
Atlantic ROSSI
Nassau County



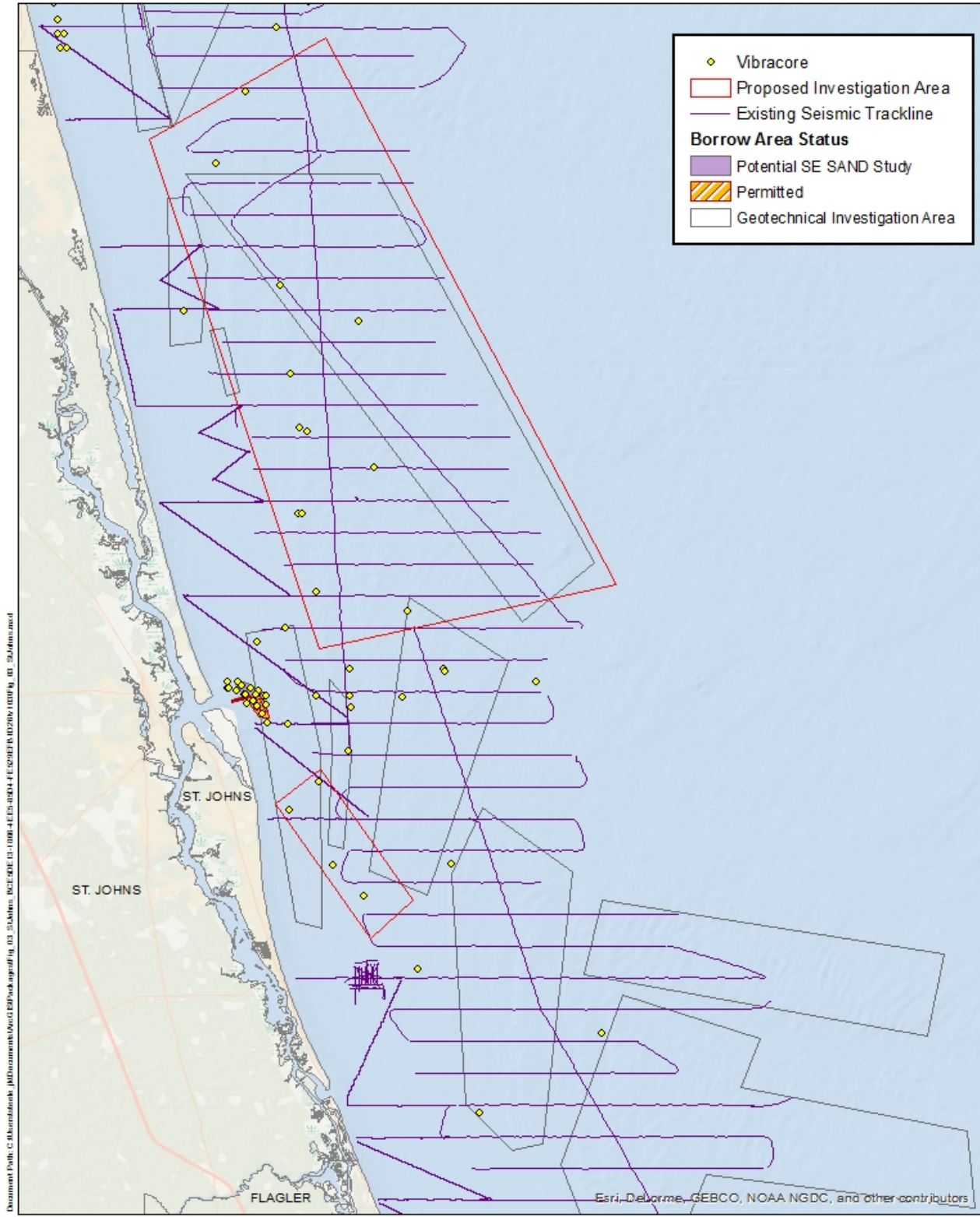
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Figure 2
Atlantic ROSSI
Duval County



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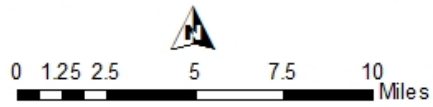


Figure 3
Atlantic ROSSI
St. Johns County

increase the level of confidence in the sediment characteristics of the sand resource. Investigation in the northern of these two areas is intended to provide more information regarding the A6 and A7 shoals which lie north of St. Augustine Inlet. Historically the A6/A7 shoal complex has been considered to be the most substantial potential source of beach restoration quality sand north of Cape Canaveral (Meisburger & Field, 1975).

Figures 4 and 5 show proposed investigation areas offshore of Flagler and Volusia counties in locations where previous investigations have occurred and some promise was shown in the quality of the sediment. More data needs to be collected to confirm the sediment quality and potentially delineate a sand resource.

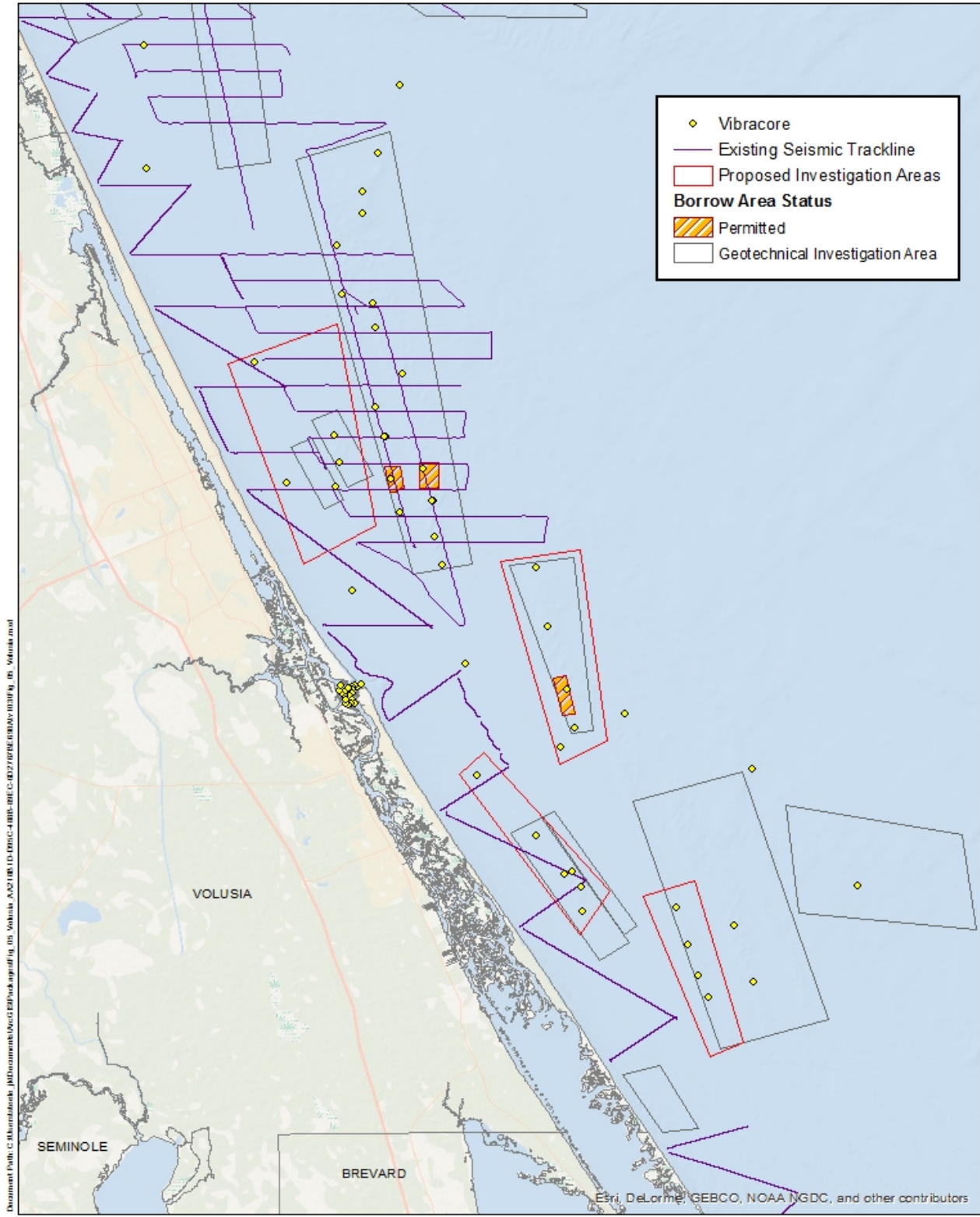
Regarding Brevard County, Figure 6 shows two proposed investigation areas south of Cape Canaveral. These areas are designed around previous investigations which included vibracore collection and sub-bottom profile lines.

Indian River County is shown on Figure 7. The two investigation areas recommended offshore of Indian River County are areas with some existing vibracore and subbottom data.

No additional work is proposed at this time in St. Lucie County due to the number of past sand search investigations in this area, the amount of work that was done during the SAND study, and possible upcoming investigations by the local sponsor in this area. Future work in this area would be to confirm the sediment quality and delineate a resource rather than add to the geologic understanding of the area and increase the confidence in the possible sources. St. Lucie County is shown on Figure 8.

Martin County is shown on Figure 9. Only one investigation area is proposed offshore of Martin County at this time due to the number of past sand search investigations and the amount of work that was done during the SAND study. The investigation area outlined would add to the geologic understanding of the sediment and help in determining whether the unverified status of the borrow areas may be upgraded to potential.

No additional geological or geophysical data are recommended to be collected offshore of Palm Beach, Broward and Miami-Dade counties at this time. Palm Beach, Broward and Miami-Dade counties are shown on Figures 10, 11, and 12 respectively.



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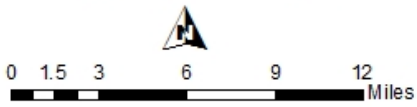
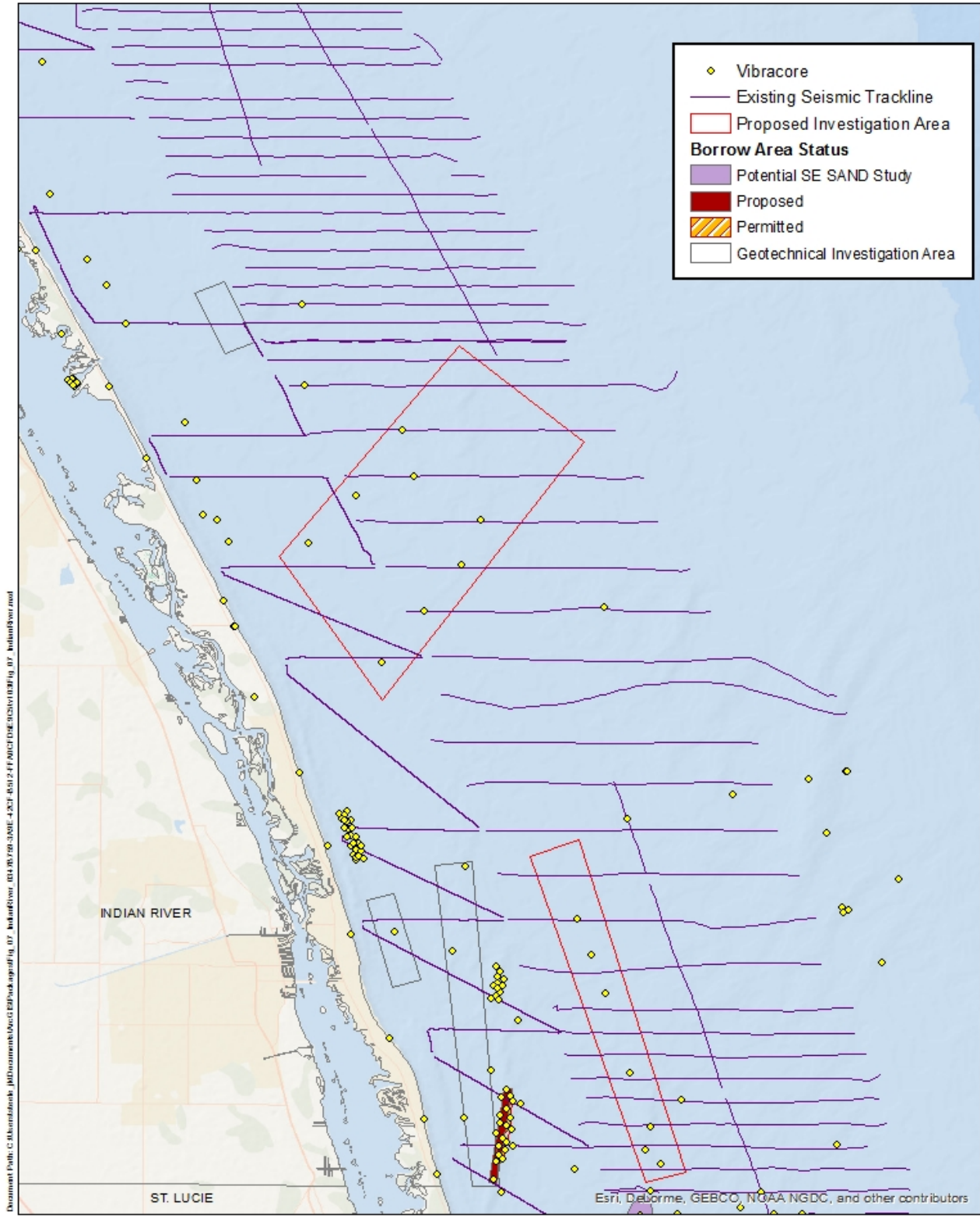


Figure 5
Atlantic ROSSI
Volusia County



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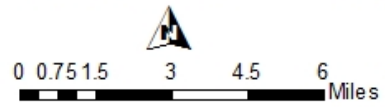
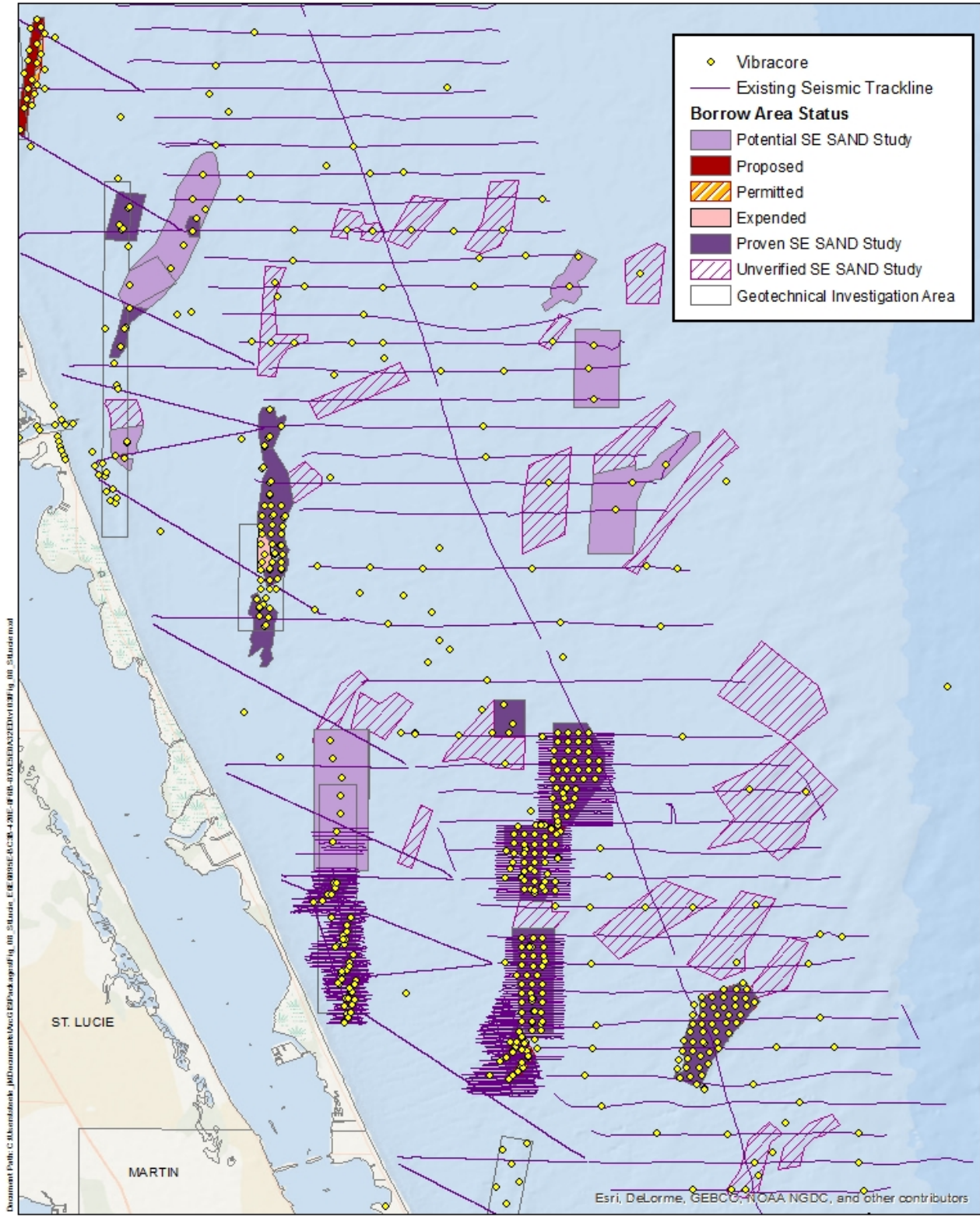


Figure 7
Atlantic ROSSI
Indian River County



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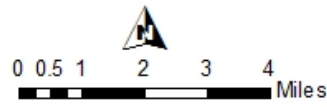
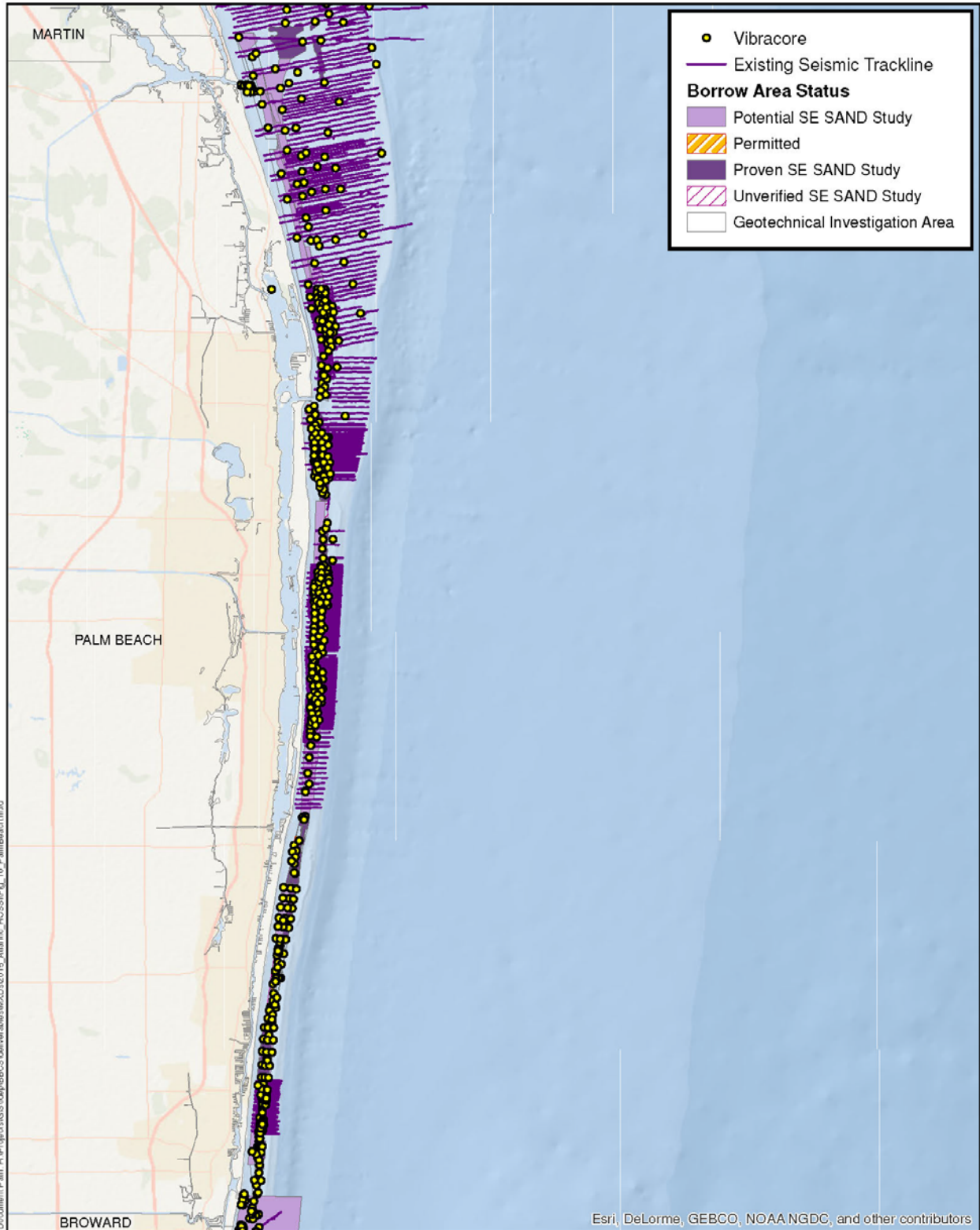


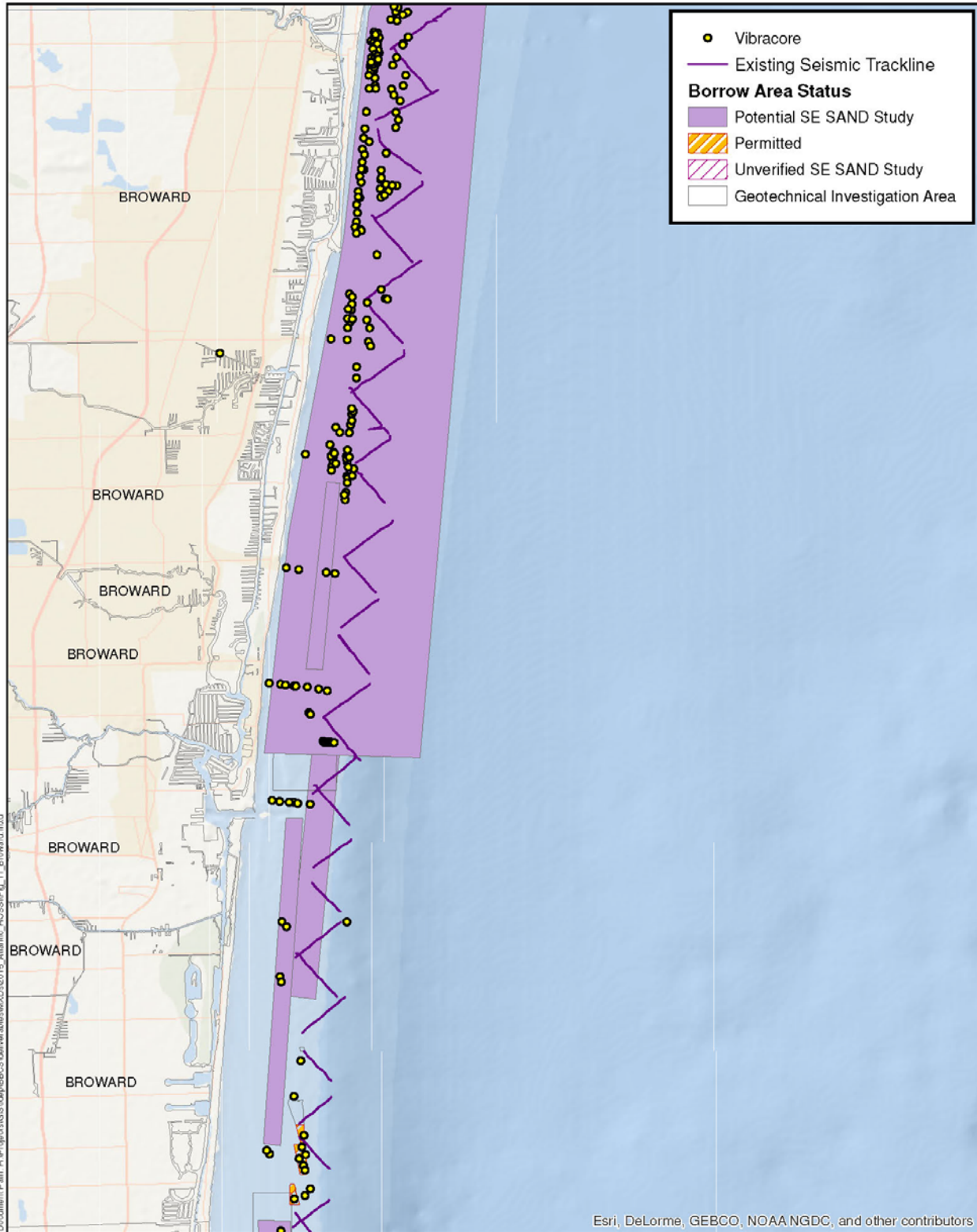
Figure 8
Atlantic ROSSI
St. Lucie County



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Figure 10
Atlantic ROSSI
Palm Beach County



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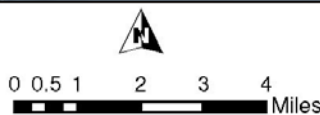
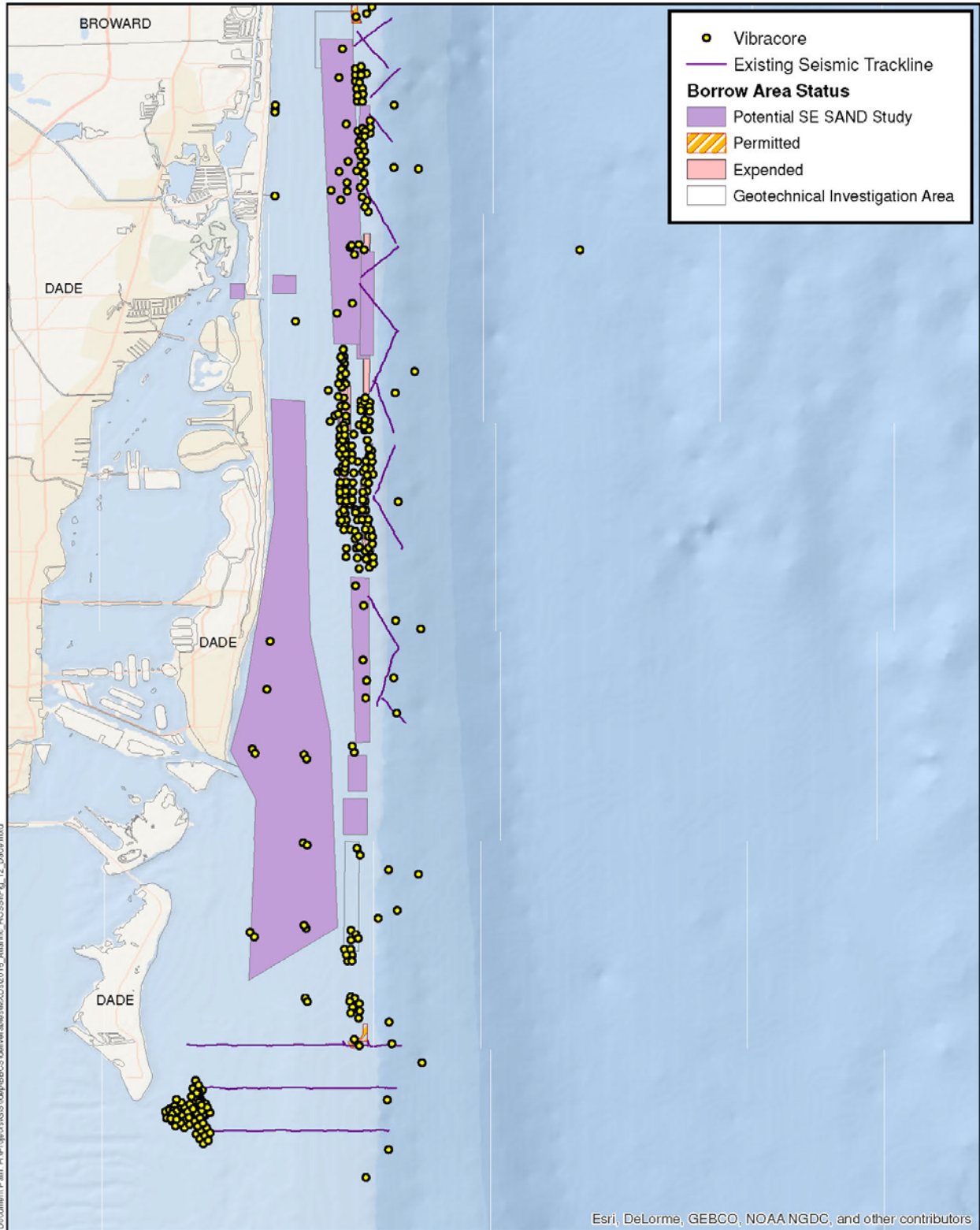


Figure 11
Atlantic ROSSI
Broward County



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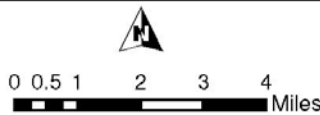


Figure 12
Atlantic ROSSI
Miami-Dade County

Sand Needs:

The sand need for each county was determined based upon the total volume of sand required to build the currently permitted projects, versus the total amount of sand identified as compatible through the state permitting process, or those sand resources identified and vetted through the sand search process but not yet permitted. This information was recently compiled for the Southeast SAND study (Ousley *et al.* 2014) and for the FDEP's SBMP (<http://www.dep.state.fl.us/beaches/publications/index.htm#SBMP>). The SBMP was last published in 2015 and is currently under revision for updating in 2016.

Currently, sufficient sand sources for beach nourishment for the next 15 years have been identified for all projects in Duval and Nassau counties (Florida Department of Environmental Protection, 2015a). The sources of beach quality sand for these two counties are a combination of offshore borrow areas in state waters associated with the ebb-tidal shoal of the Kings Bay Entrance Channel/St. Marys River (at the Florida-Georgia line), as well as beach-quality material from upland dredged material management areas and the maintenance dredging of navigation projects. Borrow areas have been permitted on the OCS as well as for Duval County.

For St. Johns County projects, the inlet ebb-tidal shoals will meet the needs of the current St. Johns County shore protection project for the next 15 years. In addition to the inlet-ebb tidal shoal at St. Augustine Inlet, the USACE has identified a possible offshore sand source north of St. Augustine Inlet as an alternative sand source for a future South Ponte Vedra Beach/Vilano Beach shore protection project.

Sufficient sand resources for the next 15 years for all projects in Flagler and Volusia counties, have not been identified (Florida Department of Environmental Protection, 2015a). Sufficient sand has been identified in the initial design on the South Peninsula Beach and Dune Restoration Project for restoration, but not future nourishment. A sand search that incorporates regional sediment management (RSM) strategies is needed in Volusia County, and a federal feasibility study for all of Flagler County is underway. While Volusia County receives dredged material from the Intracoastal Waterway and Florida Inland Navigation District dredged material management areas, additional sand sources are needed.

For Brevard County, sand sources have been identified to meet project needs for at least the next 15 years from both offshore and inlet-related sand sources. The Canaveral Shoal is estimated to contain more than 100 million cubic yards (76.46 million cubic meters) of beach-compatible sand; however, sources are being investigated in locations with a shorter haul distance to the central and southern

Brevard County project areas (Florida Department of Environmental Protection, 2015b). Beach-quality sand from upland dredged material management areas and maintenance dredging of navigation projects has been included in the Regional Sand Management (RSM) plans for the maintenance of the Brevard County – North Reach project. The FDEP, USACE, BOEM, and local governments are coordinating to use best management practices with the identified offshore sand sources in this region.

In Indian River County, adequate sand sources have not been identified for the next 15 years. Offshore borrow areas have been identified and FDEP, USACE, BOEM, and local governments are continuing to coordinate to use best management practices regarding the use of these borrow areas. While upland sand sources are often used by the Sebastian Inlet District to supplement the material being dredged from the sediment impoundment basin at Sebastian Inlet, additional sand sources are needed for this region.

In 2011, the FDEP and USACE began a study to look into the sand resources in southeast Florida (St. Lucie, Martin, Palm Beach, Broward, and Miami-Dade counties) as part of a larger RSM approach. As such, the SAND study was completed and it was determined that the regional offshore sand sources in state and federal waters was sufficient to meet the needs of all beach nourishment projects for the next 50 years (Ousley *et al.* 2014). Since then, FDEP analyzed the need for sand over the next 10 to 20 years for this region and determined that 20 to 30 million cubic yards (15.29 to 22.94 million cubic meters) of beach-compatible material will be needed for beach nourishment projects (Florida Department of Environmental Protection, 2015c). The continental shelf adjacent to the southeast Florida coast is narrow. The haul distances from offshore sources to a specific project area may be large for some of the projects in this region, which can drive up the cost of a project. For these reasons, it is expected that some counties may look to upland sand mines and/or borrow areas offshore of neighboring counties for their own projects. Therefore, it is highly recommended that FDEP, USACE, BOEM, and local governments continue to coordinate and use best management practices when utilizing the available offshore resources.

Discussion

Cost of beach restoration is heavily influenced by the cost of transportation of sediment resources from where they are to where they are needed. Recommendations for future investigations were based upon the need to identify beach-compatible sand resources in locations which are as proximal as possible to the areas where those resources are required.

The ROSSI project was created to store data collected from the investigations of marine sand sources for beach nourishment activities and to provide a centralized location for users to access the information. An Oracle enterprise database management system is used to store the tabular data. The database can be searched and manipulated through an online query builder as well as with existing ArcIMS GIS routines that provide access over the Internet.

BOEM, through the MMP, is responsible for the use of offshore sand resources located outside of state waters and within federal waters on the OCS. The MMP has initiated regional management of sand sources, where feasible, to manage the growing need for these sand sources. Projects in Brevard, Collier, Miami-Dade, Duval, Manatee, and Sarasota counties have obtained sand through the MMP leasing program.

FDEP and the USACE completed the southeast regional SAND study in a collaborative manner and the study was reviewed by, and vetted through, all the participating stakeholders. The SAND study determined that the regional offshore supply of sand in state and federal waters is adequate to meet the needs of all the beach nourishment projects in five southeastern coastal counties, (St. Lucie, Martin, Palm Beach, Broward, and Miami-Dade), for the next 50 years (year 2062); (Ousley *et al.* 2014). However, the cost of transportation of sediment within the region was not considered.

FDEP has outlined various RSM strategies in its inlet management plans and the SBMP. The USACE, Jacksonville District RSM work aids the FDEP in updating these plans. It is the goal of FDEP to coordinate with the USACE and implement strategies mutually beneficial to USACE and FDEP by leveraging federal authorities, permits, and funding. Continued coordination between FDEP, USACE, BOEM, and local governments will aid in both the identification and efficient use of the finite sand resources offshore of Florida's Atlantic coast.

Conclusions

The result of the implementation of our recommendations is that beach-compatible sand resources closest to locations of critical need will be better quantified and qualified. In order to do so, sand searches should continue to be implemented per project or region such that data gaps are filled and the compatibilities of offshore resources to specific project beaches can be individually assessed and matched. Funding is typically available on a project, rather than a regional, scale. Should funding become available for more regional data collection, research can be done without a target beach in mind, and overall beach compatibility for beaches within nearby regions investigated. Once all of the

available data are entered into the ROSSI and the BOEM MMP GIS databases, other researchers will be able to use existing data as a planning tool for the next investigation.

Having beach-compatible sand resources identified, even those characterized by minimal data, and those data available to the local sponsors for their sand search efforts, are priorities for both FDEP and BOEM. Continued coordination between FDEP, USACE, BOEM and local governments is imperative to successfully utilizing the finite sand resources available in both state and federal waters. RSM efforts should be continued throughout the region.

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