Major Modification to CAMA Permit # 91-14

For:
Village of Bald Head Island
Beach Nourishment Project

Bald Head Island, Brunswick County, North Carolina

Prepared By:

Davey Resource Group, Inc. (Agent)
3805 Wrightsville Avenue
Wilmington, North Carolina

and

Olsen Associates, Inc. (Project Engineer)
2618 Herschel Street
Jacksonville, FL 32204

August 2023

Contents

Appendices

1. Form DCM-MP-1

APPLICATION for Major Development Permit

(last revised 12/27/06)

North Carolina DIVISION OF COASTAL MANAGEMENT

1. Primary Applicant/ Landowner Information

Business Name Village of Bald Head Island		Project Name (if applicable) Village of Bald Head Island Beach Nourishment Project		
Applicant 1: First Name Chris	MI NA	Last Name McCall		
Applicant 2: First Name Jae	MI NA	Last Name Kim		
If additional applicants, please attach an additional page(s) with names listed.				
Mailing Address 106 Lighthouse Wynd		PO Box NA	City Bald Head Island	State NC
ZIP 28461	Country USA	Phone No. 910-457-9700	FAX No. NA	
Street Address *(if different from above)* NA		City	State	ZIP
Email cmccall@villagebhi.org ; jkim@villagebhi.org				

2. Agent/Contractor Information

Business Name Davey Resource Group				
Agent/ Contractor 1: First Name Christian	MI	Last Name Preziosi		
Agent/ Contractor 2: First Name Greg	MI	Last Name Finch		
Mailing Address 3805 Wrightsville Avenue, Suite 15		PO Box	City Wilmington	State NC
ZIP 28403		Phone No. 1 910-452-0001 ext. NA	Phone No. 2 NA ext. NA	
FAX No. NA		Contractor # NA		
Street Address *(if different from above)* NA		City	State	ZIP
Email christian.preziosi@davey.com ; gregory.finch@davey.com				

3. Project Location

County (can be multiple)	Street Address	State Rd. #
Brunswick	NA	NA

Subdivision Name	City	State	Zip
NA	Village of Bald Head Island	NC	28461

Phone No.	Lot No.(s) *(if many, attach additional page with list)*
NA	NA

a. In which NC river basin is the project located?	b. Name of body of water nearest to proposed project
Cape Fear	Atlantic Ocean
c. Is the water body identified in (b) above, natural or manmade? ☒Natural ☐Manmade ☐Unknown	d. Name the closest major water body to the proposed project site. Atlantic Ocean
e. Is proposed work within city limits or planning jurisdiction? ☒Yes ☐No	f. If applicable, list the planning jurisdiction or city limit the proposed work falls within. Village of Bald Head Island

4. Site Description

a. Total length of shoreline on the tract (ft.)	b. Size of entire tract (sq.ft.)
Placement Area: 12,936 ft	NA
c. Size of individual lot(s) NA *(If many lot sizes, please attach additional page with a list)*	d. Approximate elevation of tract above NHW *(normal high water)* or NWL *(normal water level)* Elevation varies 0 ft to 6 ft ☒NHW or ☐NWL

e. Vegetation on tract

Nourishment area consists of unvegetated intertidal beach and unvegetated upper beach (i.e. supratidal).

f. Man-made features and uses now on tract

Sand tube groins, dune crossovers, terminal groin at western terminus (Sta 48+00)

g. Identify and describe the existing land uses <u>adjacent</u> to the proposed project site.

Residential homes, businesses, and public infrastructure (e.g. roads, water, sewer, etc.)

h. How does local government zone the tract?	i. Is the proposed project consistent with the applicable zoning? (Attach zoning compliance certificate, if applicable) ☐Yes ☐No ☒NA
NA	

j. Is the proposed activity part of an urban waterfront redevelopment proposal? ☐Yes ☒No

k. Has a professional archaeological assessment been done for the tract? If yes, attach a copy. ☒Yes ☐No ☐NA

If yes, by whom? T.A.R. 2022 See Appendix C

l. Is the proposed project located in a National Registered Historic District or does it involve a National Register listed or eligible property? ☐Yes ☒No ☐NA

m. (i) Are there wetlands on the site?	☐Yes ☒No
(ii) Are there coastal wetlands on the site?	☐Yes ☒No
(iii) If yes to either (i) or (ii) above, has a delineation been conducted? *(Attach documentation, if available)*	☐Yes ☒No

n. Describe existing wastewater treatment facilities.

NA

o. Describe existing drinking water supply source.

NA

p. Describe existing storm water management or treatment systems.

None

5. Activities and Impacts

a. Will the project be for commercial, public, or private use? ☐Commercial ☒Public/Government ☐Private/Community

b. Give a brief description of purpose, use, and daily operations of the project when complete.

The purpose of the project is to maintain and restore beach and dune resources and thereby protect adjacent residential homes, businesses, and infrastructure. Proposed beach nourishment is intended to offset chronic and episodic sand losses along the western and eastern reaches of South Beach as well as maintain the terminal groin fillet as required by permit condition. Daily use of the beach is, and will continue to be (post-project), recreational (for use by both residents of Bald Head Island and the public).

c. Describe the proposed construction methodology, types of construction equipment to be used during construction, the number of each type of equipment and where it is to be stored.

Dredging of the proposed offshore borrow area will be by a cutter suction dredge. Material will be piped to the beach by hydraulic pipeline and booster pumps (if needed). Land-based equipment for fill placement will include bulldozers (D8 or similar), dredge pipe, and payloaders.

d. List all development activities you propose.

Excavation of beach-compatible sand (to a depth no greater than -24 ft NAVD88) from an approximate 72.8-acre borrow area within Jay Bird Shoals; placement of sand along approximately 12,936 lf of shoreline along South Beach. The construction berm will maintain an approximate elevation of +9 ft NGVD which is consistent with the federal disposal fill template. A mild slope in the seaward direction will be graded to reduce post-placement scarping.

e. Are the proposed activities maintenance of an existing project, new work, or both? Both

f. What is the approximate total disturbed land area resulting from the proposed project? ☐Sq.Ft or ☒Acres

148 acres (+/-) pending beach fill conditions at time of placement

g. Will the proposed project encroach on any public easement, public accessway or other area that the public has established use of? ☒Yes ☐No ☐NA

h. Describe location and type of existing and proposed discharges to waters of the state.

A portion of the sand placement by dredge or mechanical means will occur seaward of the MHWL on South Beach.

i. Will wastewater or stormwater be discharged into a wetland? -No new discharges	☐Yes ☒No ☐NA
If yes, will this discharged water be of the same salinity as the receiving water?	☐Yes ☐No ☒NA
j. Is there any mitigation proposed? If yes, attach a mitigation proposal.	☐Yes ☒No ☐NA

6. Additional Information

In addition to this completed application form, (MP-1) the following items below, if applicable, must be submitted in order for the application package to be complete. Items (a) – (f) are always applicable to any major development application. Please consult the application instruction booklet on how to properly prepare the required items below.

a. A project narrative.

b. An accurate, dated work plat (including plan view and cross-sectional drawings) drawn to scale. Please give the present status of the proposed project. Is any portion already complete? If previously authorized work, clearly indicate on maps, plats, drawings to distinguish between work completed and proposed.

c. A site or location map that is sufficiently detailed to guide agency personnel unfamiliar with the area to the site.

d. A copy of the deed (with state application only) or other instrument under which the applicant claims title to the affected properties.

e. The appropriate application fee. Check or money order made payable to DENR.

f. A list of the names and complete addresses of the adjacent waterfront (riparian) landowners and signed return receipts as proof that such owners have received a copy of the application and plats by certified mail. Such landowners must be advised that they have 30 days in which to submit comments on the proposed project to the Division of Coastal Management.

Name Chad and Tara Huneycutt ETUX	Phone No. NA
Address 1908 Eastwood Rd STE 320, Wilmington, NC 28403-7235	
Name David G Uslar	Phone No. NA
Address 1220 Old Philly Pike, Kempton, PA 19529-9324	
Name William C Kluttz Jr	Phone No.
Address 215 Lawton Rd, Charlotte, NC 28216-3313	
Name Laura Tomlinson Dray	Phone No. NA
Address 1868 Runnymede Rd, Winston Salem, NC 27104-3110	

g. A list of previous state or federal permits issued for work on the project tract. Include permit numbers, permittee, and issuing dates.

CAMA 91-14; COE 2014-00661; CAMA 60-09; COE 2007-02699;

CAMA 139-10; COE 2009-02334; CAMA 9-95; COE 1994-04687

h. Signed consultant or agent authorization form, if applicable.

i. Wetland delineation, if necessary.

j. A signed AEC hazard notice for projects in oceanfront and inlet areas. *(Must be signed by property owner)*

k. A statement of compliance with the N.C. Environmental Policy Act (N.C.G.S. 113A 1-10), if necessary. If the project involves expenditure of public funds or use of public lands, attach a statement documenting compliance with the North Carolina Environmental Policy Act.

7. Certification and Permission to Enter on Land

I understand that any permit issued in response to this application will allow only the development described in the application.

The project will be subject to the conditions and restrictions contained in the permit.

I certify that I am authorized to grant, and do in fact grant permission to representatives of state and federal review agencies to enter on the aforementioned lands in connection with evaluating information related to this permit application and follow-up monitoring of the project.

I further certify that the information provided in this application is truthful to the best of my knowledge.

Date: 8/4/2023 Print Name: _____, Agent, Davey Resource Group, Inc.

Signature _____

Please indicate application attachments pertaining to your proposed project.

☒ DCM MP-2 Excavation and Fill Information

☐ DCM MP-3 Upland Development

☐ DCM MP-4 Structures Information

☐ DCM MP-5 Bridges and Culverts

2. Form DCM MP-2

EXCAVATION and FILL

(Except for bridges and culverts)

	Access Channel (NLW or NWL)	Canal	Boat Basin	Boat Ramp	Rock Groin	Rock Breakwater	Other (excluding shoreline stabilization)
Length	NA	NA	NA	NA	NA	NA	12,936 lf
Width	NA	NA	NA	NA	NA	NA	Varies (avg. = 500 ft +/-)
Avg. Existing Depth	NA	NA	NA	NA	NA	NA	Variable pending profile
Final Project Depth	NA	NA	NA	NA	NA	NA	-15 ft NGVD to +9 ft NGVD

1. EXCAVATION

☐*This section not applicable*

a. Amount of material to be excavated from below NHW or NWL in cubic yards. NTE 1.4 million cubic yards.

b. Type of material to be excavated.

Beach-compatible sand (see attached Geotechnical Vibracore Report, Appendix D).

c. (i) Does the area to be excavated include coastal wetlands/marsh (CW), submerged aquatic vegetation (SAV), shell bottom (SB), or other wetlands (WL)? If any boxes are checked, provide the number of square feet affected.

☐CW _____ ☐SAV _____ ☐SB _____

☐WL _____ ☒None

(ii) Describe the purpose of the excavation in these areas:

NA

d. High-ground excavation in cubic yards.

None

2. DISPOSAL OF EXCAVATED MATERIAL

☐*This section not applicable*

a. Location of disposal area.

South Beach: Station 52+64 to 122+00 and Station 162+00 to 222+00 (See Sheets 2- 4 of 9, Appendix A)

b. Dimensions of disposal area.

The length of the disposal area is 12,936 lf. The width will vary based upon beach profiles at the time of construction (refer to Sheet 5 of 9, Appendix A). The effective width is estimated to average as much as 500 ft over the length of the project.

c. (i) Do you claim title to disposal area?

☒Yes ☐No ☐NA Easement. See Appendix B

(ii) If no, attach a letter granting permission from the owner.

d. (i) Will a disposal area be available for future maintenance?

☒Yes ☐No ☐NA

(ii) If yes, where?

South Beach receives periodic disposal from the Wilmington Harbor federal project.

e. (i) Does the disposal area include any coastal wetlands/marsh (CW), submerged aquatic vegetation (SAV), shell bottom (SB), or other wetlands (WL)? If any boxes are checked, provide the number of square feet affected.

☐CW _____ ☐SAV _____ ☐SB _____

☐WL _____ ☒None

(ii) Describe the purpose of disposal in these areas:

NA.

f. (i) Does the disposal include any area in the water?

☒Yes ☐No ☐NA

(ii) If yes, how much water area is affected?

Amount of material placed below MHW will vary (see Sheet 5 of 9, Appendix A). The area below MHW to be affected is estimated to be approximately 119 acres depending upon beach profiles at the time of construction.

3. SHORELINE STABILIZATION

☐ *This section not applicable*

(If development is a wood groin, use MP-4 – Structures)

a. Type of shoreline stabilization:
☐Bulkhead ☐Riprap ☐Breakwater/Sill ☒Other: Beach nourishment with protective berm.

b. Length: 12,936 lf
Width: variable pending beach profiles (estimated to be 500 ft)

c. Average distance waterward of NHW or NWL: Varies (see Sheet 5 of 9, Appendix A).

d. Maximum distance waterward of NHW or NWL: ~100 ft

e. Type of stabilization material: Clean beach compatible sand for protective berm at base of dunes.

f. (i) Has there been shoreline erosion during preceding 12 months?
☒Yes ☐No ☐NA
(ii) If yes, state amount of erosion and source of erosion amount information. Average 350,000 - 4,000,000 cy per year, per Village's Beach Monitoring Program.

g. Number of square feet of fill to be placed below water level.
Bulkhead backfill Riprap
Breakwater/Sill Other: Estimated 119 acres depending on profiles at the time of nourishment.

h. Type of fill material. Clean beach compatible sand.

i. Source of fill material. The Jay Bird Shoals expanded borrow site as described in this application (see Appendix A).

4. OTHER FILL ACTIVITIES

☐ *This section not applicable*

(Excluding Shoreline Stabilization)

a. (i) Will fill material be brought to the site? ☒Yes ☐No ☐NA
If yes,
(ii) Amount of material to be placed in the water varies; estimated to be 800,000 cy +/- (see Sheet 3 of 9 and 4 of 9).
(iii) Dimensions of fill area 12,936 ft x 350 ft (width varies)
(iv) Purpose of fill
Beach nourishment and maintenance of beach/dune resource for protection of homes, businesses, and infrastructure along South Beach.

b. (i) Will fill material be placed in coastal wetlands/marsh (CW), submerged aquatic vegetation (SAV), shell bottom (SB), or other wetlands (WL)? If any boxes are checked, provide the number of square feet affected.
☐CW _____ ☐SAV _____ ☐SB _____
☐WL _____ ☒None
(ii) Describe the purpose of the fill in these areas:
NA

5. GENERAL

a. How will excavated or fill material be kept on site and erosion controlled?
Shore parallel dikes, bulldozers shaping fill template. Engineered beach will help to reduce erosion of upper beach and dunes.

b. What type of construction equipment will be used (e.g., dragline, backhoe, or hydraulic dredge)?
Cutter suction dredge, bulldozers and other heavy machinery typical with beach nourishment projects

c. (i) Will navigational aids be required as a result of the project? ☐Yes ☒No ☐NA
(ii) If yes, explain what type and how they will be implemented.
NA

d. (i) Will wetlands be crossed in transporting equipment to project site? ☐Yes ☒No ☐NA
(ii) If yes, explain steps that will be taken to avoid or minimize environmental impacts.
NA

Date

8/4/2023

Project Name: Jay Bird Shoals Borrow Area Expansion Project

Applicant Name

Village of Bald Head Island

Applicant Signature

, Agent, Davey Resource Group, Inc.

3. DCM MP-1 Section 6.0 Additional Information

3.1 Section 6. a. Project Narrative

3.1.1 Introduction

The south-facing shoreline of Bald Head Island (i.e. South Beach) experiences on-going and chronic erosion resulting in predictable sand losses and shoreline recession. Severe erosion has been chronicled along South Beach (particularly its western reach) since the 1970s. Prior to 2015, the highest rates of sand loss occurred principally at the extreme west end of South Beach in the vicinity of the Cape Fear River entrance. This prompted the Village of Bald Head Island (Village) to procure authorizations for, and subsequently construct, a 1,300-lf terminal groin at this location. Construction of the terminal groin structure was completed in December 2015.

While the terminal groin addresses chronic shoreline losses along western South Beach, it has been documented that the terminal groin and existing sand tube groin field are not sufficient, in and of themselves, to prevent or to adequately offset sand losses from South Beach or West Beach. As a result, periodic nourishment through both the federally sponsored Wilmington Harbor dredge and disposal project and Village-sponsored projects are required to mitigate erosion along the entirety of South Beach and West Beach. The threat to existing homes, dunes, and infrastructure because of the erosion and shoreline recession has prompted the Village to seek longer term beach nourishment options. Predicted sand volume needs for South Beach and West Beach were identified in the terminal groin EIS (for both the terminal groin alternative and non-structural alternatives). Based upon this analysis, the Village identified and submitted permit authorization requests for use of a borrow site on Frying Pan Shoals (a sand source site with the potential to satisfy larger sand volume requirements for South Beach and West Beach). However, recent agency comments in response to this request have prompted the Village to evaluate and pursue other practicable alternatives including an expansion of the Jay Bird Shoals (JBS) permitted borrow area. Specifically, agencies recommended the prioritization of the use of JBS over the use of Frying Pan Shoals (FPS). Further information regarding existing site conditions and the proposed work activities of the current JBS expansion project are provided below.

3.1.2 Investigations

In order to determine the proposed borrow site expansion project's effects on potentially significant submerged cultural resources, OAI contracted with Tidewater Atlantic Research, Inc. (TAR) of Washington, North Carolina to conduct a magnetometer and acoustic survey. The remote sensing investigation conducted by TAR archaeologists was designed to provide accurate and reliable identification, assessment and documentation of submerged cultural resources in the study area. A copy of the TAR report in its entirety is included as Appendix C.

Having quantified potential sediment availability over depth, Olsen Associates, Inc., (OAI), authorized the acquisition of ten (10) VIBRACORES within and adjacent to the proposed expansion area. The locations of the intended cores are depicted in Sheet 7 of 9, Appendix A. Two (2) cores were sited in previously dredged areas within Area 3 of the original site for purposes of assessing the quality of the depositional material. The firm of Athena Technologies, Inc. (Athena) was contracted to acquire the desired VIBRACORES and to log, document, and perform the requisite laboratory analyses (i.e. size characteristics, % shell, % fines, etc.). Athena completed the field work associated with VIBRACORE acquisition in early July, 2022. Each core was sampled at two discrete locations as well as a composite sample that extended over the maximum design depth of excavation (-22 ft. NGVD29 +2 ft. overdepth). Such composite samples were based upon the apparent absolute depth of visible, desirable material and verification of same based upon the results of the prior 2009/2010 and 2018/2019 projects at this general location. In addition to well defined grain size distribution analyses, the percentage carbonate

material as well as fines were computed for each composite sample over depth. A brief report of findings as well as all data, photographs of cores, core logs, GDS curves, etc. are included as Appendix D.

3.1.3 Proposed Work

Annual survey monitoring of the permitted Jay Brid Shoals borrow area has documented ongoing recovery of the dredged substrate, but not of sufficient spatial distribution and sediment depth where it would be suitable for near-term excavation by a hydraulic dredge. As such, investigations for the expansion of the borrow area were conducted by Olsen Associates, Inc.

Based upon updated bathymetric conditions, the available neat volume of borrow site sand within the expanded site above a design elevation of -22 ft. NGVD is approximately 1.4 Mcy. This is theoretically sufficient for the construction of a potential interim beach fill in/or about 2025. The maximum depth of excavation during dredging would be limited to -24 ft. NGVD, as in the prior two (2) dredging events. This ensures that beach quality sediments are excavated, as well as that the exposed borrow site post-construction substrate is suitable for expeditious benthic recovery.

The intended project in-place fill volume required is estimated at 1 Mcy +/-. All sand would be placed on the two ends of South Beach. The South Beach construction berm will maintain an approximate average elevation of +9 ft. NGVD. A mild slope in the seaward direction will be introduced into the berm (by grading) to reduce post-placement scarping and enhance post-construction turtle nesting activities. Should dune erosion or benching be evident at the time of construction, up to 5 cy of sand per ft. of shorefront would be mechanically moved and graded to repair the dune line. Any revegetation necessary for dune stabilization would be performed by the Village under separate contract after fill placement completion by the dredge contractor.

The proposed timing of the work would be between 1 November and 1 April of the following year. Work would be performed by a cutter suction dredge with direct deposit on S. Beach by pipeline. It is anticipated that a submerged pipeline can cross the federal navigation project without the need for burial, i.e. seabed placement below the authorized channel depth of -44ft. MLW.

3.1.4 Avoidance and Minimization Measures

The identification and use of the expanded Jay Bird Shoals borrow site was prompted by agency comments received during the review of the Village's request to develop a sand source site on Frying Pan Shoals. Resource agencies recommended the prioritization of the use of JBS over FPS until such time the BOEM-funded research of FPS is completed. The current JBS expansion project is being proposed as a result of these requests.

Based upon prior consultation with the Corps of Engineers and the U.S. Fish and Wildlife Service (FWS) for previous beach nourishment projects on Bald Head Island and the North Carolina Coastal Beach Sand Placement Statewide Programmatic Biological Opinion (August 2017), standard conservation measures will be employed. These include, but may not be limited to, the following:

1. Nourishment to occur during winter months (reduced biological activity);
2. Utilization of beach quality sand (compatible with recipient site);
3. Visual surveys of escarpments and remediation prior to sea turtle nesting season;
4. Qualitative assessment of sand compaction subsequent to completion of beach placement (typically with staff of NC Wildlife Resource Commission);

5. The project will allow for undredged areas in proximity to be left undisturbed to promote more rapid recolonization of benthos (as was documented for previous Jay Bird Shoals and Bald Head Creek Shoals projects);
6. The project will avoid hard-bottom habitat;
7. The project will avoid Primary Nursery Area (PNA) impacts;
8. Avoidance of shorebird and colonial waterbird nesting areas;
9. The project will utilize hydraulic cutter suction dredge (thereby avoiding and minimizing physical entrainment of species in proximity to the dredge operation); and
10. The project will include post-project physical monitoring of borrow site (i.e. assessment of physical recovery); (see Section 3.15 below).

3.1.5 Post-Construction Monitoring

The Village, as the Permittee, will perform physical monitoring of the dredged borrow site immediately after construction, annually for three (3) years, and biennially thereafter. The post-construction bathymetry will be compared with subsequent monitoring results to calculate in-filling of the site. The results of the monitoring will be incorporated into the Village's existing comprehensive Shoreline Monitoring Program and reported annually.

The footprint of each monitoring survey shall include the entire permitted site as well as the actual area of excavation within. Any changes in morphology to the Jay Bird Shoals formation will be evaluated and included within the results of the monitoring report. Any changes in bathymetry proximate to cultural resource buffers will be monitored and reported.

Appendix A-Site Location Map and Work Plats

NOT FOR PURPOSES OF CONSTRUCTION

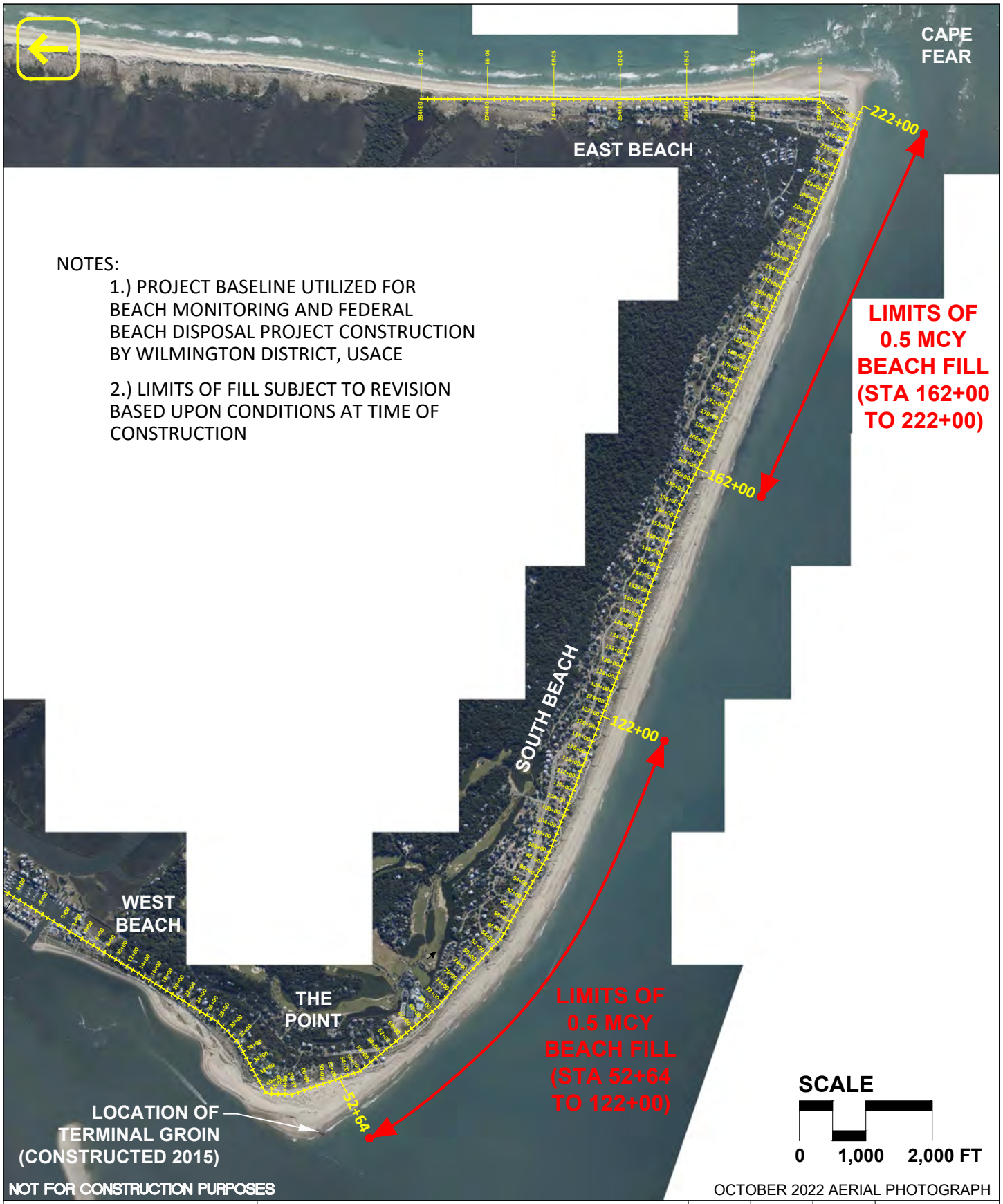
olsen associates, inc.
2618 Herschel Street
Jacksonville, FL. 32204
(904) 387-6114
C-1468

VILLAGE OF BALD HEAD ISLAND
BEACH RENOURISHMENT PROJECT

PROJECT LOCATION

DATE	APPROVED	REVISION
7/13/2023	EJO	Add Oak Is. Borrow Site

DATE: 4/13/2023
DRAWN BY: WAH
SHEET 1 of 9



NOTES:

1.) PROJECT BASELINE UTILIZED FOR BEACH MONITORING AND FEDERAL BEACH DISPOSAL PROJECT CONSTRUCTION BY WILMINGTON DISTRICT, USACE

2.) LIMITS OF FILL SUBJECT TO REVISION BASED UPON CONDITIONS AT TIME OF CONSTRUCTION

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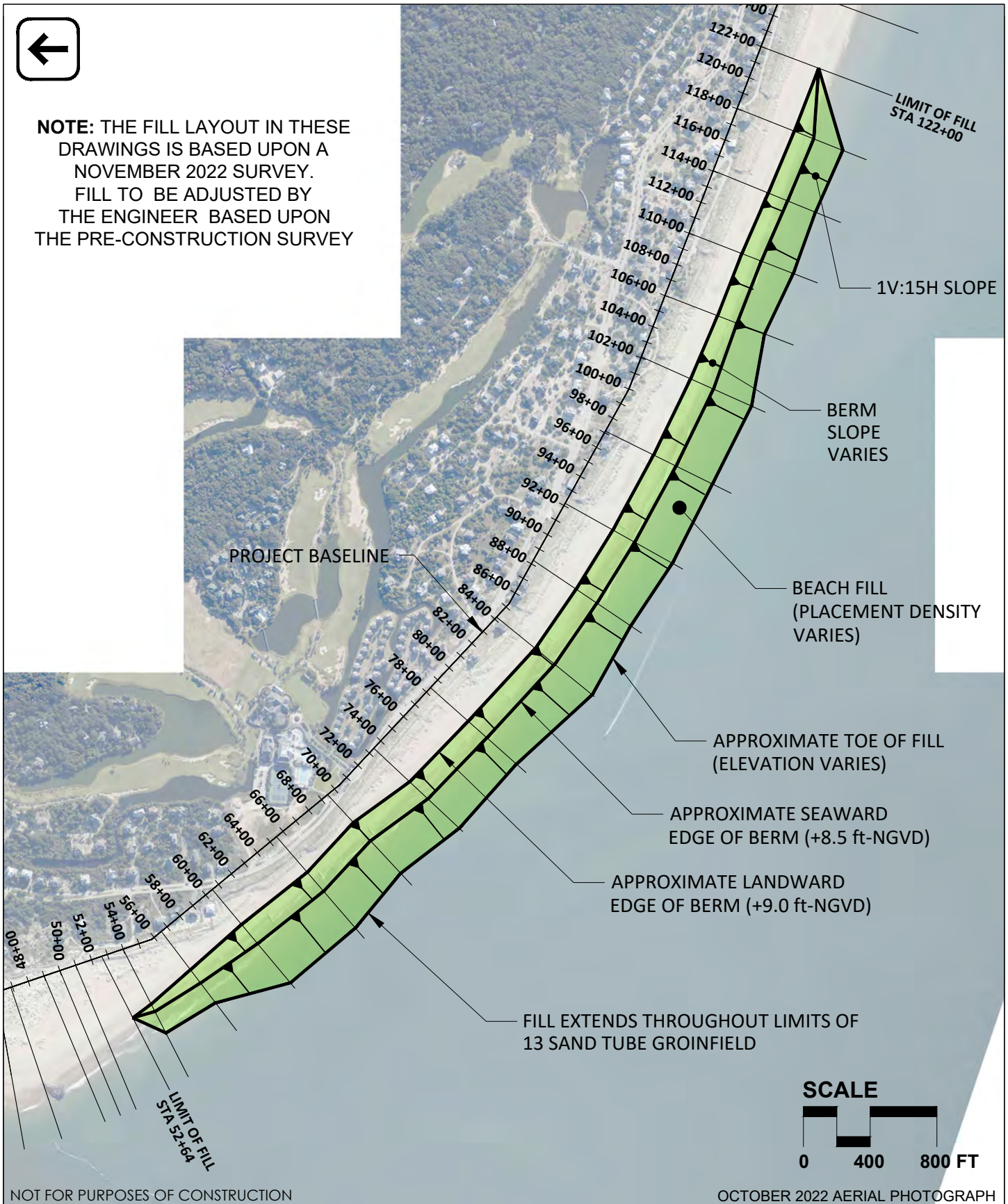
VILLAGE OF BALD HEAD ISLAND
BEACH RENOURISHMENT PROJECT

PROJECT BASELINE & LIMITS OF BEACH FILL

DATE	APPROVED	REVISION	
			4/13/2023
			WAH
			SHEET 2 of 9



NOT FOR PURPOSES OF CONSTRUCTION

OCTOBER 2022 AERIAL PHOTOGRAPH

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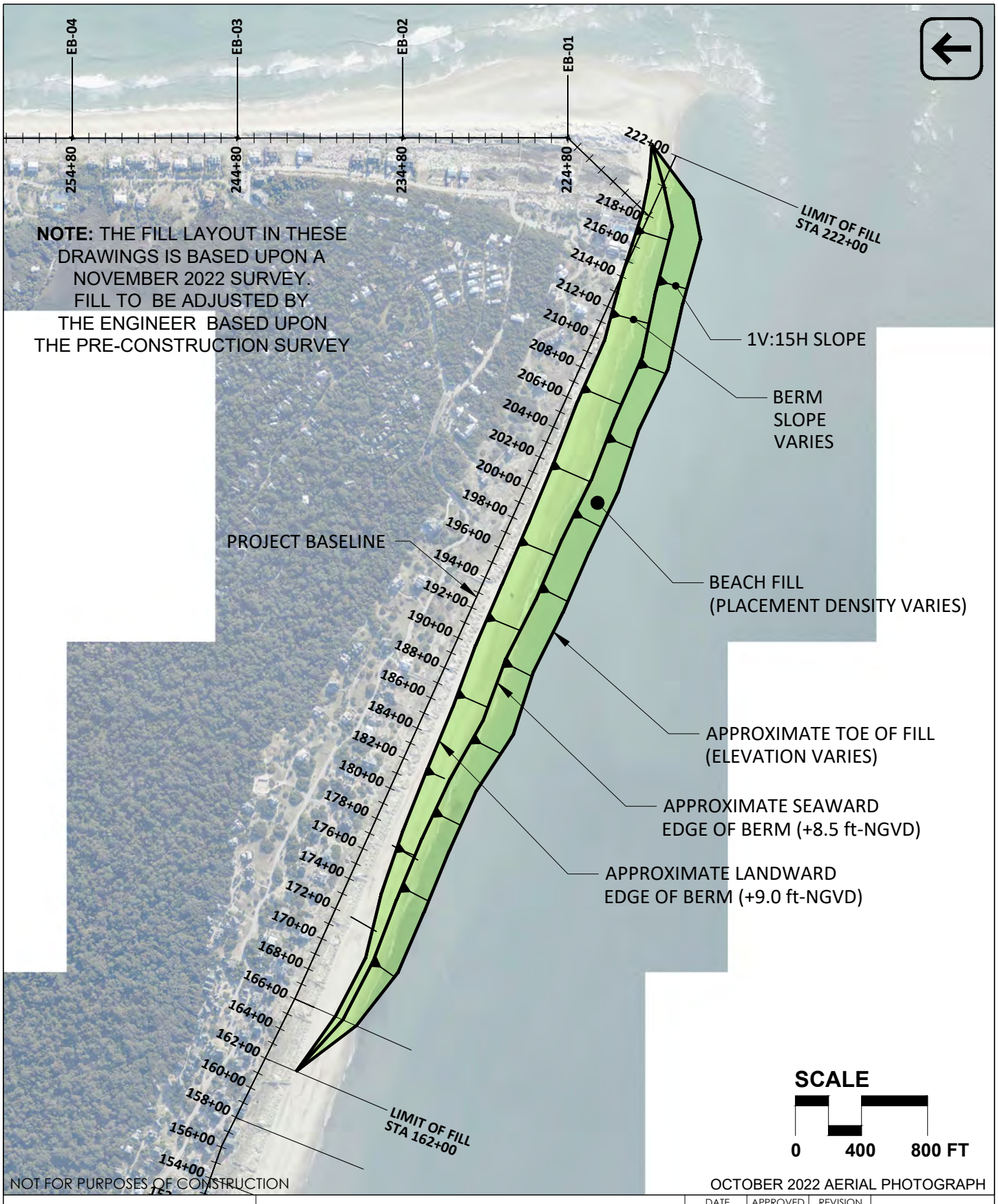
VILLAGE OF BALD HEAD ISLAND
BEACH RENOURISHMENT PROJECT

BEACH FILL
WESTERN SOUTH BEACH

DATE	APPROVED	REVISION	
			4/13/2023
			WAH
			SHEET 3 of 9



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VILLAGE OF BALD HEAD ISLAND
BEACH RENOURISHMENT PROJECT

BEACH FILL
EASTERN SOUTH BEACH

DATE	APPROVED	REVISION

4/13/2023

WAH

SHEET
4 of 9

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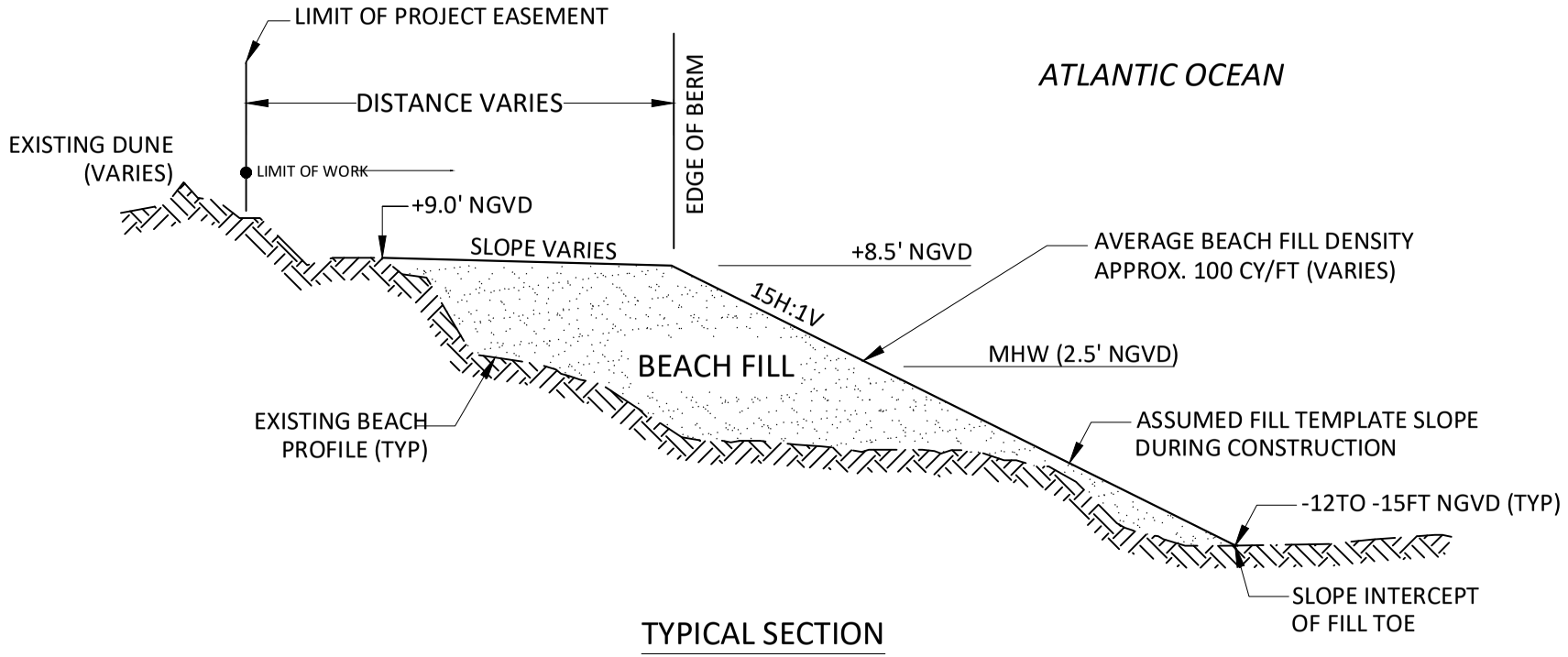
VILLAGE OF BALD HEAD ISLAND
BEACH RENOURISHMENT PROJECT

BEACH FILL
TYPICAL SECTIONS



TYPICAL SECTION

LOCAL TIDAL DATUMS (FT-NAVD)

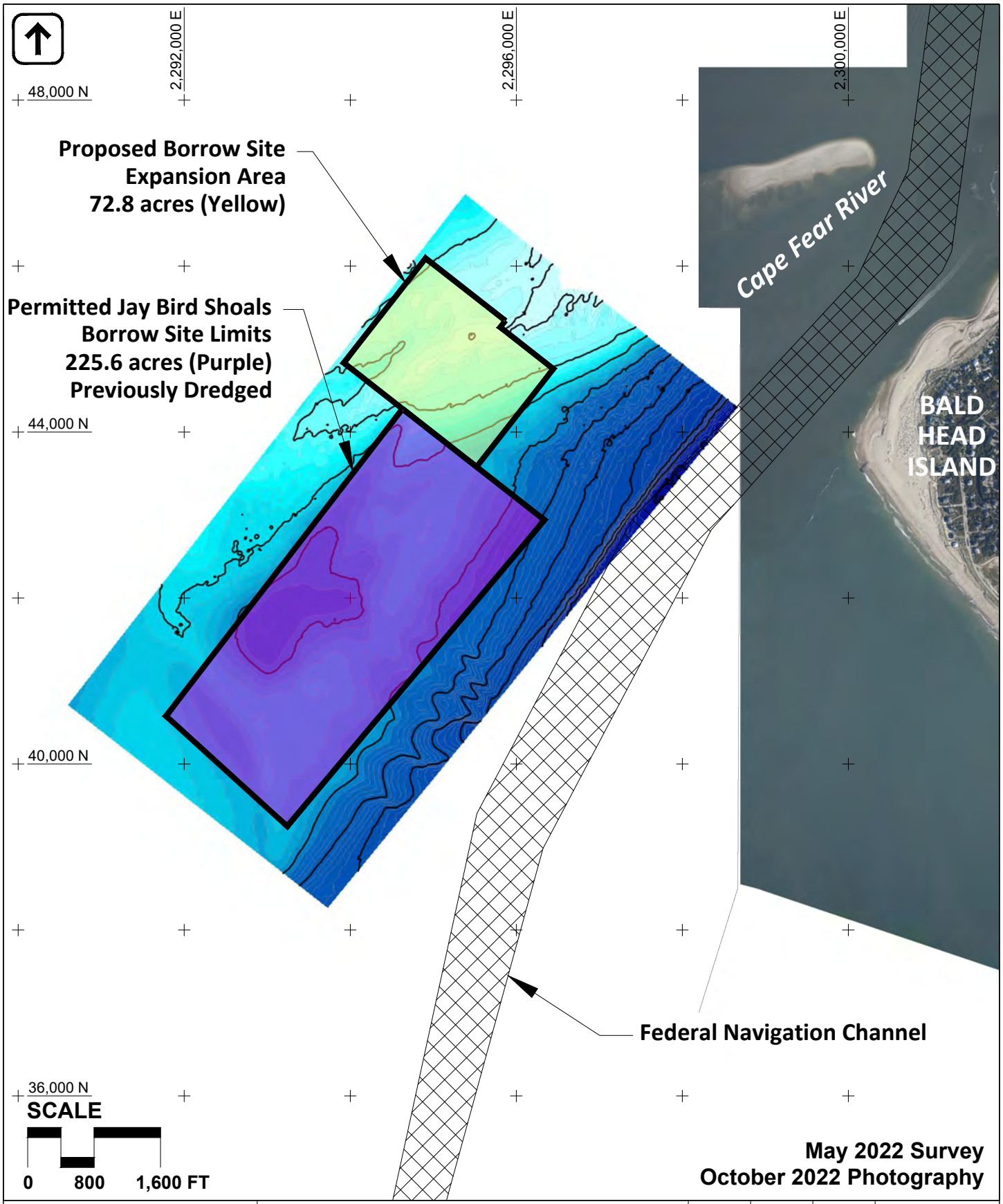
MHHW +2.8
MHW +2.5
NAVD +1.1
NGVD(29) 0.0
MLW -1.8
MLLW -2.0

NOTE:
FILL DENSITY TO VARY SPATIALLY DEPENDING ON CONDITION OF BEACH AT TIME OF CONSTRUCTION.

VERTICAL DATUM: NGVD 29

	DATE	APPROVED	REVISION

4/13/2023 | WAH | **SHEET** 5 of 9



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VILLAGE OF BALD HEAD ISLAND
BEACH RENOURISHMENT PROJECT

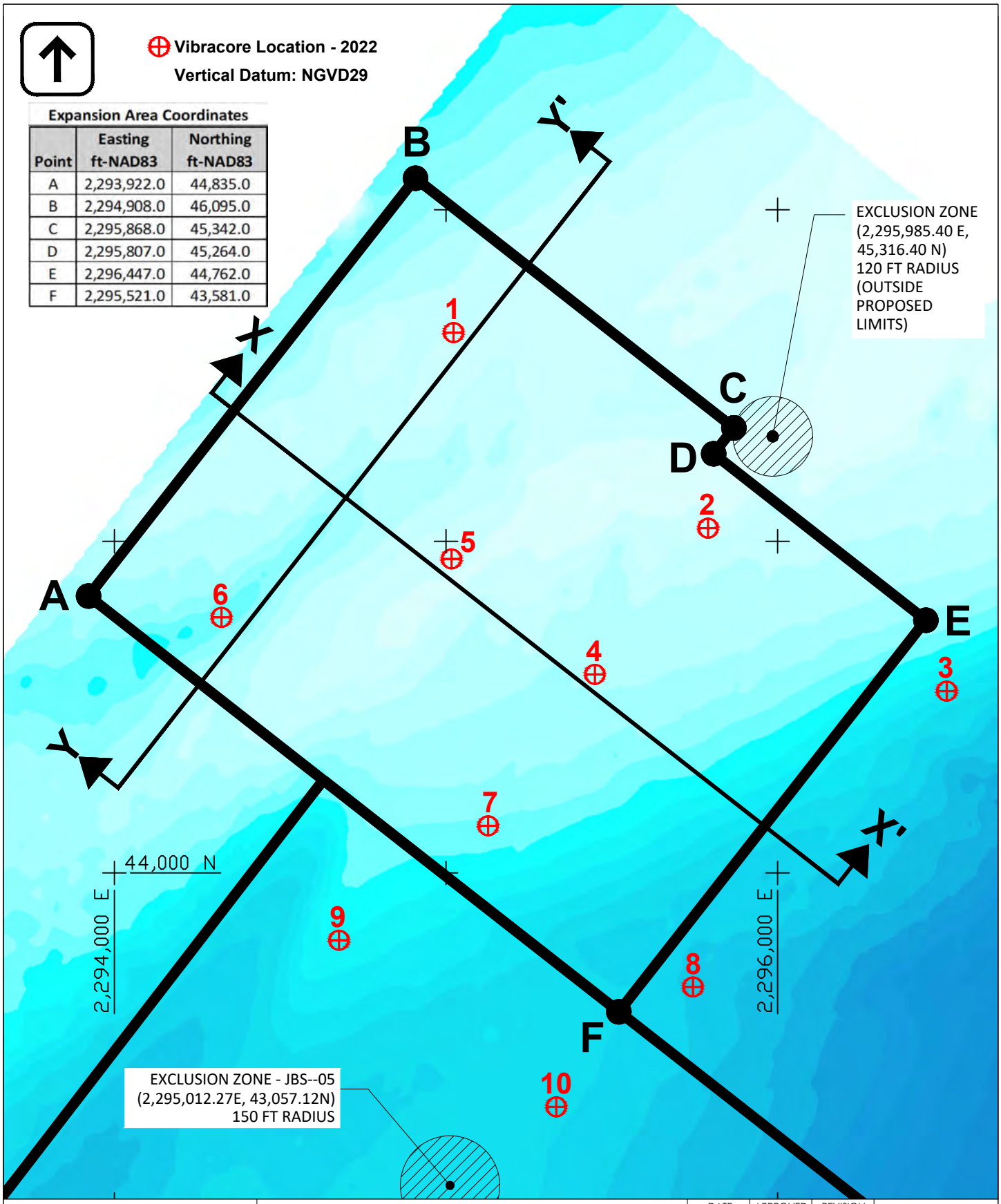
JAY BIRD SHOALS BORROW SITE

DATE	APPROVED	REVISION

4/13/2023

WAH

SHEET
6 of 9



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VILLAGE OF BALD HEAD ISLAND
BEACH RENOURISHMENT PROJECT

JAY BIRD SHOALS BORROW SITE EXPANSION AREA

DATE	APPROVED	REVISION

4/13/2023

WAH

SHEET 7 of 9

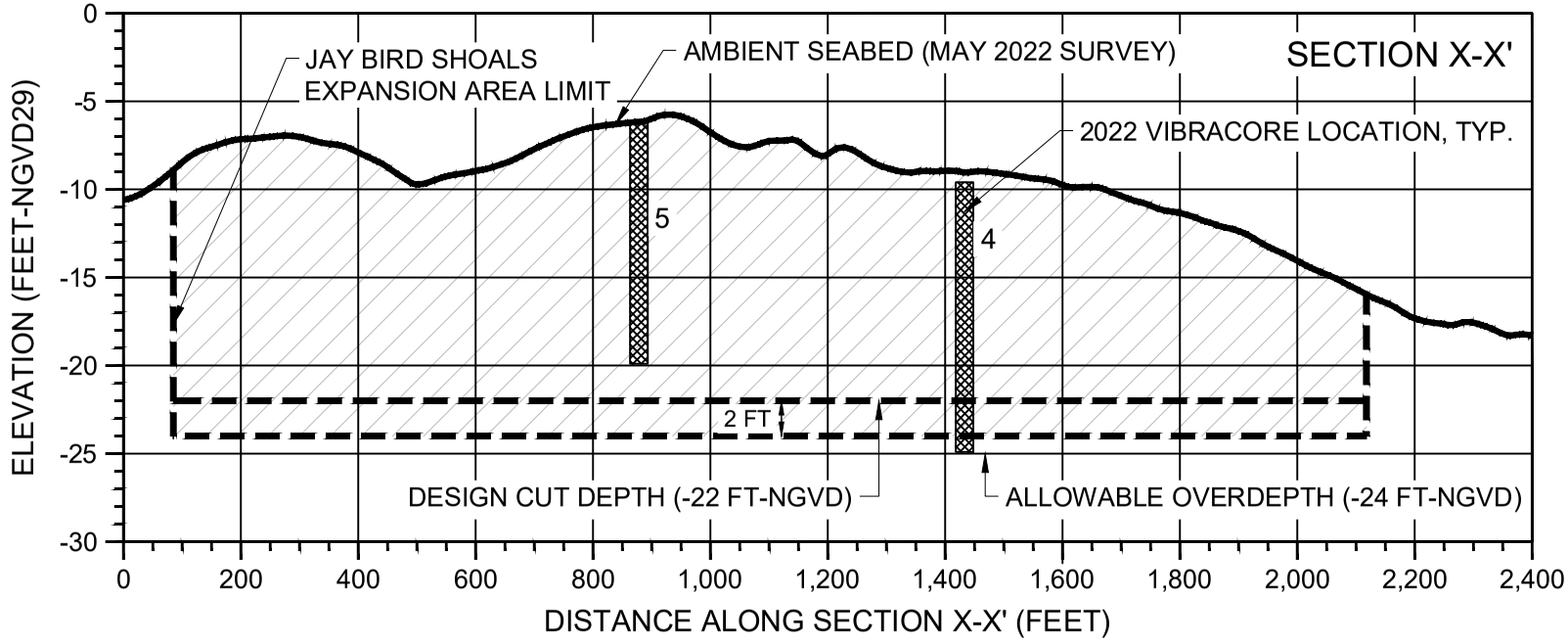
olsen associates, inc.
2618 Herschel Street
Jacksonville, FL. 32204
(904) 387-6114
C-1468

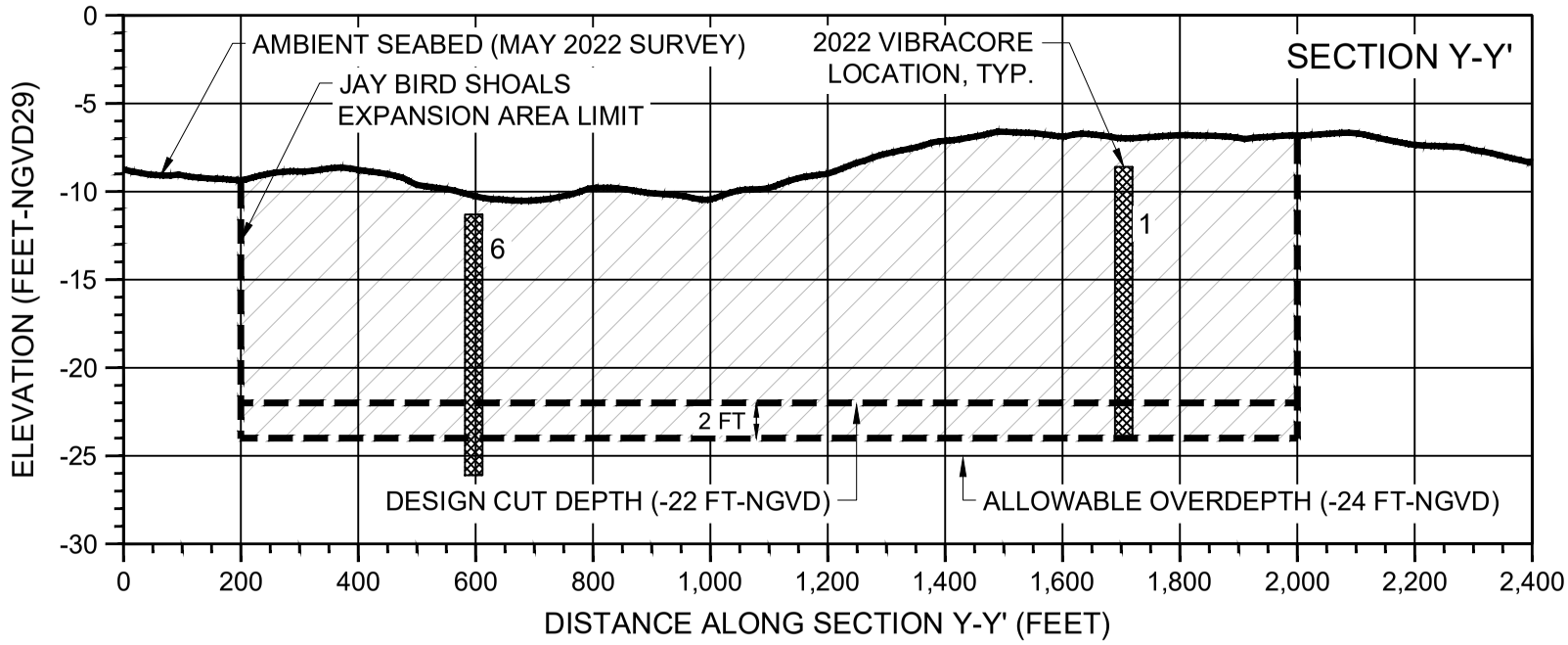
VILLAGE OF BALD HEAD ISLAND
BEACH RENOURISHMENT PROJECT

JAY BIRD SHOALS BORROW SITE
EXPANSION AREA - SECTIONS

	DATE	APPROVED	REVISION

4/13/2023 | WAH | **SHEET** 8 of 9





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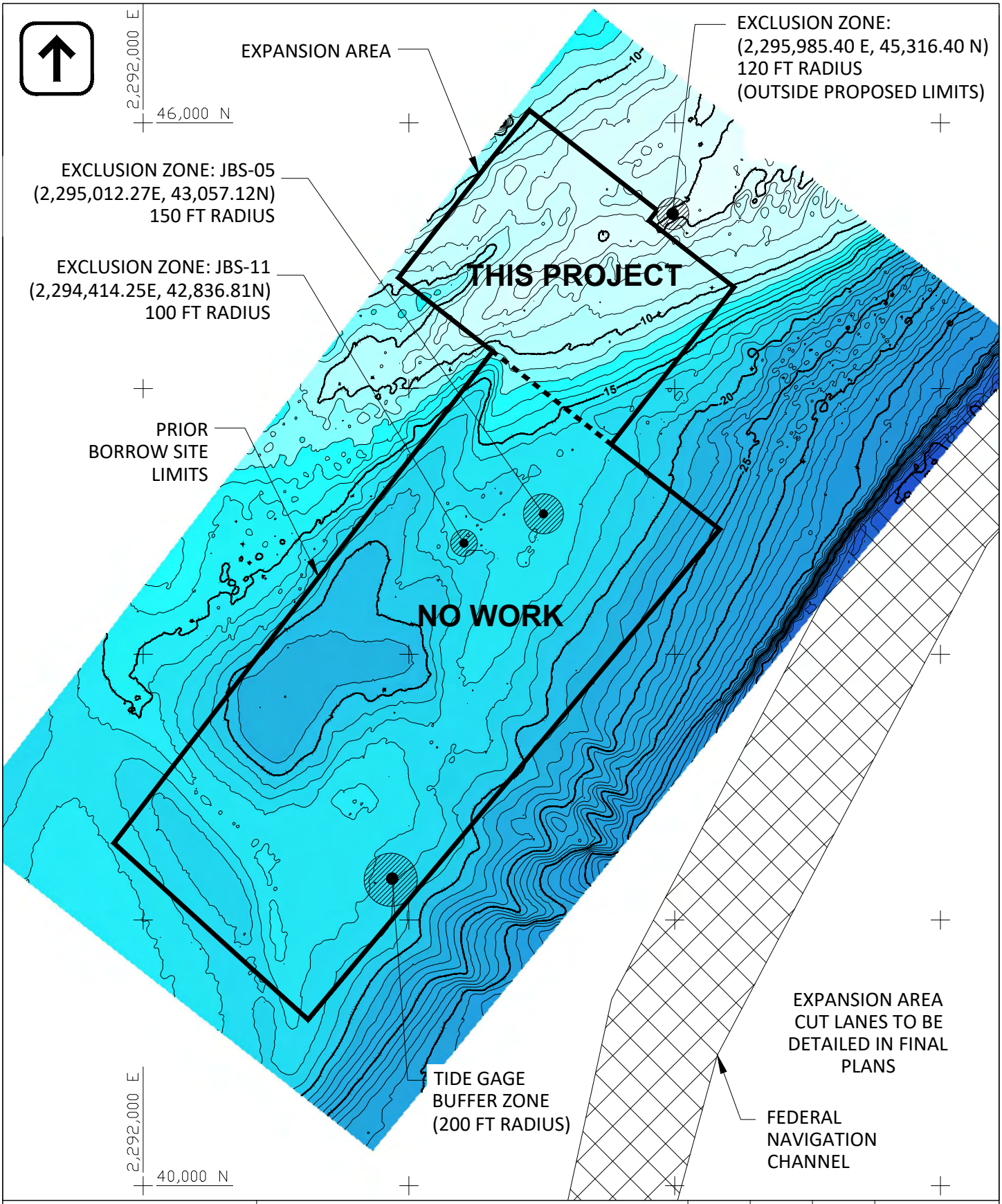

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VILLAGE OF BALD HEAD ISLAND
BEACH RENOURISHMENT PROJECT

JAY BIRD SHOALS BORROW SITE
DREDGE PLAN

DATE	APPROVED	REVISION

4/13/2023

WAH

SHEET
9 of 9

Appendix B-Agent Authorization and Adjacent Riparian Owner Notifications

AGENT AUTHORIZATION FOR CAMA PERMIT APPLICATION

Name of Property Owner Requesting Permit: Village of Bald Head Island c/o Chris McCall

Mailing Address: 106 Lighthouse Wynd

Bald Head Island, NC 28461

Phone Number: 910-457-9700

Email Address: cmccall@villagebhi.org

I certify that I have authorized Davey Resource Group,
Agent / Contractor

to act on my behalf, for the purpose of applying for and obtaining all CAMA permits necessary for the following proposed development: South Beach Renourishment Project

at my property located at Bald Head Island,

in Brunswick County.

I furthermore certify that I am authorized to grant, and do in fact grant permission to Division of Coastal Management staff, the Local Permit Officer and their agents to enter on the aforementioned lands in connection with evaluating information related to this permit application.

Property Owner Information:

_____
Signature

_____
Print or Type Name

_____
Title

_____/_____/_____
Date

This certification is valid through 6/30/2024.

DAVEY
Resource Group

August 4, 2023

Laura Tomlinson Dray
1868 Runnymede Rd
Winston Salem, NC 27104-3110

To Whom It May Concern:

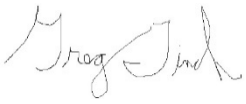
The Village of Baldhead Island is applying for a CAMA Major permit for development activity located at Village of Bald Head Island, Brunswick County, North Carolina. The specifics of the proposed work are shown in the attached permit application and drawings.

As the adjacent riparian property owner to the aforementioned project, I am required to notify you of the development in order to give you the opportunity to comment on the project. Please review the attached permit application and drawings. Should you have any objections to this proposal, please send your written comments within 30 days of your receipt of this notice to:

Heather Coats
North Carolina Department of Environmental Quality
Division of Coastal Management
127 Cardinal Drive Extension
Wilmington, NC 28405

Comments will be considered by the NC Department of Coastal Management in reaching a final decision on the application. No comment within 30 days of your receipt of this notice will be considered as no objection. If you have any questions on this project, please call me at 910-452-0001, or e-mail me at gregory.finch@davey.com

Sincerely,



Greg Finch, Agent
Davey Resource Group

Enclosures

DAVEY
Resource Group

August 4, 2023

Chad and Tara Huneycutt ETUX
1908 Eastwood Rd STE 320
Wilmington, NC 28403-7235

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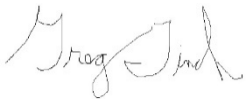

Greg Finch, Agent
Davey Resource Group

Enclosures

DAVEY
Resource Group

August 4, 2023

William C Kluttz Jr
215 Lawton Rd.
Charlotte, NC 28216-3110

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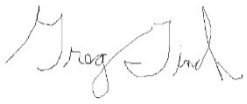

Greg Finch, Agent
Davey Resource Group

Enclosures

DAVEY
Resource Group

August 4, 2023

David G Uslar
1220 Old Philly Pike
Kempton, PA 19529-9324

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Sincerely,

Greg Finch, Agent
Davey Resource Group

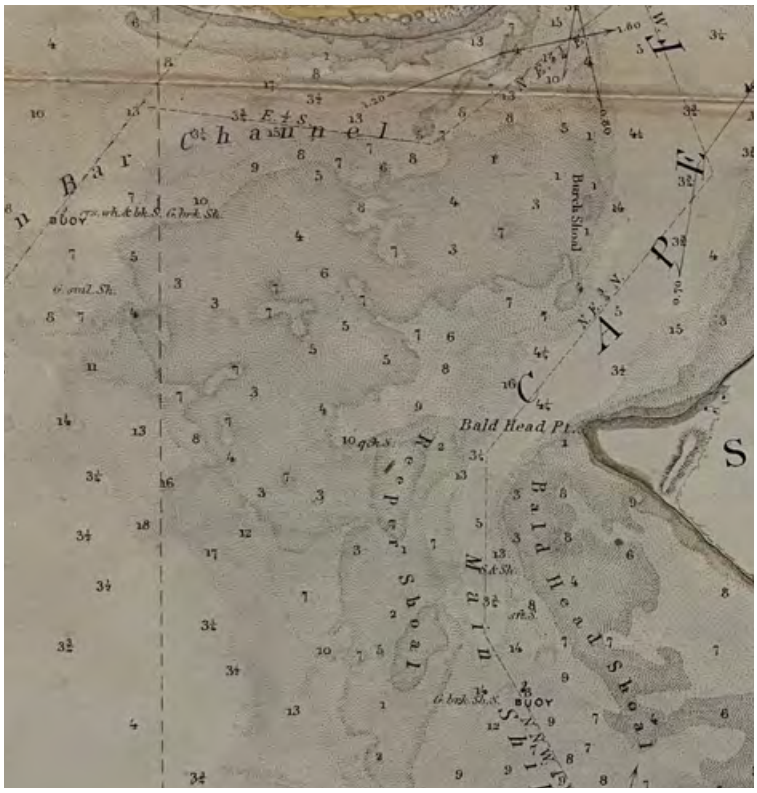
Enclosures

Appendix C-T.A.R. Archaeological Report

(Available upon request if not included)

Report entitled:

A Submerged Cultural Resource Remote-Sensing Survey On Jay Bird Shoals Off Bald Head Island, Brunswick County, North Carolina



[Detail of 1853 U.S. Coast Survey map *Preliminary Chart of the Entrances to Cape Fear River and New Inlet North Carolina*]

Submitted to:

Olsen Associates, Inc.
2618 Herschel Street
Jacksonville, Florida 32204

Submitted by:

Gordon P. Watts, Jr., Ph.D, RPA
Tidewater Atlantic Research, Inc.
P. O. Box 2494
Washington, North Carolina 27889

Submittal Date:

17 October 2022

Abstract

Olsen Associates, Inc. (OAI) of Jacksonville, Florida is the project engineer representing the Village of Bald Head Island (VBHI), North Carolina in developing and permitting an expanded borrow site on Jay Bird Shoals (JBS) near the entrance to the Cape Fear River. Material from the JBS borrow site will be used by the VBHI for engineered beach renourishment. In order to determine the proposed project's effects on potentially significant submerged cultural resources, OAI contracted with Tidewater Atlantic Research, Inc. of Washington, North Carolina to conduct a remote-sensing survey of the proposed borrow site. Field research for the project was conducted on 31 August and 1 September 2022. The survey was carried out with both magnetic and acoustic remote-sensing equipment. Navigation and data collection was controlled by differential global positioning. Analysis of the JBS survey data identified a total of 26 magnetic anomalies. Analysis of the magnetic data indicates that a cluster of four anomalies have collective signature characteristics that could represent historic vessel remains. Because JBS has a high potential for historically significant shipwrecks, those four anomalies are recommended for avoidance or additional investigation. The remaining 22 magnetic anomalies appear to be generated by modern debris such as fish and crab traps, pipes, small diameter rods, cable, wire rope, chain, small boat anchors and possibly ordnance associated with fortifications on Bald Head Island and/or Oak Island. No additional investigation of those buffered four magnetic anomalies is recommended in conjunction with the proposed dredging unless the avoidance buffer could be impacted or anomaly identification is desirable. Nine of the remaining anomalies are located in the 200-foot perimeter buffer. One magnetic anomaly is located outside the survey area. The 12 magnetic anomalies inside the borrow area are not considered to be potentially significant. None of the magnetic anomalies have an associated acoustic signature. The one sonar target is a linear object that could represent a piling or dayboard pole.

Table of Contents

List of Figures

Introduction

Olsen Associates, Inc. (OAI) of Jacksonville, Florida is the project engineer representing the Village of Bald Head Island (VBHI), North Carolina in its efforts to expand an offshore borrow site near the island for engineered beach renourishment. The expanded sand source for material is a borrow area located approximately a mile west of Bald Head Point and adjacent to a previously utilized borrow site. In order to determine the proposed project's effects on potentially significant submerged cultural resources, OAI contracted with Tidewater Atlantic Research, Inc. (TAR) of Washington, North Carolina to conduct a magnetic and acoustic survey of the proposed borrow site extension.

The remote-sensing investigation conducted by TAR archaeologists was designed to provide accurate and reliable identification, assessment and documentation of submerged cultural resources in the study area. The assessment methodology was developed to comply with the criteria of the National Historic Preservation Act of 1966 (Public Law 89-665), the National Environmental Policy Act of 1969 (Public Law 11-190), Executive Order 11593, the Advisory Council on Historic Preservation Procedures for the protection of historic and cultural properties (36 CFR Part 800) and the updated guidelines described in 36 CFR 64 and 36 CFR 66. Results of the remote-sensing investigation were designed to furnish OA and VBHI with the remote-sensing data required to comply with the North Carolina State Historic Preservation Office (NCHPO) and North Carolina Department of Natural and Cultural Resources (NCDNCR) submerged cultural resource legislation and regulations.

Field research for the project was conducted on 31 August 2022 and 1 September 2022. The survey was carried out with both magnetic and acoustic remote-sensing equipment. Navigation and data collection was controlled by differential global positioning. Analysis of the JBS survey data identified a total of 26 magnetic anomalies. Analysis of the data indicates that a cluster of four anomalies have collective signature characteristics that could represent historic vessel remains. Because JBS has a high potential for historically significant shipwrecks, those four anomalies are buffered and recommended for avoidance or additional investigation if the avoidance buffer could be impacted or anomaly identification is desirable.

Nine of the remaining 22 anomalies are located in the 200-foot perimeter buffer. One magnetic anomaly is located outside the survey area. The 12 unbuffered anomalies inside the borrow area are not considered to be potentially significant. Those anomalies appear to be generated by modern debris such as fish and crab traps, pipes, small diameter rods, cable, wire rope, chain, small boat anchors, and possibly ordnance associated with fortifications on Bald Head Island (BHI) and Oak Island. None of the magnetic anomalies have an associated acoustic signature.

Analysis of the sidescan sonar data identified only one acoustic target. The signature for that target represents a linear object on the bottom surface. No magnetic anomaly is associated with the target. It likely represents a piling or navigation reference dayboard. Analysis of the sub-bottom profiler data identified no geological features or targets associated with the magnetic anomalies.

Project Personnel

Project survey personnel consisted of Principal Investigator Gordon P. Watts, Jr., Vessel Captain Ralph Wilbanks, and Remote-Sensing Operator Harry Pecorelli. Senior Historian Robin Arnold carried out the archival, cartographical, and literature research. Dr. Watts analyzed the remote-sensing data. Dr. Watts and Ms. Arnold prepared this document.

Project Location

The remote-sensing project area is situated on JBS, which is located at the entrance to the Cape Fear River on the west side of the navigation channel (Figure1). The potential borrow site is located near the southwest of the shoals approximately a mile west of Bald Head Point.

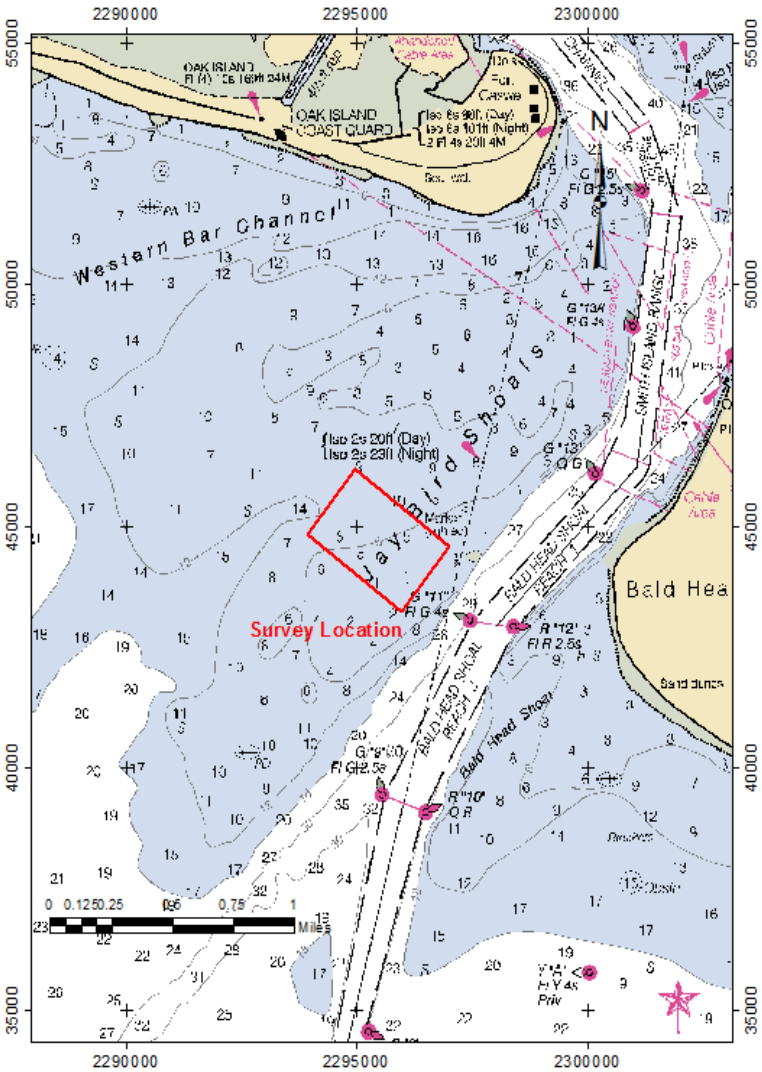


Figure 1. Project location on detail of NOAA Chart 11537-1.

The area surveyed is roughly rectangular in shape measuring 2,576 feet long and 1,700 feet wide. Water depths ranged between 6 to 33 feet. To ensure sufficient data would be available to locate any potentially significant targets in the project area, remote-sensing data were collected along 36 parallel lanes spaced on 50-foot intervals. The area surveyed included a 200-foot perimeter buffer zone so that magnetic anomalies and/or acoustic targets located along the periphery of the borrow area could be identified and the impact from dredging assessed. Survey boundaries defined in North Carolina State Plane (NCSP) coordinates [NAD-83, U S Survey Foot] are presented in Table 1.

Border Point	X Coordinates	Y Coordinate
North West	2294966.9	46181.1
North East	2296993.1	44587.7
South East	2295947.1	43247.8
South West	2293917.7	44836.7

Table 1. Survey boundaries defined by NCSP coordinates.

Research Methodology

Literature and Historical Research

The TAR historian conducted a literature search of primary/scholarly secondary sources to find significant cultural resources within the proposed project area. A background history of BHI and the lower Cape Fear region was updated. Preliminary wreck-specific information was reviewed in manuscripts and published sources that include; Wreck Logs: 5 November 1883-18 January 1906. Life Saving Station No. Cape Fear, District No. Six (Old Baldy Foundation n.d.), *Merchant Vessels of the United States* (U.S. Bureau of Navigation 1906 through U.S. Coast Guard 1970); *A Guide to Sunken Ships in American Waters* (Lonsdale and Kaplan 1964); *Encyclopedia of American Shipwrecks* (Berman 1972), *Shipwrecks of the Civil War* (Shomette 1973), *Merchant Steam Vessels of the United States 1790 - 1868* (Lytle and Holdcamper 1975), *Shipwrecks of the Americas* (Marx 1983), *Official Records of the Union and Confederate Navies in the War of the Rebellion* (National Historical Society 1987), and *The Story of Cape Fear and Bald Head Island* (Duffus 2017). Newspapers and journals digitally archived by Britishnewspaperarchive.co.uk, Chronicling America (Library of Congress), Genealogybank.com, Fold 3, Navyrecords.org.uk, Newspapers.com, and Newspaperarchive.com were examined for site-specific terms.

In addition, the National Register of Historic Places database (maintained by the National Park Service) and the Office of Coast Survey's Automated Wreck and Obstruction Information System (AWOIS) was queried. According to the second website, “AWOIS records are not comprehensive. There are wrecks in AWOIS that do not appear on the nautical chart and wrecks on the nautical chart that do not appear in AWOIS. In 2016 the Office of Coast Survey stopped updating the AWOIS database. Reported wrecks that have been salvaged or disproved by further investigation are not included in AWOIS”. Relevant shipwrecks based on primary and secondary sources are listed in Appendix A.

Personnel at the North Carolina Underwater Archaeology Branch (UAB), the North Carolina Maritime Museum (Southport), and the Brunswick County Library (Southport) were contacted [January 2022 and August 2022] for shipwreck data associated with Bald Head Island (BHI) and the lower Cape Fear River. TAR personnel interviewed archaeologists, area residents, and professional historians knowledgeable in maritime and shipwreck research to solicit their assistance to generate relevant data.

Remote-Sensing Survey

In order to reliably identify submerged cultural resources, TAR archaeologists conducted a systematic remote-sensing survey of the proposed dredge site. All survey activities were conducted from a 24-foot Parker vessel (Figure 2). In order to fulfill the requirements for survey activities in North Carolina, magnetic and acoustic remote-sensing equipment were employed. This combination of remote sensing represents the state of the art in submerged cultural resource location technology and it offers the most reliable and cost-effective method to locate and identify potentially significant magnetic anomalies and/or acoustic targets. Data collection was controlled using a differential global positioning system (DGPS). DGPS produces the highly accurate coordinates necessary to support a sophisticated navigation program and assures reliable target location.

Figure 2. Project survey vessel.

An EG&G GEOMETRICS G-881 marine cesium magnetometer, capable of plus or minus 0.001 gamma resolution, was employed to collect magnetic data in the survey area (Figure 3). To produce the most comprehensive magnetic record, data was collected at 10 samples per second. Due to shoal water within the project area, the magnetometer sensor was towed at the water surface at a speed of approximately three to four knots. Magnetic data were recorded as a data file associated with the computer navigation system. Data from the survey were contour plotted using QUICKSURF software to facilitate anomaly location and definition of target signature characteristics. All magnetic data were correlated with the acoustic remote sensing records.

Figure 3. Launching the Geometrics 881 Cesium Vapor magnetometer.

A KLEIN 3900 450/900 kHz digital sidescan sonar (interfaced with CHESAPEAKE TECHNOLOGY SONARWIZ.MAP data acquisition software was employed to collect acoustic data in the survey area (Figure 4). Due to shoal water within the project area, the sidescan sonar transducer was deployed and maintained between 3 and 5 feet below the water surface. Acoustic data were collected using a range scale of 30 meters to provide a combination of 200% coverage and high-target signature definition. Acoustic data were recorded as a digital file with SonarWiz.MAP and tied to the magnetic and positioning data by the computer navigation system.

Figure 4. Launching the Klein 3900 sidescan sonar.

A TRIMBLE AgGPS was used to control navigation and data collection in the survey area. That system can be used to generate highly accurate coordinates for the computer navigation system. The DGPS was employed in conjunction with an onboard Compaq 2.4 GHz laptop loaded with a HYPACK navigation and data collection software program (Figure 5).

Figure 5. Bridge electronics for navigation and data collection.

All magnetic and acoustic records were tied to positioning events generated by HYPACK. Positioning data generated by the navigation system were tied to magnetometer records by regular annotations to facilitate target location and anomaly analysis. All data is related to the NCSP Coordinate System, NAD 83.

Historical Background

European settlement of the present day Cape Fear region began as early as 1526 when Lucas Vásquez de Ayllón led an expedition from Florida into the Cape Fear region. One of the Spanish vessels was recorded lost near the mouth of the Cape Fear River, referred to by the Spanish as the Jordon River. During the brief existence of the Spanish settlement, the area was known as the "Land of Ayllón" (Lee 1965:3-4). A chart drawn during the very late sixteenth century or early seventeenth century shows the location of the Cape Fear by the proximity to the Island of Bermuda (Figure 6).

The next attempt to settle the Cape Fear region came almost a century and a half later with the arrival of the English (Figure 7). Settlers from New England came to the area eager to establish a Puritan colony in the less harsh climate of the southern Colonies. Under the leadership of Captain William Hilton, a group arrived in the summer of 1662 to find a suitable location. Arriving at the river and "Cape Fear" as he called it, the group remained for three weeks during which time they purchased the surrounding area from the indigenous population. The Puritan settlers that followed during the winter of 1662 remained in the Cape Fear vicinity for only a brief time before abandoning the area (Lee 1965:4-5).

Figure 6. Detail of *Americae sive novi orbis, nova description* (courtesy of the New York Public Library [NYPL]).

Figure 7. Detail of 1639 *America Septentrionalis* identifying the "C. of Feare" (courtesy of the NYPL).

In early 1663, King Charles II granted territory south of Virginia to eight noblemen in tribute for restoring the Stuart dynasty to the monarchy. That conveyance included the area from Georgia to the Albemarle Sound region of North Carolina. The territory was divided into three counties: Albermarle [Albemarle Sound area], Clarendon [Cape Fear region] and Craven [South Carolina]. Shortly after, the Lords Proprietors received a proposal from a group of Barbadians for a settlement within the Cape Fear region. In late spring 1664, a group of 200 settlers, under the command of John Vassall, established a colony at the confluence of the Charles [modern Cape Fear] River and Town Creek (Potter 1993:5-6). The capital, Charlestown, was the first English town in Carolina (Lee 1965:5). The colony was reported to have reached a population of 800 and extended some 60 miles along the river at its zenith.

In October 1665, a second expedition by the Barbadians was launched with the intent of establishing a colony in the vicinity of Port Royal. A small fleet consisting of a frigate, sloop and a flyboat, under command of Sir John Yeamans, stopped at the Charlestown settlement after an arduous journey from Barbados. While entering the river, the flyboat, carrying the new colony's armament, ran aground on the shoals on the west side of the channel [modern JBS] and was lost (Potter 1993:9, 29). The loss of this important cargo abruptly ended the Port Royal venture. Within another two years Charlestown would also be abandoned. Difficulty in obtaining supplies, differences between the proprietors and settlers over land policies and hostilities with the Natives resulted in the colony being deserted by late 1667 (Potter 1993:10-11).

In 1726, permanent settlements on the lower Cape Fear were established by South Carolina and upper North Carolina colonists (Lee 1977:7). On the west bank of the river, about 12 miles above its mouth and several miles below a shoal in the river called "the Flats," Maurice Moore established the town of Brunswick. A shoal located at the mouth of Town Creek impeded larger ships from venturing further upstream. Situated below "the Flats" Brunswick was accessible to vessels of large or small size (Lee 1977:12). In April 1733, another community was established 15 miles upstream from Brunswick. The new settlement became known as New Town or Newton to distinguish it from the "old town" of Brunswick. In 1740, the town was incorporated and the name was changed to Wilmington (Lee 1977:12).

As hostilities with France and Spain grew during the 1740s Governor Gabriel Johnston authorized the construction of a fort along the lower Cape Fear to protect the burgeoning towns of Brunswick and Wilmington. Construction began in July 1745 on a small bluff overlooking the mouth of the river. Johnston's Fort, as it was called, was still uncompleted in 1748 when two Spanish vessels entered the river and raided Brunswick (Carson 1992:20). Efforts to finish construction intensified after the raid and in less than a year the fort was completed. The resulting structure was small and poorly constructed. It was manned by only three men and armed with four rusty cannons (Carson 1992:20; Figure 8). In 1751, the fort was assigned to double as a quarantine station.

Development based upon a maritime economy played a major role in the growth of both Wilmington and Brunswick during the eighteenth century. Vessels of varying size entered the Cape Fear from other coastal ports, the West Indies and Europe. Larger vessels, unable to cross over "the Flats," called at Brunswick, while vessels of smaller size could travel further

up the river to Wilmington. Consequently, Brunswick was established as the center for overseas shipping and Wilmington as the center for local and West Indian trade (Lee 1977:16-17). Rice, cattle, swine, lumber and naval stores made up the majority of the exports from the port district of Brunswick. Prior to the Revolution numerous ships left the Cape Fear River for other ports. The West Indies served as the main destination of these ships with English ports following a close second. A lesser number carried cargo to coastal ports, mostly in the northern colonies, but occasionally some ventured south, down the coast to Charleston (Lee 1977:33).

The Cape Fear region played a minor role in the events of the American Revolution. In June 1775, Royal Governor Martin fled from New Bern to Fort Johnston, then under the protection of the British man-of-war *Cruizer*. Growing patriot activity in the area forced the governor to relocate to the warship a month later. All portable materials were transferred to the ship and the fort's guns were spiked and pushed into the river (Carson 1992:22; Figure 9). Local forces later burned the fort and its outbuildings.

Knowing that a large number of Loyalists inhabited the interior of the colony Governor Martin initiated a plan to subjugate the region using a combination of British and Loyalist forces (Sprunt 2005:113). British reinforcements arrived off the North Carolina coast by the end of March, but by then the opportunity to subdue the colony had passed. On 27 February 1776, Colonel James Moore and the First North Carolina Continentals with a group of militias defeated a contingent of Scottish Loyalists at the battle of Moore's Creek Bridge. This battle, called the "Lexington and Concord of the south," kept the British from occupying the South at the beginning of the war (Powell 1989:180-182).

Naval operations were of limited importance in the Cape Fear region. In mid-1776, British warships began taking up regular station over the mouth of the river. In May of the following year two British men-of-war entered the river and destroyed a number of colonial vessels at anchor (Watson 1992:29; Figure 10). To counter the threat posed by British warships the General Assembly voted to purchase and arm three brigs for the defense of the Cape Fear River. However, these vessels proved inadequate for the task and suggestions were made for either selling them or sending them on trading or privateering expeditions (Watson 1992:29).

The lower Cape Fear remained quiet until 1781 when Major James H. Craig was dispatched by Lord Cornwallis in Charleston to take Wilmington. Craig, with a force of 18 vessels and 400 troops, quickly captured the defenseless town (Sprunt 2005:114). From Wilmington, Craig dispatched parties throughout the countryside to rally local Loyalists and to obtain supplies for Cornwallis's troops, then marching through North Carolina. After being checked by Colonial forces in the battle of Guilford Courthouse the British retreated to Wilmington to recoup and replenish supplies. Later, when Lord Cornwallis moved north to suppress Virginia, Craig remained behind in Wilmington to disrupt Colonial activity in that region. News of Cornwallis's surrender at Yorktown made the British position in Wilmington untenable and on 17 November Major Craig evacuated the city.

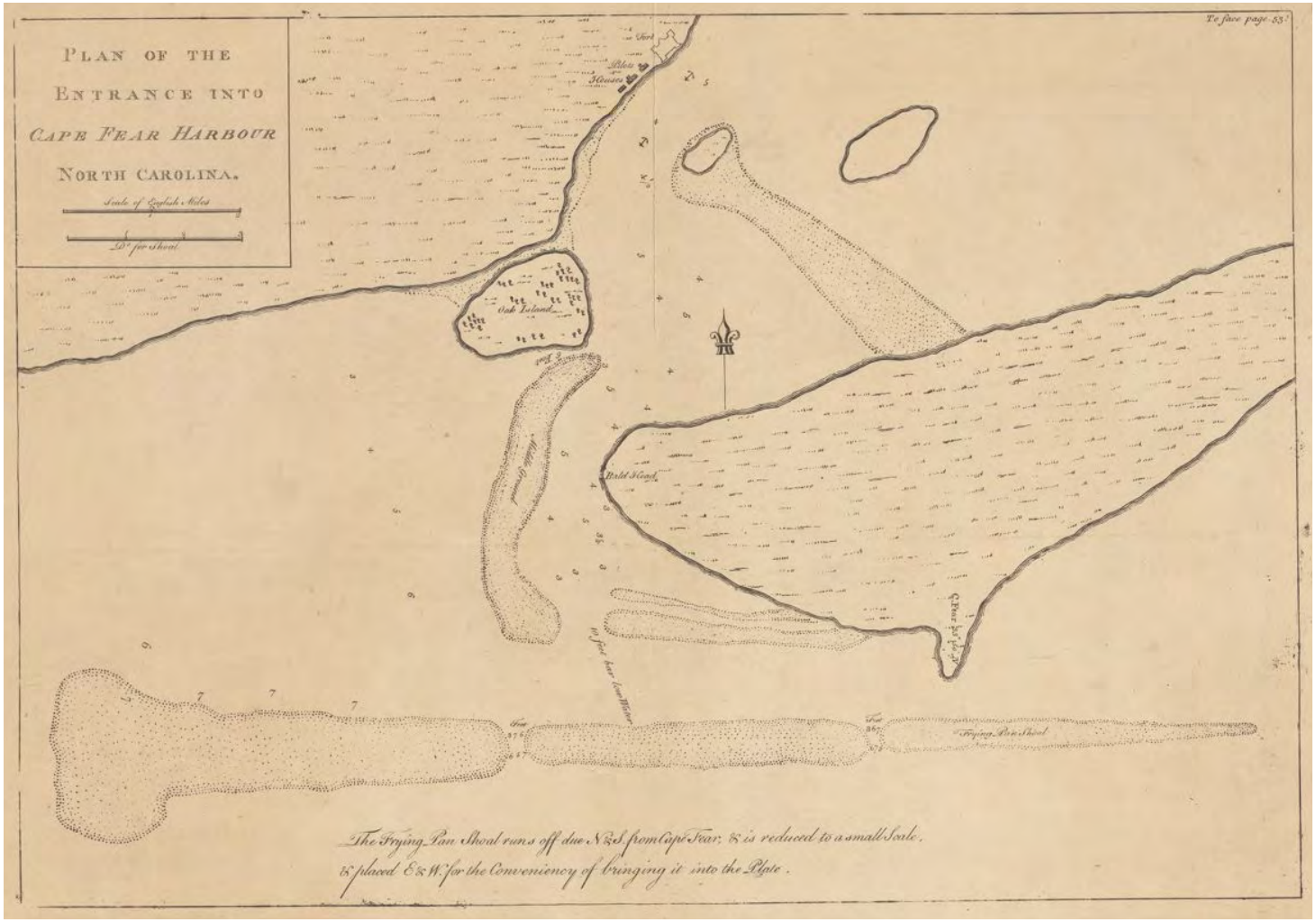


Figure 8. Ca. 1775 British chart identifying the Middle Ground and Frying Pan Shoal (courtesy of the NYPL).

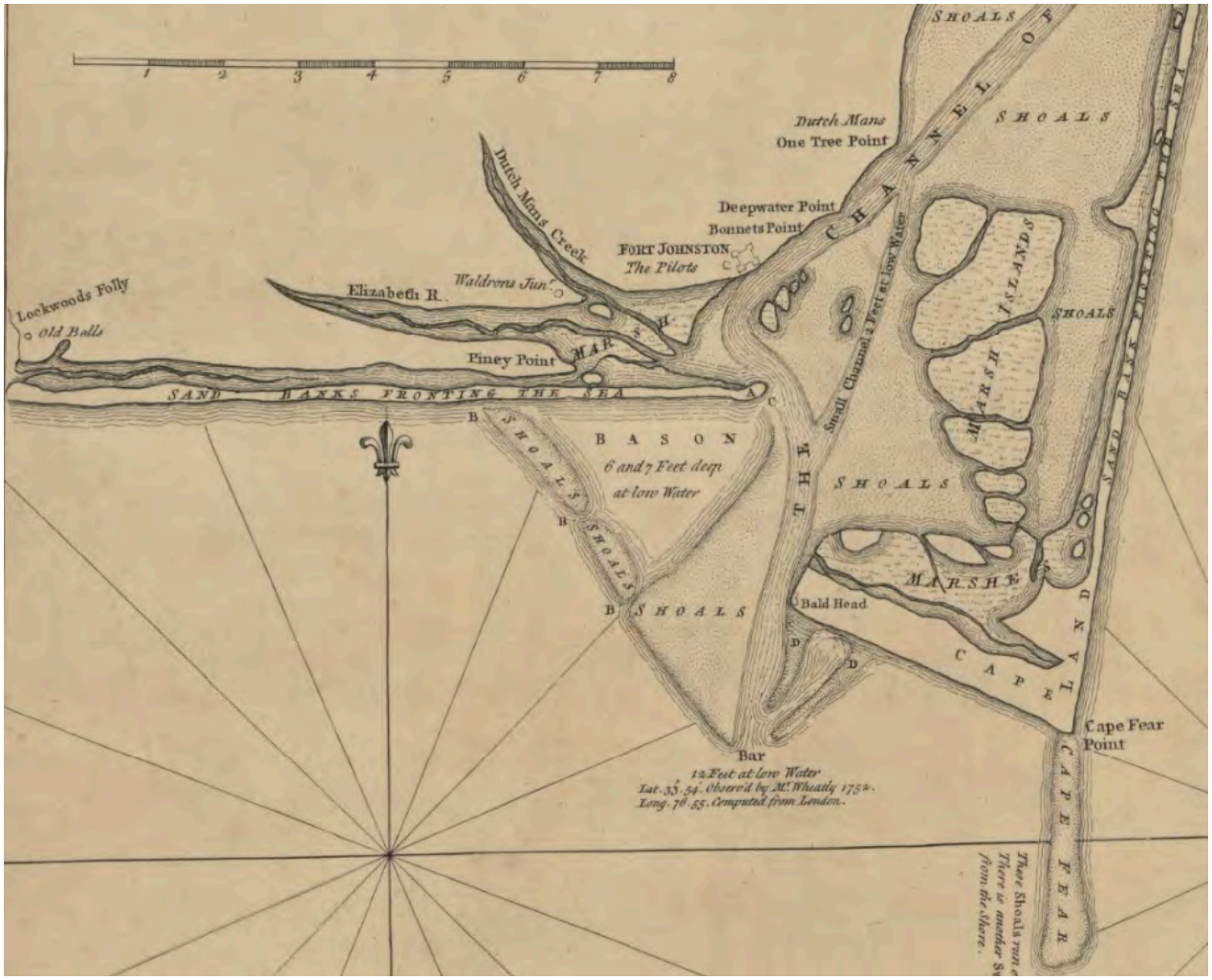


Figure 9. Detail of 1753 *A new and exact plan of Cape Fear River, from the bar to Brunswick*... (courtesy of the LOC).

Figure 10. Detail of 1780 *Plan de la rivière du Cap Fear depuis la barre jusques à Brunswick* (courtesy of the LOC).

After the conclusion of the war there was a shift in the maritime development of the Cape Fear region. Almost all the ships that left the Cape Fear now went to Charleston and few to England or the West Indies (Lee 1977:33). Inbound ships now proceeded up to Wilmington. This shift brought about the decline of the town of Brunswick as was indicated by the change in name of the "Port of Brunswick" to the "Port of Wilmington" (Lee 1977:34).

During the last decades of the eighteenth century the area that would become the town of Southport consisted of little more than the remains of Fort Johnston and the homes of local river pilots. The region's potential, however, was realized by three men from Wilmington, Joshua Potts, John Brown and John Husk, who the viewed the area, with its salubrious sea breezes, as an ideal spot for a new town. Though the men's initial petition was rejected in 1790 the group persevered and on 15 November 1792, the General Assembly issued a charter for the establishment of a town on the bluff overlooking the mouth of the river.

The town was named Smithville, after Benjamin Smith who introduced the bill into the legislature. The town was laid out with lots offered for sale in Wilmington and Fayetteville newspapers. The charter specified that no person could purchase more than six lots in their name and the purchase price of lots was to be 40 shillings per lot (Carson 1992:26). The town plan also reserved space for Fort Johnston which was rebuilt in 1804.

With the growing amount of vessel traffic sailing up to Wilmington there arose a need for improvements in the navigability of the river. As early as 1784, measures were taken to improve the conditions of the lower Cape Fear River (Lee 1977:36). Improvements were needed at the treacherous entrances to the river, at the Bar and upstream at New Inlet. Three major shoals between Wilmington and the sea also caused problems for ships trying to navigate the river. The "upper shoal," located near the foot of Clarks Island, off the southern tip of Eagles Island, had eight and one-half feet of water. The "middle shoal," also known as "the Flats," had nine feet. The "lower shoal," at the foot of Campbell Island, had nine and one-half feet. The main channel of the river was then located in a narrow passage between Campbell Island, Clarks Island and the west bank (Lee 1978:112).

In addition to the shoals, ships deliberately sunk during the American Revolution as obstructions needed to be removed (Lee 1977:36-37). Around 1819, Hamilton Fulton, a noted English engineer, was hired to make improvements on the Cape Fear River mainly between Wilmington and the ocean where a system of jetties was planned. Work continued for six years until financial limitations halted this project. Some improvements were made on the river up until the start of the Civil War with sporadic financing by the state and local Wilmington businessmen (Lee 1977:37).

Steam vessels first appeared on the Cape Fear River in 1817. The first steamboat to arrive was the side-wheel *Prometheus*, built in Beaufort for a firm in Wilmington that intended to run the vessel from Wilmington to Fayetteville and Southport. The following year the Clarendon Steamboat Company was established at Wilmington. The company held the exclusive right to operate steamboats on the Cape Fear for a period of seven years provided that it kept one boat in service. In addition to the *Prometheus*, the side-wheel *Henrietta*, also made regular runs between Wilmington and Fayetteville (Lee 1977:37-38). By 1822, a second steamship venture,

the Cape Fear Steamboat Company, had begun service on the river. With time the number of steamboats on the river increased significantly (Lee 1977:38: Figure 11). By the 1850s, nearly a hundred vessels of all types were in Wilmington at the same time. Many of the ships were large square-rigged foreign craft, while others were side-wheel steamers. Most, however, were American schooners engaged in the coastal trade (Lee 1978:116).

Development of the Cape Fear region was soon disrupted by the Civil War. After Confederate forces in South Carolina attacked the U.S. garrison at Fort Sumter, President Abraham Lincoln declared a state of open rebellion and called for volunteers to preserve the Union. Lincoln also issued a proclamation on 19 April 1861 establishing a blockade of Confederate ports in South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana and Texas. Eight days later, Lincoln extended the blockade to include ports in Virginia and North Carolina. With North Carolina's withdrawal from the Union, Governor John W. Ellis ordered the occupations of forts Johnston and Caswell.

Union naval forces were inadequate to properly enforce the blockade at the onset of the war. In 1861, U.S. navy registers listed 90 vessels, 50 of which were propelled by sail and were considered obsolete for the task at hand. The remaining 40 were steam, but several of the deep draft vessels proved unsuitable for the shallow southern waters. Eight others were laid up while 22 vessels remained at station off foreign shores and would require at least six months travel to reach the United States (Browning 1980:24). However, within a few months of Lincoln's proclamation, the new Secretary of the Navy, Gideon Welles, took steps to implement an effective blockade off the southern coastline.

The navy department bought or leased nearly any vessel that could be of service. In nine months, U.S. navy agents purchased 136 ships, constructed 52 and commissioned and repaired another 76 (Engle and Lott 1975:180). The Union blockade in turn gave rise to the practice of blockade running. At the beginning of the blockade, practically any vessel was considered suitable for breaking through the Atlantic squadrons to carry cargo in or out of the isolated southern ports. The most successful of the early runners were steamers that had belonged to the Southern Coasting Lines and were idle due to the outbreak of the war. The illicit trade carried on by these ships reaped considerable profit, but failed to compare with the great capital resources brought in during the latter part of the war.

Wilmington provided North Carolina with a deepwater port. By 1860, Wilmington had emerged as a modern shipping center with excellent internal communication. Three railroads ran through the city and daily steamboat service to Charleston and New York, as well as, up the Cape Fear River to Fayetteville. With the capture of New Bern, Roanoke Island and Beaufort, Wilmington was the only North Carolina port left open for the importation and exportation of goods. As long as supplies were imported through the two inlets of the Cape Fear River and transported along the railroad lines, which connected with Lee's army in Virginia, the Confederacy had a lifeline. Wilmington soon became the most vital seaport in the "Southern Cause" (Pleasants 1979:15; Figure 12; Figure 13).

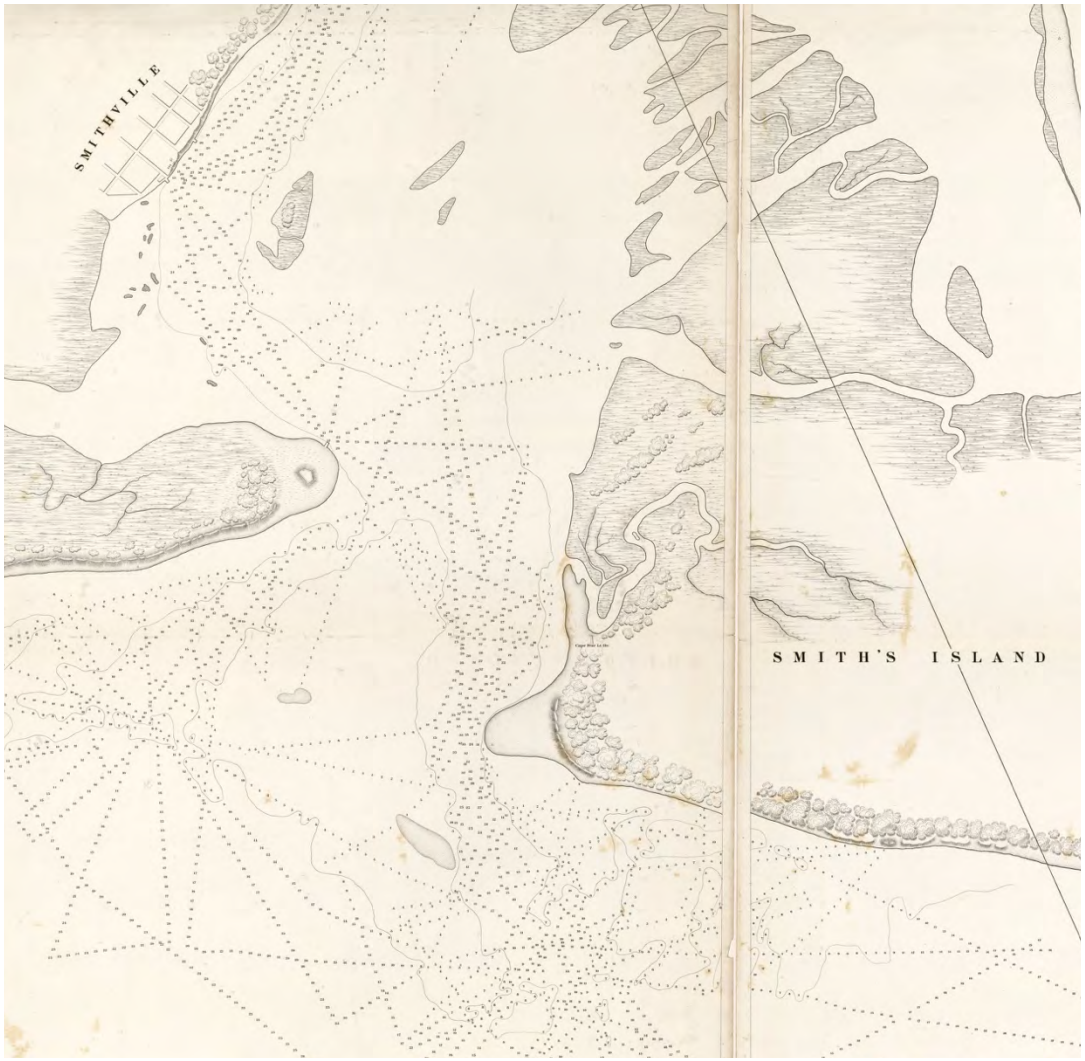


Figure 11. Detail of 1829 chart entitled *The Entrance of Cape Fear River* (courtesy of the LOC).

Figure 12. Detail of 1861 Colton map illustrating Brunswick County and contemporary watercraft (courtesy of the NYPL).

Figure 13. Detail of Confederate chart produced ca. 1862 (courtesy of the LOC).

Wilmington became the key port for "runners" largely because of the area's topography. Located 28 miles from the mouth of the Cape Fear River, the port had access to the Atlantic through two separate entrances; eastward through New Inlet and southward through the river mouth (Figure 14). Although the two entrances were only six miles apart, Smith's Island, a strip of sand and shoal, lay in between. Continuing along Cape Fear were the dangerous Frying Pan Shoals, which extended 10 miles further into the Atlantic, making the distance by water between the two entrances a little less than 40 miles (Soley 1883:91).

This geographical configuration proved highly advantageous for blockade runners and the initial blockade of Wilmington proved ineffective. When the *Daylight*, the first and at the time the only Union vessel sent to blockade these waters, arrived, it immediately experienced the difficulties associated with guarding the dual entrances of the Cape Fear River. While pursuing a steamer out of the western bar entrance, the *Daylight* inadvertently allowed several other small vessels to pass out of the New Inlet entrance. Within three months of the *Daylight's* arrival, 42 vessels either entered or cleared Wilmington (Browning 1980:27).

Figure 14. July 1864 image of the deck of the blockade runner *Lilian* running into Wilmington (courtesy of the NYPL).

During a two-year period (January 1863-November 1864), Confederate naval sources listed numerous vessel stations on the Cape Fear. These vessels were identified as: the ironclad sloop *North Carolina*, the floating battery *Artic*, the steam gunboat *Yadkin*, the steam gunboat *Equator*, the torpedo boat *Squib*, and the ironclad sloop *Raleigh*, and two, long one-gun cutters. In November 1864, Confederate Secretary of the Navy Stephen Mallory also reported to President Jefferson Davis that two new torpedo boats were under construction at Wilmington (U.S. Navy [USN], 1921, ser. II, 2:passim).

The capture of Wilmington proved difficult because both entrances to the Cape Fear were guarded by powerful fortifications and lesser works. Collectively those fortifications became known as the Lower Cape Fear Defense System. The central point of that system was Fort Fisher, located on Confederate Point. That fortification was originally a small earthwork constructed to protect New Inlet. By 1864, Fort Fisher had become the largest seacoast fortification in the Confederacy.

Shaped like an inverted "L," Fort Fisher's land face ran 628 yards and was guarded by 20 of the heaviest seacoast guns. The sea face included a 130-pound Armstrong rifle and a 170-pound Blakely, both from England (Browning 1980:35). Extending from the land face was a string of torpedoes, which could be exploded from inside of the fort (Pleasants 1979:22). Mound Battery, towering to a height of 60 feet with two mounted heavy guns, stood near the end of Confederate Point. Augusta Battery, which stood behind Mound Battery, was located near the river (Pleasants 1979:24).

Fort Holmes, on the other side of New Inlet on Smith's Island, shared the protection of Smith's Inlet in the Cape Fear River with the batteries at Oak Island. Oak Island, located opposite Fort Holmes, held another series of forts and batteries, such as Fort Campbell, Fort Caswell and Battery Shaw (Pleasants 1979:24). Fort Caswell guarded the western bar entrance. Captured by Confederate militia on 14 April 1861, Caswell was renovated into a strong casemated work with new armament consisting of seven 10-inch, four 8-inch Columbiads and one 9-inch Dahlgren gun (Browning 1980:35; Pleasants 1979:24).

Both Fort Caswell and Fort Holmes were responsible for shelling union vessels in the Middle Ground area, including the stranded tug *Violet* which went aground off the Western Bar Channel on the night of 7 August 1864. After his tug struck the shoal Ensign Thomas Stothard requested assistance from the crew of the nearby 866-ton brig USS *Vicksburg* to attempt to re-float the *Violet.* Despite their quick response, the extra manpower and effort proved fruitless as Stothard was ordered to fire the *Violet* after midnight. In response to a court of enquiry [sic] investigation, Captain Stothard submitted an incident report to Captain B.F. Sands of the USS *Fort Jackson* and offered this account:

> After all preparations for sending officers, crew, and ship's effects off in boats that he [Lieutenant-Commander Braine of the USS *Vicksburg*] and Acting Volunteer Lieutenant Williams, of the *Emma*, had sent, all of which I did, sending property, a list of which you will find enclosed, also a list of crew, I made preparations for her destruction as follows: I put a lighted slow match to a powder tank in the magazine and closed the door, then filled a large, fine drawer with shavings and straw taken from pillows and mattresses, partially covered it with another, and sprinkled two quarts of spirits of turpentine over all and on the woodwork around it; hung up an oilcloth from the table, one corner hanging in the shavings, which I touched with a lighted match (in the wardroom), after all the boats, but mine in waiting, had left the side, and I followed about 2:00 o'clock a.m. this morning. The explosion of the magazine containing about 200 pounds of powder occurred within half an hour afterwards, and by daylight she was

> effectually consumed. One 12-pounder was thrown overboard, one left on the forecastle, spiked with rat-tail file, and the 24-pounder was directly over the magazine aft when it exploded, so that it was thrown into the sea (National Historical Society [NHS] 1987, ser. I, 10:343,344).

Rear-Admiral S.P. Lee recommended that no action be taken to discipline the acting officer of the *Violet*. Lee remarked to Union Secretary of the Navy Gideon Welles, that: "Stothard is a very intelligent and efficient officer, notwithstanding this casualty" (NHS 1987, Ser. I, 10:344). Prior to its destruction, the *Violet* (ex-*Martha*) was described as a fourth-rate, wooden screw steamer measuring 85 feet in length, with a beam of 19 feet. The 166-ton tug housed one, inverted, direct-acting engine with a 30-inch diameter cylinder and one return flue boiler (U.S. Navy 1921, Ser. II, 1:233).

Farther up river from the *Violet* wreck site there were a series of forts and batteries used as secondary defenses for Wilmington and as protection for blockade runners outbound from Smith's Inlet. Fort Lamb was located on the west side of the Cape Fear River on Reeve's Point. Above Fort Lamb was Fort Anderson, the most important of the secondary defenses. Partially built from the ruins of Old Brunswick Town, Anderson consisted of a series of trenches and earthworks approximately a mile long. Three smoothbore 24-pounders, three rifled 32-pounders and six smoothbore 32-pounders comprised the Fort's armaments. By 1864, Fort Anderson had become an inspection station for all craft heading up the Cape Fear River to Wilmington (Pleasants 1979:25). Several secondary forts, including Stokes, Lee, French, Campbell, Strong and Sugarloaf, were situated on the east side of the river (Pleasants 1979:25).

In addition to this impressive array of forts, a naval construction program was initiated in Wilmington to contribute to the defenses of the harbor. The success of the ironclad ram CSS *Virginia* in the March 1862 battles at Hampton Roads demonstrated the superiority of armored warships to naval officers of both the North and South. In late March 1862, Confederate Secretary of the Navy Stephen R. Mallory, sent "instructions relative to gunboats" to Commander William T. Muse, the ranking naval officer at Wilmington. Shortly thereafter, the navy began building two ironclads in the city, the *Raleigh* at James Cassidy's shipyard at the foot of Church Street, and the *North Carolina* at the Beery shipyard on Eagle Island (Still 1985:5-17, 79-92).

Both vessels utilized a design based on plans conceived by naval constructor John L. Porter. The plans called for a tightly framed hull, with a slight deadrise and a hard chine. The vessels were to be 174 feet long (150 feet between perpendiculars) with a draft of 13 feet. Amidships, a 105-foot long casemate, angled at thirty-five degrees and covered with 4 inches of iron plate, protected the gun deck. Two boilers provided steam for the vessel's two horizontal engines, which were geared to a single 10-foot screw. The first ironclad built on this design, the CSS *Richmond*, was completed in Richmond in 1862. Known as the *Richmond* class, this group, consisting of five vessels, was numerically the largest standardized class of ironclads constructed by the Confederacy (Holcombe 1993:63-64).

The two Cape Fear ironclads entered into active service by late 1863/early 1864 (*North Carolina* in December 1863 and the *Raleigh* in April 1864) after numerous delays resulting from material shortages, strikes and epidemics. However, the usefulness of these two vessels to the Confederacy's war effort was limited. *Raleigh* grounded on a shoal near the mouth of New Inlet and was destroyed after a sortie against the blockading squadron on 7 May 1864, less than a month after entering service. The *North Carolina*, on the other hand, was reduced to serving as a floating battery; its deep draft and lack of motive power rendered the vessel ineffective as a ram.

The ironclad was further hampered by the use of unseasoned timber in its construction. Warping and splitting timbers caused the ship to leak incessantly and an infestation by teredo worms further weakened the hull. For most of its career, the ironclad remained at anchor near Smithville, positioned to support the nearby forts in the defense of Wilmington. The *North Carolina* finally sank at its moorings in September 1864. Though useless as an offensive weapon, the *North Carolina* served as a deterrent, preventing the U.S. Navy from entering and seizing the lower Cape Fear until the fall of Fort Fisher in the closing days of the war (Figure 15).

Figure 15. Julian Davidson's "Capture of Fort Fisher" (courtesy of the NYPL).

When hostilities ended in 1865 so did some of the regular river trade. The prewar steamer service between Wilmington, Charleston and Savannah was not resumed, since rail service had been established. Steamship service did, however, resume to the northern cities of Baltimore, Philadelphia and New York (Lee 1977:91). The coastal trade also revived and was conducted mainly by schooners ranging between 150 and 600 tons. Because of the decimation of American shipping during the conflict international commerce was carried in foreign bottoms, usually of British, German or Scandinavian origins (Sprunt 2005:501). Industry had been severely interrupted during the war, but was beginning to make a comeback.

Naval stores and lumber continued to be the principal exports with the addition of some cotton. Exports recorded for the year 1871 amounted to some 95,000 bales of cotton, 100,000 bushels of peanuts, 112,024 barrels of spirits of turpentine, 568,441 barrels of rosin, 37,867 barrels of tar and 17,963 barrels of turpentine (Sprunt 2005:513-514). Without the use of slave labor, the rice industry declined dramatically (Lee 1977:86-87).

By the turn of the century, a decrease in the availability of pine trees resulted in a decline of the naval stores industry. With improvements in cultivation and transportation, cotton became a major industry in Wilmington until its decline in the 1930s. Guano from the West Indies was brought in for the new fertilizer plants. The production of creosote impregnated wood also helped increase shipping in the region (Lee 1977:87-88). During the last quarter of the nineteenth century, efforts were undertaken to develop Smithville into a port city. In 1886, the North and Southern Railroad Company announced plans to extend rail service from Wilmington to Smithville.

Developers, envisioning a port that would rival Charleston and Norfolk, requested that the town's name be changed to Southport to draw attention to the "Port of the South" (Carson 1992:61). In anticipation of the expected development the town's dirt roads were paved in crushed shell and the dredge boat *Woodbury* began deepening and straightening the channel to accommodate increased vessel traffic. However, the proposed rail line did not materialize and Southport remained a small town relying on fishing and tourism for its economic livelihood. The Wilmington, Brunswick and Southport Railroad eventually extended a line to the town in 1911.

Improvements to navigation on the Cape Fear River had deteriorated during the American Civil War. Continual silting reduced the navigable channel. By 1870, federally financed projects were again started to improve the conditions of the river. One such project was the closure of one of the two inlets. New Inlet was closed in 1881 with the belief that the increased force of the concentrated flow would sweep out the channel. The closure was accomplished by placing a rock dam that extended for more than a mile from Federal Point to Zeke's Island. The dam was completed in 1881 and later became known as "the Rocks." Another rock barrier was later built between Zeke's Island and Smith's Island. The channel depth was dredged to accommodate the deeper draft vessels (Lee 1977:91).

Two life-saving stations were established near the mouth of the Cape Fear River during the 1880s. Those stations included the Cape Fear station (b. 1882) at east end of BHI and the Oak Island station (b. 1889) located west of Fort Caswell. Each station was equipped with line-throwing guns and self-righting surfboats (Sprunt 2005:527). Surf men maintained a constant vigil of the sea from the station house and conducted regular nightly beach patrols; additional patrols were conducted in daylight during stormy weather. Both stations remained active until the 1930s when newer Coast Guard facilities were constructed as replacements.

On 20 July 1895, the U.S. Marine Hospital Service appropriated $25,000 for the construction of a quarantine station at Southport. The new station was to be located on the river on the east side of the channel between the upper end of Battery Island and Price's Creek Lighthouse (Carson 1992:73). The entire station was to be built on a pier 600 feet long and to consist of a

hospital building, a disinfecting house, attendant's quarters and a kitchen. The station opened for service by the middle of 1897 with Dr. J. M. Eager appointed as the station's first quarantine officer. A report for the fiscal year 1907 illustrates the level of activity at the station:

> [Eighty six] vessels spoken and passed; 19 steamers and 1 sailing vessels inspected and passed; 2 steamers and 3 sailing vessels disinfected; and 485 crew on steamers, 125 crew on sailing vessels, and 3 passengers on sailing vessels inspected. The vessels disinfected were from Bahia, Portobello, Santos, Rios, and Barbados (Brown 1974).

By 1937 the station had become obsolete and was placed on caretaker status. As the facility was located on water and not a navigation hazard it was left to deteriorate and on 19 August 1951, the abandoned station was destroyed by fire (Brown 1974). The fishing industry provided the financial stamina for the economy on the lower Cape Fear during the early years of the twentieth century.

The principal source of income for Southport was the menhaden fisheries. Most catches were processed into oil which was used in the manufacture of paints, linoleum, tanning solutions, soaps and waterproof fabrics (Carson 1992:96). Leftover scrap was ground up for fertilizer and feed for livestock. The Southport Fish Scrap and Oil Company and the Brunswick Navigation Company established processing plants along the Elizabeth River while additional plants could be found above the town on the Cape Fear River.

World War I initiated a revitalization of the economy with the establishment of the Carolina Shipyard in May 1918. At about the same time, the Liberty Shipyard started producing steel ships as well as experimental concrete ships. The success of the shipyards was short-lived and the economy fluctuated for several years until it fell during the 1930s. Though Wilmington saw moderate success in shipping and shipbuilding after the war, most of the yards had closed by the mid-1920s and competition from Norfolk and Charleston slowly relegated the city to an import distribution center catering mainly to regional trade (Watson 1992:145).

This trade averaged 200,000 or more tons through most of the 1920s, but with the coming of the Great Depression, the amount fell to 94,007 tons by 1932 (Watson 1992:150). Wilmington's economy would not fully recover from the effects of the depression until the end of the decade. Despite this economic uncertainty, foundations were laid for future development. By the beginning of World War II, Wilmington boasted 54 wharves, piers and docks and the opening of the Atlantic Intracoastal Waterway expanded the city's trade with its hinterland and increased its role in the coastal trade (Watson 1992:148-9).

With war in Europe and German submarines prowling the east coast during the early 1940s protection and defense of the coast became a top priority in Washington. The vulnerability of the Cape Fear had been confirmed during World War I and U.S. Navy officials were anxious to be prepared for future enemy intrusions (Gannon 1990:242-243). On 17 November 1941, the U.S. Navy reacquired the 248.8-acre Fort Caswell reservation, sold into private hands in 1929. The old fort grounds were to be used for training, communications and submarine tracking (Carson 1992:126).

The U-boat threat finally reached the Cape Fear region in early 1942. On 16 March, the 11,641-ton tanker *John D. Gill* was torpedoed in the coastal waters off the mouth of the river. As a result of the high number of vessel losses during the early stages of the war, defensive measures were put into place. Coastal communities were systematically blacked out, a more efficient convoy system was devised and additional planes and patrol vessels were put into service along the North Carolina coast (Stick 1952:237-239).

In addition to the menace that Axis submarines and aircraft represented during the conflict, a significant hurricane struck the project area in late summer 1944. On 1 August, the tropical storm made landfall near Southport and the Oak Island coast guard station reported maximum wind speeds of 80 miles per hour. To the north, "substantial damage" occurred in Wilmington and Wrightsville Beach and the combined losses of real estate and crops amounted to two million dollars (Galecki 2005:133-134).

World War II also brought renewed growth to the shipyards and relief to the area (Lee 1977:88-90). The increased jobs and higher wages allowed Wilmington's economy to increase and become stable. After the war many of the people brought in to build ships chose to stay and make Wilmington their home. In 1945, the State Port Authority was formed, promoting ports in Wilmington and Morehead City and creating new jobs. In 1955, the military established the Sunny Point Army Terminal [Military Ocean Terminal at Sunny Point]. The facility serves as a terminal for shipping military hardware and ammunition to American forces around the globe. The base is a major employer in the area and local service and retail industries serving the military contribute to the economic prosperity of the region.

By 1960, the population of Southport was reported as 2,034 residents. At that time, the town boasted a popular bookmobile, a new water tank, a "lighted" athletic field and a picnic area at the community park. Maritime news included the launch of a "big, new charter boat," the *Riptide*. Herman Sellers constructed the vessel for Glenn Trunnell of Southport. Other local commercial fishermen commenced discussions on the merits to install an artificial reef near the town. In September 1960, Hurricane *Donna* struck the region and fortunately caused only minimal damage in Brunswick County (Reaves 1999:169,172).

In early February 1970, the Atomic Energy Commission approved construction of a 385 million dollar nuclear power plant to be situated north of Southport. The downtown also experienced a significant economic boost when First-Citizens corporation elected to build a bank in Southport, its first branch in Brunswick County. At the same time, waterfront interests offered services to the public such as the modern 150-seat restaurant Herman's and the new 450-foot long "fishing and pleasure pier" (Reaves 1999:243).

Today, the region presents a strong economy with a state port facility that is daily frequented by international cargo vessels. The economy is further augmented by the military and commercial fisheries which provide an important source of income to area residents. In addition, Southport and the coastal communities on Oak Island and the resort on BHI are popular tourist destinations. The area's offshore waters are a sportsman's paradise catering to recreational boaters and sport fishermen alike.

Improvement History of the Entrance Channel to the Cape Fear River

In 1870, the U.S. Army Corps of Engineers (USACE) initiated a project to improve navigation on the Cape Fear River. An examination of the river conducted by a commission appointed by the War Department suggested that priorities at that time should be given to closing off the channel between Smith's and Zeke's Islands (USACE 1870:70). In 1874, the closing off of New Inlet had increased the flow of water in the main navigation channel and scouring effects were noted to be deepening the channel over Bald Head Bar (USACE 1874:88-89). The officer in charge of operations also stated that a suction dredge was employed at Bald Head Bar to assist in the scouring process.

Furthermore, the officer's report also noted that there were two channels into the river: a western channel with two bars (an outer with 14 feet at low water and an inner or "rip" with 10 feet at low water) and the Bald Head channel (USACE 1874:69). It was suggested that since the Bald Head channel was the natural channel all efforts should be directed towards maintaining a 12-foot level of water over it and that the western channel be disregarded.

During 1889, the project was modified to provide for a 20-foot depth, at low water, from Wilmington to the Ocean. Surveys conducted during the fiscal year ending 30 June 1890 reported that the depth of water over bar had reached 16 feet (USACE 1890:131). The wreck of a Civil War gunboat was uncovered during dredging activities on the bar in 1891. The boiler from the wreck reduced water depths in the channel to 13.5 feet providing a serious impediment to navigation (*The Messenger* [*TM*] 16 May 1891).

Examinations of the wreck indicated that it was a wooden-hull vessel approximately 110 tons and 100 to 110 feet long (USACE 1893 Appendix L:1451). Portions of the flue and boiler were removed by the government in 1890. On 20 May 1893, Messrs. Johnston and Townsend were awarded a contract to remove the rest of the wreck structure (USACE 1893 Appendix L:1451). The wreck site was dynamited and remaining sections of boiler recovered for disposal. Inspection of the wreck area by First Lieut. E. W. V. Lucas, E. D. Thompson and Robert Merritt revealed no trace of the hull and soundings in the vicinity indicated a depth of water of 22 feet (*TM* 7 July 1893; USACE 1893 Appendix L:1451).

The River and Harbor Act of 2 March 1907 provided for additional dredging for completing the channel to the mandated 20-foot depth level. In addition, the act also authorized for improvements in excess of 20 feet as appropriations permitted (USACE 1912:459). The project was modified again in the River and Harbor Act of 25 July 1912. Those modifications called for a channel of 26 feet deep at low water with widths of 300 feet in the river, increasing to 400 feet across the bar and in curves in the river (USACE 1912:459-460). The controlling depths of the channel were increased to 30 feet in the River and Harbor Act of 2 March 1919. In 1922, the USACE discontinued the then current entrance channel and authorized for a new one over the bar with the same dimensions as the previous one (USACE 1922:682-683). The new channel was to run in a southwesterly direction from Bald Head Point. These improvements were noted as being completed in 1932.

In the River and Harbor Act of 2 March 1945, the controlling dimensions for the navigation channels on the Cape Fear River were increased further. Water depths from the outer end of the bar to Wilmington were increased to 32 feet and all channels were now to maintain a width of 400 feet throughout (USACE 1945:632-631). The project was estimated to be 65 per cent complete by the end of the fiscal year. In 1950, the controlling depths over the ocean bar were increased to 35 feet (USACE 1950:653-654).

Additional modifications to the navigation channels were authorized in the River and Harbor Act of 23 October 1962. Among the provisions of that Act was the deepening and widening of the entrance channel to 40 feet deep and 500 feet wide (USACE 1962:360-361). The channel was to maintain those dimensions as far as Southport were they were reduced to 38 feet deep and 400 feet wide up to Wilmington. The project was reported as being completed in 1973 (USACE 1979:6-9).

Survey Data Analysis

The remote-sensing survey of the JBS borrow site extension included a 200-foot perimeter buffer on all sides except the southwest. That side corresponded to the buffer included on the previously surveyed area (Figure 16). The borrow site and buffer areas were investigated on northwest to southeast survey lines laid out on 50-foot centers (Figure 17).

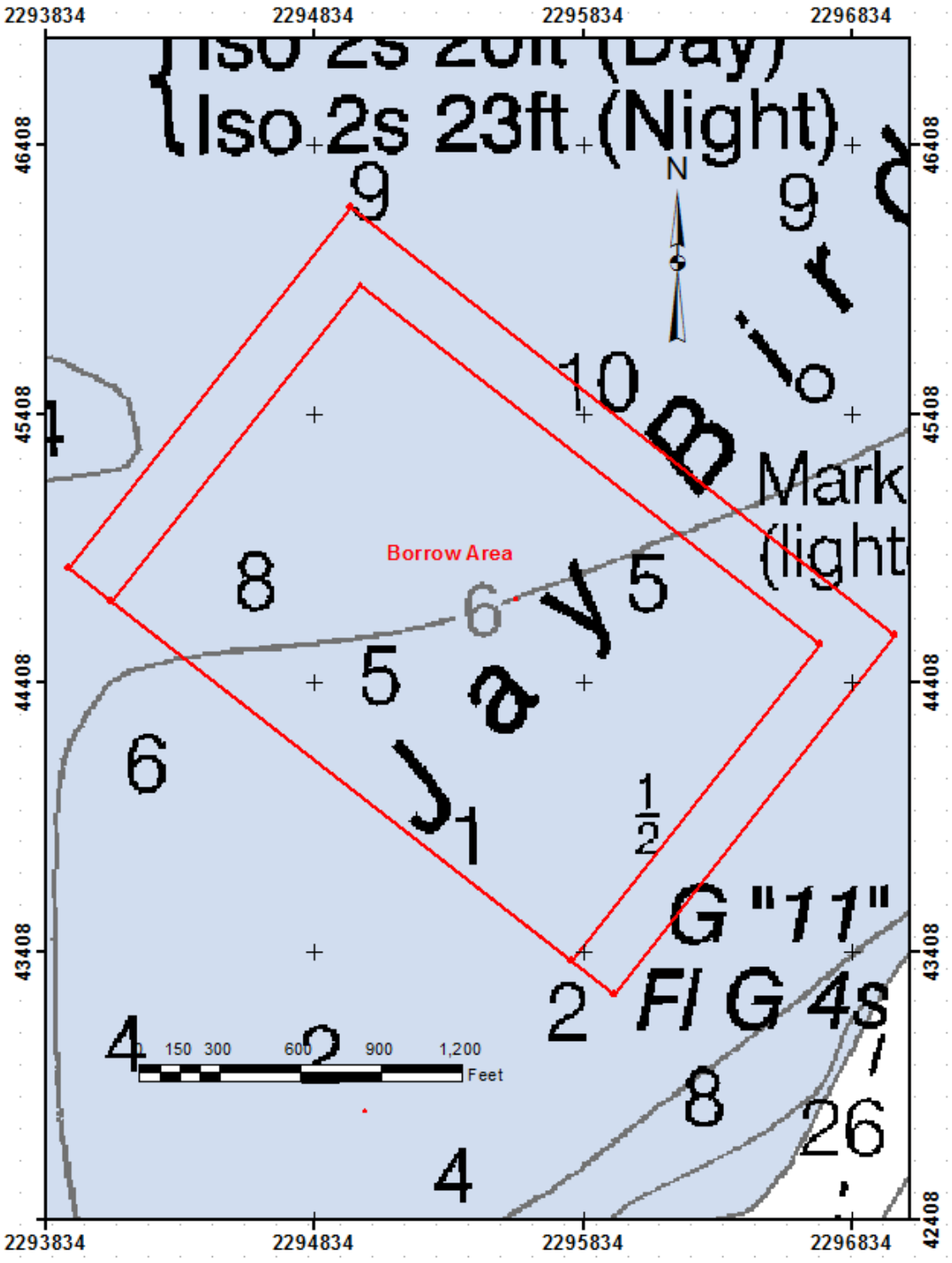


Figure 16. The JBS borrow area and 200-foot buffer.

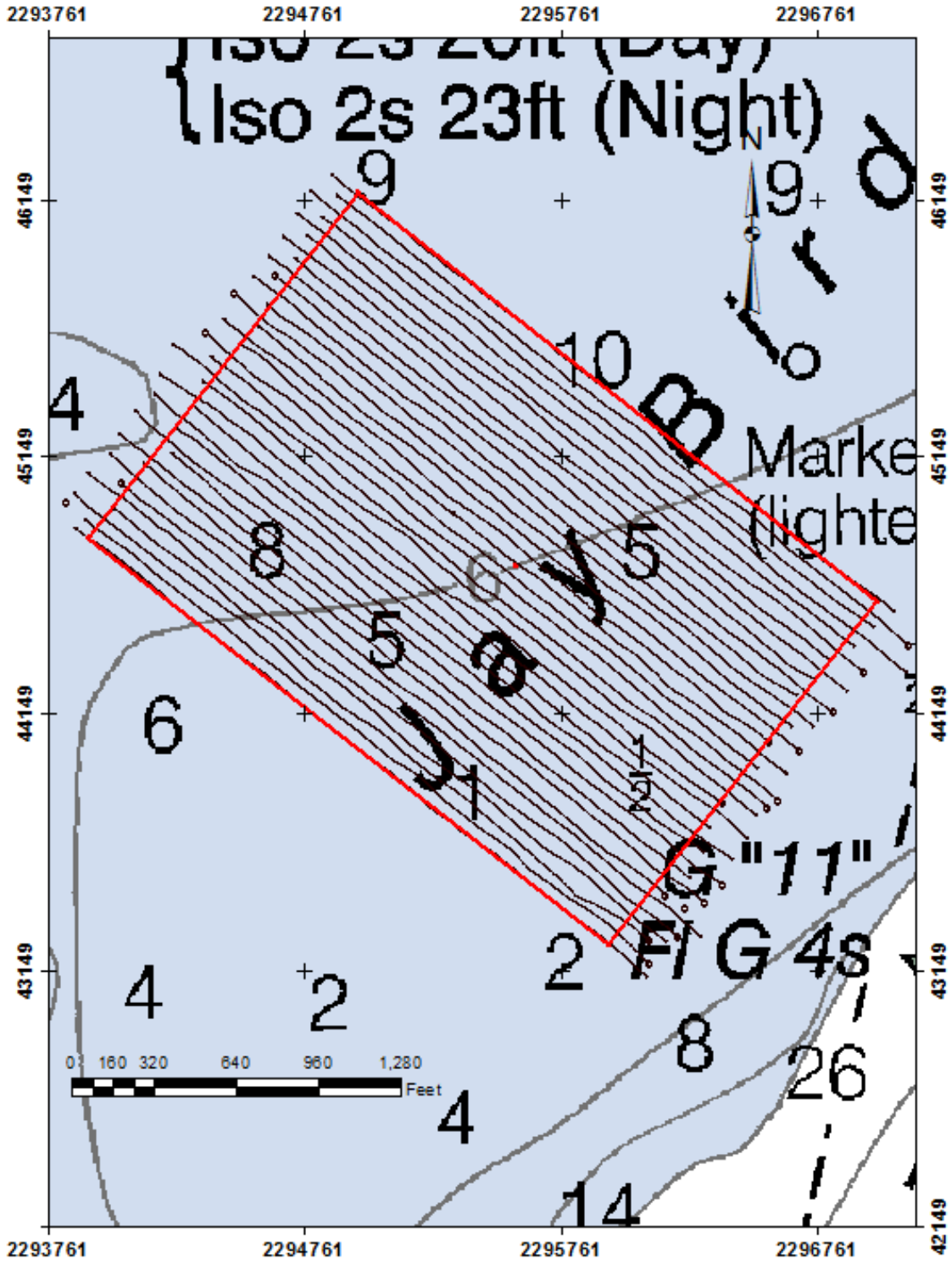


Figure 17. As-run JBS data collection survey lines.

Contouring and analysis of the JBS magnetometer data identified a total of 26 magnetic anomalies (Figure 18; Appendix B). Nine of those were located within the 200-foot perimeter buffer area. A cluster of four anomalies within the borrow area have collective signature characteristics that could represent historic vessel remains. Those four anomalies are buffered and recommended for avoidance or additional investigation. That avoidance buffer is a 300-foot-diameter circle (Figure 19) centered on coordinates presented in Table 2.

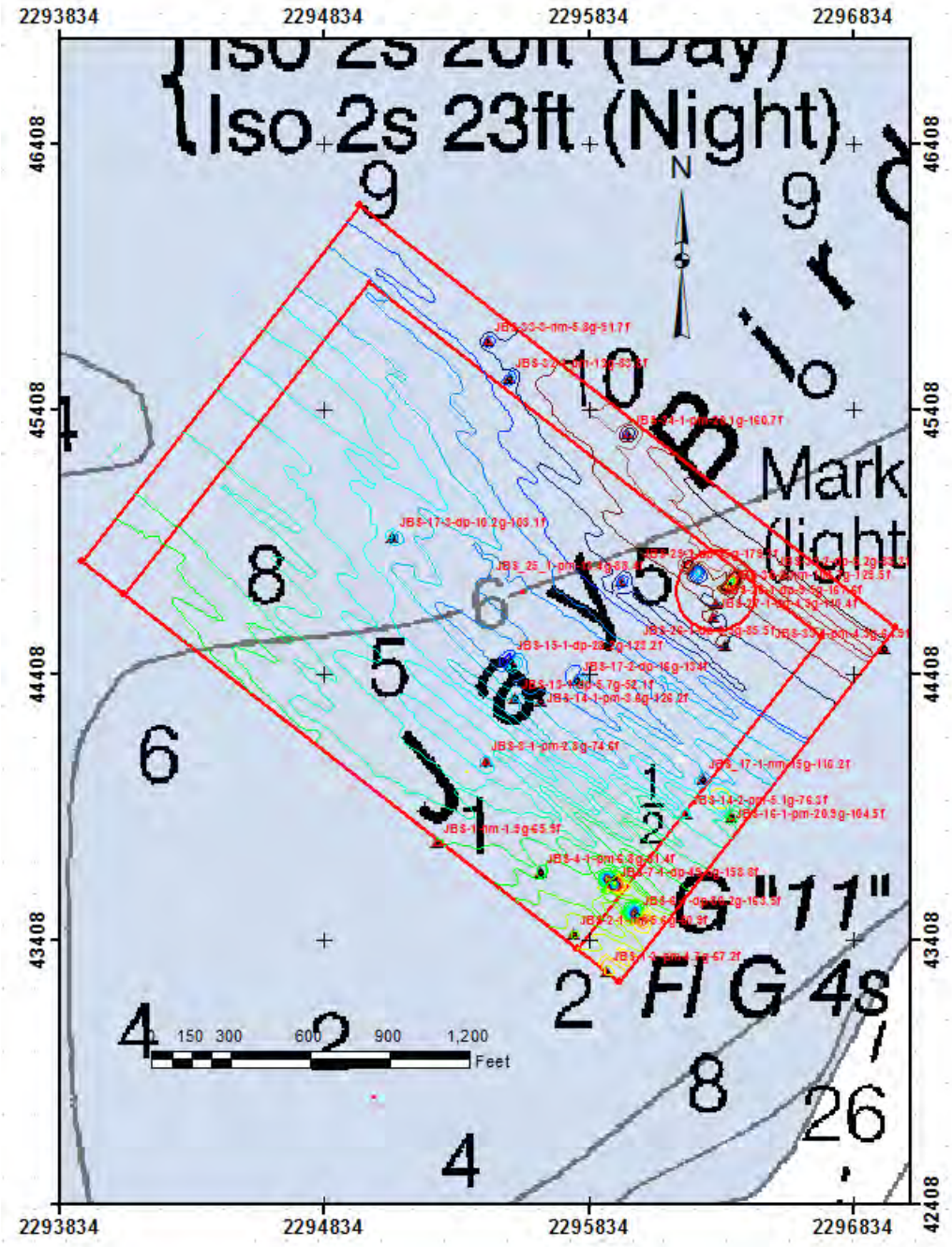


Figure 18. Survey area magnetic contours, anomalies, and avoidance buffer.

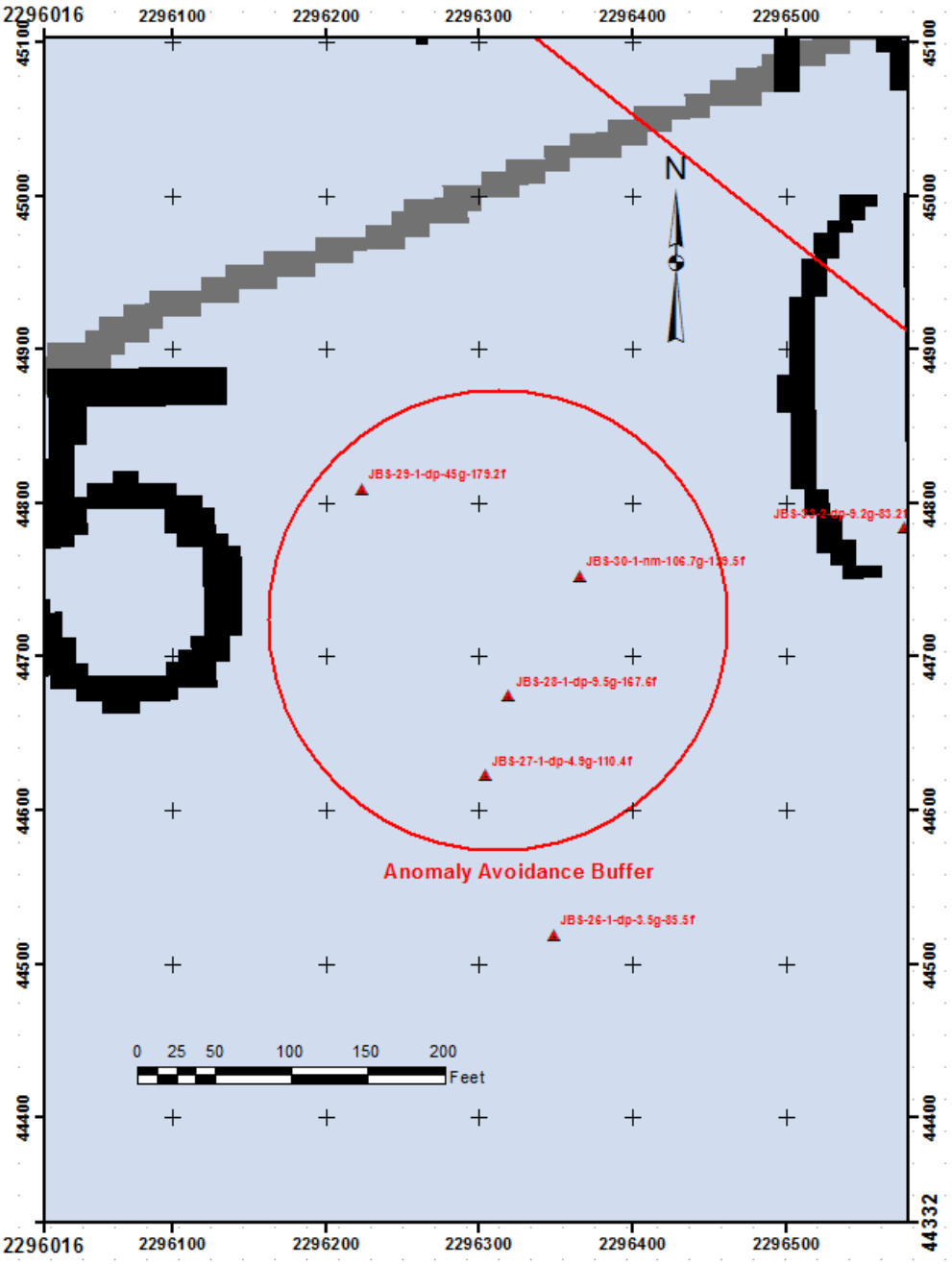


Figure 19. Recommended magnetic anomaly avoidance buffer.

Avoidance Buffer	X Coordinate	Y Coordinate
Center	2296306.5	44731.4

Table 2. Magnetic anomaly avoidance buffer coordinates.

JBS has a high potential for submerged historically significant shipwrecks that include the “Sir John Yeamans flyboat”. That vessel wrecked on JBS in 1665 and could well be one of the oldest known wrecks in North Carolina waters. No additional investigation of those buffered anomalies is recommended in conjunction with the proposed dredging unless the buffer could be impacted or anomaly identification is desirable. The remaining 22 anomalies within and outside the borrow area appear to have been generated by modern debris such as fish and crab traps, pipes, small diameter rods, cable, wire rope, chain, small boat anchors and possibly ordnance associated with fortifications on BHI and Oak Island.

Analysis of the JBS sidescan sonar data identified only one bottom surface target (Figure 20). The signature for that acoustic target represents a linear object on the bottom surface (Figure 21). No magnetic anomaly is associated with the acoustic target. It likely represents a piling or navigation reference day board.

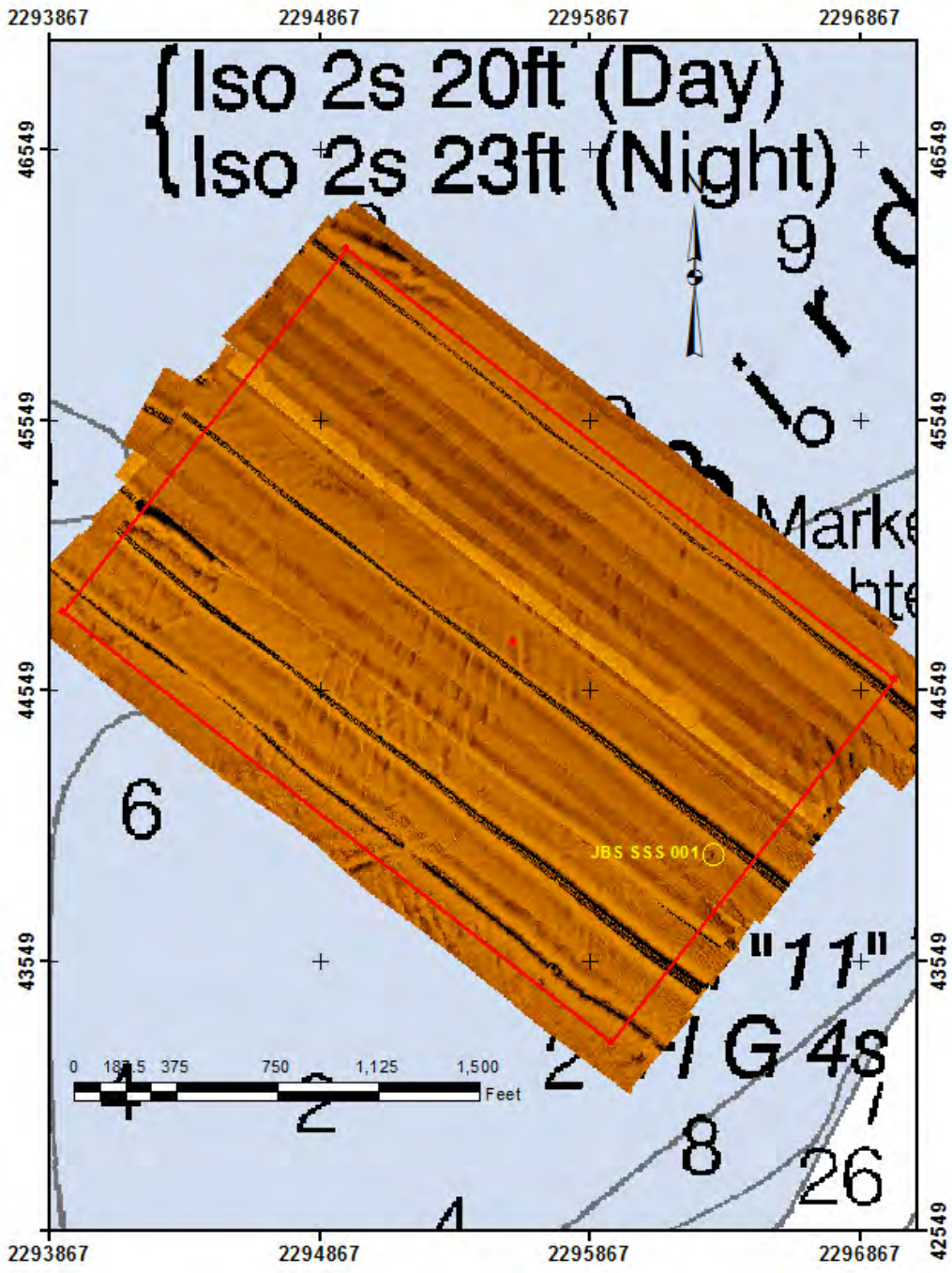


Figure 20. Sidescan sonar coverage mosaic and Target JBS SSS 001 location.

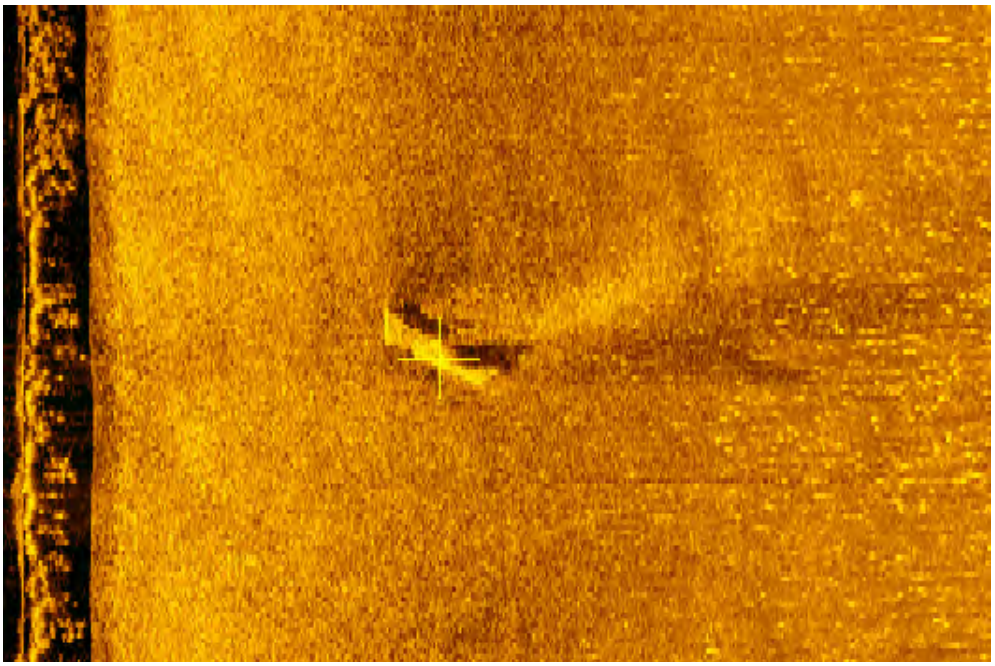


Figure 21. Sonar image of Target JBS SSS 001.

Analysis of the sub-bottom profiler data identified no geological features or targets associated with any of the magnetic anomalies. Due to shallow water and wave generated disturbance in the survey area, the EdgeTech 214 sub-bottom profiler provided less than ideal sediment profiles in the survey area (Figure 22). Although some of the seismic survey lines crossed over magnetic anomalies, no correlation with material generating magnetic signatures could be established.

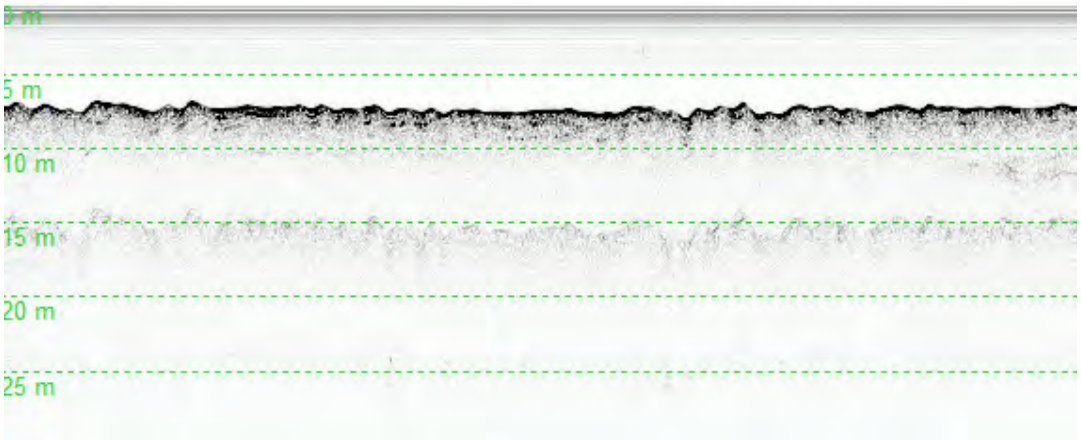


Figure 22. Example of sub-bottom profiler data where water depth near the channel was sufficient to produce reasonable definition.

Previous Remote-Sensing Survey Investigations

Report Title: *A Remote Sensing Survey and Anomaly Assessment Investigation On Jay Bird Shoal off Smith Island Channel, Cape Fear River, Brunswick County, North Carolina*
Submittal Date: 2007
Corporate Author: Tidewater Atlantic Research, Inc., Washington, North Carolina
Principal Investigator: Gordon P. Watts, Jr.
Client: Olsen Associates, Inc., Jacksonville, Florida

Report Title: *Anomaly Reassessment Investigation* [Addendum Report for *A Remote Sensing Survey and Anomaly Assessment Investigation On Jay Bird Shoal off Smith Island Channel, Cape Fear River, Brunswick County, North Carolina* submitted 2007]
Submittal Date: 30 November 2017
Corporate Author: Tidewater Atlantic Research, Inc., Washington, North Carolina
Principal Investigator: Gordon P. Watts, Jr.
Client: Olsen Associates, Inc., Jacksonville, Florida

Report Title: *Phase II Remote-Sensing Archaeological Survey of the Western Extremity of Jay Bird Shoals Near the Mouth of the Cape Fear River, Brunswick County, North Carolina*
Submittal Date: 27 September 2019
Corporate Author: Tidewater Atlantic Research, Inc., Washington, North Carolina
Principal Investigator: Gordon P. Watts, Jr.
Client: Geodynamics LLC, Newport, North Carolina

Conclusions and Recommendations

A survey of historical and archaeological literature and extensive background research confirmed evidence of sustained maritime activity associated with the Cape Fear River. That activity began in the seventeenth century and continues in the present day. Twenty-seven vessels have been documented as lost in the Smith Island vicinity. Seven have been documented as lost on the "Middle Ground" now identified as JBS. An additional nine vessels have been recorded as being lost on the bar or at the mouth of the Cape Fear River and may lie in the vicinity of the proposed borrow site.

One of the earliest and most significant historically documented shipwrecks in North Carolina waters is the flyboat of Sir John Yeamans which was lost on the "middle ground" in October 1665. The Union armed-tug *Violet* was lost on the "western bar channel shoal" in August 1864. An 1884 U.S. Coast and Geodetic chart of the entrance to the Cape Fear (Figure 23) documented the possible location of *Violet.* Although USACE records indicated that elements of the steam machinery associated with a Civil War era shipwreck were removed from the channel adjacent to the shoal, archaeological evidence from other subject period shipwrecks "cleared" as obstructions has confirmed that considerable amounts of vessel structures were frequently left at sites. Among those examples are the USS *Southfield* (Roanoke River NC), the CSS *Fredericksburg* (James River VA), CSS *Chattahoochee* (Chattahoochee River GA), and tug *Lavender* (off Egmont Key FL).

Figure 23. Detail of 1884 U.S. Coast & Geodetic Survey chart of the Cape Fear River Entrance.

While there is documentary evidence of historic shipwrecks in the project vicinity, the one-charted wreck in the survey area was not previously located. Several lines previously surveyed in 2007 (Tidewater Atlantic Research 2007) ran across the wreck symbol that appears on the current Cape Fear River NOAA Chart 11537-1 (Figure 24). No magnetic anomalies or acoustic targets were identified on any of the lines. Additional lines run through the wreck symbol roughly perpendicular to the planned lines also failed to produce any indication of a wreck at (or near) the site.

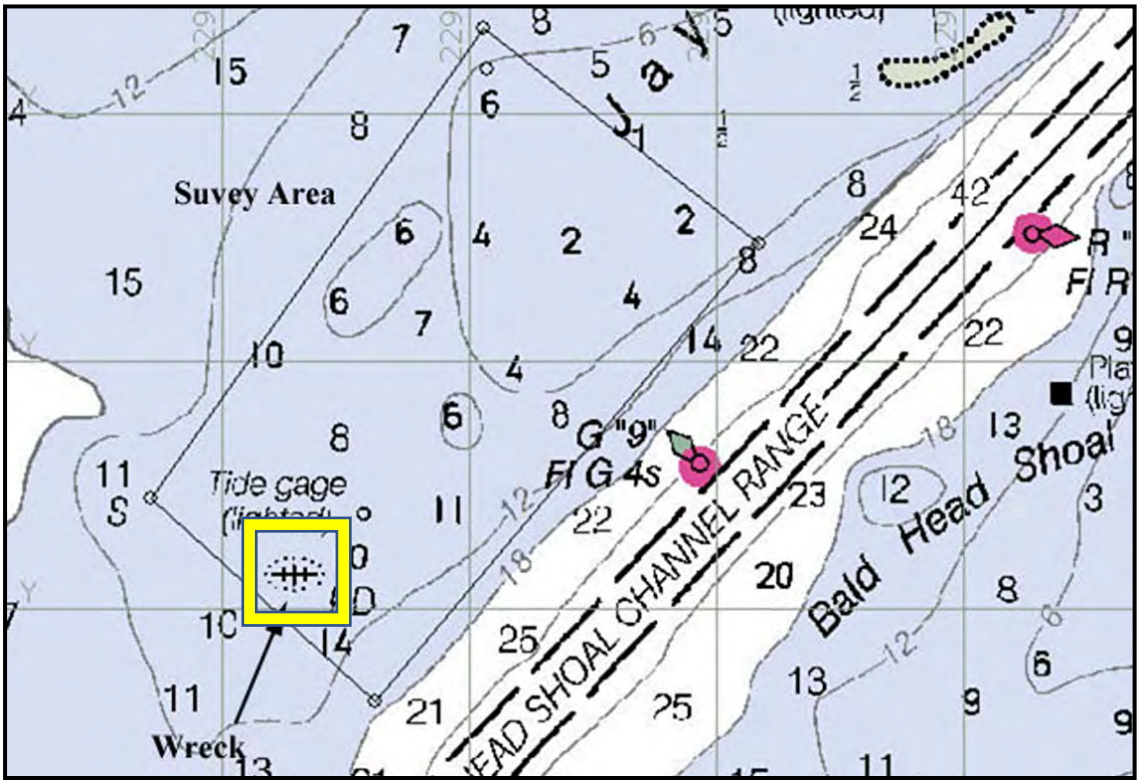


Figure 24. Detail of NOAA Chart 11537-1 showing mapped wreck in 2007 survey area.

Twenty-six magnetic anomalies were identified in the current JBS survey data. Analysis of those data identified a cluster of four anomalies that have collective signature characteristics that could represent historic vessel remains. Those four anomalies are recommended for avoidance or additional investigation. Nine of the remaining 22 anomalies are located in the 200-foot perimeter buffer. One magnetic anomaly is located outside the current survey area.

The 12 unbuffered anomalies inside the borrow area are not considered to be potentially significant. Those anomalies appear to have been generated by modern debris such as fish and crab traps, pipes, small diameter rods, cable, wire rope, chain, small boat anchors and possibly ordnance associated with fortifications on BHI and Oak Island. None of the magnetic anomalies have an associated acoustic signature.

Analysis of the sidescan sonar data identified only one target. The signature for that acoustic target represents a linear object on the bottom surface. No magnetic anomaly is associated with the target. It likely represents a piling or navigation reference such as a dayboard. Analysis of the sub-bottom profiler data was not ideal due to shallow water in the majority of the area surveyed. No geological features or targets were identified in those data.

Unexpected Discovery Protocol

In the event that any project activities expose potential prehistoric or historic cultural material not identified during the remote-sensing survey, the dredge company under contract should *immediately* shift operations away from the site (or sites) and notify the respective Point of Contact for VBHI, OAI, the NCHPO (Raleigh), the NCDNCR (Raleigh), and the UAB (Kure Beach). Notification should address the exact location, where possible, the nature of material exposed by project activities and options for *immediate* archaeological inspection and assessment of the site (or sites).

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Appendix A: Known Shipwreck Losses in the Vicinity of JBS

Vessel	Type	Use	Date of Loss	Location	Disposition
Spanish Vessel			1526	Mouth of the Cape Fear River	
Sir John	Fly Boat		OCT 1665	Middle Ground	
Unknown			FEB 1767	Cape Fear River Bar	
Enterprise			15 FEB 1768	Mouth of the Cape Fear River	
Clementine			MAR 1775	Middle Ground	Salvaged(?)
Unknown			FEB 1784	Mouth of the Cape Fear River	
Neptune	Brig		26 JAN 1789	Middle Ground	
Sabine		Privateer	11 SEP 1814		
Florie		Blockade Runner	OCT 1864	Inside Bar	
Georgiana McCaw		Blockade Runner	2 JUN 1864	SW of Baldhead Light	
Violet		U.S.S. Gunboat	7 AUG 1864	Western Bar	Possibly cleared by USACE
Frying Pan Shoals Lightship		Light Ship	20 DEC 1861	North of Fort Caswell	Sunk by U.S.S. *Mount Vernon*
Ellen	Schooner	Blockade Runner	26 JUN 1862	Burned while ashore at Bald Head Channel	Taken in tow by U.S.S. *Victoria*. Sunk in 15 minutes.
Emily	Schooner	Blockade Runner	26 JUN 1862	Burned under the guns of Fort Caswell	
Lizzie	Sloop	Blockade Runner	1 AUG 1862	Captured and burned by USS *Penobscot* off Bald Head.	
Ella	Steamer	Blockade Runner	3 DEC 1864	Run ashore on Bald Head Beach.	Partially Salvaged
Agnes Emily Frye	Steamer	Blockade Runner	27 DEC 1864	Lost 2 miles south of Fort Caswell off Old Inlet	
Pine	Sloop		MAY 1868	Cape Fear Bar	
Alex Sprunt		Lighter	FEB 1872		
Felicitus	Bark (Ger.)		JUL 1874	Main Bar	Salvaged
Maria Needham	Bark (Br.)		14 JAN 1874	Middle Ground	Salvaged
Vapor	Schooner		5 NOV 1895	Cape Fear Bar	
San Antonio	Bark (Br.)		13 JAN 1890		Salvaged
Ogir	Bark (Nor.)		10 NOV 1894	Middle Ground	Salvaged
Clarence H	Schooner		9 DEC 1902	South of Cape Fear Bar	
Col. Thos. F. Austin	Schooner		24 FEB 1916	Middle Ground	
Unknown	Bark		13 JUN 1930	Middle Ground	
Magnolia	Sailboat	Pleasure	30 OCT 1993	“on Jay Bird Shoal”	
Apnoia	Tanker	Commercial	20 DEC 1999	“west of Buoy #7 at Jay Bird Shoal”	Refloated

Appendix B: JBS Magnetic Anomaly Table

Appendix B: Magnetic Anomaly Table

Name	X Coordinate	Y Coordinate	Survey Line #	Anomaly #	Signature	Gammas	Duration	Assessment	Significance
JBS-1-nm-1.9g-65.9f	2295264.6	43772	1	1	Negative Monopolar	1.9g	65.9f	In Perimeter Buffer	Not Potentially Significant
JBS-1-2-pm-4.7g-67.2f	2295906.1	43288.8	1	2	Positive Monopolar	4.7g	67.2f	In Perimeter Buffer	Not Potentially Significant
JBS-2-1-nm-5.6g-60.9f	2295779.3	43428.1	2	1	Negative Monopolar	5.6g	60.9f	Small Ferrous Object	Not Potentially Significant
JBS-4-1-pm-6.8g-81.4f	2295654.3	43659.4	4	1	Positive Monopolar	6.8g	81.4f	Small Ferrous Object	Not Potentially Significant
JBS-6-1-dp-80.2g-163.5f	2296018.3	43501.5	6	1	Dipolar	80.2g	163.5f	In Perimeter Buffer	Not Potentially Significant
JBS-7-1-dp-49.5g-158.8f	2295929.8	43644.6	7	1	Dipolar	49.5g	158.8f	Moderate Ferrous Object	Not Potentially Significant
JBS-8-1-pm-2.8g-74.6f	2295447.3	44081.1	8	1	Positive Monopolar	2.8g	74.6f	Small Ferrous Object	Not Potentially Significant
JBS-13-1-dp-5.7g-52.1f	2295557.1	44318.5	13	1	Dipolar	5.7g	52.1f	Small Ferrous Object	Not Potentially Significant
JBS-14-1-pm-3.6g-126.2f	2295652.6	44309.4	14	1	Positive Monopolar	3.6g	126.2f	Small Ferrous Object	Not Potentially Significant
JBS-14-2-pm-5.1g-76.3f	2296201.4	43882.4	14	2	Positive Monopolar	5.1g	76.3f	In Perimeter Buffer	Not Potentially Significant
JBS-15-1-dp-28.2g-123.2f	2295539.1	44461.3	15	1	Dipolar	28.2g	123.2f	Moderate Ferrous Object	Not Potentially Significant
JBS-16-1-pm-20.9g-104.5f	2296372.4	43873.9	16	1	Positive Monopolar	20.9g	104.5f	In Perimeter Buffer	Not Potentially Significant
JBS_17-1-nm-15g-110.2f	2296267.2	44013.7	17	1	Negative Monopolar	15g	110.2f	Small Ferrous Object	Not Potentially Significant
JBS-17-2-dp-16g-134f	2295790.9	44385.5	17	2	Dipolar	16g	134f	Moderate Ferrous Object	Not Potentially Significant
JBS-17-3-dp-10.2g-103.1f	2295093.1	44927	17	3	Dipolar	10.2g	103.1f	Small Ferrous Object	Not Potentially Significant
JBS_25_1-pm-13.4g-88.4f	2295957.8	44762.7	25	1	Positive Monopolar	13.4g	88.4f	Small Ferrous Object	Not Potentially Significant
JBS-26-1-dp-3.5g-85.5f	2296349.5	44518.9	26	1	Dipolar	3.5g	85.5f	Small Ferrous Object	Not Potentially Significant
JBS-27-1-dp-4.9g-110.4f	2296304.3	44622.9	27	1	Dipolar	4.9g	110.4f	Avoidance Buffered	Potentially Significant
JBS-28-1-dp-9.5g-167.6f	2296320	44674.7	28	1	Dipolar	9.5g	167.6f	Avoidance Buffered	Potentially Significant
JBS-29-1-dp-45g-179.2f	2296224.5	44809.3	29	1	Dipolar	45g	179.2f	Avoidance Buffered	Potentially Significant
JBS-30-1-nm-106.7g-129.5f	2296366	44752.5	30	1	Negative Monopolar	106.7g	129.5f	Avoidance Buffered	Potentially Significant
JBS-32-1-pm-13g-83.8f	2295535.7	45528	32	1	Positive Monopolar	13g	83.8f	In Perimeter Buffer	Not Potentially Significant
JBS-33-1-pm-4.3g-64.9f	2296951.9	44508.4	33	1	Positive Monopolar	4.3g	64.9f	Out of Survey Area	Not Potentially Significant
JBS-33-2-dp-9.2g-83.2f	2296578.6	44784	33	2	Dipolar	9.2g	83.2f	In Perimeter Buffer	Not Potentially Significant
JBS-33-3-nm-5.8g-91.7f	2295453.2	45667.4	33	3	Negative Monopolar	5.8g	91.7f	In Perimeter Buffer	Not Potentially Significant
JBS-34-1-pm-20.1g-160.7f	2295985.4	45316.4	34	1	Positive Monopolar	20.1g	160.7f	In Perimeter Buffer	Not Potentially Significant

Appendix D-Geotechnical Report

(Available upon request if not included)

MEMORANDUM

TO: Heather Coates, Beaches & Inlet Mgt. Project Coordinator

CC: G. Finch; C. Preziosi; C. McCall; Emily Hughes

FROM: Erik J. Olsen, P.E. EJO

DATE: 25 July 2023

RE: Village of Bald Head Island – Borrow Site Expansion Project
Geotechnical Report Dated October 2022

Pursuant to your request, the attached signed and sealed document certifies sediment compatibility of the proposed Jay Bird Shoal borrow site expansion with respect to its use as a source of beach fill at Bald Head Island, N.C. If you recall, the sediments typifying the entirety of the recipient shoreline at South Beach do *not* constitute a "natural beach" condition. That is to say, the subject shoreline has received approximately 12.9 Mcy of beach fill since about 2001 -- with about 77% of that volume being placed as disposal material excavated from the adjacent federal navigation project channel. The most recent federal disposal project was completed in early 2023. As directed by CAMA during the permitting of the original Jay Bird Borrow Site in or about 2007, the Applicant's engineer was directed to evaluate borrow site "compatibility" based upon the sediment characteristics of East Beach -- which to-date remains in a natural beach condition, *i.e.* never affected by beach fill placement. Accordingly, as you will note therein, the October 2022 Borrow Site Expansion Investigation follows that original guidance in its present-day compatibility determination.

If I can provide any additional information at this time regarding the enclosed document, please let me know.

Thank you.

Enc.

olsen associates, inc. | 2618 Herschel Street | Jacksonville, FL 32204 | 904.387.6114 | FAX 904.384.7368
www.olsen-associates.com.

GEOTECHNICAL VIBRACORE REPORT

2022 GEOTECHNICAL INVESTIGATION
JAY BIRD SHOALS BORROW AREA EXPANSION
BRUNSWICK COUNTY, NORTH CAROLINA

September 2022

Prepared for:

Olsen Associates, Inc.
2618 Herschel Street
Jacksonville, FL 32204

Prepared by:

Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458

GEOTECHNICAL VIBRACORE REPORT

2022 GEOTECHNICAL INVESTIGATION
JAY BIRD SHOALS BORROW AREA EXPANSION
BRUNSWICK COUNTY, NORTH CAROLINA

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Section 1: Introduction

Athena Technologies, Inc. (Athena) was contracted by Olsen Associates, Inc. (OAI) of Jacksonville, Florida to collect geotechnical vibracore samples in the vicinity of Jay Bird Shoals, which is located west of Bald Head Island in Brunswick County, North Carolina (**Figure 1**). The scope of the project included the collection of 10 geotechnical vibracores. Two of the vibracores were positioned in the existing permitted borrow site at Jay Bird Shoals, and the remaining 8 vibracores were located in a proposed expansion area. The scope of services also included geological logging, core photography, vibracore sub-sampling, contracting laboratory analyses, and geotechnical reporting. Vibracore sampling was conducted in July 2022; a summary of the vibracore collection methodology and findings of the geotechnical investigation are presented below.

Section 2: Methodology

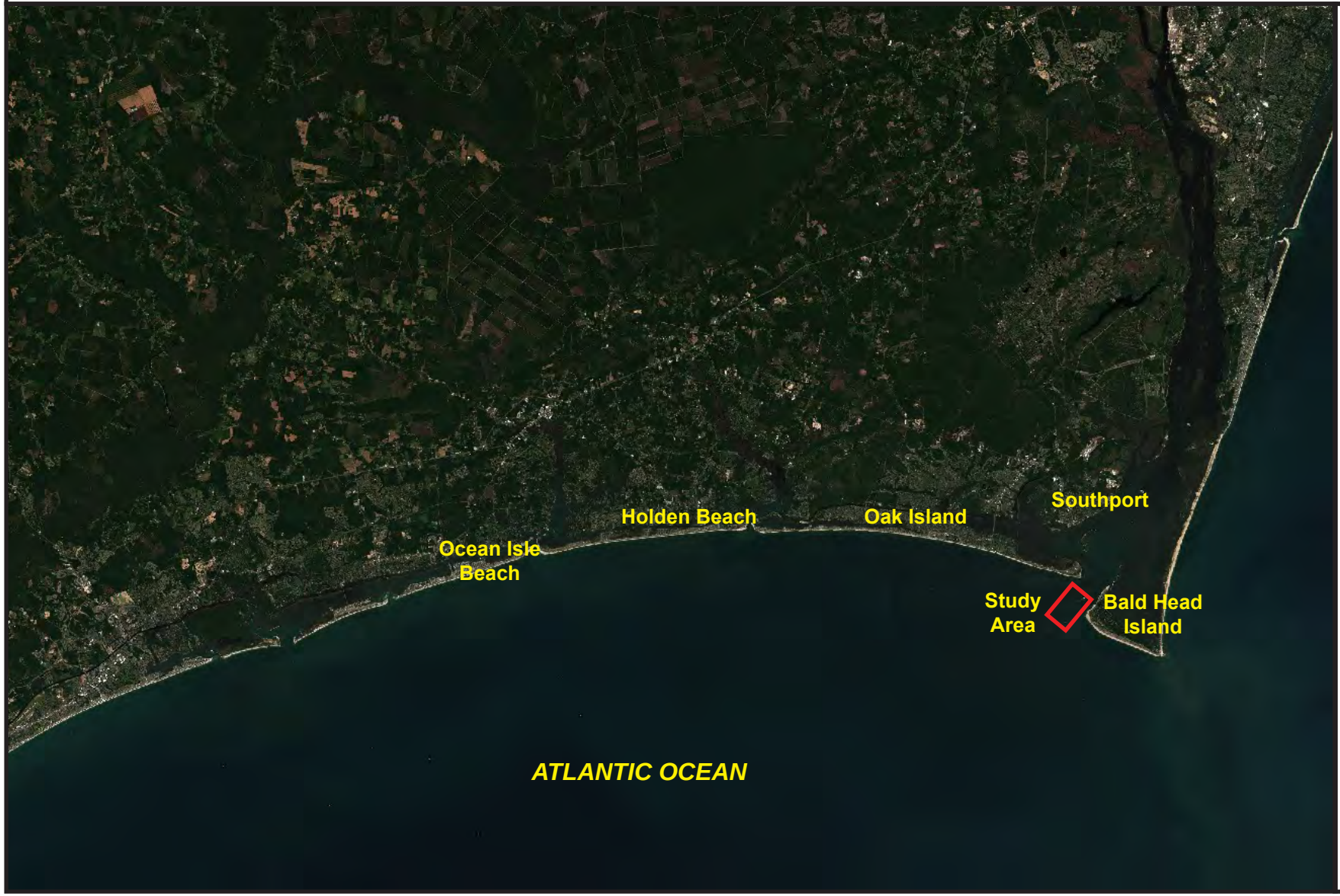
Athena utilized the 35-foot research vessel, *Artemis*, to act as the sampling platform for this project. *Artemis* was equipped with all required US Coast Guard (USCG) safety gear and was operated by a USCG-certified, 100 Ton Master Captain. A Trimble Differential Global Positioning System (sub-meter accuracy) interfaced with HYPACK was utilized for primary navigation. Horizontal coordinates were recorded in North American Datum of 1983 State Plane Coordinate System, North Carolina (Zone 3200), U.S. Survey Feet. Real-time tide elevation data was obtained using a Champion TKO Global Navigation Satellite System receiver interfaced with the North Carolina Continuously Operating Reference Station Network, which served as the base station.

During field operations, *Artemis* was immobilized over the desired sample sites (provided by OAI) using a triple-point anchor system. Once on station, the coordinates at the vessel location were compared with the coordinates for the desired sample location to ensure accurate vessel positioning. Upon satisfactory positioning, a water depth was collected via lead line or fathometer and final horizontal coordinates were recorded at each station. Tide elevation data were also recorded in the field and were referenced to North American Vertical Datum of 1988. Elevation data were subsequently converted to National Geodetic Vertical Datum of 1929 (NGVD 29) using the National Oceanic and Atmospheric Administration’s (NOAA) VDatum software program (Version 4.4.2). A summary of the data conversion has been included as **Table 1**. The tide elevation data was utilized to determine the sediment surface elevation at each sample location.

1293 Graham Farm Road, PO Box 68
McClellanville, South Carolina 29458
(843) 887-3800
www.athenatechnologies.com

FIGURE 1: Study Area Location Map
2022 Geotechnical Investigation,
Jay Bird Shoals Borrow Area Expansion,
Brunswick County, North Carolina

ATHENA TECHNOLOGIES, INC.
www.athenatechnologies.com



NOTES:

- Vibracores were collected in July 2022

VIBRACORE STUDY AREA

N
W E
S

0 4 8
Miles

IMAGE SOURCE:
Sentinel 2
ESA

Athena Technologies, Inc.
PO Box 68
McClellanville, SC 29458
843-887-3844

A custom-designed and fabricated vibracore system was utilized to collect the geotechnical cores. The system consists of a generator with a mechanical vibrator attached via cable. The vibrator is attached directly to a 3-inch diameter, galvanized sample barrel. The sample barrel was lowered until the bottom of the barrel was directly above the sediment surface. The vibracore machine was turned on and the sample barrel was allowed to penetrate to a depth of -24 feet NGVD 29, or to refusal. Vibracore penetration was recorded from the deck using marked drill stems. Once the sample barrel reached the desired depth, the machine was turned off and the sample barrel was retrieved using an electric winch. The recovered core length was measured following core retrieval, and percent recovery was verified. The cores were then capped, labeled, and cut into 5-foot sections. A vibracore summary table containing final location coordinates, elevation data, and penetration and recovery lengths has been included as **Table 2**, and a vibracore location map has been included as **Figure 2**.

The completed cores were opened longitudinally at Athena's core processing facility in McClellanville, South Carolina. The cores were photographed after opening and were logged by Athena's geologist in accordance with protocol outlined in ASTM D 2488 and ASTM D 2487. Draft core logs and photo-mosaic images of the cores were provided to OAI for selection of sediment sub-sample intervals. Upon receipt of sub-sample selections from OAI, Athena extracted and shipped the sub-samples to Terracon Consultants, Inc. (Terracon) in Jacksonville, Florida. Terracon is a USACE-certified geotechnical laboratory. One composite sub-sample and 2 discrete sub-samples were collected from each core. The sub-samples were analyzed for grain size distribution in accordance with ASTM D 6913 using the following sieve sizes: 3/4 in., 5/8 in., 7/16 in., 5/16 in., No. 3.5, No. 4, No. 5, No. 7, No. 10, No. 14, No. 18, No. 25, No. 35, No. 45, No. 60, No. 80, No. 120, No. 170, No. 200, and No. 230. Visual estimation of shell content was also conducted on all sub-samples using the Terry and Chilingar method (1955), and the composite samples were analyzed for carbonate content using the Twenhofel and Tyler acid digestion method (1941). Vibracore logs were developed using gINT (Version 8.2), and laboratory analytical data were incorporated into the gINT project file for statistical evaluation. A tabular summary of grain size data is presented in **Table 3**. Core photographs and logs have been included in **Appendix A**, and grain size distribution curves and granularmetric reports have been included as **Appendix B**. Graphs depicting percent accessory components (i.e., carbonate, gravel, silt/clay, etc.) and grain size distribution parameters (e.g., mean grain size, percent passing the No. 230 sieve, etc.) have been included as **Appendix C**.

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FIGURE 2: Vibracore Location Map
2022 Geotechnical Investigation,
Jay Bird Shoals Borrow Area Expansion,
Brunswick County, North Carolina

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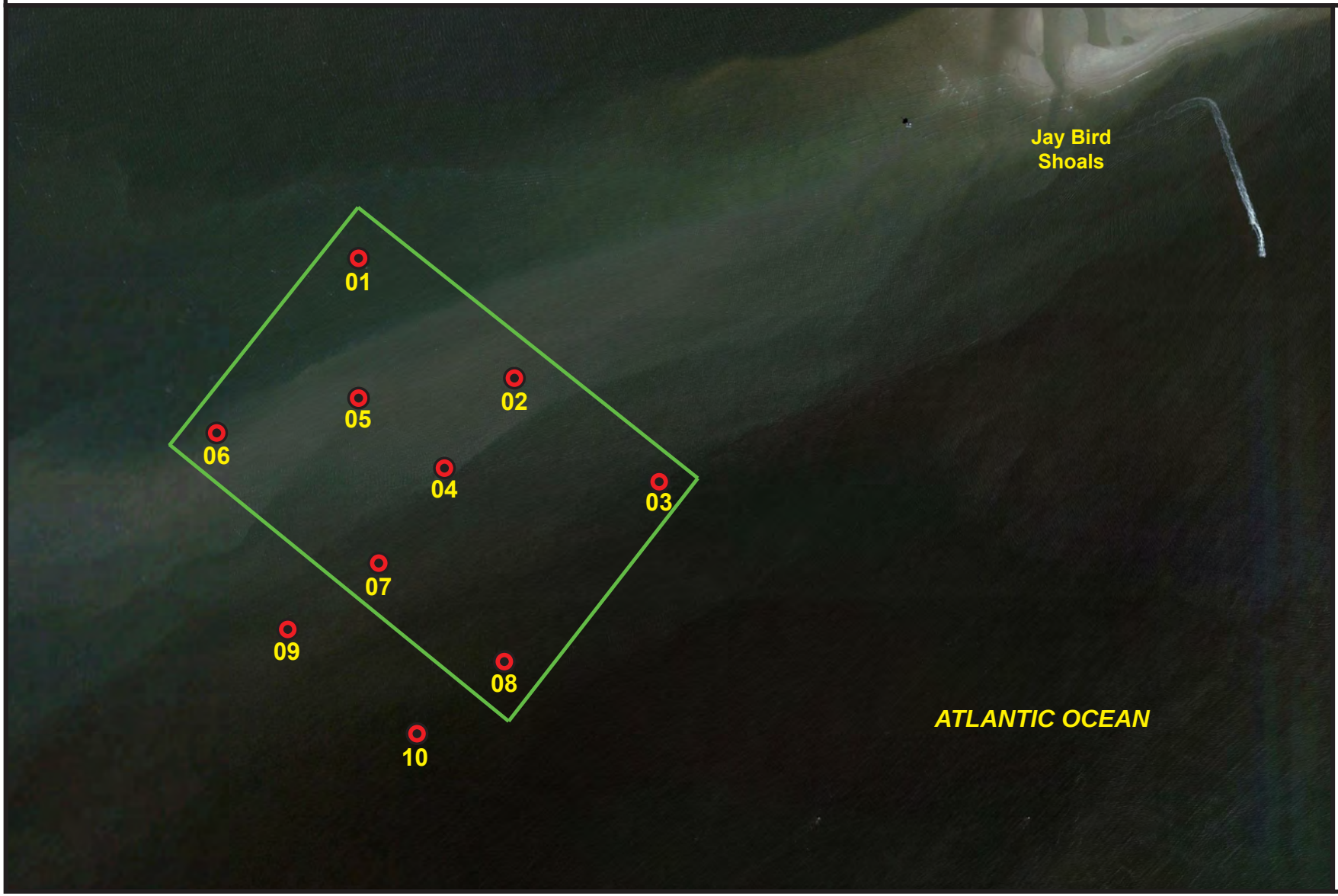

NOTES:

- Vibracores were collected in July 2022

- Station prefix "JBS-22-" removed for clarity.

PROPOSED EXPANSION AREA

VIBRACORE LOCATION

N
W E
S

0 1000 2000

Feet

IMAGE SOURCE: GoogleEarth

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Section 3: Discussion

The vibracore study area (depicted on **Figure 1**) is located approximately 1 mile to the west of Bald Head Island, near the entrance to the Cape Fear River. More specifically, the vibracores were positioned southwest of the aerially exposed portion of Jay Bird Shoals, which is located northwest of the federal navigation channel entering the Cape Fear River. The mean tidal range at the study area is approximately 4.5 feet, and tidal current velocities in the channel adjacent to the study area range from 0.5 to greater than 1.5 knots during peak tidal exchange periods (National Oceanic and Atmospheric Administration).

Sediment surface elevations ranged from -6.3 to -17.7 feet NGVD 29 at sample locations in the study area. Vibracore penetration depths ranged from 10.0 feet to 19.3 feet below sediment surface and recovered core depths ranged from -19.9 to -27.5 feet NGVD 29. Upon review of the data set, the cores can generally be grouped according to water depths and energy regimes from which they were collected around the study area; shallow, intermediate, and deep sample locations. Observations regarding each grouping of cores is presented below.

Shallow Cores (JBS-22-01, -02, -05, and -06)

- Sediment surface elevations ranged from -7 to -11 feet NGVD 29.

- Cores were generally characterized by a dominance of fine-grained quartz sand with minimal silt/clay-sized constituents in the analyzed composite intervals. Silt/clay-lined burrow traces were also commonly observed in these cores.

- The average mean grain size from composite sub-samples from these cores was 0.26 millimeters (mm), while the average carbonate content percentage was 9.0%.

- The average percentage of fine-grained constituents (i.e., silt and/or clay-sized material) was 2.96%.

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Intermediate Cores (JBS-22-03, -04, -07 and -09)

- Sediment surface elevations ranged from -10 to -15 feet NGVD 29.

- Tidally influenced bedding characteristics, as evidenced by the presence of interbedded quartz sand and fine-grained silt/clay, were noted below a surficial fine-grained sand interval. The depth at which the fine-grained tidal bedding was first encountered in the cores ranged from approximately -17 to -23 feet NGVD 29.

- The average mean grain size in composite sub-samples from these cores was 0.17 mm, while the average carbonate content percentage was 7.4%.

- The average percentage of fine-grained constituents was 3.67% and there was negligible amounts of gravel and granule-sized constituents in the sub-samples.

- Although a majority of these cores terminated in sandy intervals (USCS = SP), core JBS-22-07 terminated in a fat clay (USCS = CH) interval greater than 3 feet in thickness. The CH interval was encountered at a depth of approximately -24' NGVD 29, though smaller CH and clayey sand (USCS = SC) intervals were first noted at approximately -21 feet NGVD 29 in that core.

Deep Cores (JBS-22-08 and -10)

- Cores JBS-22-08 and -10 were located in deepest water depths where sediment surface elevations were below -17' NGVD 29.

- These cores were dominated by fine to medium-grained quartz sand with relatively high percentages of shell content.

- Composite sub-samples from those cores reported the highest mean grain size and highest percentages of carbonate content, gravel-sized constituents and granule-sized constituents among all the cores. The average carbonate content from composite samples from the 2 locations was 17.3% and average mean grain size was 0.48 mm.

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- The average percentage of fine-grained was 1.61%; very little fine-grained tidal bedding was observed in these cores.

- The coarser-grained sediment characteristics in these 2 cores is likely due to the fact that they were positioned closest to the high current velocities in the main navigation channel.

Discussion Regarding Laboratory Analyses

It should be noted that hydrometer analysis was not conducted on the fine-grained fraction of the sub-samples. As a result, the relative percentages of silt- and clay-sized particles in each sub-sample was not established. In response, the laboratory assigned a default designation of “silt” and a liquid limit of greater than 50% to all material passing the No. 200 sieve. Lacking sufficient laboratory data to differentiate between silt- and clay-sized particles, the USCS classification assigned by Athena’s geologist took precedence, when a discrepancy was noted between the laboratory USCS designation and the USCS designation in the associated core log.

Section 4: References

ASTM D 2487-11, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System), ASTM International, West Conshohocken, PA. 2011.

ASTM D 2488-00, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), ASTM International, West Conshohocken, PA. 2000.

ASTM D 6913-04, Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis, ASTM International, West Conshohocken, PA. 2004.

National Oceanic and Atmospheric Administration, Center for Operational Oceanographic Products and Services, Station ID: 8658901 Bald Head Island, Cape Fear River, NC. Accessed on 30 August 2022. Obtained from: https://tidesandcurrents.noaa.gov/noaatidepredictions.html?id=8658901

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Terry, R. D. and Chilingar, C. V., Summary of "Concerning some additional aids in studying sedimentary formations" by M. S. Shvetsov. Journal of Sedimentary Petrology, v. 25, pp. 214-229. 1955.

Twenhofel, W.H. and Tyler S.A., Methods of Study of Sediments, McGraw-Hill, New York, p. 183. 1941.

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TABLES

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TABLE 1 - Elevation Data Conversion Summary
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2022 Geotechnical Investigation
Jay Bird Shoals Borrow Area Expansion
Brunswick County, North Carolina

Station ID	Data Conversion Input Parameters [1]			Data Conversion Output Parameters [2]		
	East (x)	North (y)	Elevation (ft NAVD 88)	Latitude	Longitude	Elevation (ft NGVD 29)
JBS-22-01	45628.13	2295027.53	1.66	33.871222	-78.028523	2.81
JBS-22-02	45037.75	2295796.15	1.27	33.869579	-78.026010	2.42
JBS-22-03	44547.99	2296515.45	-0.52	33.868214	-78.023657	0.63
JBS-22-04	44598.57	2295455.88	-1.26	33.868381	-78.027145	-0.11
JBS-22-05	44945.79	2295026.10	3.38	33.869347	-78.028549	4.53
JBS-22-06	44768.94	2294325.98	-1.06	33.868880	-78.030861	0.09
JBS-22-07	44140.78	2295131.85	-2.35	33.867132	-78.028227	-1.20
JBS-22-08	43656.45	2295748.75	-2.23	33.865785	-78.026211	-1.08
JBS-22-09	43797.80	2294681.54	-2.67	33.866202	-78.029721	-1.52
JBS-22-10	43297.10	2295334.73	-2.27	33.864809	-78.027585	-1.12
Notes	**[1]** = Horizontal coordinates were recorded in the field and were referenced to North American Datum of 1983, State Plane Coordinate System, North Carolina (Zone 3200), US Survey Feet. Elevation data were also collected in the field using a Spectra SP80 Global Navigation Satellite System receiver interfaced with the North Carolina Continuously Operating Reference Station network, and were referenced to North American Vertical Datum of 1988.					
	[2] = Coordinate and elevation conversion performed by the National Oceanic and Atmospheric Administration's Vertical Datum Online Transformation Tool (VDatum) software, Version 4.4.2					
	ft NAVD 88 = Feet relative to North American Vertical Datum of 1988					
	ft NGVD 29 = Feet relative to National Geodetic Vertical Datum of 1929					

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TABLE 2 - Geotechnical Vibracore Summary
Olsen Associates, Inc.
2022 Geotechnical Investigation
Jay Bird Shoals Borrow Area Expansion
Brunswick County, North Carolina

Boring ID	Collection Date	Time	East (x)	North (y)	Water Depth (ft)	Tide Elevation (ft NGVD 29)	Sediment Surface Elevation (ft NGVD 29)	Bottom Elevation of Recovered Core (ft NGVD 29)	Penetration (ft)	Recovery (ft)	Notes
JBS-22-01	7/11/2022	16:11	2295022.79	45629.44	11.4	2.8	-8.6	-24.1	17.2	15.5	
JBS-22-02	7/11/2022	15:21	2295790.28	45039.62	9.5	2.4	-7.1	-23.9	19.3	16.8	
JBS-22-03	7/11/2022	14:28	2296509.99	44548.06	15.2	0.6	-14.6	-27.5	15.2	12.9	
JBS-22-04	7/11/2022	13:54	2295448.97	44598.66	9.5	-0.1	-9.6	-24.9	18.0	15.3	
JBS-22-05	7/11/2022	17:00	2295016.76	44946.78	10.8	4.5	-6.3	-19.9	16.9	13.6	Made 3 coring attempts; surging waves and excessive boat movement resulted in unsafe conditions and bent sample barrel; we accessed the location at high tide because conditions were too shallow at lower parts of the tidal cycle; 3rd core retained for processing and location abandoned.
JBS-22-06	7/11/2022	13:14	2294323.07	44770.52	11.4	0.1	-11.3	-26.1	17.8	14.8	
JBS-22-07	7/11/2022	12:45	2295127.02	44141.92	11.5	-1.2	-12.7	-27.0	16.2	14.3	
JBS-22-08	7/11/2022	11:54	2295744.80	43655.87	16.5	-1.1	-17.6	-25.7	10.0	8.1	
JBS-22-09	7/11/2022	11:31	2294677.37	43796.77	11.4	-1.5	-12.9	-27.0	16.0	14.1	
JBS-22-10	7/11/2022	10:45	2295332.62	43294.35	16.6	-1.1	-17.7	-26.4	10.3	8.7	
Notes	ft = feet										
	NGVD 29 = National Geodetic Vertical Datum of 1929										

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TABLE 3 - Grain Size Data Summary
Olsen Associates, Inc.
2022 Geotechnical Investigation
Jay Bird Shoals Borrow Area Expansion
Brunswick County, North Carolina

Boring ID	Sample ID	Sample Interval		Laboratory USCS Classification	Percent Gravel-Sized Fraction [1]	Percent Granule-Sized Fraction [2]	Percent Sand-Sized Fraction [3]	Percent Fine-Grained Fraction [4]	Visual Percent Shell [5]	Percent Carbonate [6]	Mean Grain Size [7] (mm)	Grain Size Diameter				
		Depth Interval (ft bss)	Depth Interval (ft NGVD 29)									D 90 (mm)	D 85 (mm)	D 50 (mm)	D 15 (mm)	D 10 (mm)
JBS-22-01	C1	0 to 15.4	-8.6 to -24.0	SP	0.29	0.72	97.17	1.83	4	6.9	0.24	0.50	0.36	0.21	0.14	0.13
	S1	5.1	-13.7	SP	0.16	0.04	98.31	1.49	11	N/A	0.22	0.38	0.33	0.20	0.14	0.13
	S2	10.3	-18.9	SP	0.11	0.85	97.80	1.24	4	N/A	0.23	0.41	0.33	0.20	0.14	0.13
JBS-22-02	C1	0 to 16.8	-7.1 to -23.9	SP	0.75	0.66	96.54	2.05	11	9.3	0.26	0.69	0.50	0.21	0.14	0.13
	S1	5.6	-12.7	SP	0.04	0.12	98.50	1.35	4	N/A	0.22	0.36	0.32	0.20	0.14	0.14
	S2	11.2	-18.3	SP	0.00	0.09	96.15	3.75	3	N/A	0.19	0.30	0.26	0.18	0.13	0.13
JBS-22-03	C1	0 to 9.4	-14.6 to -24.0	SP	0.00	0.08	97.88	2.04	2	6.0	0.16	0.23	0.21	0.16	0.13	0.11
	S1	3.1	-17.7	SP	0.00	0.18	97.90	1.93	6	N/A	0.18	0.24	0.23	0.17	0.13	0.13
	S2	6.3	-20.9	SP	0.00	0.00	97.60	2.40	6	N/A	0.16	0.23	0.21	0.15	0.13	0.11
JBS-22-04	C1	0 to 7.4	-9.6 to -17.0	SP	0.00	0.02	97.10	2.88	4	7.5	0.19	0.31	0.26	0.17	0.13	0.11
	S1	4.8	-14.4	SP	0.00	0.09	98.00	1.91	1	N/A	0.19	0.28	0.25	0.18	0.13	0.13
	S2	9.6	-19.2	SP-SM	0.00	0.05	92.93	7.01	0	N/A	0.16	0.23	0.22	0.15	0.12	0.10
JBS-22-05	C1	0 to 13.6	-6.3 to -19.9	SP	0.66	0.42	96.74	2.17	13	9.5	0.28	0.69	0.56	0.23	0.15	0.14
	S1	4.5	-10.8	SP	0.05	0.32	97.51	2.12	10	N/A	0.22	0.37	0.32	0.20	0.14	0.13
	S2	9.1	-15.4	SP	0.00	0.37	98.54	1.09	18	N/A	0.42	0.99	0.88	0.42	0.19	0.17
JBS-22-06	C1	0 to 12.7	-11.3 to -24.0	SP-SM	0.56	0.83	92.84	5.77	5	10.2	0.26	0.71	0.53	0.20	0.13	0.11
	S1	4.2	-15.5	SP	0.03	0.41	98.08	1.49	3	N/A	0.26	0.49	0.41	0.24	0.15	0.14
	S2	8.5	-19.8	SP	0.15	0.41	98.52	0.92	2	N/A	0.18	0.28	0.24	0.16	0.13	0.13
JBS-22-07	C1	0 to 7.3	-12.7 to -20.0	SP	0.00	0.04	97.50	2.46	4	7.7	0.18	0.29	0.25	0.17	0.13	0.11
	S1	2.4	-15.1	SP	0.00	0.05	98.69	1.26	2	N/A	0.18	0.27	0.24	0.17	0.13	0.13
	S2	4.9	-17.6	SP	0.00	0.11	97.35	2.53	3	N/A	0.16	0.26	0.23	0.15	0.11	0.10
JBS-22-08	C1	0 to 6.4	-17.6 to -24.0	SP	1.64	3.18	93.57	1.60	15	19.8	0.55	1.40	1.21	0.61	0.19	0.16
	S1	2.1	-19.7	SP	6.58	7.61	85.05	0.75	26	N/A	0.90	3.04	1.93	0.80	0.39	0.33
	S2	4.3	-21.9	SP	1.01	5.44	93.30	0.25	24	N/A	0.85	1.77	1.50	0.87	0.45	0.37

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TABLE 3 - Grain Size Data Summary
Olsen Associates, Inc.
2022 Geotechnical Investigation
Jay Bird Shoals Borrow Area Expansion
Brunswick County, North Carolina

Boring ID	Sample ID	Sample Interval		Laboratory USCS Classification	Percent Gravel-Sized Fraction [1]	Percent Granule-Sized Fraction [2]	Percent Sand-Sized Fraction [3]	Percent Fine-Grained Fraction [4]	Visual Percent Shell [5]	Percent Carbonate [6]	Mean Grain Size [7] (mm)	Grain Size Diameter				
		Depth Interval (ft bss)	Depth Interval (ft NGVD 29)									D 90 (mm)	D 85 (mm)	D 50 (mm)	D 15 (mm)	D 10 (mm)
JBS-22-09	C1	0 to 11.1	-12.9 to -24.0	SP-SM	0.04	0.31	92.35	7.30	9	8.5	0.16	0.23	0.21	0.15	0.10	0.09
	S1	3.7	-16.6	SP	0.00	0.14	97.68	2.18	4	**N/A**	0.17	0.23	0.22	0.16	0.13	0.13
	S2	7.4	-20.3	SP-SM	0.00	0.32	89.70	9.99	2	**N/A**	0.15	0.20	0.18	0.14	0.10	0.06
JBS-22-10	C1	0 to 6.3	-17.7 to -24.0	SP	4.01	1.83	92.55	1.61	12	14.8	0.42	1.24	0.94	0.36	0.15	0.14
	S1	2.1	-19.8	SP	0.37	0.95	97.56	1.12	7	**N/A**	0.26	0.69	0.53	0.21	0.15	0.14
	S2	4.2	-21.9	SP	0.00	0.08	98.94	0.98	8	**N/A**	0.40	0.70	0.64	0.40	0.25	0.21

Notes

ft bss = feet below sediment surface

ft NGVD 29 = feet relative to National Geodetic Vertical Datum of 1929

USCS = Unified Soil Classification System

[1] = Defined as the sample fraction which is greater than or equal to 4.76 millimeters (i.e., retained on sieve sizes greater than or equal to the Number 4 sieve).

[2] = Defined as the sample fraction which is greater than or equal to 2 millimeters and less than 4.76 millimeters (i.e., retained on sieve sizes between the Number 5 and Number 10 sieves).

[3] = Defined as the sample fraction which is greater than or equal to 0.0625 millimeters and less than 2 millimeters (i.e., retained on sieve sizes between the Number 12 and Number 230 sieves).

[4] = Defined as the sample fraction which is less than 0.0625 millimeters (i.e., passes the Number 230 sieve).

[5] = Visual percent shell determined using the Terry and Chilingar method (1955).

[6] = Percent carbonate determined using the Tyler and Twenhofel acid digestion method (1941).

[7] = Mean grain size was calculated in gINT using the Moment Method.

mm = millimeters

N/A = Not analyzed

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APPENDIX A
Core Photographs and Logs

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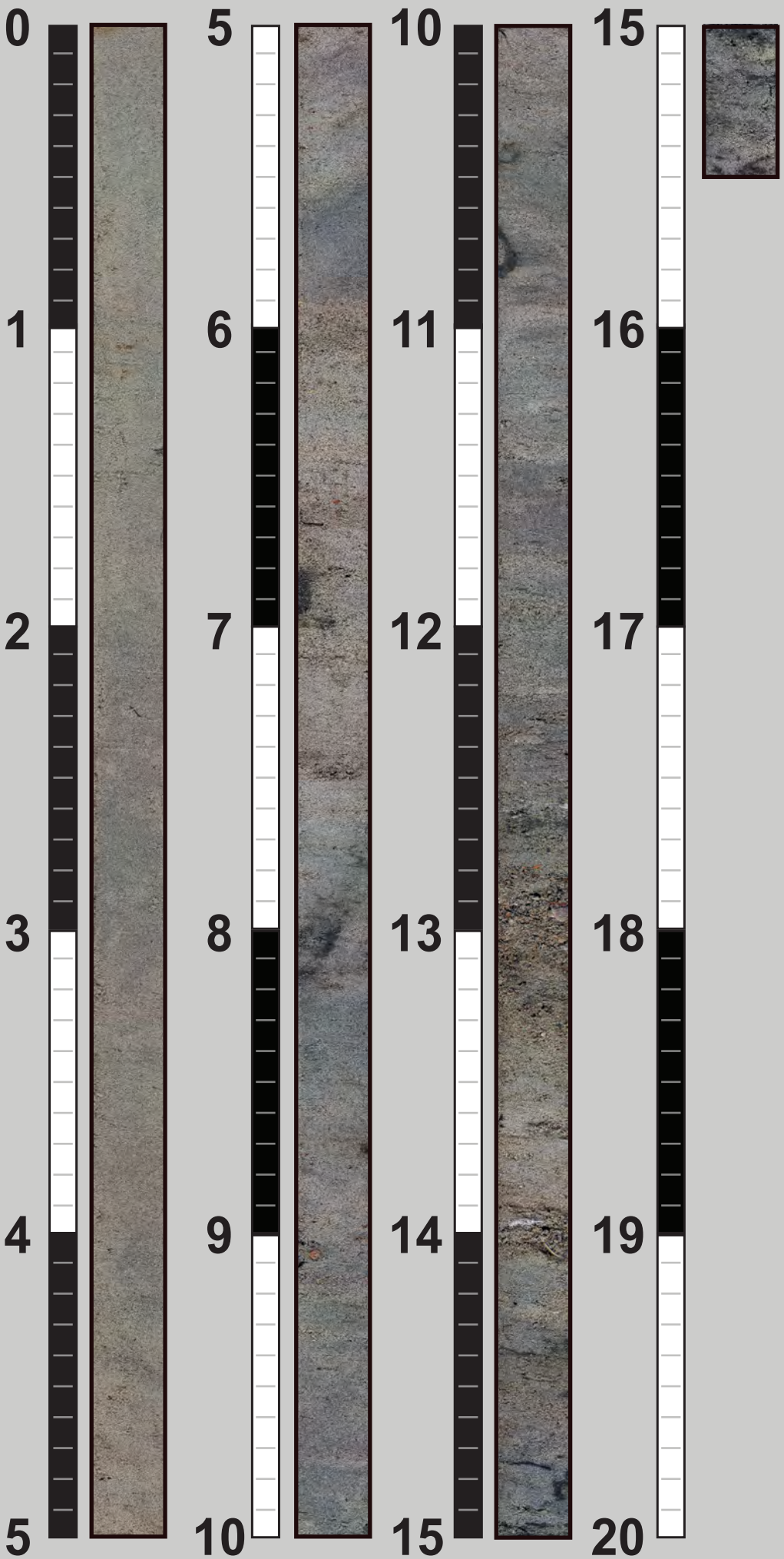

Olsen Associates, Inc.

**2022 Geotechnical Investigation,
Jay Bird Shoals
Borrow Area Expansion,
Brunswick County,
North Carolina**

JBS-22-01

Top Elev. (ft NAVD88): -8.6
Bottom Elev. (ft NAVD88): -24.1

Notes:
- Photo Mosaic Image
- Photo Scale in Feet

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Boring Designation JBS-22-01

DRILLING LOG	CLIENT	PROJECT OWNER	SHEET
	Olsen Associates, Inc.	Village Of Bald Head Island	1 OF 2 SHEETS

1. PROJECT: Jay Bird Shoals Borrow Area Expansion, Brunswick County, NC		9. SIZE AND TYPE OF BIT: 3.0 In.	
		10. COORDINATE SYSTEM/DATUM: NC State Plane	HORIZONTAL: NAD 1983 / VERTICAL: NGVD 29
2. BORING DESIGNATION: JBS-22-01	LOCATION COORDINATES: X = 2,295,023 Y = 45,629	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: Athena Technologies, Inc.	CONTRACTOR FILE NO.	12. TOTAL SAMPLES	DISTURBED: 1 / UNDISTURBED (UD): 2
4. NAME OF DRILLER: P. McClellan		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL	BEARING	14. WATER DEPTH: 11.4 Ft.
		15. DATE BORING	STARTED: 07-11-22 16:11 / COMPLETED: 07-11-22
6. THICKNESS OF OVERBURDEN: 0.0 Ft.		16. ELEVATION TOP OF BORING: -8.6 Ft.	
7. DEPTH DRILLED INTO ROCK: 0.0 Ft.		17. TOTAL RECOVERY FOR BORING: 15.5 Ft.	
8. TOTAL DEPTH OF BORING: 17.2 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Adam Freeze	

ELEV. (ft)	SCALE (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-8.6	0.0					
			Poorly graded SAND; fine to medium quartz sand, trace fine to medium sand-sized shells in matrix occasional fine gravel-sized shells below 5.0', loose, subangular, gray (2.5Y-6/1), (SP).		S1	Sample #S1, Depth = 5.1' (SP), Mean (mm): 0.22, Phi Sorting: 0.66 Shell: 11% Fines (#230) - 1.49
-14.5	5.9					
			Poorly graded SAND; fine to medium quartz sand, trace fine to coarse sand-sized shells, clay-lined Callianassa major burrow trace at 6.8-7.0', loose, subangular, light brownish gray (2.5Y-6/2), (SP).		C1	Sample #C1, Depth = 0.0' - 15.4' (SP), Mean (mm): 0.24, Phi Sorting: 0.85 Shell: 4% Carbonate: 6.9% Fines (#230) - 1.82
-15.8	7.2					
			Poorly graded SAND; fine grading to fine to medium quartz sand, trace inorganic clay in occasional burrows, clay-lined burrow trace at 10.7-10.9', trace fine to coarse sand-sized shells in matrix & in layers below 10.9', loose, subangular, gray (2.5Y-6/1), (SP).		S2	Sample #S2, Depth = 10.3' (SP), Mean (mm): 0.23, Phi Sorting: 0.79 Shell: 4% Fines (#230) - 1.25

FLORIDA DEP ROSS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

SAJ FORM 1836 JUN 02 — MODIFIED FOR THE NC DEQ AUGUST 21

(Continued)

Boring Designation JBS-22-01

DRILLING LOG (Cont. Sheet)	INSTALLATION		SHEET 2 OF 2 SHEETS
	Village Of Bald Head Island		
PROJECT	**COORDINATE SYSTEM/DATUM**	**HORIZONTAL**	**VERTICAL**
Jay Bird Shoals Borrow Area Expansion	NC State Plane	NAD 1983	NGVD 29
LOCATION COORDINATES	**ELEVATION TOP OF BORING**		
X = 2,295,023 Y = 45,629	-8.6 Ft.		

ELEV. (ft)	SCALE (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-21.5	12.9					
-22.8	14.2		Poorly graded SAND; medium quartz sand, few fine sand to coarse gravel-sized shells in matrix & in layer at base, loose, subangular, grayish brown (2.5Y-5/2), (SP).		C1	
-23.6	15.0		Poorly graded SAND; fine to medium quartz sand, trace fine to coarse sand-sized shells in matrix, trace inorganic clay in occasional burrows & flaser beds, loose, subangular, grayish brown (2.5Y-5/2) grades to, gray (2.5Y-5/1), (SP).			
-24.1	15.5		Poorly graded SAND; fine quartz sand, trace inorganic/organic clay in matrix, burrows & laminations, trace fine to coarse sand-sized shells, loose, subangular, olive gray (5Y-4/2), (SP).			
			End of Boring			

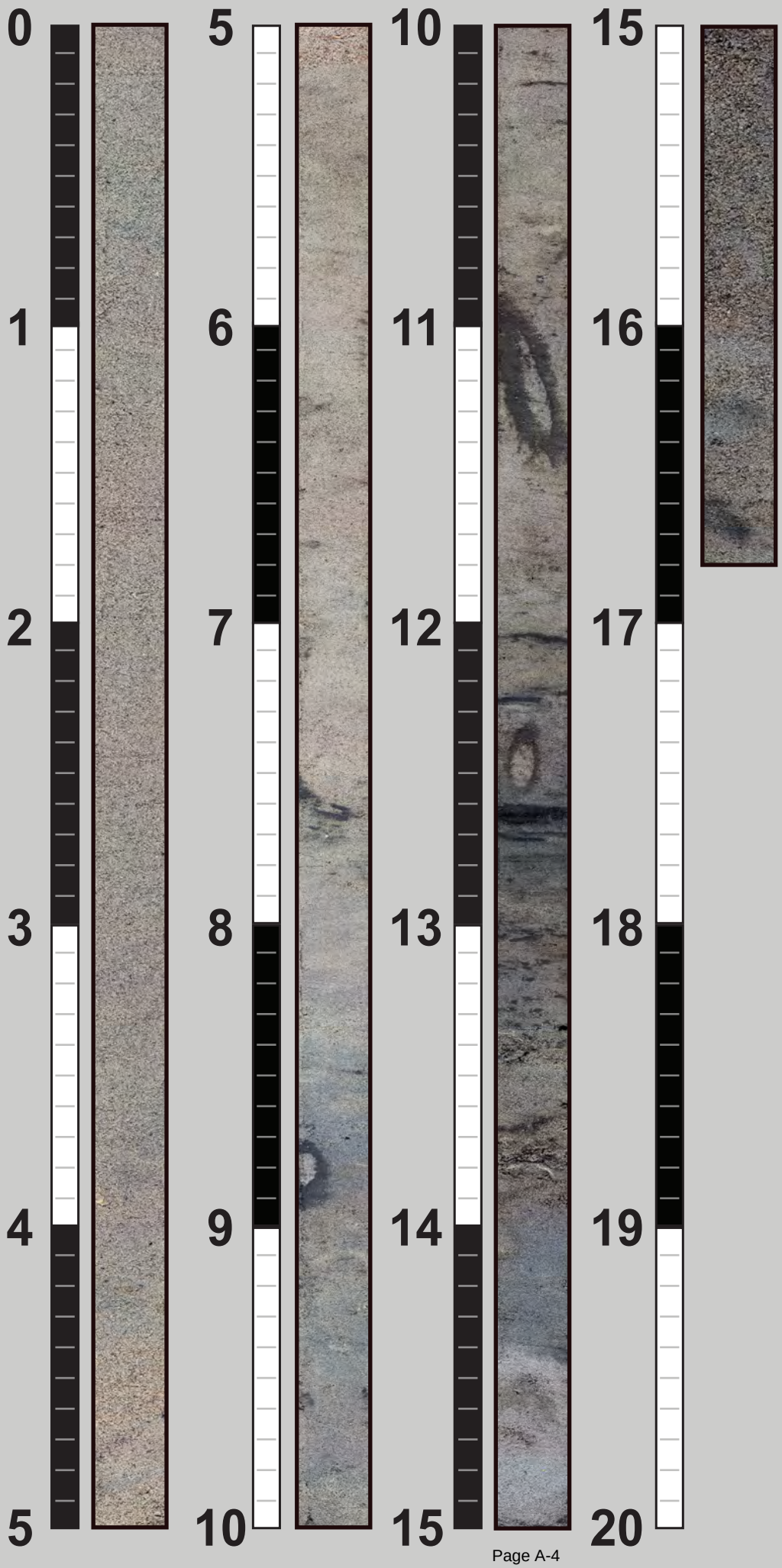
15

20

25

FLORIDA DEP ROSS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

SAJ FORM 1836 **MODIFIED FOR THE NC DEQ**
JUN 02 **AUGUST 21**



Olsen Associates, Inc.

**2022 Geotechnical Investigation,
Jay Bird Shoals
Borrow Area Expansion,
Brunswick County,
North Carolina**

JBS-22-02

Top Elev. (ft NAVD88): -7.1
Bottom Elev. (ft NAVD88): -23.9

Notes:
- Photo Mosaic Image
- Photo Scale in Feet

ATHENA TECHNOLOGIES, INC.

Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
www.athenatechnologies.com
(843) 887-3800

Boring Designation JBS-22-02

DRILLING LOG	CLIENT	PROJECT OWNER	SHEET 1 OF 2 SHEETS
	Olsen Associates, Inc.	Village Of Bald Head Island	

1. PROJECT: Jay Bird Shoals Borrow Area Expansion, Brunswick County, NC		9. SIZE AND TYPE OF BIT: 3.0 In.	
		10. COORDINATE SYSTEM/DATUM: NC State Plane	HORIZONTAL: NAD 1983 / VERTICAL: NGVD 29
2. BORING DESIGNATION: JBS-22-02	LOCATION COORDINATES: X = 2,295,790 Y = 45,040	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: Athena Technologies, Inc.	CONTRACTOR FILE NO.	12. TOTAL SAMPLES	DISTURBED: 1 / UNDISTURBED (UD): 2
4. NAME OF DRILLER: P. McClellan		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. WATER DEPTH: 9.5 Ft.	
		15. DATE BORING	STARTED: 07-11-22 15:21 / COMPLETED: 07-11-22
6. THICKNESS OF OVERBURDEN: 0.0 Ft.		16. ELEVATION TOP OF BORING: -7.1 Ft.	
7. DEPTH DRILLED INTO ROCK: 0.0 Ft.		17. TOTAL RECOVERY FOR BORING: 16.8 Ft.	
8. TOTAL DEPTH OF BORING: 19.3 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Adam Freeze	

ELEV. (ft)	SCALE (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-7.1	0.0					0
			Poorly graded SAND; fine to medium quartz sand, few fine to coarse sand-sized shells in matrix, occasional fine gravel-sized shells, loose, subangular, olive gray (5Y-5/2), (SP).			
-12.3	5.2					5
			Poorly graded SAND; fine quartz sand, trace inorganic clay in burrows, clay-lined Callianassa major burrow traces at 8.7-8.9' & 10.8-11.5', trace fine to coarse sand-sized shells, loose, subangular, light brownish gray (2.5Y-6/2), (SP).		S1	Sample #S1, Depth = 5.6' (SP), Mean (mm): 0.22, Phi Sorting: 0.67 Shell: 4% Fines (#230) - 1.34
					C1	Sample #C1, Depth = 0.0' - 16.8' (SP), Mean (mm): 0.26, Phi Sorting: 1.01 Shell: 11% Carbonate: 9.3% Fines (#230) - 2.05
						10
					S2	Sample #S2, Depth = 11.2' (SP), Mean (mm): 0.19, Phi Sorting: 0.56 Shell: 3% Fines (#230) - 3.76
-19.3	12.2					

FLORIDA DEP ROSS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

SAJ FORM 1836 **MODIFIED FOR THE NC DEQ**
JUN 02 **AUGUST 21**

(Continued)

Boring Designation JBS-22-02

DRILLING LOG (Cont. Sheet)	INSTALLATION		SHEET 2 OF 2 SHEETS
	Village Of Bald Head Island		
PROJECT	**COORDINATE SYSTEM/DATUM**	**HORIZONTAL**	**VERTICAL**
Jay Bird Shoals Borrow Area Expansion	NC State Plane	NAD 1983	NGVD 29
LOCATION COORDINATES	**ELEVATION TOP OF BORING**		
X = 2,295,790 Y = 45,040	-7.1 Ft.		

ELEV. (ft)	SCALE (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-20.4	13.3		Poorly graded SAND; fine quartz sand, trace inorganic clay in burrows & laminations, clay-lined Callianassa major burrow trace at 12.3-12.6', organic silt present at 12.6', trace fine to medium sand-sized shells, notable mica, loose, subangular, dark gray (5Y-4/1), (SP). *(continued)*			
-20.9	13.8					
-22.1	15.0		Poorly graded SAND; fine to medium quartz sand, few fine sand to coarse gravel-sized shells, trace inorganic clay in laminations, loose, subangular, olive gray (5Y-5/2), (SP).		C1	
			Poorly graded SAND; fine quartz sand, trace fine to coarse sand-sized shells, loose, subangular, notable mica, gray (5Y-5/1) grades to, gray (5Y-6/1), (SP).			
-23.9	16.8		Poorly graded SAND; medium quartz sand, few fine sand to fine gravel-sized shells in matrix, trace inorganic clay in burrow at base, loose, subangular, grayish brown (2.5Y-5/2), (SP).			
			End of Boring			

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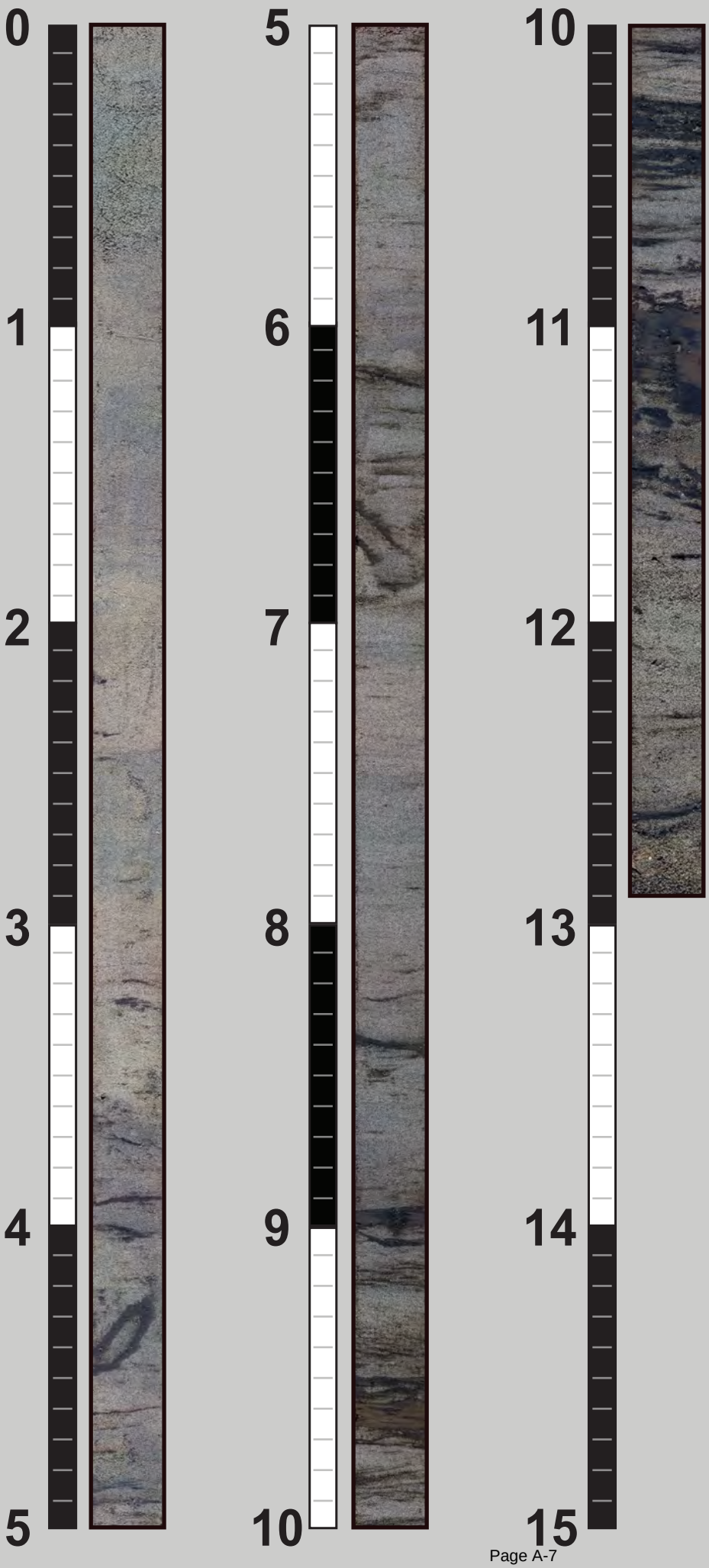
FLORIDA DEP ROSS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

SAJ FORM 1836 **MODIFIED FOR THE NC DEQ**
JUN 02 **AUGUST 21**



Olsen Associates, Inc.

**2022 Geotechnical Investigation,
Jay Bird Shoals
Borrow Area Expansion,
Brunswick County,
North Carolina**

JBS-22-03

Top Elev. (ft NAVD88): -14.6
Bottom Elev. (ft NAVD88): -27.5

Notes:
- Photo Mosaic Image
- Photo Scale in Feet

ATHENA TECHNOLOGIES, INC.

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1293 Graham Farm Road
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Boring Designation JBS-22-03

DRILLING LOG	CLIENT	PROJECT OWNER	SHEET 1 OF 2 SHEETS
	Olsen Associates, Inc.	Village Of Bald Head Island	

1. PROJECT: Jay Bird Shoals Borrow Area Expansion, Brunswick County, NC		9. SIZE AND TYPE OF BIT: 3.0 In.	
		10. COORDINATE SYSTEM/DATUM: NC State Plane	HORIZONTAL: NAD 1983 / VERTICAL: NGVD 29
2. BORING DESIGNATION: JBS-22-03	LOCATION COORDINATES: X = 2,296,510 Y = 44,548	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: Athena Technologies, Inc.	CONTRACTOR FILE NO.	12. TOTAL SAMPLES	DISTURBED: 1 / UNDISTURBED (UD): 2
4. NAME OF DRILLER: P. McClellan		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. WATER DEPTH: 15.2 Ft.	
		15. DATE BORING	STARTED: 07-11-22 14:28 / COMPLETED: 07-11-22
6. THICKNESS OF OVERBURDEN: 0.0 Ft.		16. ELEVATION TOP OF BORING: -14.6 Ft.	
7. DEPTH DRILLED INTO ROCK: 0.0 Ft.		17. TOTAL RECOVERY FOR BORING: 12.9 Ft.	
8. TOTAL DEPTH OF BORING: 15.2 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Adam Freeze	

ELEV. (ft)	SCALE (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-14.6	0.0					
			Poorly graded SAND; fine quartz sand, trace inorganic/organic clay in occasional burrows, trace fine sand-sized shells, notable mica, loose, subangular, olive gray (5Y-5/2), (SP).		S1	Sample #S1, Depth = 3.1' (SP), Mean (mm): 0.18, Phi Sorting: 0.43 Shell: 6% Fines (#230) - 1.91
-18.2	3.6					
			Poorly graded SAND; fine quartz sand, trace inorganic/organic clay in burrows & laminations, clay-lined Callianassa major burrow traces at 4.2-4.5' & 6.6-6.8', notable mica, loose, subangular, olive gray (5Y-5/2) and, very dark grayish brown (2.5Y-3/2), (SP).		C1	Sample #C1, Depth = 0.0' - 9.4' (SP), Mean (mm): 0.16, Phi Sorting: 0.39 Shell: 2% Carbonate: 6.0% Fines (#230) - 2.05
					S2	Sample #S2, Depth = 6.3' (SP), Mean (mm): 0.16, Phi Sorting: 0.37 Shell: 6% Fines (#230) - 2.41
-23.5	8.9					
			Poorly graded SAND; fine quartz sand interbedded with inorganic/organic clay in laminations & layers, trace fine sand-sized shells, loose, subangular, olive gray (5Y-5/2) and, dark olive gray (5Y-3/2), (SP-SC).			
-25.5	10.9					
-25.9	11.3		Clayey SAND; fine quartz sand, some inorganic/organic clay, clean sand in burrows, loose/soft, very dark grayish brown (2.5Y-3/2), (SC).			

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FLORIDA DEP ROSS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

SAJ FORM 1836 **MODIFIED FOR THE NC DEQ**
JUN 02 **AUGUST 21**

(Continued)

Boring Designation JBS-22-03

DRILLING LOG (Cont. Sheet)	INSTALLATION		SHEET 2 OF 2 SHEETS
	Village Of Bald Head Island		
PROJECT	**COORDINATE SYSTEM/DATUM**	**HORIZONTAL**	**VERTICAL**
Jay Bird Shoals Borrow Area Expansion	NC State Plane	NAD 1983	NGVD 29
LOCATION COORDINATES	**ELEVATION TOP OF BORING**		
X = 2,296,510 Y = 44,548	-14.6 Ft.		

ELEV. (ft)	SCALE (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-27.5	12.9		Poorly graded SAND; fine to medium quartz sand, trace fine sand to fine gravel-sized shells, trace inorganic/organic clay in burrows & in lamination at 12.6', coarse gravel-sized shell at 12.8', loose, subangular, grayish brown (2.5Y-5/2), (SP). *(continued)*			
			End of Boring			

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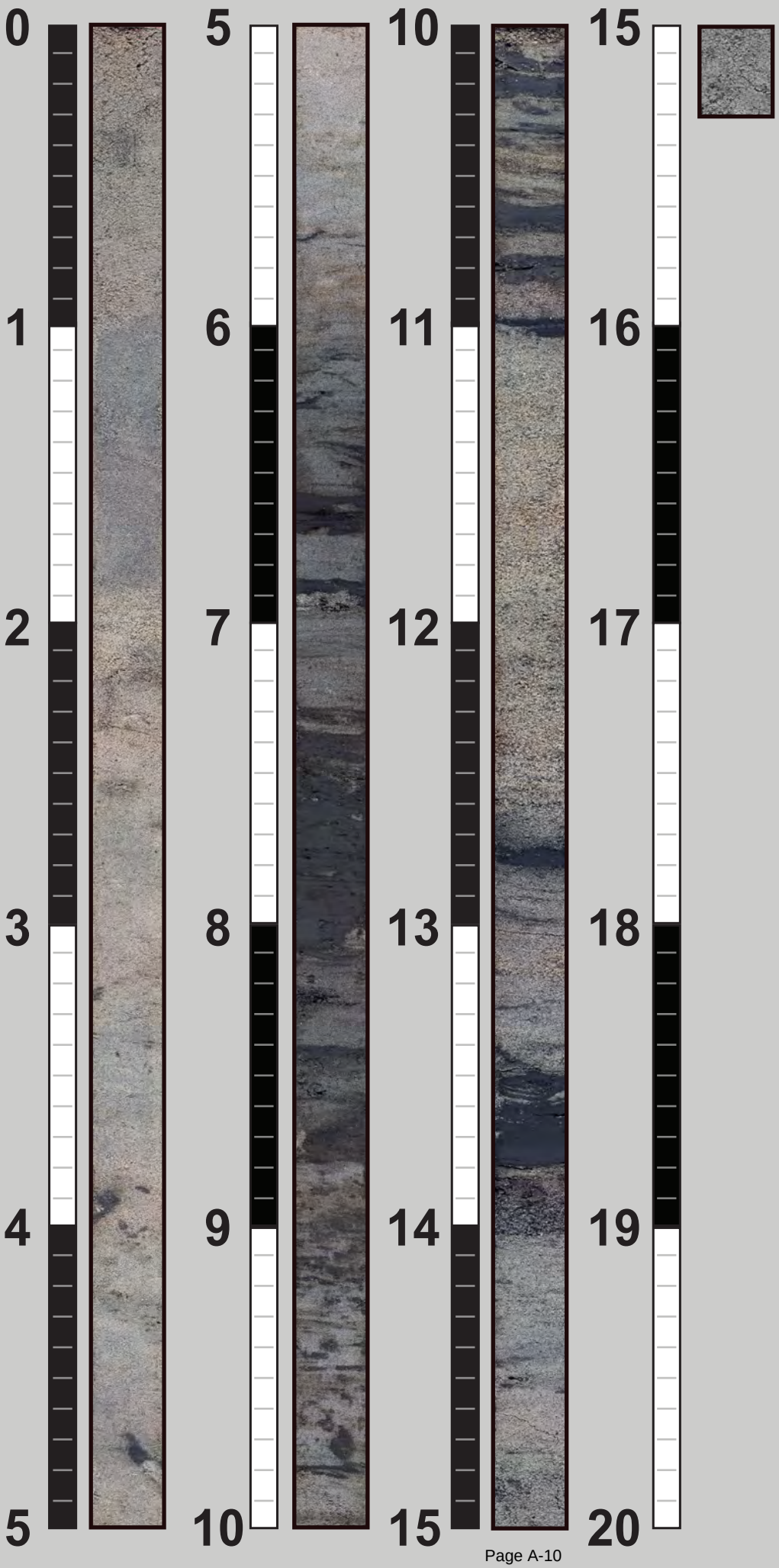
FLORIDA DEP ROSS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

SAJ FORM 1836 **MODIFIED FOR THE NC DEQ**
JUN 02 **AUGUST 21**



Olsen Associates, Inc.

**2022 Geotechnical Investigation,
Jay Bird Shoals
Borrow Area Expansion,
Brunswick County,
North Carolina**

JBS-22-04

Top Elev. (ft NAVD88): -9.6
Bottom Elev. (ft NAVD88): -24.9

Notes:
- Photo Mosaic Image
- Photo Scale in Feet

ATHENA TECHNOLOGIES, INC.

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Boring Designation JBS-22-04

DRILLING LOG	CLIENT	PROJECT OWNER	SHEET 1 OF 2 SHEETS
	Olsen Associates, Inc.	Village Of Bald Head Island	

1. PROJECT: Jay Bird Shoals Borrow Area Expansion, Brunswick County, NC		9. SIZE AND TYPE OF BIT: 3.0 In.	
		10. COORDINATE SYSTEM/DATUM: NC State Plane	HORIZONTAL: NAD 1983 / VERTICAL: NGVD 29
2. BORING DESIGNATION: JBS-22-04	LOCATION COORDINATES: X = 2,295,449 Y = 44,599	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: Athena Technologies, Inc.	CONTRACTOR FILE NO.	12. TOTAL SAMPLES	DISTURBED: 1 / UNDISTURBED (UD): 2
4. NAME OF DRILLER: P. McClellan		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. WATER DEPTH: 9.5 Ft.	
		15. DATE BORING	STARTED: 07-11-22 13:54 / COMPLETED: 07-11-22
6. THICKNESS OF OVERBURDEN: 0.0 Ft.		16. ELEVATION TOP OF BORING: -9.6 Ft.	
7. DEPTH DRILLED INTO ROCK: 0.0 Ft.		17. TOTAL RECOVERY FOR BORING: 15.3 Ft.	
8. TOTAL DEPTH OF BORING: 18.0 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Adam Freeze	

ELEV. (ft)	SCALE (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-9.6	0.0					
			Poorly graded SAND; fine quartz sand, trace fine to medium sand-sized shells in matrix, loose, subangular, gray (2.5Y-6/1), (SP).			
-11.5	1.9					
			Poorly graded SAND; fine to medium grading to fine quartz sand, trace inorganic clay in burrows, trace fine to coarse sand-sized shells in matrix & in layer at top, occasional fine gravel-sized shells to 2.4', loose, subangular, grayish brown (2.5Y-5/2), (SP).		C1	Sample #C1, Depth = 0.0' - 7.4' (SP), Mean (mm): 0.19, Phi Sorting: 0.62 Shell: 4% Carbonate: 7.5% Fines (#230) - 2.88
					S1	Sample #S1, Depth = 4.8' (SP), Mean (mm): 0.19, Phi Sorting: 0.48 Shell: 1% Fines (#230) - 1.93
-15.2	5.6					
			Poorly graded SAND; fine quartz sand, trace inorganic/organic clay in flaser beds, laminations & layers, notable mica, loose, subangular, olive gray (5Y-5/2) grades to, olive gray (5Y-4/2), (SP).			
-16.9	7.3					
			Clayey SAND; fine quartz sand, little inorganic/organic clay, clean sand in burrows, loose/soft, very dark gray (2.5Y-3/1), (SC).			
-17.7	8.1					
			Poorly graded SAND with clay; fine quartz sand, few inorganic/organic clay in matrix, burrows, laminations & in layers below 10.1', sand grain size increases slightly below 10.4', loose, subangular, olive gray (5Y-4/2) and, very dark grayish brown (2.5Y-3/2), (SP-SC).		S2	Sample #S2, Depth = 9.6' (SP-SM), Mean (mm): 0.16, Phi Sorting: 0.40 Shell: 0% Fines (#230) - 7.01
-20.6	11.0					
			Poorly graded SAND; medium quartz sand, few fine to coarse sand-sized shells in matrix, loose, subangular, grayish brown (2.5Y-5/2), (SP).			

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FLORIDA DEP ROSS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

SAJ FORM 1836 **MODIFIED FOR THE NC DEQ**
JUN 02 **AUGUST 21**

(Continued)

Boring Designation JBS-22-04

DRILLING LOG (Cont. Sheet)	INSTALLATION		SHEET 2 OF 2 SHEETS
	Village Of Bald Head Island		
PROJECT	**COORDINATE SYSTEM/DATUM**	**HORIZONTAL**	**VERTICAL**
Jay Bird Shoals Borrow Area Expansion	NC State Plane	NAD 1983	NGVD 29
LOCATION COORDINATES	**ELEVATION TOP OF BORING**		
X = 2,295,449 Y = 44,599	-9.6 Ft.		

ELEV. (ft)	SCALE (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-22.4	12.8					
-23.1	13.5		Poorly graded SAND; fine to medium quartz sand, trace inorganic/organic clay in layer at top, trace fine to medium sand-sized shells, loose, subangular, gray (2.5Y-5/1) and, black (2.5Y-2.5/1), (SP).			
-23.4	13.8		Sandy fat CLAY; little fine quartz sand in matrix & laminations, medium plasticity, soft, possibly OH, black (2.5Y-2.5/1), (CH).			
-24.9	15.3		Poorly graded SAND; medium grading to fine quartz sand, trace inorganic clay in occasional burrows, fine to coarse sand-sized shells, loose, subangular, gray (2.5Y-5/1), (SP).			
			End of Boring			

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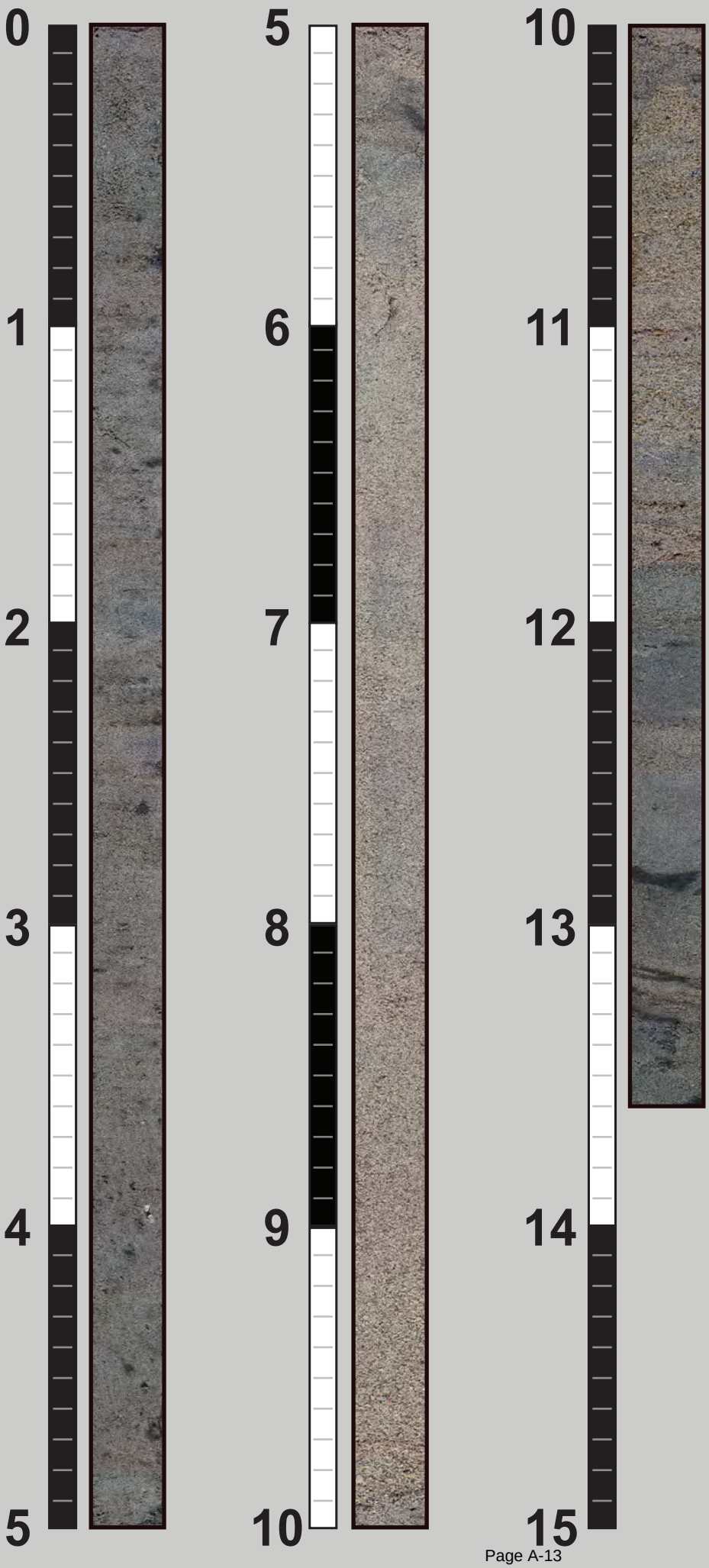
FLORIDA DEP ROSS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

SAJ FORM 1836 **MODIFIED FOR THE NC DEQ**
JUN 02 **AUGUST 21**



Olsen Associates, Inc.

**2022 Geotechnical Investigation,
Jay Bird Shoals
Borrow Area Expansion,
Brunswick County,
North Carolina**

JBS-22-05

Top Elev. (ft NAVD88): -6.3
Bottom Elev. (ft NAVD88): -19.9

Notes:
- Photo Mosaic Image
- Photo Scale in Feet

ATHENA TECHNOLOGIES, INC.

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1293 Graham Farm Road
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Boring Designation JBS-22-05

DRILLING LOG	CLIENT	PROJECT OWNER	SHEET 1 OF 2 SHEETS
	Olsen Associates, Inc.	Village Of Bald Head Island	

1. PROJECT: Jay Bird Shoals Borrow Area Expansion, Brunswick County, NC		9. SIZE AND TYPE OF BIT: 3.0 In.	
		10. COORDINATE SYSTEM/DATUM: NC State Plane	HORIZONTAL: NAD 1983 / VERTICAL: NGVD 29
2. BORING DESIGNATION: JBS-22-05	LOCATION COORDINATES: X = 2,295,017 Y = 44,947	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: Athena Technologies, Inc.	CONTRACTOR FILE NO.	12. TOTAL SAMPLES	DISTURBED: 1 / UNDISTURBED (UD): 2
4. NAME OF DRILLER: P. McClellan		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL	BEARING	14. WATER DEPTH: 10.8 Ft.
		15. DATE BORING	STARTED: 07-11-22 17:00 / COMPLETED: 07-11-22
6. THICKNESS OF OVERBURDEN: 0.0 Ft.		16. ELEVATION TOP OF BORING: -6.3 Ft.	
7. DEPTH DRILLED INTO ROCK: 0.0 Ft.		17. TOTAL RECOVERY FOR BORING: 13.6 Ft.	
8. TOTAL DEPTH OF BORING: 16.9 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Adam Freeze	

ELEV. (ft)	SCALE (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-6.3	0.0					
			Poorly graded SAND; fine quartz sand, trace inorganic clay in burrows, trace fine to coarse sand-sized shells in matrix, occasional fine gravel-sized shells, loose, subangular, olive gray (5Y-5/2), (SP).		S1	Sample #S1, Depth = 4.5' (SP), Mean (mm): 0.22, Phi Sorting: 0.73 Shell: 10% Fines (#230) - 2.13
-11.7	5.4					
			Poorly graded SAND; fine grading to medium quartz sand, few fine to medium sand-sized shells in matrix, occasional fine gravel-sized shells, shell % increases with depth, loose, subangular, light olive gray (5Y-6/2) grades to, light brownish gray (2.5Y-6/2), (SP).		C1	Sample #C1, Depth = 0.0' - 13.6' (SP), Mean (mm): 0.28, Phi Sorting: 0.97 Shell: 13% Carbonate: 9.5% Fines (#230) - 2.17
					S2	Sample #S2, Depth = 9.1' (SP), Mean (mm): 0.42, Phi Sorting: 0.96 Shell: 18% Fines (#230) - 1.09
-18.2	11.9					
			Poorly graded SAND; fine quartz sand, trace inorganic clay in occasional burrows, trace			

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FLORIDA DEP ROSS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

SAJ FORM 1836 **MODIFIED FOR THE NC DEQ**
JUN 02 **AUGUST 21**

(Continued)

Boring Designation JBS-22-05

DRILLING LOG (Cont. Sheet)	INSTALLATION		SHEET 2 OF 2 SHEETS
	Village Of Bald Head Island		
PROJECT	**COORDINATE SYSTEM/DATUM**	**HORIZONTAL**	**VERTICAL**
Jay Bird Shoals Borrow Area Expansion	NC State Plane	NAD 1983	NGVD 29
LOCATION COORDINATES	**ELEVATION TOP OF BORING**		
X = 2,295,017 Y = 44,947	-6.3 Ft.		

ELEV. (ft)	SCALE (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-19.1	12.8		fine to coarse sand-sized shells, loose, subangular, light olive gray (5Y-6/2), (SP). *(continued)*		C1	
-19.9	13.6		Poorly graded SAND; fine quartz sand, trace inorganic clay in burrows, laminations & in layer at top, trace fine to medium sand-sized shells, loose, subangular, olive gray (5Y-5/2), (SP).			
			End of Boring			

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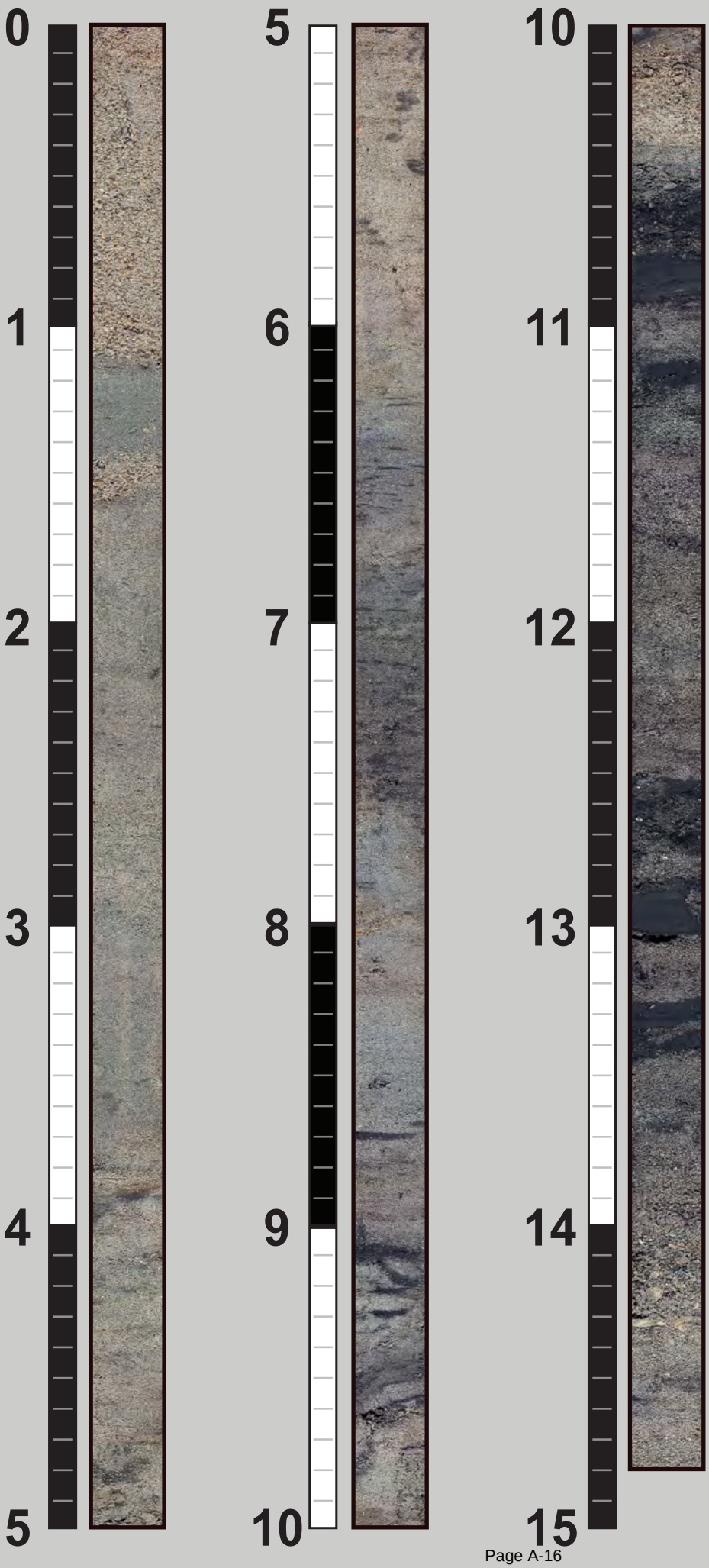
FLORIDA DEP ROSS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

SAJ FORM 1836 **MODIFIED FOR THE NC DEQ**
JUN 02 **AUGUST 21**



Olsen Associates, Inc.

**2022 Geotechnical Investigation,
Jay Bird Shoals
Borrow Area Expansion,
Brunswick County,
North Carolina**

JBS-22-06

Top Elev. (ft NGVD29): -11.3
Bottom Elev. (ft NGVD29): -26.1

Notes:
- Photo Mosaic Image
- Photo Scale in Feet

ATHENA TECHNOLOGIES, INC.

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(843) 887-3800

DRILLING LOG

CLIENT: Olsen Associates, Inc.		PROJECT OWNER: Village Of Bald Head Island	SHEET 1 OF 2 SHEETS
1. PROJECT: Jay Bird Shoals Borrow Area Expansion, Brunswick County, NC		9. SIZE AND TYPE OF BIT: 3.0 In.	
		10. COORDINATE SYSTEM/DATUM: NC State Plane	HORIZONTAL: NAD 1983 / VERTICAL: NGVD 29
2. BORING DESIGNATION: JBS-22-06	LOCATION COORDINATES: X = 2,294,323 Y = 44,771	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: Athena Technologies, Inc.	CONTRACTOR FILE NO.	12. TOTAL SAMPLES	DISTURBED: 1 / UNDISTURBED (UD): 2
4. NAME OF DRILLER: P. McClellan		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. WATER DEPTH: 11.4 Ft.	
		15. DATE BORING	STARTED: 07-11-22 13:14 / COMPLETED: 07-11-22
6. THICKNESS OF OVERBURDEN: 0.0 Ft.		16. ELEVATION TOP OF BORING: -11.3 Ft.	
7. DEPTH DRILLED INTO ROCK: 0.0 Ft.		17. TOTAL RECOVERY FOR BORING: 14.8 Ft.	
8. TOTAL DEPTH OF BORING: 17.8 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Graham Schertz	

ELEV. (ft)	SCALE (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-11.3	0.0					
-12.4	1.1		Poorly graded SAND; fine to medium quartz sand, few fine sand to fine gravel-sized shells in matrix, loose, subangular, light brownish gray (2.5Y-6/2), (SP).			
-17.3	6.0		Poorly graded SAND; fine quartz sand, trace fine to medium sand-sized shells in matrix, occasional fine gravel-sized shells below 3.5', trace inorganic clay in occasional burrows, loose, subangular, grayish brown (2.5Y-5/2), (SP).		S1	Sample #S1, Depth = 4.2' (SP), Mean (mm): 0.26, Phi Sorting: 0.75 Shell: 3% Fines (#230) - 1.47
-20.9	9.6		Poorly graded SAND; fine quartz sand, trace inorganic clay in matrix, burrows & flaser beds, trace fine to medium sand-sized shells in matrix, notable mica, loose, subangular, bioturbated, gray (2.5Y-5/1) and, very dark gray (2.5Y-3/1), (SP).		C1	Sample #C1, Depth = 0.0' - 12.7' (SP-SM), Mean (mm): 0.26, Phi Sorting: 1.04 Shell: 5% Carbonate: 10.2% Fines (#230) - 5.76
-21.8	10.5		Poorly graded SAND; fine to medium quartz sand, few fine sand to fine gravel-sized shells, trace inorganic clay in burrow at 10.0', loose, subangular, gray (2.5Y-5/1), (SP).		S2	Sample #S2, Depth = 8.5' (SP), Mean (mm): 0.18, Phi Sorting: 0.69 Shell: 2% Fines (#230) - 0.92
-22.5	11.2		Poorly graded SAND with clay; fine to medium quartz sand, few inorganic clay in matrix & layers, trace fine to coarse sand-sized shells, loose, subangular, very dark gray (2.5Y-3/1) and, gray (2.5Y-5/1), (SP-SC).			
-23.8	12.5		Poorly graded SAND; medium quartz sand, few fine sand to fine gravel-sized shells in			

0 5 10

(Continued)

FLORIDA DEP ROSS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

SAJ FORM 1836 JUN 02 **MODIFIED FOR THE NC DEQ** AUGUST 21

DRILLING LOG (Cont. Sheet)	INSTALLATION		SHEET 2 OF 2 SHEETS
	Village Of Bald Head Island		
PROJECT	**COORDINATE SYSTEM/DATUM**	**HORIZONTAL**	**VERTICAL**
Jay Bird Shoals Borrow Area Expansion	NC State Plane	NAD 1983	NGVD 29
LOCATION COORDINATES	**ELEVATION TOP OF BORING**		
X = 2,294,323 Y = 44,771	-11.3 Ft.		

ELEV. (ft)	SCALE (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
			matrix, trace inorganic silt/clay in matrix, loose, subangular, dark gray (5Y-4/1), (SP).			
-24.7	13.4		Poorly graded SAND with clay; fine to medium quartz sand, few inorganic clay in matrix & layers, trace fine to coarse sand-sized shells, loose, subangular, very dark gray (5Y-3/1) and, dark gray (5Y-4/1), (SP-SC).			
-25.7	14.4		Poorly graded SAND; medium quartz sand, little fine sand to coarse gravel-sized shells in layer between 13.9-14.4', trace inorganic clay at 13.7', loose, subangular, dark gray (5Y-4/1) grades to, gray (2.5Y-5/1), (SP).			
-26.1	14.8		Poorly graded SAND; fine to medium quartz sand, trace inorganic clay in occasional burrows, trace fine to coarse sand-sized shells, loose, subangular, gray (2.5Y-5/1), (SP).			
			End of Boring			

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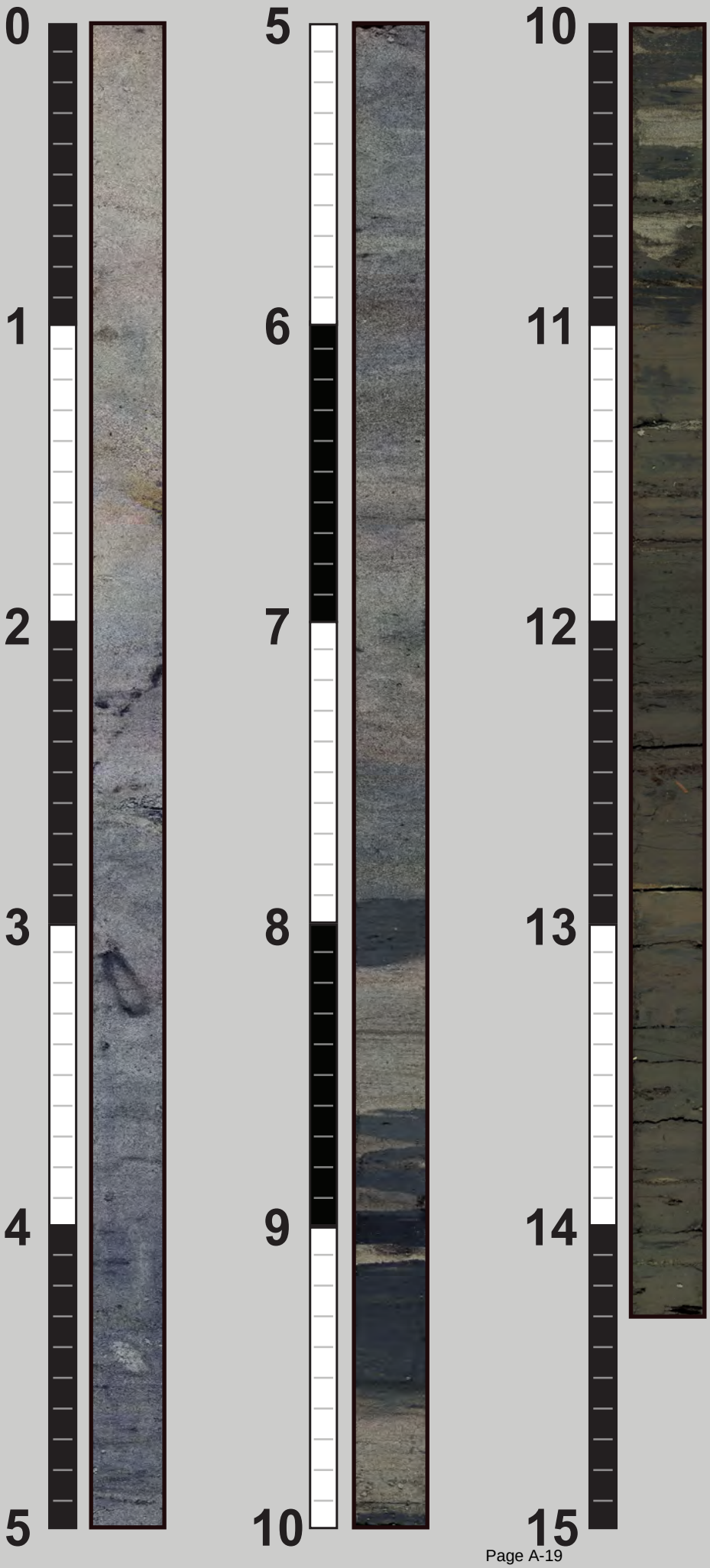
FLORIDA DEP ROSS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

SAJ FORM 1836 **MODIFIED FOR THE NC DEQ**
JUN 02 **AUGUST 21**



Olsen Associates, Inc.

**2022 Geotechnical Investigation,
Jay Bird Shoals
Borrow Area Expansion,
Brunswick County,
North Carolina**

JBS-22-07

Top Elev. (ft NGVD29): -12.7
Bottom Elev. (ft NGVD29): -27.0

Notes:
- Photo Mosaic Image
- Photo Scale in Feet

ATHENA TECHNOLOGIES, INC.

Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
www.athenatechnologies.com
(843) 887-3800

DRILLING LOG

CLIENT	Olsen Associates, Inc.
PROJECT OWNER	Village Of Bald Head Island
SHEET	1 OF 2 SHEETS
1. PROJECT	Jay Bird Shoals Borrow Area Expansion Brunswick County, NC
9. SIZE AND TYPE OF BIT	3.0 In.
10. COORDINATE SYSTEM/DATUM	NC State Plane / HORIZONTAL: NAD 1983 / VERTICAL: NGVD 29
2. BORING DESIGNATION	JBS-22-07
LOCATION COORDINATES	X = 2,295,127 Y = 44,142
11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY	Athena Technologies, Inc.
CONTRACTOR FILE NO.	
12. TOTAL SAMPLES	DISTURBED: 1 / UNDISTURBED (UD): 2
4. NAME OF DRILLER	P. McClellan
13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
14. WATER DEPTH	11.5 Ft.
15. DATE BORING	STARTED: 07-11-22 12:45 / COMPLETED: 07-11-22
6. THICKNESS OF OVERBURDEN	0.0 Ft.
16. ELEVATION TOP OF BORING	-12.7 Ft.
7. DEPTH DRILLED INTO ROCK	0.0 Ft.
17. TOTAL RECOVERY FOR BORING	14.3 Ft.
8. TOTAL DEPTH OF BORING	16.2 Ft.
18. SIGNATURE AND TITLE OF INSPECTOR	Adam Freeze

ELEV. (ft)	SCALE (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-12.7	0.0					
			Poorly graded SAND; fine quartz sand, trace fine to coarse sand-sized shells in matrix, loose, subangular, olive gray (5Y-5/2), (SP).			
-14.8	2.1				S1	Sample #S1, Depth = 2.4' (SP), Mean (mm): 0.18, Phi Sorting: 0.47 Shell: 2% Fines (#230) - 1.26
			Poorly graded SAND; fine quartz sand, trace fine sand-sized shells in matrix & laminations, trace inorganic clay in burrows & laminations, clay-lined Callianassa major burrow trace at 3.0-3.3', notable mica, loose, subangular, gray (5Y-5/1) grades to, dark gray (5Y-4/1), (SP).		C1	Sample #C1, Depth = 0.0' - 7.3' (SP), Mean (mm): 0.18, Phi Sorting: 0.53 Shell: 4% Carbonate: 7.7% Fines (#230) - 2.45
					S2	Sample #S2, Depth = 4.9' (SP), Mean (mm): 0.16, Phi Sorting: 0.53 Shell: 3% Fines (#230) - 2.54
-20.6	7.9					
-20.8	8.1		Clayey SAND, very dark gray (2.5Y-3/1), (SC).			
-21.3	8.6		Poorly graded SAND; fine quartz sand, trace fine sand-sized shells, notable mica, loose, subangular, grayish brown (2.5Y-5/2), (SP).			
-22.2	9.5		Sandy fat CLAY; little fine quartz sand in matrix & layers, trace organic silt/material in matrix, medium plasticity, soft, possibly OH, very dark gray (2.5Y-3/1), (CH).			
-22.7	10.0		Poorly graded SAND; fine quartz sand, trace inorganic clay in occasional burrows, trace fine sand-sized shells, notable mica, loose, subangular, grayish brown (2.5Y-5/2), (SP).			
-23.5	10.8		Clayey SAND; fine quartz sand, some inorganic/organic clay in layers and laminations, trace organic silt in clay intervals, trace fine sand-sized shells, notable mica, loose/soft, dark olive gray (5Y-3/2) and, grayish brown (2.5Y-5/2), (SC).			

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FLORIDA DEP ROSS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

SAJ FORM 1836 **MODIFIED FOR THE NC DEQ**
JUN 02 **AUGUST 21**

(Continued)

Boring Designation JBS-22-07

DRILLING LOG (Cont. Sheet)	INSTALLATION		SHEET 2 OF 2 SHEETS
	Village Of Bald Head Island		
PROJECT	**COORDINATE SYSTEM/DATUM**	**HORIZONTAL**	**VERTICAL**
Jay Bird Shoals Borrow Area Expansion	NC State Plane	NAD 1983	NGVD 29
LOCATION COORDINATES	**ELEVATION TOP OF BORING**		
X = 2,295,127 Y = 44,142	-12.7 Ft.		

ELEV. (ft)	SCALE (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-27.0	14.3		Fat CLAY with sand; few fine quartz sand in matrix & laminations, organic material present throughout, clay % increases with depth, medium plasticity, soft, possibly OH, black (2.5Y-2.5/1), (CH). *(continued)*			
			End of Boring			

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FLORIDA DEP ROSS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

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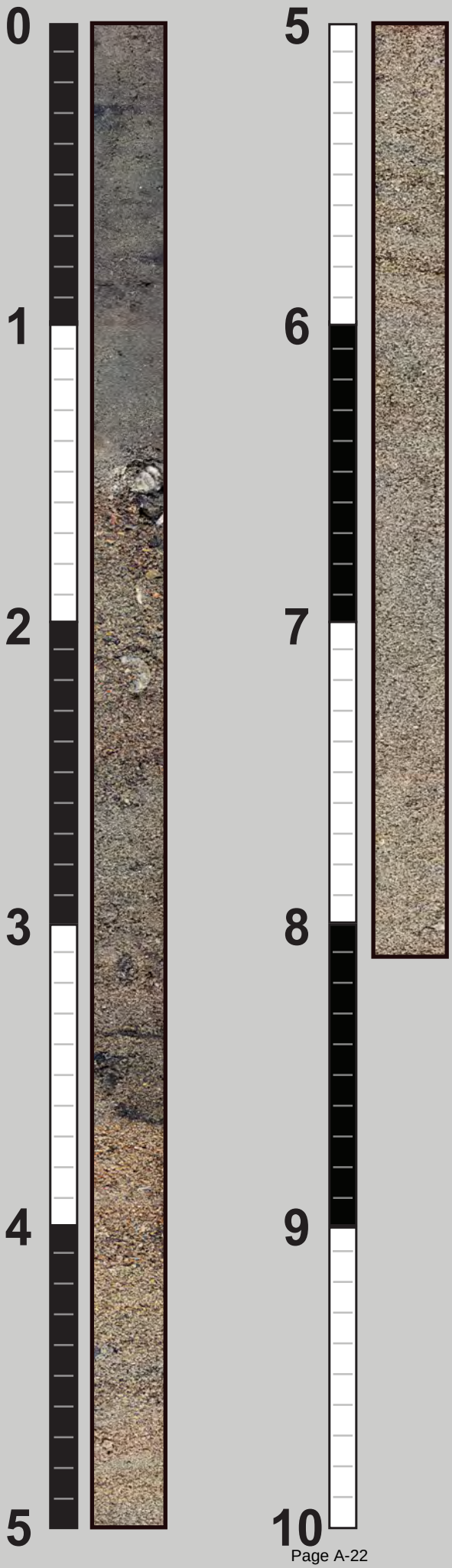
JUN 02 **AUGUST 21**



Olsen Associates, Inc.

**2022 Geotechnical Investigation,
Jay Bird Shoals
Borrow Area Expansion,
Brunswick County,
North Carolina**

JBS-22-08

Top Elev. (ft NGVD29): -17.6
Bottom Elev. (ft NGVD29): -25.7

Notes:
- Photo Mosaic Image
- Photo Scale in Feet

ATHENA TECHNOLOGIES, INC.

Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
www.athenatechnologies.com
(843) 887-3800

Boring Designation JBS-22-08

DRILLING LOG

CLIENT	Olsen Associates, Inc.
PROJECT OWNER	Village Of Bald Head Island
SHEET	1 OF 1 SHEETS
1. PROJECT	Jay Bird Shoals Borrow Area Expansion Brunswick County, NC
2. BORING DESIGNATION	JBS-22-08
LOCATION COORDINATES	X = 2,295,745 Y = 43,656
3. DRILLING AGENCY	Athena Technologies, Inc.
CONTRACTOR FILE NO.	
4. NAME OF DRILLER	P. McClellan
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
6. THICKNESS OF OVERBURDEN	0.0 Ft.
7. DEPTH DRILLED INTO ROCK	0.0 Ft.
8. TOTAL DEPTH OF BORING	10.0 Ft.
9. SIZE AND TYPE OF BIT	3.0 In.
10. COORDINATE SYSTEM/DATUM	NC State Plane / HORIZONTAL NAD 1983 / VERTICAL NGVD 29
11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
12. TOTAL SAMPLES	DISTURBED 1 / UNDISTURBED (UD) 2
13. TOTAL NUMBER CORE BOXES	
14. WATER DEPTH	16.5 Ft.
15. DATE BORING	STARTED 07-11-22 11:54 / COMPLETED 07-11-22
16. ELEVATION TOP OF BORING	-17.6 Ft.
17. TOTAL RECOVERY FOR BORING	8.1 Ft.
18. SIGNATURE AND TITLE OF INSPECTOR	Adam Freeze

ELEV. (ft)	SCALE (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-17.6	0.0					
-19.1	1.5		Poorly graded SAND; fine quartz sand, trace inorganic clay in burrows, trace fine to coarse sand-sized shells in matrix, loose, subangular, olive gray (5Y-5/2), (SP).			
-20.2	2.6		Poorly graded SAND; medium quartz sand, little fine sand to coarse gravel-sized shells in matrix, loose, subangular, grayish brown (2.5Y-5/2), (SP).		S1	Sample #S1, Depth = 2.1' (SP), Mean (mm): 0.90, Phi Sorting: 1.28 Shell: 26% Fines (#230) - 0.77
-21.2	3.6		Poorly graded SAND; medium quartz sand, few fine sand to fine gravel-sized shells, trace inorganic clay in occasional laminations, loose, subangular, grayish brown (2.5Y-5/2), (SP).		C1	Sample #C1, Depth = 0.0' - 6.4' (SP), Mean (mm): 0.55, Phi Sorting: 1.25 Shell: 15% Carbonate: 19.8% Fines (#230) - 1.60
-25.7	8.1		Poorly graded SAND; medium to coarse grading to medium quartz sand, few fine to coarse sand-sized shells in matrix, occasional fine gravel-sized shells, sand size decreases slightly with depth, loose, subangular, light olive brown (2.5Y-5/3) grades to, grayish brown (2.5Y-5/2), (SP).		S2	Sample #S2, Depth = 4.3' (SP), Mean (mm): 0.85, Phi Sorting: 0.91 Shell: 24% Fines (#230) - 0.22
			End of Boring			

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FLORIDA DEP ROSS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

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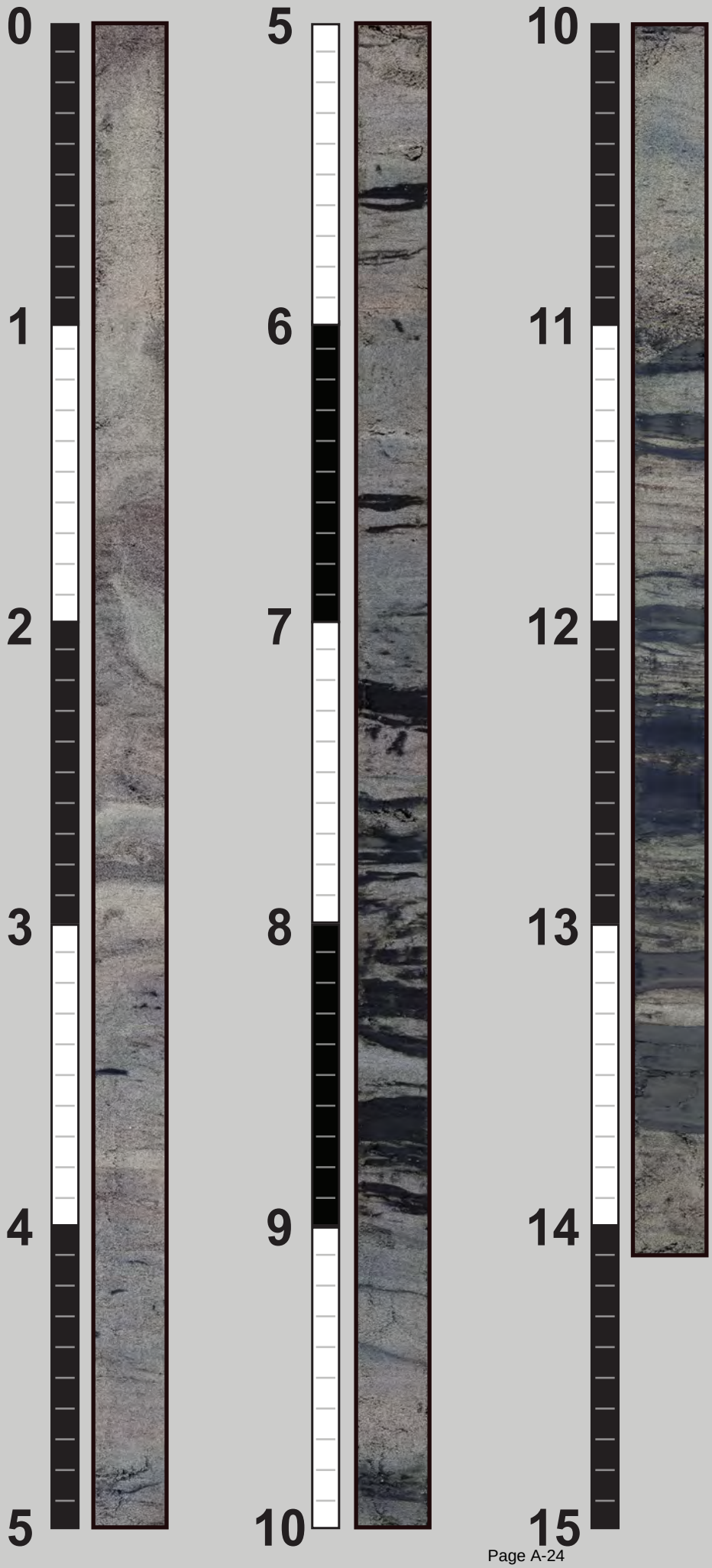
JUN 02 **AUGUST 21**



Olsen Associates, Inc.

**2022 Geotechnical Investigation,
Jay Bird Shoals
Borrow Area Expansion,
Brunswick County,
North Carolina**

JBS-22-09

Top Elev. (ft NAVD88): -12.9
Bottom Elev. (ft NAVD88): -27.0

Notes:
- Photo Mosaic Image
- Photo Scale in Feet

ATHENA TECHNOLOGIES, INC.

Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
www.athenatechnologies.com
(843) 887-3800

Boring Designation JBS-22-09

DRILLING LOG	CLIENT	PROJECT OWNER	SHEET 1 OF 2 SHEETS
	Olsen Associates, Inc.	Village Of Bald Head Island	

1. PROJECT: Jay Bird Shoals Borrow Area Expansion, Brunswick County, NC		9. SIZE AND TYPE OF BIT: 3.0 In.	
		10. COORDINATE SYSTEM/DATUM: NC State Plane	HORIZONTAL: NAD 1983 / VERTICAL: NGVD 29
2. BORING DESIGNATION: JBS-22-09	LOCATION COORDINATES: X = 2,294,677 Y = 43,797	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: Athena Technologies, Inc.	CONTRACTOR FILE NO.	12. TOTAL SAMPLES	DISTURBED: 1 / UNDISTURBED (UD): 2
4. NAME OF DRILLER: P. McClellan		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. WATER DEPTH: 11.4 Ft.	
		15. DATE BORING	STARTED: 07-11-22 11:31 / COMPLETED: 07-11-22
6. THICKNESS OF OVERBURDEN: 0.0 Ft.		16. ELEVATION TOP OF BORING: -12.9 Ft.	
7. DEPTH DRILLED INTO ROCK: 0.0 Ft.		17. TOTAL RECOVERY FOR BORING: 14.1 Ft.	
8. TOTAL DEPTH OF BORING: 16.0 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Graham Schertz	

ELEV. (ft)	SCALE (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-12.9	0.0					
			Poorly graded SAND; fine quartz sand, trace fine sand-sized shells in matrix (primarily below 1.6'), trace inorganic clay in occasional burrows below 1.9', notable mica, loose, subangular, olive gray (5Y-5/2), (SP).			
-16.0	3.1					
			Poorly graded SAND; fine quartz sand, trace inorganic/organic clay in rip-ups, flaser beds, burrows & laminations, trace fine sand-sized shells, gravel-sized shell at 5.4', loose, subangular, olive gray (5Y-5/2), (SP).		S1	Sample #S1, Depth = 3.7' (SP), Mean (mm): 0.17, Phi Sorting: 0.45 Shell: 4% Fines (#230) - 2.20
					C1	Sample #C1, Depth = 0.0' - 11.1' (SP-SM), Mean (mm): 0.16, Phi Sorting: 0.63 Shell: 9% Carbonate: 8.5% Fines (#230) - 7.31
-20.1	7.2					
			Poorly graded SAND with clay; fine quartz sand interbedded with inorganic/organic clay layers, notable mica, loose, subangular, olive gray (5Y-5/2) and, dark olive gray (5Y-3/2), (SP-SC).		S2	Sample #S2, Depth = 7.4' (SP-SM), Mean (mm): 0.15, Phi Sorting: 0.46 Shell: 2% Fines (#230) - 9.98
-21.9	9.0					
			Poorly graded SAND; fine quartz sand, trace inorganic clay in occasional burrows & laminations, trace fine to medium sand-sized shells in matrix at base, sand size increases at 10.8', loose, subangular, olive gray (5Y-5/2), (SP).			
-24.0	11.1					
			Clayey SAND; fine quartz sand interbedded with inorganic/organic clay layers, loose/soft, dark olive gray (5Y-3/2) and, olive gray (5Y-5/2), (SC).			

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FLORIDA DEP ROSS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

SAJ FORM 1836 **MODIFIED FOR THE NC DEQ**
JUN 02 **AUGUST 21**

(Continued)

DRILLING LOG (Cont. Sheet)

INSTALLATION			SHEET 2 OF 2 SHEETS
Village Of Bald Head Island			
PROJECT	**COORDINATE SYSTEM/DATUM**	**HORIZONTAL**	**VERTICAL**
Jay Bird Shoals Borrow Area Expansion	NC State Plane	NAD 1983	NGVD 29
LOCATION COORDINATES	**ELEVATION TOP OF BORING**		
X = 2,294,677 Y = 43,797	-12.9 Ft.		

ELEV. (ft)	SCALE (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-26.6	13.7		Clayey SAND; fine quartz sand interbedded with inorganic/organic clay layers, loose/soft, dark olive gray (5Y-3/2) and, olive gray (5Y-5/2), (SC). *(continued)*			
-27.0	14.1		Poorly graded SAND; fine quartz sand, trace inorganic/organic clay in burrows, loose, subangular, olive gray (5Y-4/2), (SP).			
			End of Boring			

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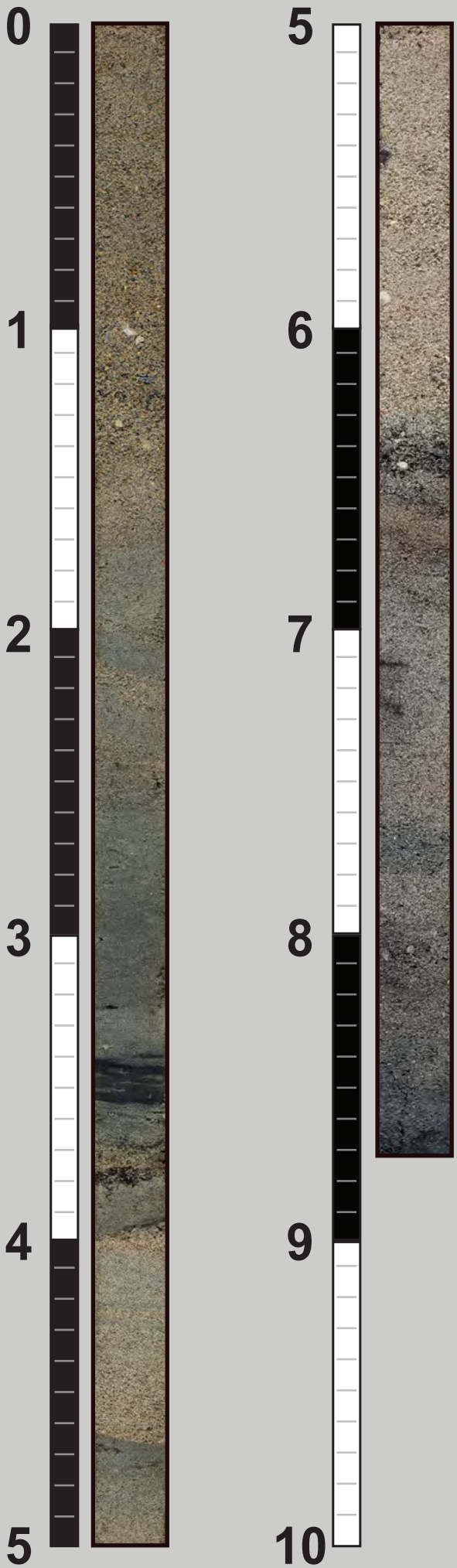
FLORIDA DEP ROSS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

SAJ FORM 1836 **MODIFIED FOR THE NC DEQ**
JUN 02 **AUGUST 21**



Olsen Associates, Inc.

**2022 Geotechnical Investigation,
Jay Bird Shoals
Borrow Area Expansion,
Brunswick County,
North Carolina**

JBS-22-10

Top Elev. (ft NGVD29): -17.7
Bottom Elev. (ft NGVD29): -26.4

Notes:
- Photo Mosaic Image
- Photo Scale in Feet

ATHENA TECHNOLOGIES, INC.

Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
www.athenatechnologies.com
(843) 887-3800

Boring Designation JBS-22-10

DRILLING LOG	CLIENT	PROJECT OWNER	SHEET 1 OF 1 SHEETS
	Olsen Associates, Inc.	Village Of Bald Head Island	

1. PROJECT: Jay Bird Shoals Borrow Area Expansion, Brunswick County, NC		9. SIZE AND TYPE OF BIT: 3.0 In.	
		10. COORDINATE SYSTEM/DATUM: NC State Plane	HORIZONTAL: NAD 1983 / VERTICAL: NGVD 29
2. BORING DESIGNATION: JBS-22-10	LOCATION COORDINATES: X = 2,295,333 Y = 43,294	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: Athena Technologies, Inc.	CONTRACTOR FILE NO.	12. TOTAL SAMPLES	DISTURBED: 1 / UNDISTURBED (UD): 2
4. NAME OF DRILLER: P. McClellan		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. WATER DEPTH: 16.6 Ft.	
		15. DATE BORING	STARTED: 07-11-22 10:45 / COMPLETED: 07-11-22
6. THICKNESS OF OVERBURDEN: 0.0 Ft.		16. ELEVATION TOP OF BORING: -17.7 Ft.	
7. DEPTH DRILLED INTO ROCK: 0.0 Ft.		17. TOTAL RECOVERY FOR BORING: 8.7 Ft.	
8. TOTAL DEPTH OF BORING: 10.3 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Adam Freeze	

ELEV. (ft)	SCALE (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-17.7	0.0					
-19.1	1.4		Poorly graded SAND; medium quartz sand, few fine sand to fine gravel0sized shells, occasional coarse gravel-sized shells, loose, subangular, grayish brown (2.5Y-5/2), (SP).			
-20.3	2.6		Poorly graded SAND; fine to medium quartz sand, trace fine to coarse sand-sized shells in matrix & layers, loose, subangular, gray (2.5Y-5/1), (SP).		S1	Sample #S1, Depth = 2.1' (SP), Mean (mm): 0.26, Phi Sorting: 0.94 Shell: 7% Fines (#230) - 1.12
-21.6	3.9		Poorly graded SAND; fine quartz sand, trace inorganic clay in lenticular bedding at 3.4-3.6', medium quartz sand & organic material in layer at 3.8', notable mica, loose, subangular, gray (2.5Y-5/1) and, dark gray (2.5Y-4/1), (SP).		C1	Sample #C1, Depth = 0.0' - 6.3' (SP), Mean (mm): 0.42, Phi Sorting: 1.44 Shell: 12% Carbonate: 14.8% Fines (#230) - 1.61
-24.2	6.5		Poorly graded SAND; medium quartz sand, few fine sand to fine gravel-sized shells in matrix, coarse gravel-sized shells below 5.9' & in layer at base, clay rip-up at 5.4', loose, subangular, grayish brown (2.5Y-5/2), (SP).		S2	Sample #S2, Depth = 4.2' (SP), Mean (mm): 0.40, Phi Sorting: 0.67 Shell: 8% Fines (#230) - 0.99
-25.7	8.0		Poorly graded SAND; medium quartz sand, trace fine to coarse sand-sized shells, occasional fine gravel-sized shells, inorganic clay present in occasional burrows, loose, subangular, olive gray (5Y-5/2), (SP).			
-26.4	8.7		Poorly graded SAND with clay; fine to medium quartz sand, few inorganic clay in matrix & in layer at base, trace fine sand to fine gravel-sized shells, loose, subangular, dark gray (5Y-4/1) grades to, dark gray (5Y-4/1), (SP-SC).			
			End of Boring			

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FLORIDA DEP ROSS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

SAJ FORM 1836 **MODIFIED FOR THE NC DEQ**
JUN 02 **AUGUST 21**

APPENDIX B
Grain Size Distribution Data

ATHENA TECHNOLOGIES, INC.

1293 Graham Farm Road, PO Box 68
McClellanville, South Carolina 29458
(843) 887-3800
www.athenatechnologies.com

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-01 #C1

Analysis Date: 08-12-22

Analyzed By: CRM

Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
Office: 843-887-3800

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,295,023	45,629	NC State Plane	-8.6 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 5Y-6/2	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

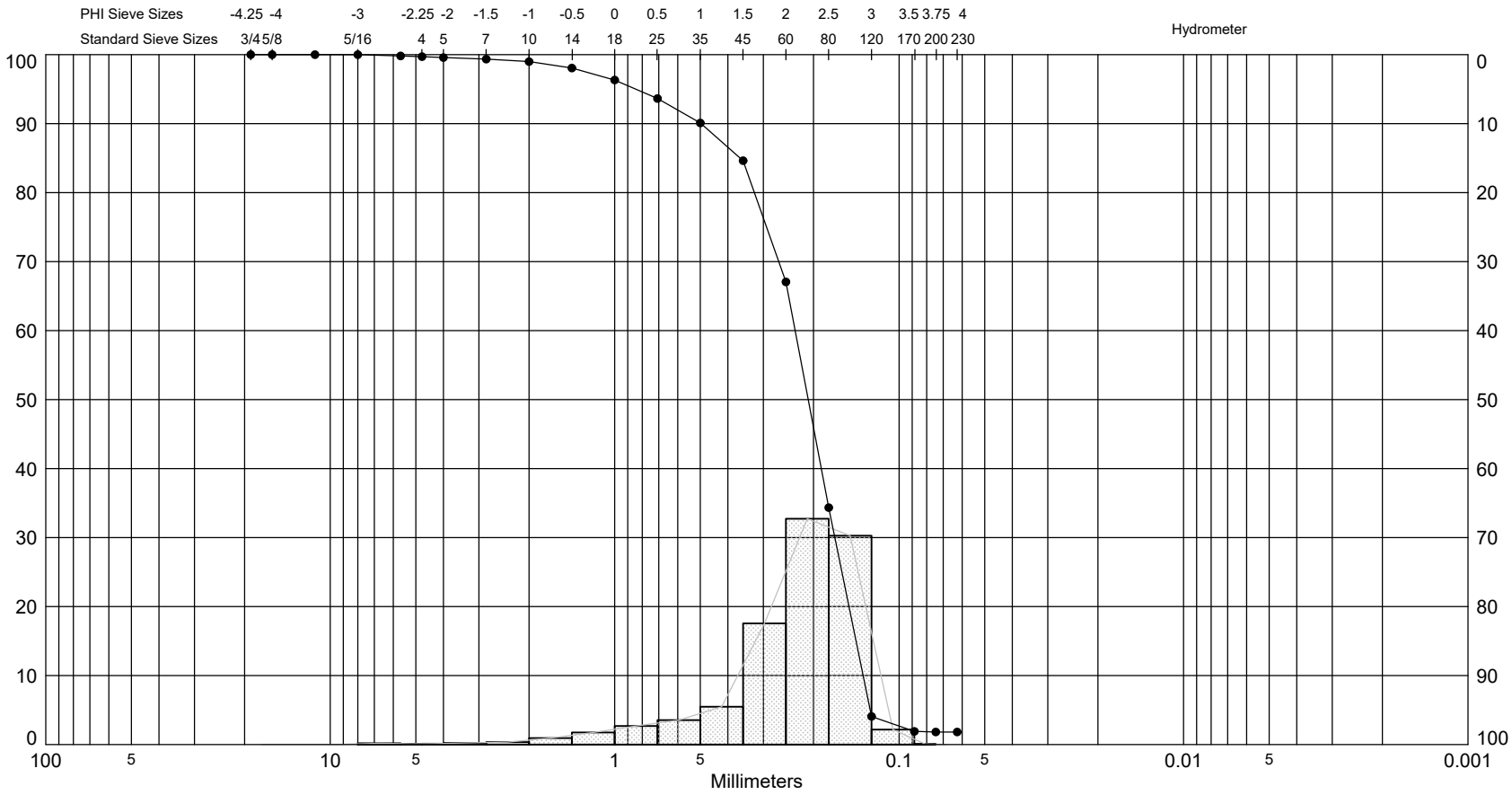
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
157.72	154.84			#200 - 1.82 #230 - 1.82		6.9	4

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.30	0.19	0.30	99.81
#4	-2.25	4.76	0.15	0.10	0.45	99.71
#5	-2.00	4.00	0.21	0.13	0.66	99.58
#7	-1.50	2.83	0.36	0.23	1.02	99.35
#10	-1.00	2.00	0.57	0.36	1.59	98.99
#14	-0.50	1.41	1.47	0.93	3.06	98.06
#18	0.00	1.00	2.74	1.74	5.80	96.32
#25	0.50	0.71	4.22	2.68	10.02	93.64
#35	1.00	0.50	5.59	3.54	15.61	90.10
#45	1.50	0.35	8.63	5.47	24.24	84.63
#60	2.00	0.25	27.71	17.57	51.95	67.06
#80	2.50	0.18	51.61	32.72	103.56	34.34
#120	3.00	0.13	47.74	30.27	151.30	4.07
#170	3.50	0.09	3.40	2.16	154.70	1.91
#200	3.75	0.07	0.14	0.09	154.84	1.82
#230	4.00	0.06	0.00	0.00	154.84	1.82

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.98	2.80	2.65	2.26	1.77	1.52	0.25

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.06	0.24	0.85	-1.96	8.28

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-01 #C1	—●—	-8.6	SP	#200 - 1.82 #230 - 1.82		6.9	2.26	2.06	-1.96	8.28	0.85

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,295,023
Northing (Y, ft):	45,629
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

Athena Technologies, Inc.
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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-01 #S1

Analysis Date: 08-12-22

Analyzed By: CRM

Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
Office: 843-887-3800

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,295,023	45,629	NC State Plane	-13.7 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 5Y-6/2	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

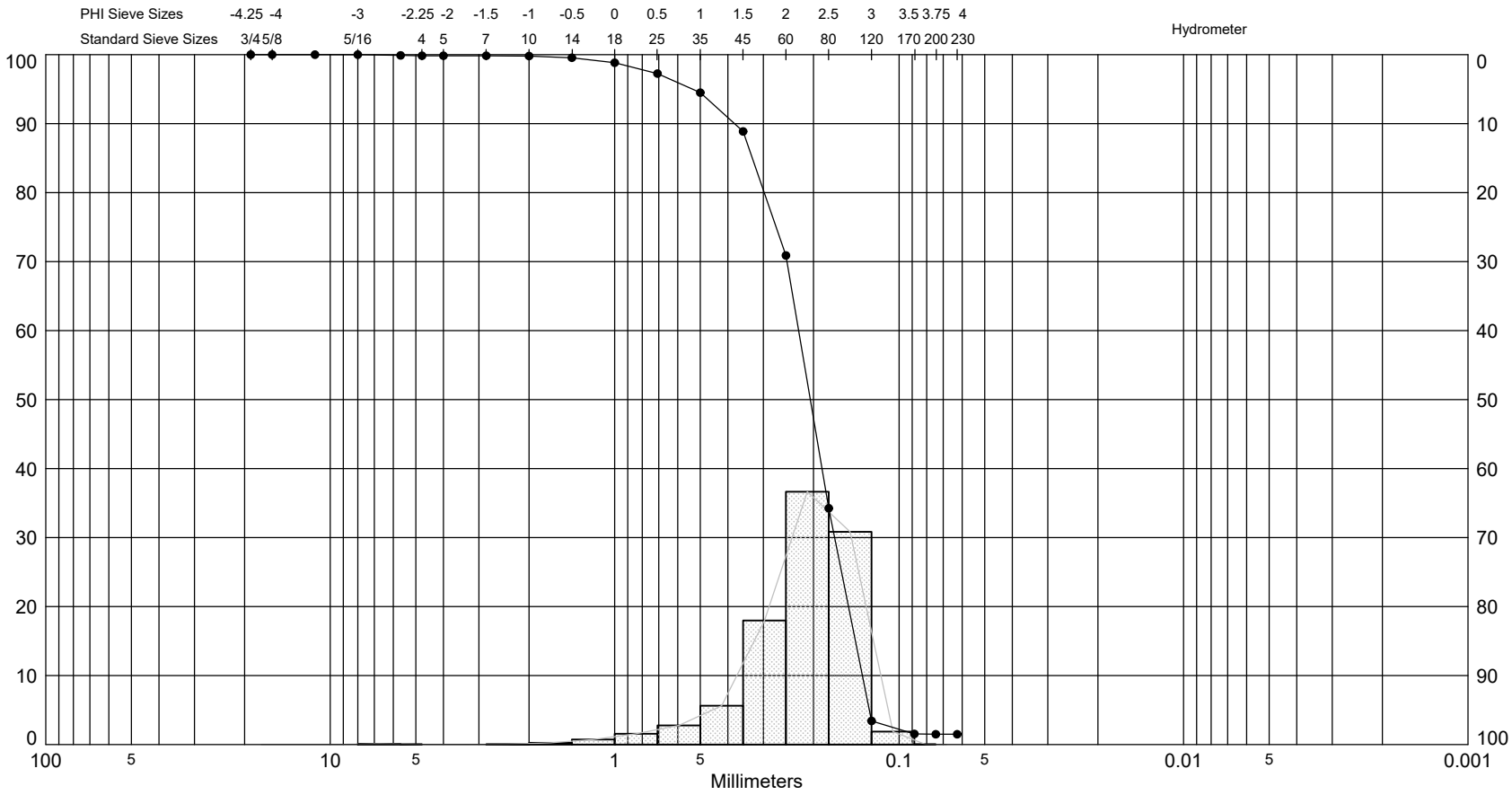
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
154.52	152.22			#200 - 1.49 #230 - 1.49			11

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.17	0.11	0.17	99.89
#4	-2.25	4.76	0.08	0.05	0.25	99.84
#5	-2.00	4.00	0.00	0.00	0.25	99.84
#7	-1.50	2.83	0.00	0.00	0.25	99.84
#10	-1.00	2.00	0.06	0.04	0.31	99.80
#14	-0.50	1.41	0.38	0.25	0.69	99.55
#18	0.00	1.00	1.11	0.72	1.80	98.83
#25	0.50	0.71	2.43	1.57	4.23	97.26
#35	1.00	0.50	4.28	2.77	8.51	94.49
#45	1.50	0.35	8.69	5.62	17.20	88.87
#60	2.00	0.25	27.78	17.98	44.98	70.89
#80	2.50	0.18	56.62	36.64	101.60	34.25
#120	3.00	0.13	47.64	30.83	149.24	3.42
#170	3.50	0.09	2.91	1.88	152.15	1.54
#200	3.75	0.07	0.07	0.05	152.22	1.49
#230	4.00	0.06	0.00	0.00	152.22	1.49

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.97	2.80	2.65	2.29	1.89	1.64	0.91

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.17	0.22	0.66	-1.85	9.59

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-01 #S1	—●—	-13.7	SP	#200 - 1.49 #230 - 1.49			2.29	2.17	-1.85	9.59	0.66

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,295,023
Northing (Y, ft):	45,629
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Athena Technologies, Inc.
1293 Graham Farm Road
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Office: 843-887-3800

Project Name:	Jay Bird Shoals Borrow Area Expansion
Sample Name:	JBS-22-01 #S2
Analysis Date:	08-12-22
Analyzed By:	CRM

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,295,023	45,629	NC State Plane	-18.9 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 5Y-5/2	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

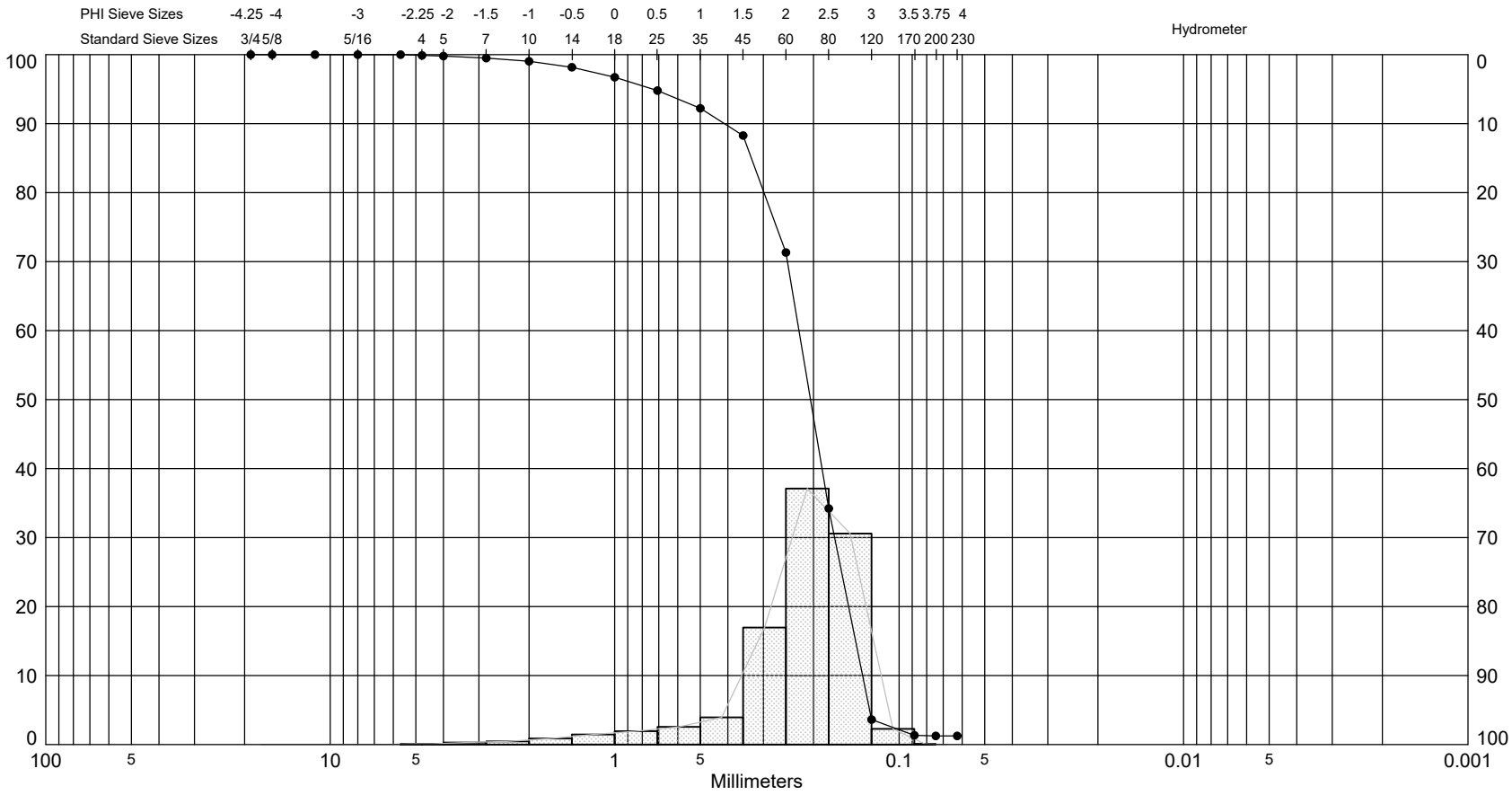
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
147.63	145.80			#200 - 1.25 #230 - 1.25			4

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.16	0.11	0.16	99.89
#5	-2.00	4.00	0.15	0.10	0.31	99.79
#7	-1.50	2.83	0.43	0.29	0.74	99.50
#10	-1.00	2.00	0.68	0.46	1.42	99.04
#14	-0.50	1.41	1.28	0.87	2.70	98.17
#18	0.00	1.00	2.14	1.45	4.84	96.72
#25	0.50	0.71	2.85	1.93	7.69	94.79
#35	1.00	0.50	3.79	2.57	11.48	92.22
#45	1.50	0.35	5.82	3.94	17.30	88.28
#60	2.00	0.25	25.04	16.96	42.34	71.32
#80	2.50	0.18	54.79	37.11	97.13	34.21
#120	3.00	0.13	45.16	30.59	142.29	3.62
#170	3.50	0.09	3.37	2.28	145.66	1.34
#200	3.75	0.07	0.14	0.09	145.80	1.25
#230	4.00	0.06	0.00	0.00	145.80	1.25

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.98	2.80	2.65	2.29	1.89	1.63	0.45

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.12	0.23	0.79	-2.14	9.16

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-01 #S2	—●—	-18.9	SP	#200 - 1.25 #230 - 1.25			2.29	2.12	-2.14	9.16	0.79

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,295,023
Northing (Y, ft):	45,629
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-02 #C1

Analysis Date: 08-12-22

Analyzed By: CRM

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McClellanville, SC 29458
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Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,295,790	45,040	NC State Plane	-7.1 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 5Y-6/2	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

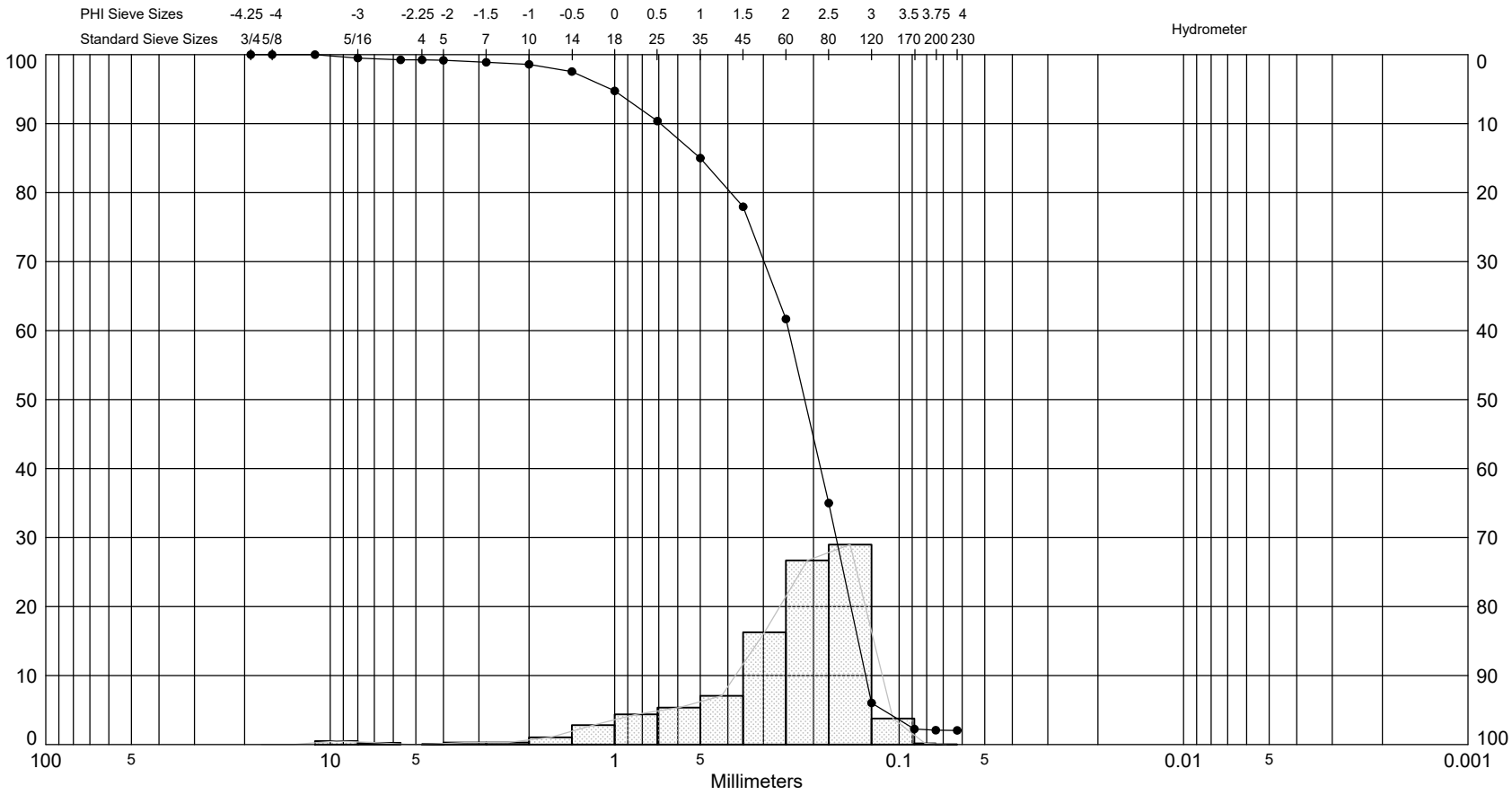
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
156.86	153.64			#200 - 2.08 #230 - 2.05		9.3	11

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.77	0.49	0.77	99.51
#3.5	-2.50	5.66	0.41	0.26	1.18	99.25
#4	-2.25	4.76	0.00	0.00	1.18	99.25
#5	-2.00	4.00	0.11	0.07	1.29	99.18
#7	-1.50	2.83	0.45	0.29	1.74	98.89
#10	-1.00	2.00	0.47	0.30	2.21	98.59
#14	-0.50	1.41	1.63	1.04	3.84	97.55
#18	0.00	1.00	4.41	2.81	8.25	94.74
#25	0.50	0.71	6.86	4.37	15.11	90.37
#35	1.00	0.50	8.40	5.36	23.51	85.01
#45	1.50	0.35	11.08	7.06	34.59	77.95
#60	2.00	0.25	25.52	16.27	60.11	61.68
#80	2.50	0.18	41.85	26.68	101.96	35.00
#120	3.00	0.13	45.45	28.97	147.41	6.03
#170	3.50	0.09	5.93	3.78	153.34	2.25
#200	3.75	0.07	0.26	0.17	153.60	2.08
#230	4.00	0.06	0.04	0.03	153.64	2.05

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.14	2.83	2.67	2.22	1.59	1.07	-0.05

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.94	0.26	1.01	-1.78	7.53

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-02 #C1	—●—	-7.1	SP	#200 - 2.08 #230 - 2.05		9.3	2.22	1.94	-1.78	7.53	1.01

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,295,790
Northing (Y, ft):	45,040
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-02 #S1

Analysis Date: 08-12-22

Analyzed By: CRM

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Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,295,790	45,040	NC State Plane	-12.7 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 5Y-6/2	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

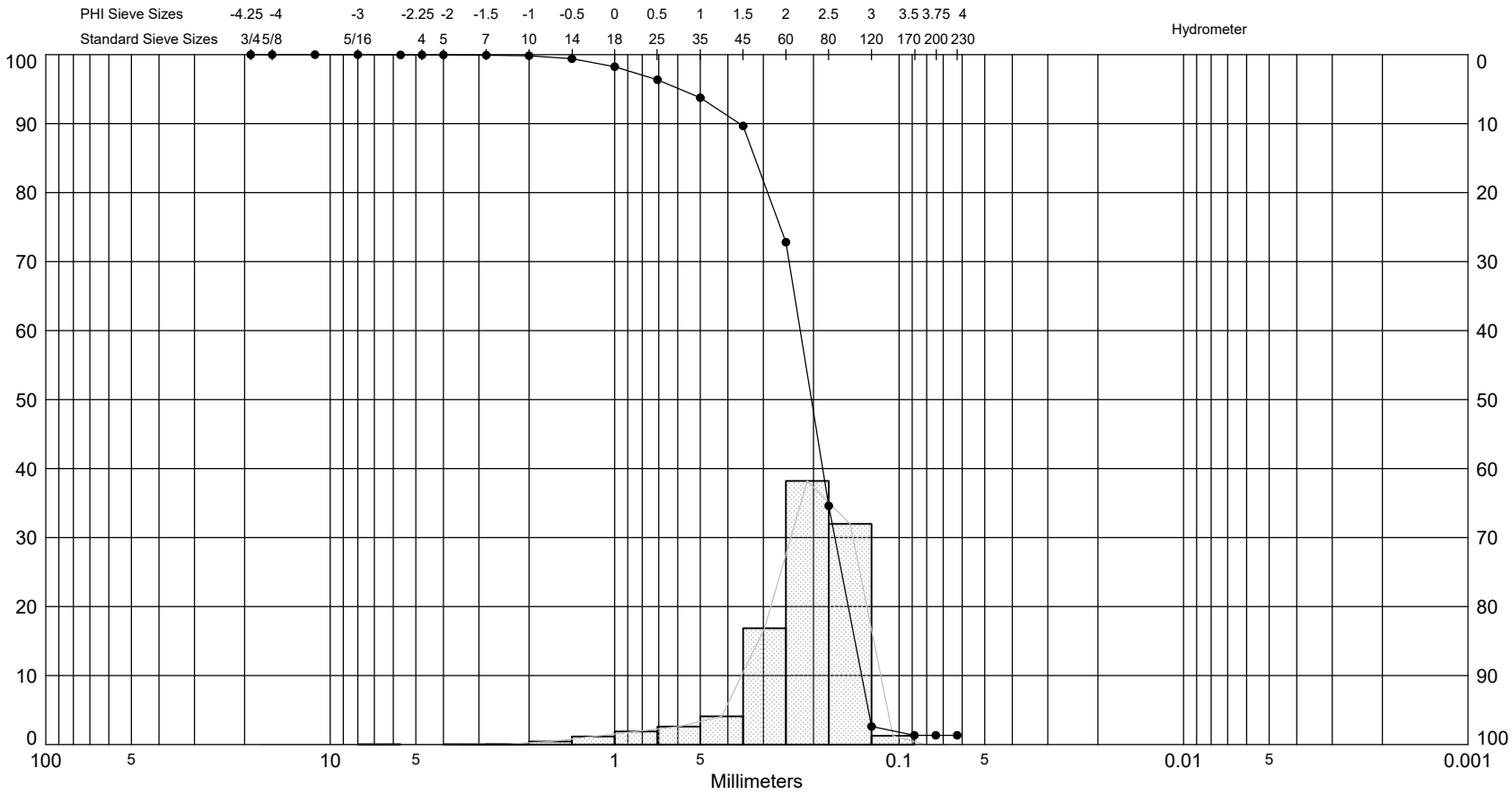
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
138.26	136.39			#200 - 1.34 #230 - 1.34			4

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.05	0.04	0.05	99.96
#4	-2.25	4.76	0.00	0.00	0.05	99.96
#5	-2.00	4.00	0.00	0.00	0.05	99.96
#7	-1.50	2.83	0.05	0.04	0.10	99.92
#10	-1.00	2.00	0.11	0.08	0.21	99.84
#14	-0.50	1.41	0.60	0.43	0.81	99.41
#18	0.00	1.00	1.60	1.16	2.41	98.25
#25	0.50	0.71	2.62	1.89	5.03	96.36
#35	1.00	0.50	3.59	2.60	8.62	93.76
#45	1.50	0.35	5.65	4.09	14.27	89.67
#60	2.00	0.25	23.31	16.86	37.58	72.81
#80	2.50	0.18	52.83	38.21	90.41	34.60
#120	3.00	0.13	44.21	31.98	134.62	2.62
#170	3.50	0.09	1.77	1.28	136.39	1.34
#200	3.75	0.07	0.00	0.00	136.39	1.34
#230	4.00	0.06	0.00	0.00	136.39	1.34

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.96	2.79	2.65	2.30	1.94	1.67	0.76

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.17	0.22	0.67	-1.86	8.02

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-02 #S1	—●—	-12.7	SP	#200 - 1.34 #230 - 1.34			2.3	2.17	-1.86	8.02	0.67

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,295,790
Northing (Y, ft):	45,040
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-02 #S2

Analysis Date: 08-12-22

Analyzed By: CRM

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Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,295,790	45,040	NC State Plane	-18.3 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 5Y-6/2	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

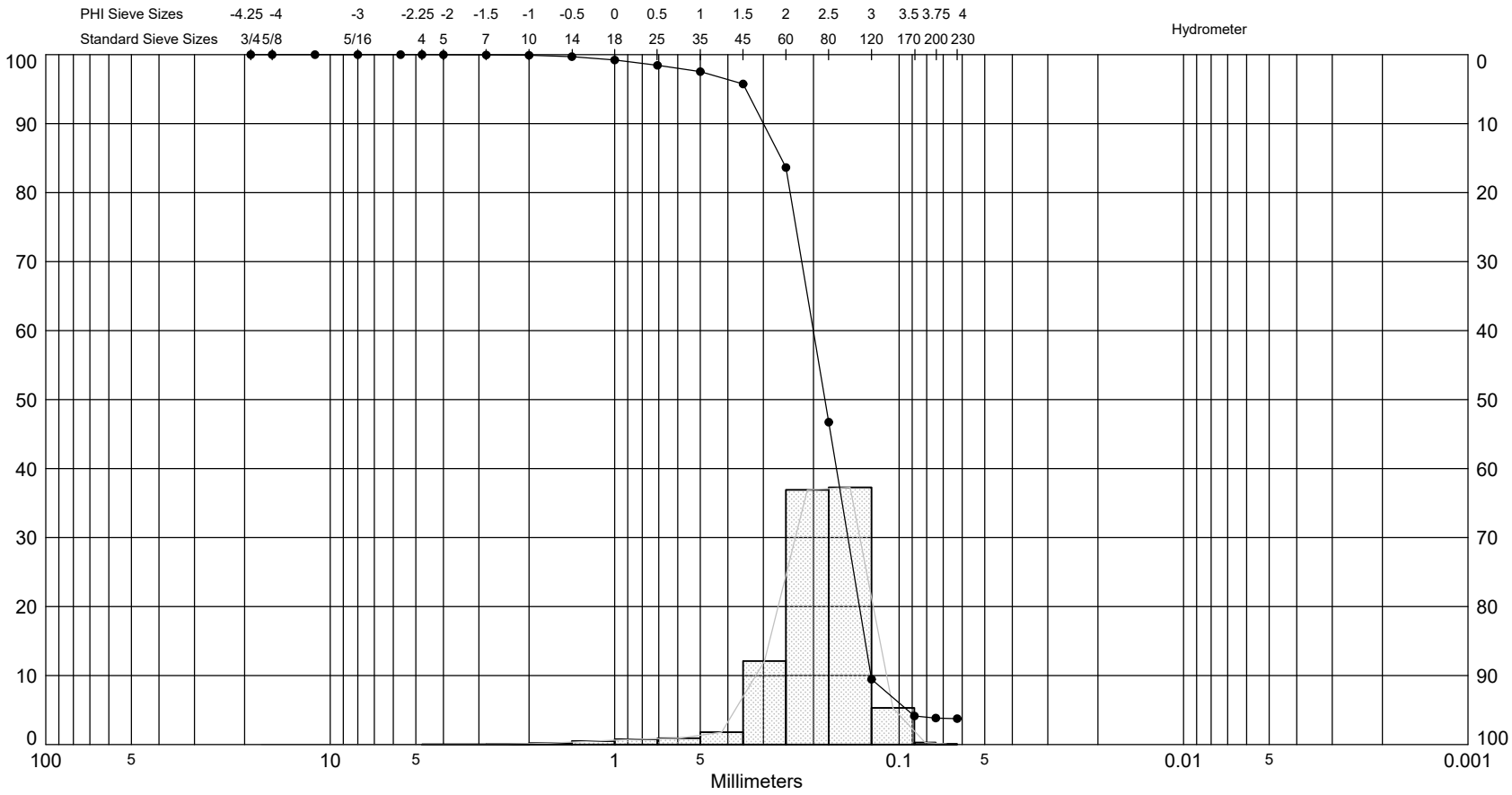
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
158.51	152.56			#200 - 3.84 #230 - 3.76			3

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.00	0.00	0.00	100.00
#5	-2.00	4.00	0.03	0.02	0.03	99.98
#7	-1.50	2.83	0.05	0.03	0.08	99.95
#10	-1.00	2.00	0.07	0.04	0.15	99.91
#14	-0.50	1.41	0.32	0.20	0.47	99.71
#18	0.00	1.00	0.78	0.49	1.25	99.22
#25	0.50	0.71	1.22	0.77	2.47	98.45
#35	1.00	0.50	1.44	0.91	3.91	97.54
#45	1.50	0.35	2.84	1.79	6.75	95.75
#60	2.00	0.25	19.19	12.11	25.94	83.64
#80	2.50	0.18	58.50	36.91	84.44	46.73
#120	3.00	0.13	59.08	37.27	143.52	9.46
#170	3.50	0.09	8.43	5.32	151.95	4.14
#200	3.75	0.07	0.48	0.30	152.43	3.84
#230	4.00	0.06	0.13	0.08	152.56	3.76

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.42	2.91	2.79	2.46	2.12	1.99	1.53

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.37	0.19	0.56	-1.83	10.32

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-02 #S2	—●—	-18.3	SP	#200 - 3.84 #230 - 3.76			2.46	2.37	-1.83	10.32	0.56

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,295,790
Northing (Y, ft):	45,040
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-03 #C1

Analysis Date: 08-12-22

Analyzed By: CRM

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McClellanville, SC 29458
Office: 843-887-3800

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,296,510	44,548	NC State Plane	-14.6 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 5Y-5/2	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

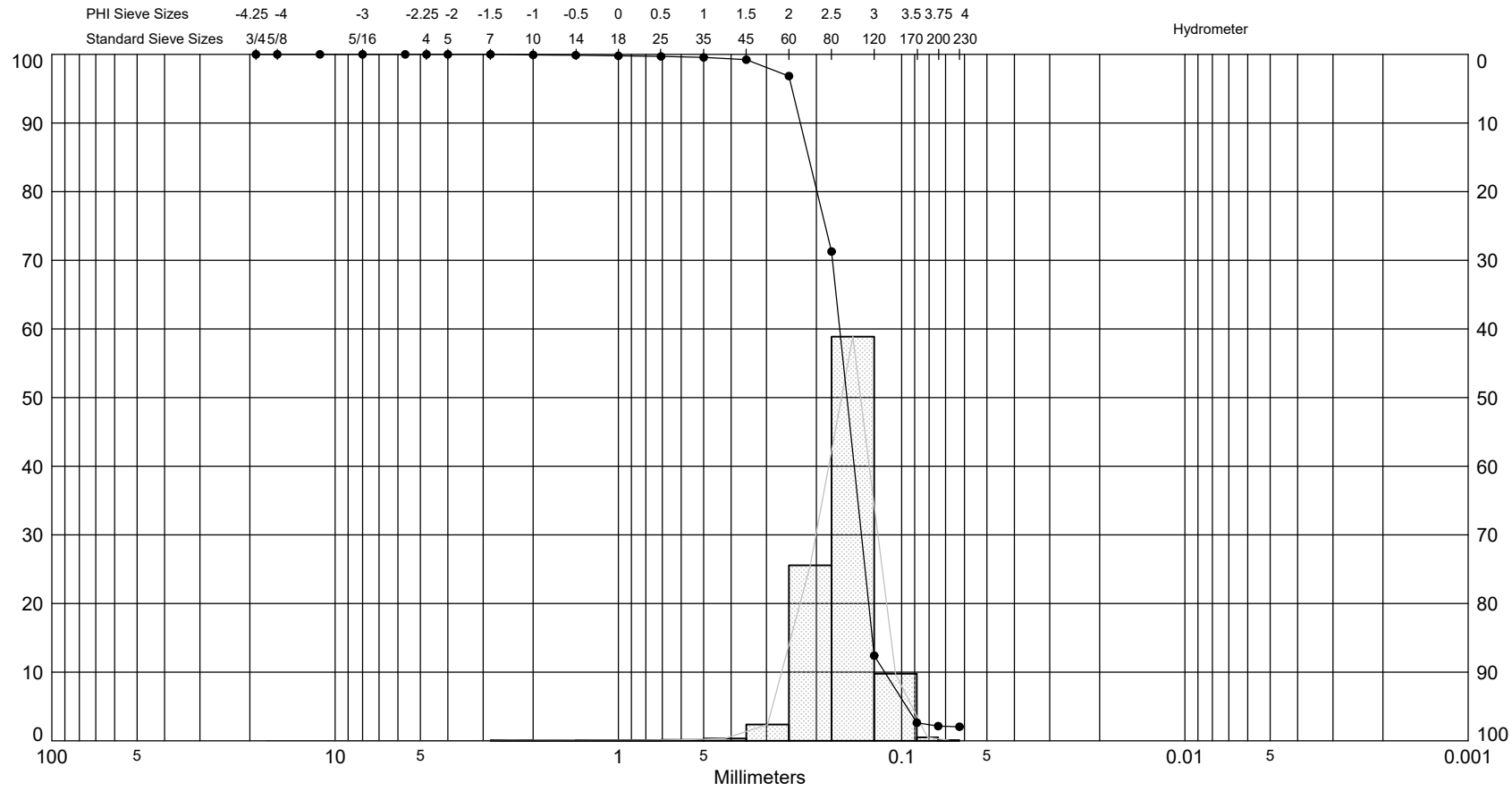
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
160.48	157.20			#200 - 2.14 #230 - 2.05		6.0	2

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.00	0.00	0.00	100.00
#5	-2.00	4.00	0.00	0.00	0.00	100.00
#7	-1.50	2.83	0.00	0.00	0.00	100.00
#10	-1.00	2.00	0.13	0.08	0.13	99.92
#14	-0.50	1.41	0.06	0.04	0.19	99.88
#18	0.00	1.00	0.15	0.09	0.34	99.79
#25	0.50	0.71	0.15	0.09	0.49	99.70
#35	1.00	0.50	0.22	0.14	0.71	99.56
#45	1.50	0.35	0.54	0.34	1.25	99.22
#60	2.00	0.25	3.82	2.38	5.07	96.84
#80	2.50	0.18	41.02	25.56	46.09	71.28
#120	3.00	0.13	94.47	58.87	140.56	12.41
#170	3.50	0.09	15.70	9.78	156.26	2.63
#200	3.75	0.07	0.79	0.49	157.05	2.14
#230	4.00	0.06	0.15	0.09	157.20	2.05

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.38	2.97	2.89	2.68	2.43	2.25	2.04

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.63	0.16	0.39	-1.99	17.7

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-03 #C1	—●—	-14.6	SP	#200 - 2.14 #230 - 2.05		6.0	2.68	2.63	-1.99	17.7	0.39

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,296,510
Northing (Y, ft):	44,548
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-03 #S1

Analysis Date: 08-12-22

Analyzed By: CRM

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McClellanville, SC 29458
Office: 843-887-3800

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,296,510	44,548	NC State Plane	-17.7 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 5Y-6/1	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

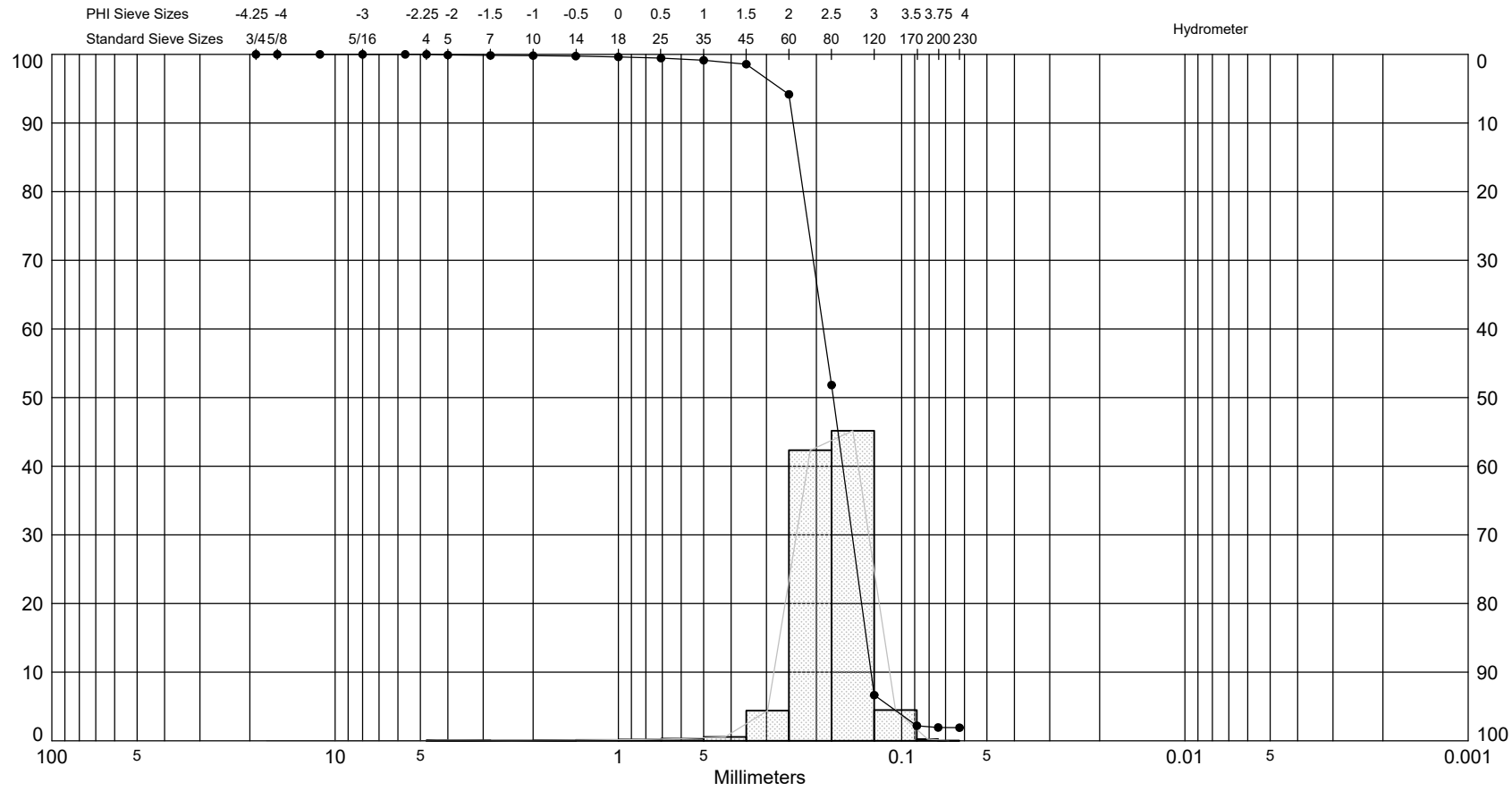
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
142.81	140.06			#200 - 1.94 #230 - 1.91			6

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.00	0.00	0.00	100.00
#5	-2.00	4.00	0.13	0.09	0.13	99.91
#7	-1.50	2.83	0.08	0.06	0.21	99.85
#10	-1.00	2.00	0.04	0.03	0.25	99.82
#14	-0.50	1.41	0.10	0.07	0.35	99.75
#18	0.00	1.00	0.17	0.12	0.52	99.63
#25	0.50	0.71	0.26	0.18	0.78	99.45
#35	1.00	0.50	0.44	0.31	1.22	99.14
#45	1.50	0.35	0.81	0.57	2.03	98.57
#60	2.00	0.25	6.29	4.40	8.32	94.17
#80	2.50	0.18	60.46	42.34	68.78	51.83
#120	3.00	0.13	64.51	45.17	133.29	6.66
#170	3.50	0.09	6.38	4.47	139.67	2.19
#200	3.75	0.07	0.35	0.25	140.02	1.94
#230	4.00	0.06	0.04	0.03	140.06	1.91

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.19	2.90	2.80	2.52	2.23	2.12	1.91

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.48	0.18	0.43	-2.85	25.95

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-03 #S1	—●—	-17.7	SP	#200 - 1.94 #230 - 1.91			2.52	2.48	-2.85	25.95	0.43

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,296,510
Northing (Y, ft):	44,548
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-03 #S2

Analysis Date: 08-12-22

Analyzed By: CRM

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Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,296,510	44,548	NC State Plane	-20.9 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 5Y-6/2	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

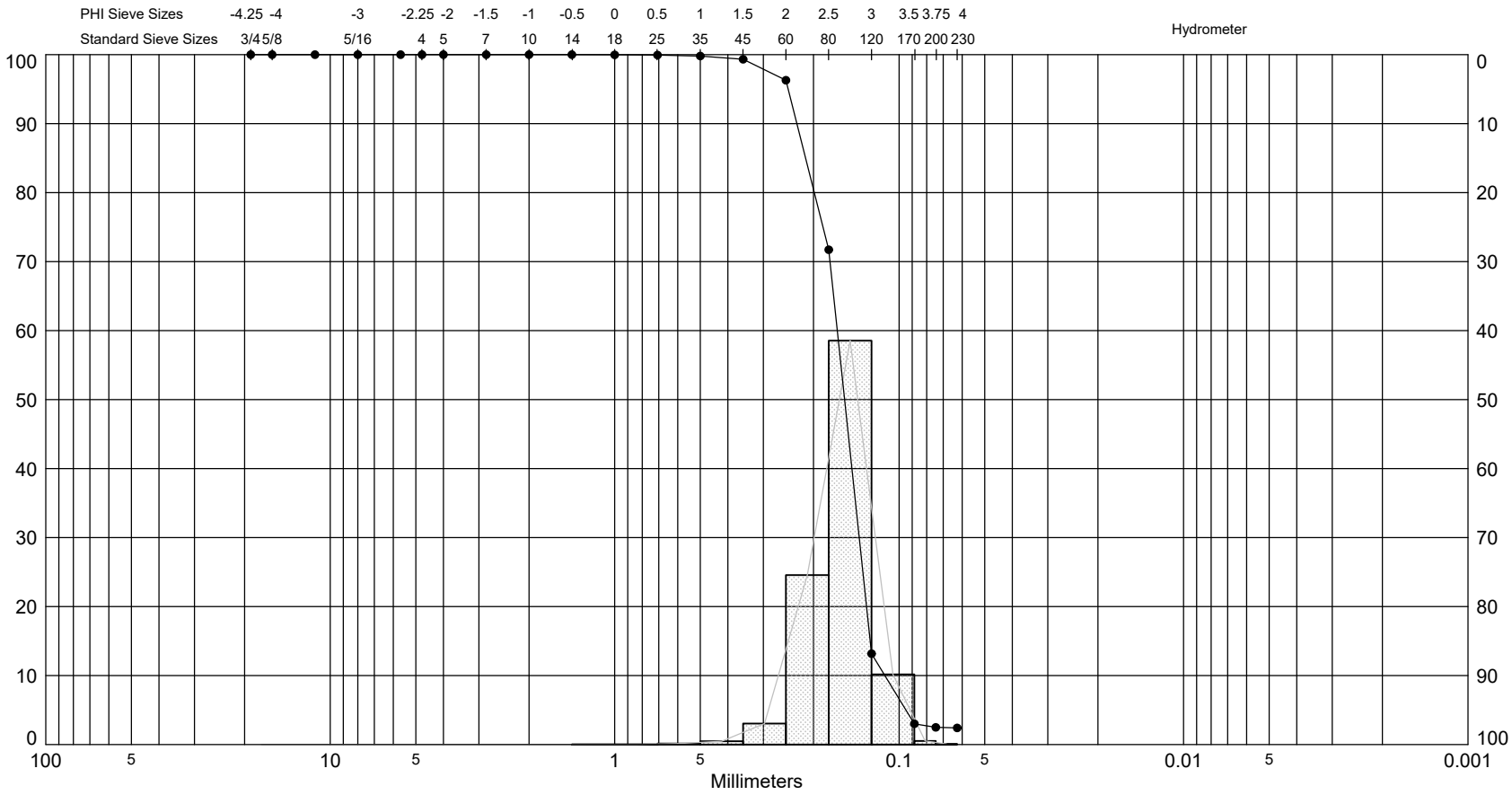
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
149.24	145.66			#200 - 2.49 #230 - 2.41			6

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.00	0.00	0.00	100.00
#5	-2.00	4.00	0.00	0.00	0.00	100.00
#7	-1.50	2.83	0.00	0.00	0.00	100.00
#10	-1.00	2.00	0.00	0.00	0.00	100.00
#14	-0.50	1.41	0.00	0.00	0.00	100.00
#18	0.00	1.00	0.05	0.03	0.05	99.97
#25	0.50	0.71	0.05	0.03	0.10	99.94
#35	1.00	0.50	0.21	0.14	0.31	99.80
#45	1.50	0.35	0.70	0.47	1.01	99.33
#60	2.00	0.25	4.54	3.04	5.55	96.29
#80	2.50	0.18	36.67	24.57	42.22	71.72
#120	3.00	0.13	87.38	58.55	129.60	13.17
#170	3.50	0.09	15.16	10.16	144.76	3.01
#200	3.75	0.07	0.78	0.52	145.54	2.49
#230	4.00	0.06	0.12	0.08	145.66	2.41

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.40	2.98	2.90	2.69	2.43	2.25	2.03

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.64	0.16	0.37	-0.83	6.51

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-03 #S2	—●—	-20.9	SP	#200 - 2.49 #230 - 2.41			2.69	2.64	-0.83	6.51	0.37

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,296,510
Northing (Y, ft):	44,548
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-04 #C1

Analysis Date: 08-12-22

Analyzed By: CRM

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Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,295,449	44,599	NC State Plane	-9.6 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 2.5Y-5/2	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

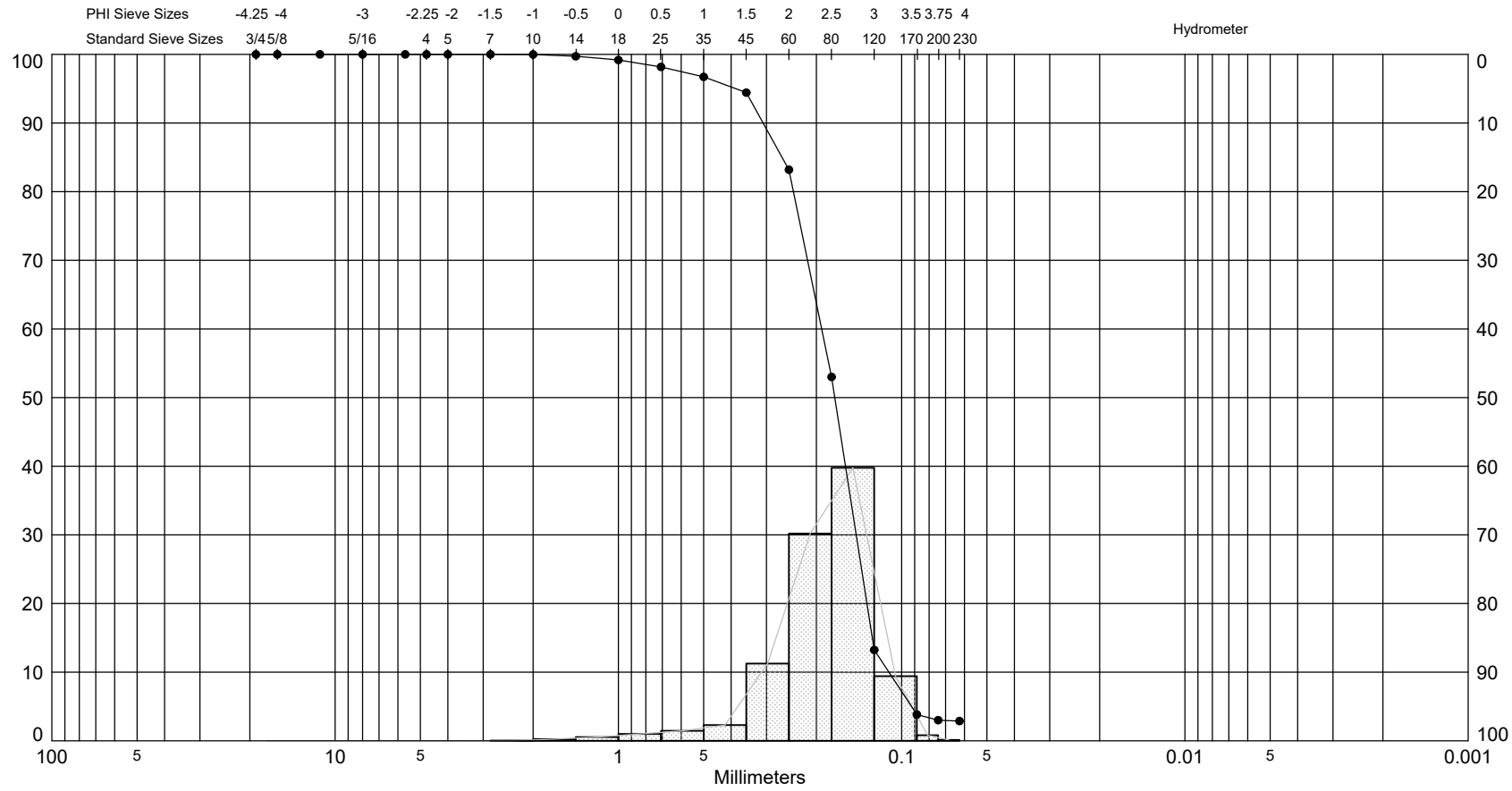
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
162.97	158.27			#200 - 3.01 #230 - 2.88		7.5	4

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.00	0.00	0.00	100.00
#5	-2.00	4.00	0.00	0.00	0.00	100.00
#7	-1.50	2.83	0.00	0.00	0.00	100.00
#10	-1.00	2.00	0.03	0.02	0.03	99.98
#14	-0.50	1.41	0.42	0.26	0.45	99.72
#18	0.00	1.00	0.88	0.54	1.33	99.18
#25	0.50	0.71	1.64	1.01	2.97	98.17
#35	1.00	0.50	2.37	1.45	5.34	96.72
#45	1.50	0.35	3.73	2.29	9.07	94.43
#60	2.00	0.25	18.32	11.24	27.39	83.19
#80	2.50	0.18	49.18	30.18	76.57	53.01
#120	3.00	0.13	64.81	39.77	141.38	13.24
#170	3.50	0.09	15.33	9.41	156.71	3.83
#200	3.75	0.07	1.34	0.82	158.05	3.01
#230	4.00	0.06	0.22	0.13	158.27	2.88

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.44	2.97	2.85	2.54	2.14	1.96	1.38

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.42	0.19	0.62	-1.53	7.45

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-04 #C1	—●—	-9.6	SP	#200 - 3.01 #230 - 2.88		7.5	2.54	2.42	-1.53	7.45	0.62

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,295,449
Northing (Y, ft):	44,599
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-04 #S1

Analysis Date: 08-12-22

Analyzed By: CRM

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Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,295,449	44,599	NC State Plane	-14.4 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 2.5Y-6/2	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

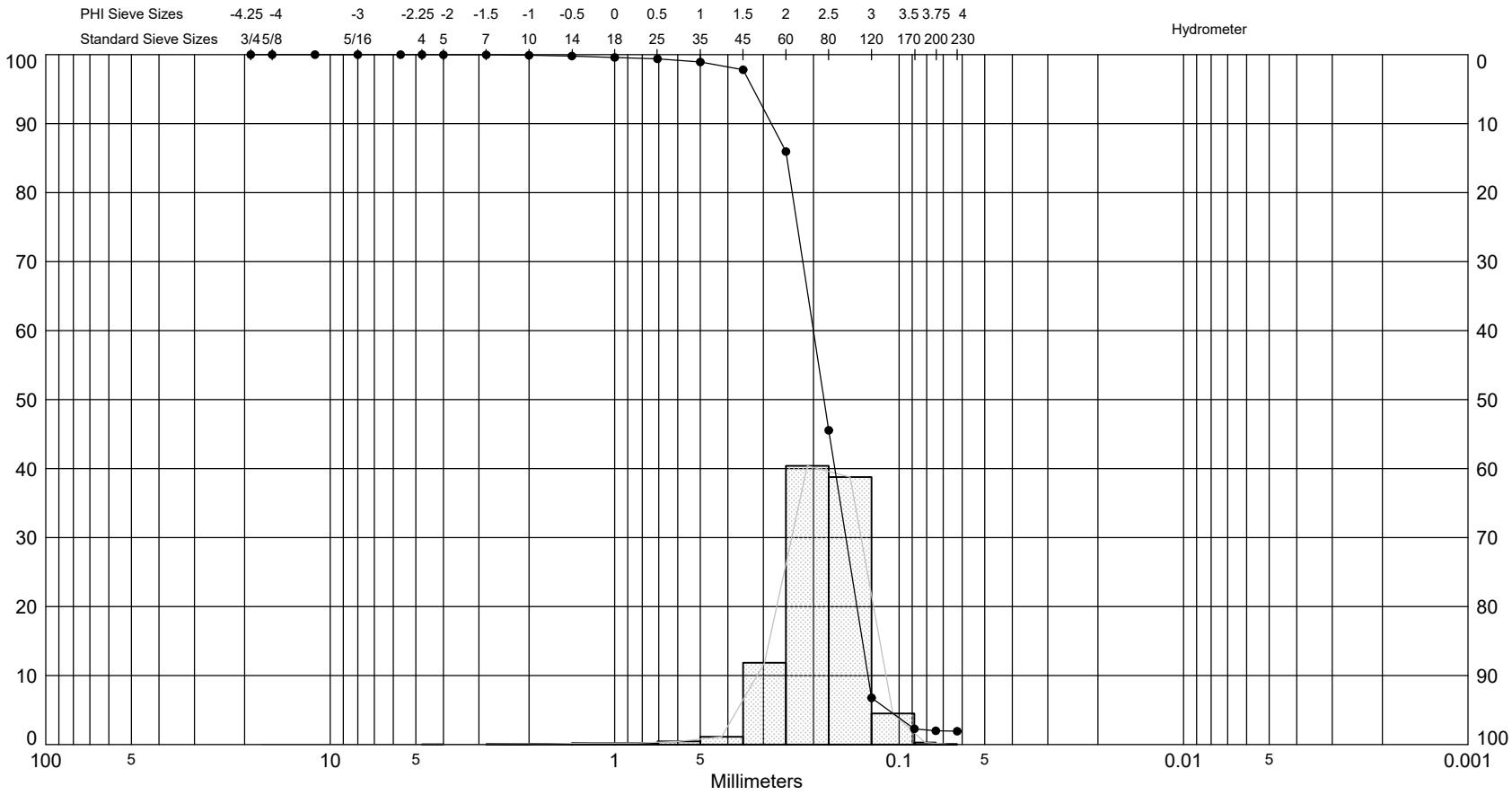
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
149.60	146.75			#200 - 1.99 #230 - 1.93			1

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.00	0.00	0.00	100.00
#5	-2.00	4.00	0.05	0.03	0.05	99.97
#7	-1.50	2.83	0.00	0.00	0.05	99.97
#10	-1.00	2.00	0.09	0.06	0.14	99.91
#14	-0.50	1.41	0.17	0.11	0.31	99.80
#18	0.00	1.00	0.32	0.21	0.63	99.59
#25	0.50	0.71	0.30	0.20	0.93	99.39
#35	1.00	0.50	0.69	0.46	1.62	98.93
#45	1.50	0.35	1.67	1.12	3.29	97.81
#60	2.00	0.25	17.75	11.86	21.04	85.95
#80	2.50	0.18	60.44	40.40	81.48	45.55
#120	3.00	0.13	58.02	38.78	139.50	6.77
#170	3.50	0.09	6.72	4.49	146.22	2.28
#200	3.75	0.07	0.44	0.29	146.66	1.99
#230	4.00	0.06	0.09	0.06	146.75	1.93

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.20	2.88	2.76	2.44	2.14	2.02	1.62

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.4	0.19	0.48	-1.67	12.33

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-04 #S1	—●—	-14.4	SP	#200 - 1.99 #230 - 1.93			2.44	2.4	-1.67	12.33	0.48

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,295,449
Northing (Y, ft):	44,599
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-04 #S2

Analysis Date: 08-12-22

Analyzed By: CRM

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Office: 843-887-3800

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,295,449	44,599	NC State Plane	-19.2 NGVD 29

USCS:	Munsell:	Comments:
SP-SM	Moist - 5Y-6/2	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

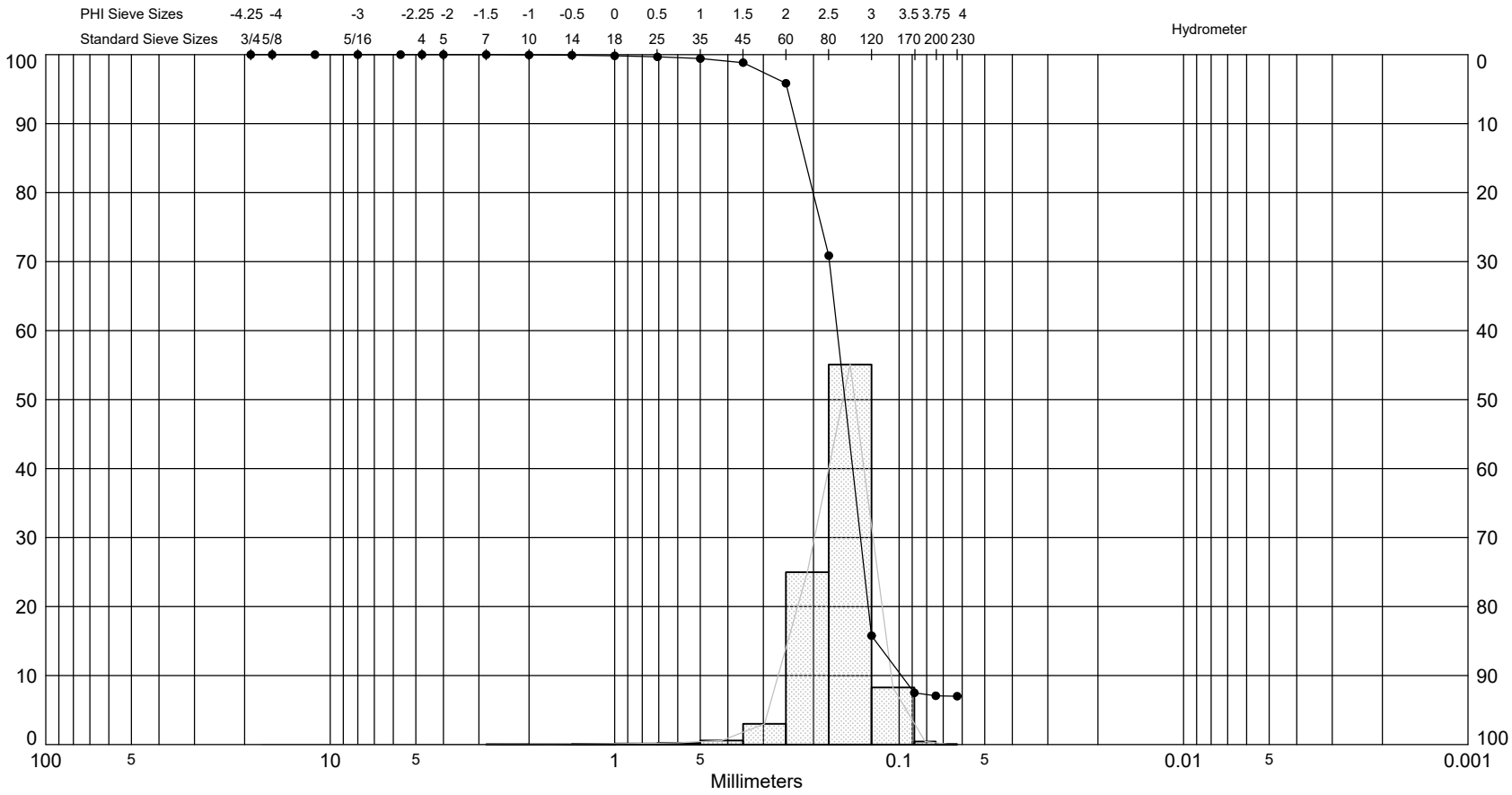
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
155.83	144.90			#200 - 7.07 #230 - 7.01			0

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.00	0.00	0.00	100.00
#5	-2.00	4.00	0.00	0.00	0.00	100.00
#7	-1.50	2.83	0.00	0.00	0.00	100.00
#10	-1.00	2.00	0.08	0.05	0.08	99.95
#14	-0.50	1.41	0.04	0.03	0.12	99.92
#18	0.00	1.00	0.14	0.09	0.26	99.83
#25	0.50	0.71	0.23	0.15	0.49	99.68
#35	1.00	0.50	0.39	0.25	0.88	99.43
#45	1.50	0.35	0.92	0.59	1.80	98.84
#60	2.00	0.25	4.66	2.99	6.46	95.85
#80	2.50	0.18	38.93	24.98	45.39	70.87
#120	3.00	0.13	85.84	55.09	131.23	15.78
#170	3.50	0.09	12.90	8.28	144.13	7.50
#200	3.75	0.07	0.67	0.43	144.80	7.07
#230	4.00	0.06	0.10	0.06	144.90	7.01

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	3.00	2.92	2.69	2.42	2.24	2.02

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.61	0.16	0.4	-1.84	14.1

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-04 #S2	—●—	-19.2	SP-SM	#200 - 7.07 #230 - 7.01			2.69	2.61	-1.84	14.1	0.4

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,295,449
Northing (Y, ft):	44,599
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-05 #C1

Analysis Date: 08-12-22

Analyzed By: CRM

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1293 Graham Farm Road
McClellanville, SC 29458
Office: 843-887-3800

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,295,017	44,947	NC State Plane	-6.3 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 5Y-6/2	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

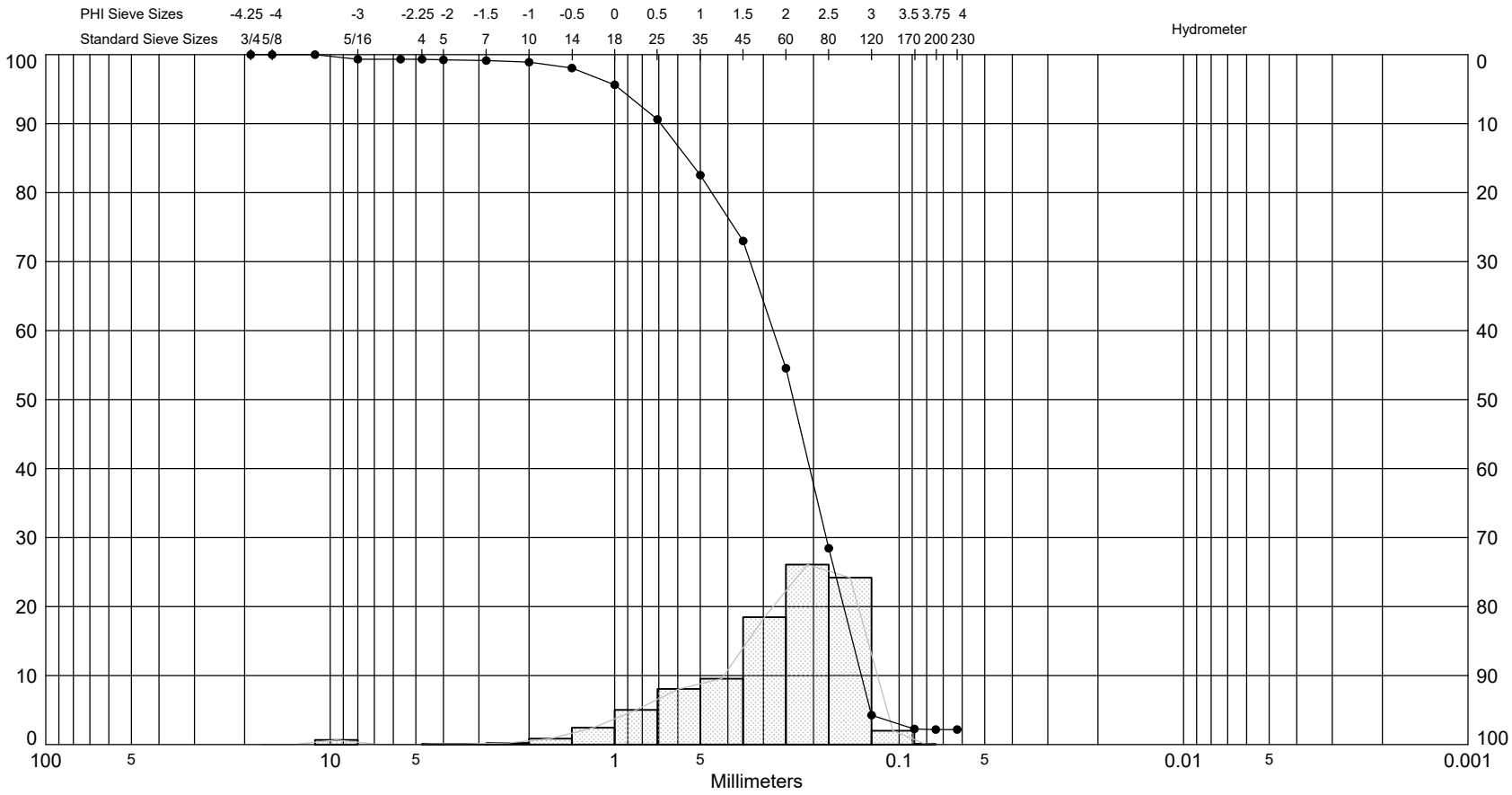
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
153.69	150.35			#200 - 2.17 #230 - 2.17		9.5	13

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	1.02	0.66	1.02	99.34
#3.5	-2.50	5.66	0.00	0.00	1.02	99.34
#4	-2.25	4.76	0.00	0.00	1.02	99.34
#5	-2.00	4.00	0.15	0.10	1.17	99.24
#7	-1.50	2.83	0.15	0.10	1.32	99.14
#10	-1.00	2.00	0.35	0.23	1.67	98.91
#14	-0.50	1.41	1.31	0.85	2.98	98.06
#18	0.00	1.00	3.74	2.43	6.72	95.63
#25	0.50	0.71	7.71	5.02	14.43	90.61
#35	1.00	0.50	12.41	8.07	26.84	82.54
#45	1.50	0.35	14.67	9.55	41.51	72.99
#60	2.00	0.25	28.35	18.45	69.86	54.54
#80	2.50	0.18	40.10	26.09	109.96	28.45
#120	3.00	0.13	37.17	24.19	147.13	4.26
#170	3.50	0.09	3.08	2.00	150.21	2.26
#200	3.75	0.07	0.14	0.09	150.35	2.17
#230	4.00	0.06	0.00	0.00	150.35	2.17

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.98	2.76	2.57	2.09	1.39	0.91	0.06

Moment Statistics	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
	1.84	0.28	0.97	-1.62	7.47

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-05 #C1	—●—	-6.3	SP	#200 - 2.17 #230 - 2.17		9.5	2.09	1.84	-1.62	7.47	0.97

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,295,017
Northing (Y, ft):	44,947
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-05 #S1

Analysis Date: 08-12-22

Analyzed By: CRM

Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
Office: 843-887-3800

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,295,017	44,947	NC State Plane	-10.8 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 5Y-5/2	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

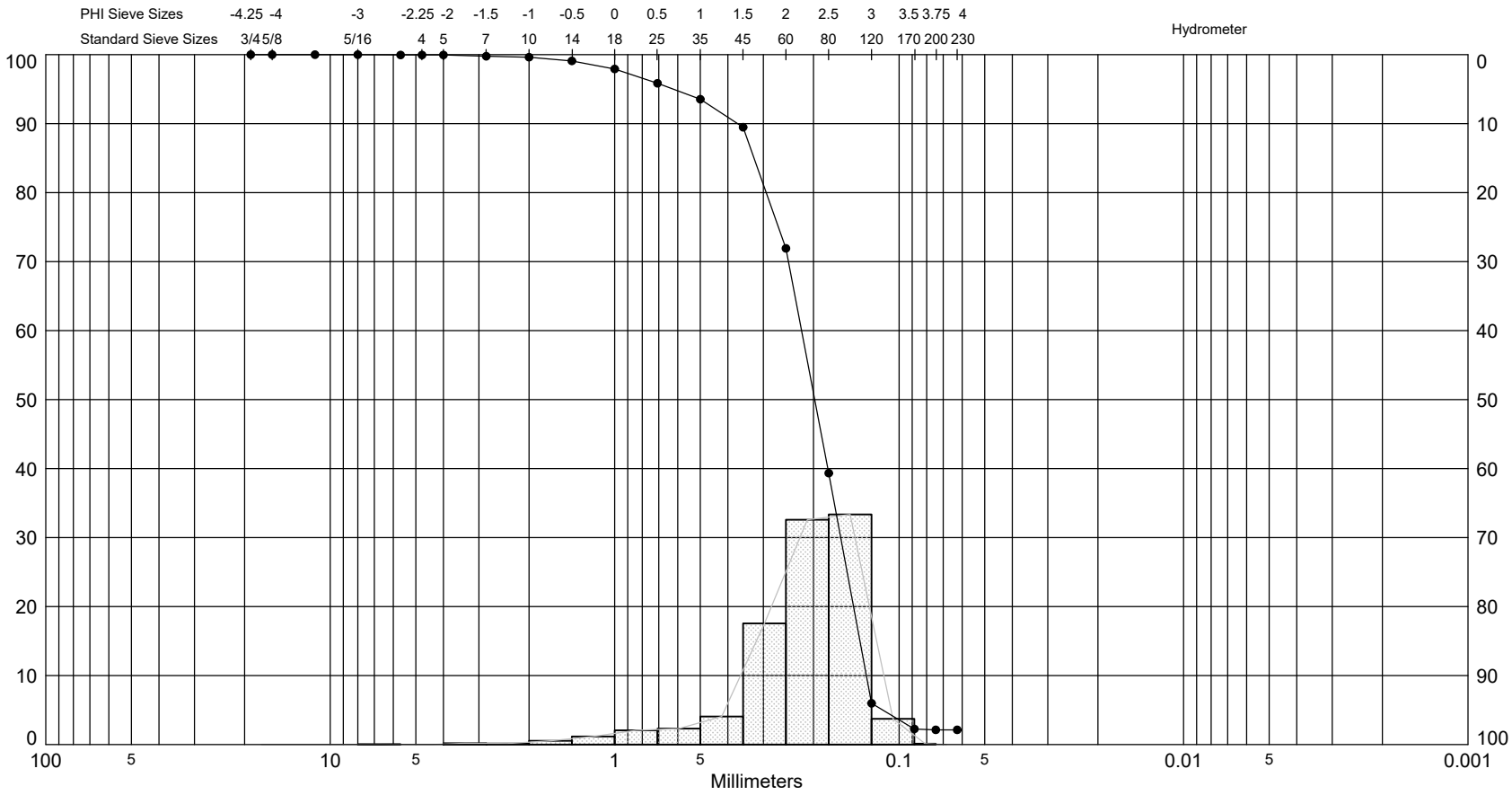
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
146.33	143.23			#200 - 2.13 #230 - 2.13			10

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.08	0.05	0.08	99.95
#4	-2.25	4.76	0.00	0.00	0.08	99.95
#5	-2.00	4.00	0.00	0.00	0.08	99.95
#7	-1.50	2.83	0.26	0.18	0.34	99.77
#10	-1.00	2.00	0.21	0.14	0.55	99.63
#14	-0.50	1.41	0.79	0.54	1.34	99.09
#18	0.00	1.00	1.71	1.17	3.05	97.92
#25	0.50	0.71	3.03	2.07	6.08	95.85
#35	1.00	0.50	3.38	2.31	9.46	93.54
#45	1.50	0.35	5.94	4.06	15.40	89.48
#60	2.00	0.25	25.70	17.56	41.10	71.92
#80	2.50	0.18	47.67	32.58	88.77	39.34
#120	3.00	0.13	48.82	33.36	137.59	5.98
#170	3.50	0.09	5.45	3.72	143.04	2.26
#200	3.75	0.07	0.19	0.13	143.23	2.13
#230	4.00	0.06	0.00	0.00	143.23	2.13

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.13	2.85	2.71	2.34	1.91	1.66	0.68

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.19	0.22	0.73	-1.85	8.28

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-05 #S1	—●—	-10.8	SP	#200 - 2.13 #230 - 2.13			2.34	2.19	-1.85	8.28	0.73

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,295,017
Northing (Y, ft):	44,947
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-05 #S2

Analysis Date: 08-12-22

Analyzed By: CRM

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Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,295,017	44,947	NC State Plane	-15.4 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 5Y-6/2	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

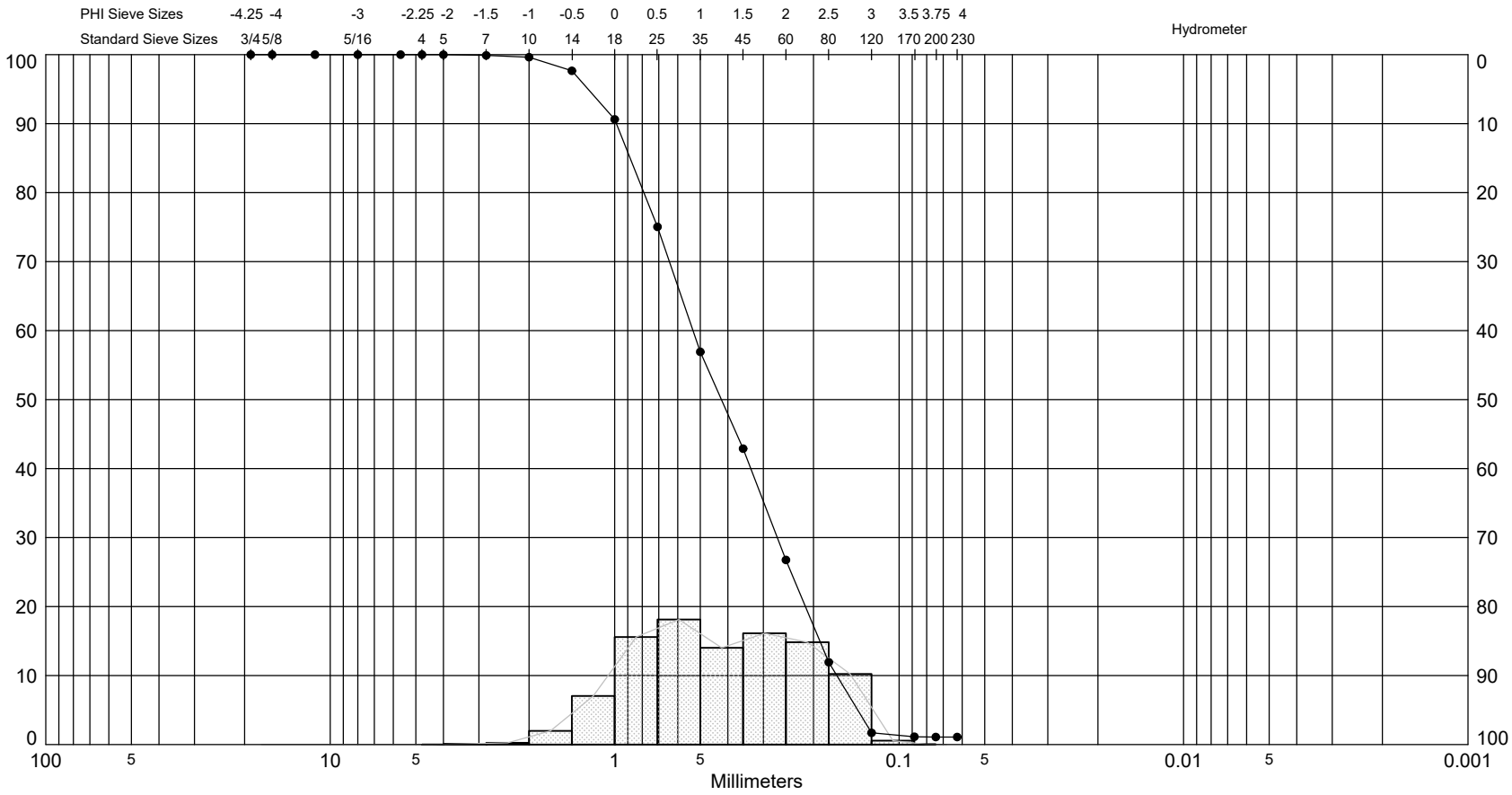
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
158.41	156.68			#200 - 1.09 #230 - 1.09			18

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.00	0.00	0.00	100.00
#5	-2.00	4.00	0.02	0.01	0.02	99.99
#7	-1.50	2.83	0.16	0.10	0.18	99.89
#10	-1.00	2.00	0.41	0.26	0.59	99.63
#14	-0.50	1.41	3.12	1.97	3.71	97.66
#18	0.00	1.00	11.15	7.04	14.86	90.62
#25	0.50	0.71	24.68	15.58	39.54	75.04
#35	1.00	0.50	28.70	18.12	68.24	56.92
#45	1.50	0.35	22.23	14.03	90.47	42.89
#60	2.00	0.25	25.55	16.13	116.02	26.76
#80	2.50	0.18	23.49	14.83	139.51	11.93
#120	3.00	0.13	16.20	10.23	155.71	1.70
#170	3.50	0.09	0.91	0.57	156.62	1.13
#200	3.75	0.07	0.06	0.04	156.68	1.09
#230	4.00	0.06	0.00	0.00	156.68	1.09

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.84	2.36	2.06	1.25	0.50	0.21	-0.31

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.24	0.42	0.96	-0.07	2.18

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-05 #S2	—●—	-15.4	SP	#200 - 1.09 #230 - 1.09			1.25	1.24	-0.07	2.18	0.96

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,295,017
Northing (Y, ft):	44,947
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-06 #C1

Analysis Date: 08-12-22

Analyzed By: CRM

Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
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Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,294,323	44,771	NC State Plane	-11.3 NGVD 29

USCS:	Munsell:	Comments:
SP-SM	Moist - 5Y-5/2	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

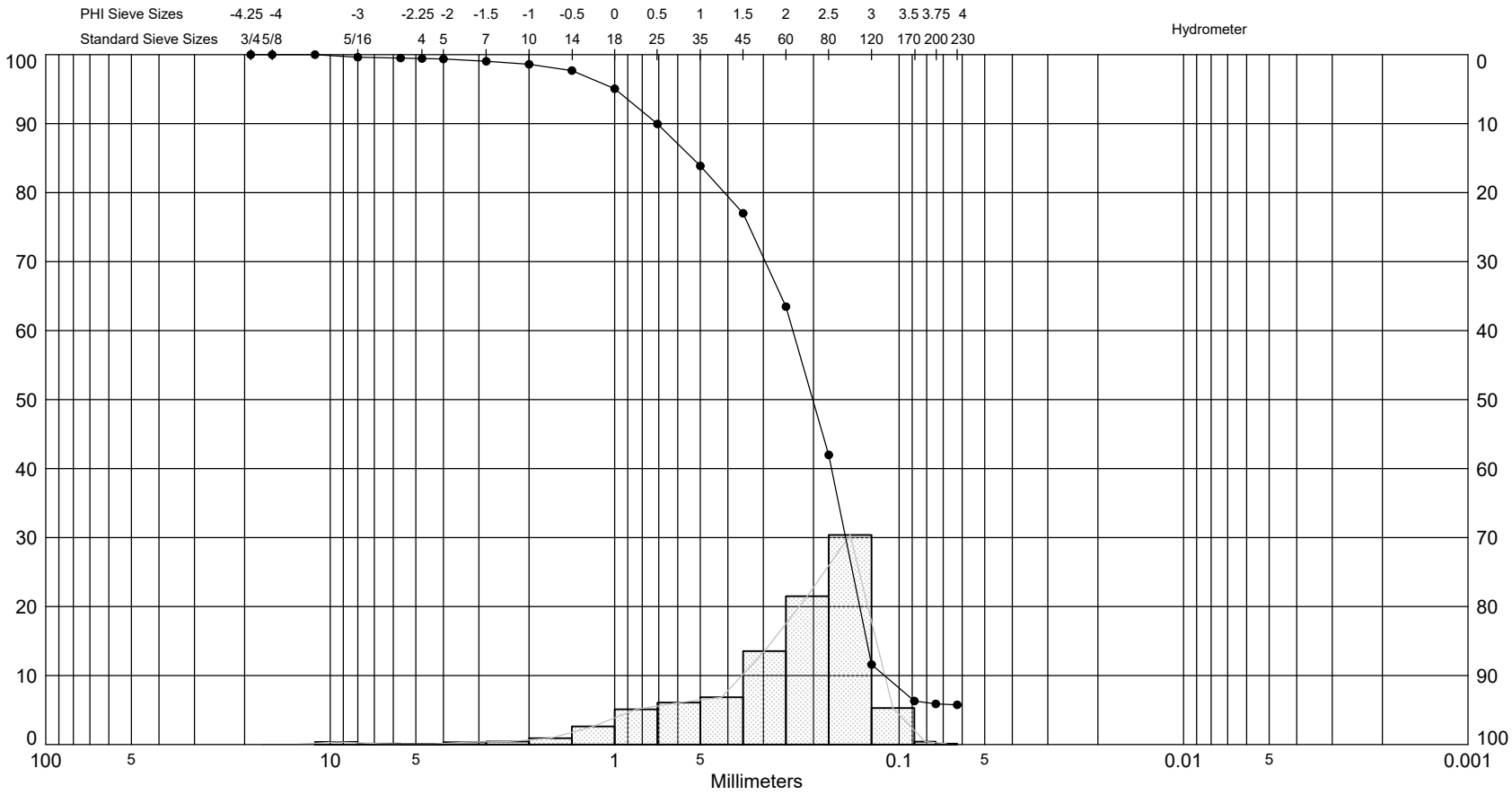
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
137.77	129.82			#200 - 5.89 #230 - 5.76		10.2	5

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.51	0.37	0.51	99.63
#3.5	-2.50	5.66	0.17	0.12	0.68	99.51
#4	-2.25	4.76	0.09	0.07	0.77	99.44
#5	-2.00	4.00	0.09	0.07	0.86	99.37
#7	-1.50	2.83	0.46	0.33	1.32	99.04
#10	-1.00	2.00	0.60	0.44	1.92	98.60
#14	-0.50	1.41	1.26	0.91	3.18	97.69
#18	0.00	1.00	3.63	2.63	6.81	95.06
#25	0.50	0.71	7.04	5.11	13.85	89.95
#35	1.00	0.50	8.37	6.08	22.22	83.87
#45	1.50	0.35	9.45	6.86	31.67	77.01
#60	2.00	0.25	18.65	13.54	50.32	63.47
#80	2.50	0.18	29.60	21.49	79.92	41.98
#120	3.00	0.13	41.85	30.38	121.77	11.60
#170	3.50	0.09	7.29	5.29	129.06	6.31
#200	3.75	0.07	0.58	0.42	129.64	5.89
#230	4.00	0.06	0.18	0.13	129.82	5.76

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	2.93	2.78	2.31	1.57	0.99	0.01

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.96	0.26	1.04	-1.52	6.12

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-06 #C1	—●—	-11.3	SP-SM	#200 - 5.89 #230 - 5.76		10.2	2.31	1.96	-1.52	6.12	1.04

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,294,323
Northing (Y, ft):	44,771
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
Office: 843-887-3800

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-06 #S1

Analysis Date: 08-12-22

Analyzed By: CRM

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,294,323	44,771	NC State Plane	-15.5 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 5Y-6/2	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

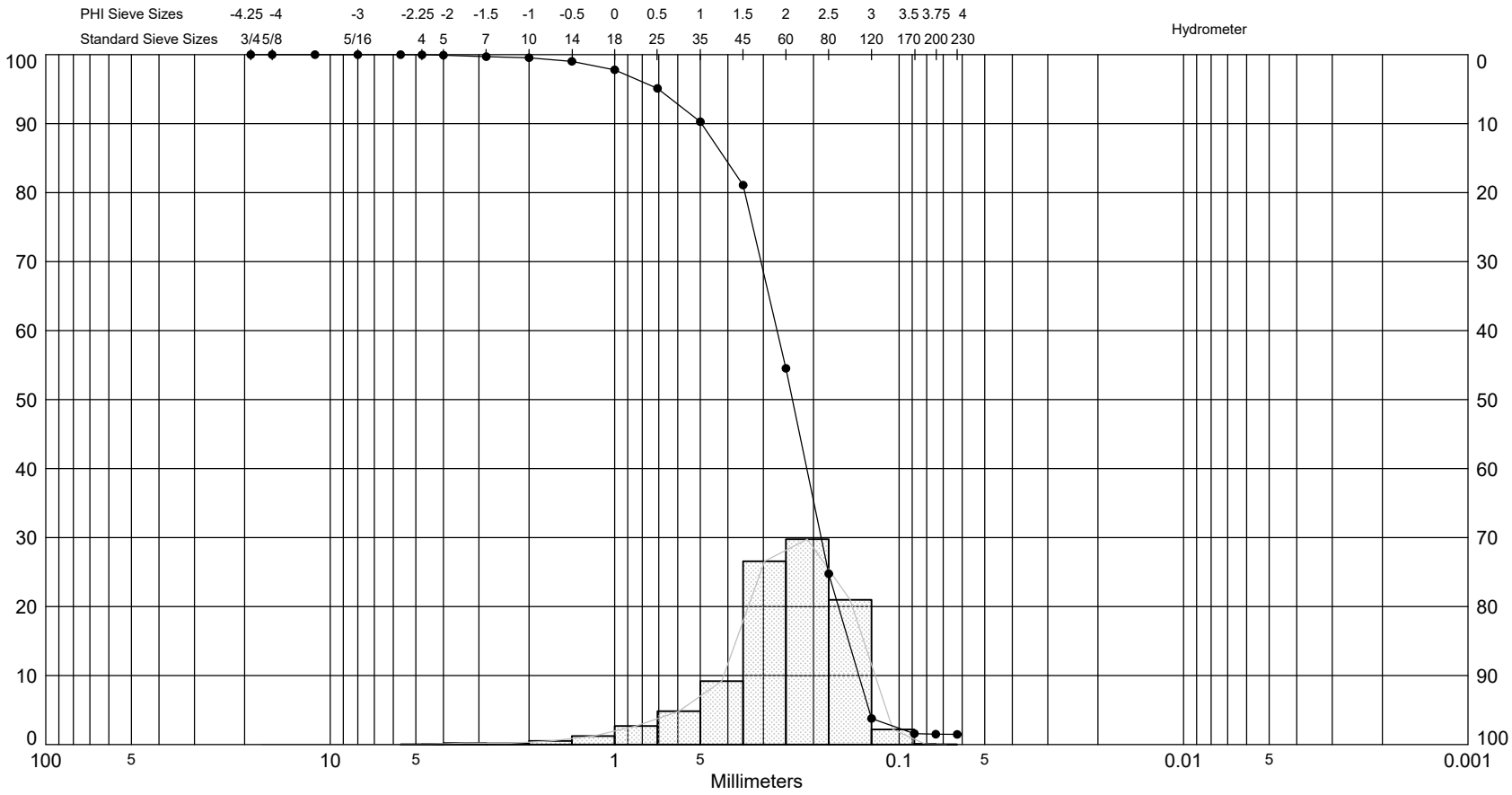
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
154.81	152.51			#200 - 1.50 #230 - 1.47			3

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.05	0.03	0.05	99.97
#5	-2.00	4.00	0.07	0.05	0.12	99.92
#7	-1.50	2.83	0.32	0.21	0.44	99.71
#10	-1.00	2.00	0.24	0.16	0.68	99.55
#14	-0.50	1.41	0.80	0.52	1.48	99.03
#18	0.00	1.00	1.91	1.23	3.39	97.80
#25	0.50	0.71	4.17	2.69	7.56	95.11
#35	1.00	0.50	7.48	4.83	15.04	90.28
#45	1.50	0.35	14.22	9.19	29.26	81.09
#60	2.00	0.25	41.11	26.56	70.37	54.53
#80	2.50	0.18	46.08	29.77	116.45	24.76
#120	3.00	0.13	32.48	20.98	148.93	3.78
#170	3.50	0.09	3.39	2.19	152.32	1.59
#200	3.75	0.07	0.14	0.09	152.46	1.50
#230	4.00	0.06	0.05	0.03	152.51	1.47

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.97	2.71	2.50	2.08	1.61	1.34	0.51

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.96	0.26	0.75	-1.28	5.92

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-06 #S1	—●—	-15.5	SP	#200 - 1.50 #230 - 1.47			2.08	1.96	-1.28	5.92	0.75

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,294,323
Northing (Y, ft):	44,771
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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Office: 843-887-3800

SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-06 #S2

Analysis Date: 08-12-22

Analyzed By: CRM

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McClellanville, SC 29458
Office: 843-887-3800

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,294,323	44,771	NC State Plane	-19.8 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 5Y-5/2	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

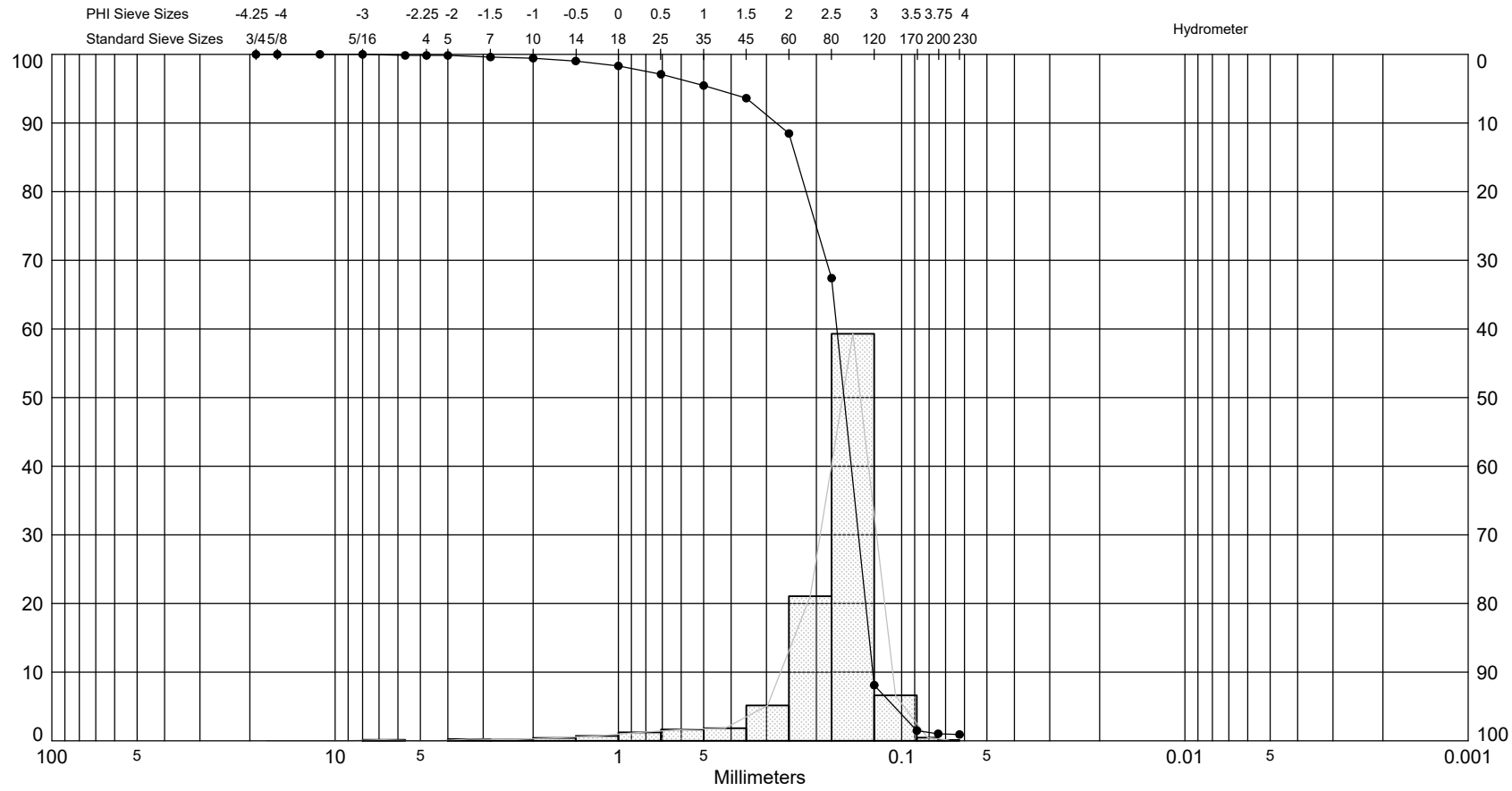
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
145.80	144.46			#200 - 1.03 #230 - 0.92			2

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.22	0.15	0.22	99.85
#4	-2.25	4.76	0.00	0.00	0.22	99.85
#5	-2.00	4.00	0.00	0.00	0.22	99.85
#7	-1.50	2.83	0.35	0.24	0.57	99.61
#10	-1.00	2.00	0.25	0.17	0.82	99.44
#14	-0.50	1.41	0.60	0.41	1.42	99.03
#18	0.00	1.00	1.03	0.71	2.45	98.32
#25	0.50	0.71	1.78	1.22	4.23	97.10
#35	1.00	0.50	2.39	1.64	6.62	95.46
#45	1.50	0.35	2.68	1.84	9.30	93.62
#60	2.00	0.25	7.51	5.15	16.81	88.47
#80	2.50	0.18	30.72	21.07	47.53	67.40
#120	3.00	0.13	86.45	59.29	133.98	8.11
#170	3.50	0.09	9.66	6.63	143.64	1.48
#200	3.75	0.07	0.66	0.45	144.30	1.03
#230	4.00	0.06	0.16	0.11	144.46	0.92

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.23	2.93	2.86	2.65	2.32	2.11	1.13

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.48	0.18	0.69	-3.05	16.12

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-06 #S2	—●—	-19.8	SP	#200 - 1.03 #230 - 0.92			2.65	2.48	-3.05	16.12	0.69

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,294,323
Northing (Y, ft):	44,771
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-07 #C1

Analysis Date: 08-12-22

Analyzed By: CRM

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McClellanville, SC 29458
Office: 843-887-3800

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,295,127	44,142	NC State Plane	-12.7 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 5Y-5/1	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

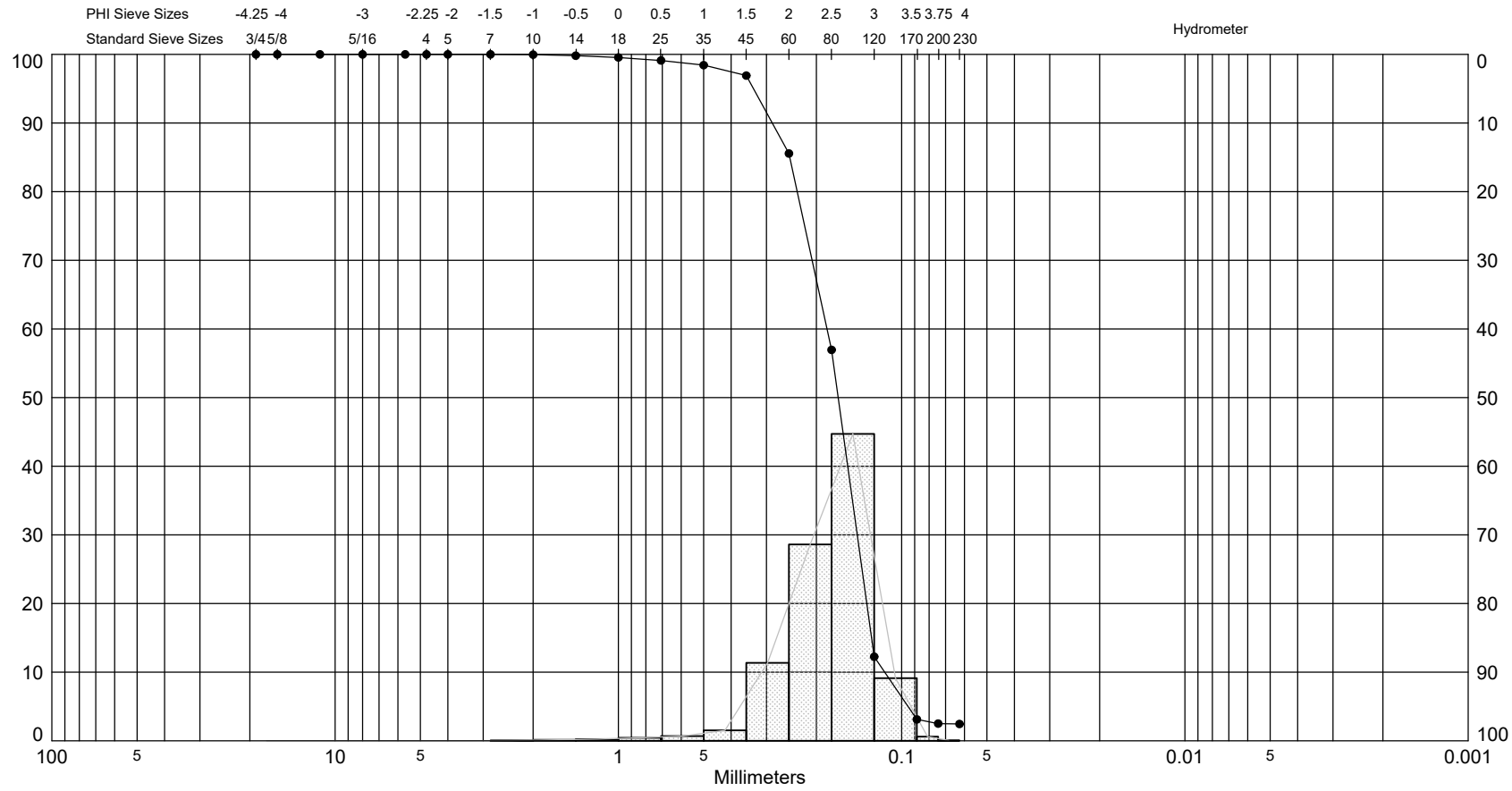
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
138.38	134.98			#200 - 2.51 #230 - 2.45		7.7	4

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.00	0.00	0.00	100.00
#5	-2.00	4.00	0.00	0.00	0.00	100.00
#7	-1.50	2.83	0.00	0.00	0.00	100.00
#10	-1.00	2.00	0.06	0.04	0.06	99.96
#14	-0.50	1.41	0.21	0.15	0.27	99.81
#18	0.00	1.00	0.36	0.26	0.63	99.55
#25	0.50	0.71	0.61	0.44	1.24	99.11
#35	1.00	0.50	0.94	0.68	2.18	98.43
#45	1.50	0.35	2.10	1.52	4.28	96.91
#60	2.00	0.25	15.70	11.35	19.98	85.56
#80	2.50	0.18	39.59	28.61	59.57	56.95
#120	3.00	0.13	61.85	44.70	121.42	12.25
#170	3.50	0.09	12.63	9.13	134.05	3.12
#200	3.75	0.07	0.85	0.61	134.90	2.51
#230	4.00	0.06	0.08	0.06	134.98	2.45

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.40	2.96	2.86	2.58	2.18	2.03	1.58

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.48	0.18	0.53	-1.5	8.52

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-07 #C1	—●—	-12.7	SP	#200 - 2.51 #230 - 2.45		7.7	2.58	2.48	-1.5	8.52	0.53

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,295,127
Northing (Y, ft):	44,142
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-07 #S1

Analysis Date: 08-12-22

Analyzed By: CRM

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McClellanville, SC 29458
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Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,295,127	44,142	NC State Plane	-15.1 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 5Y-6/1	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

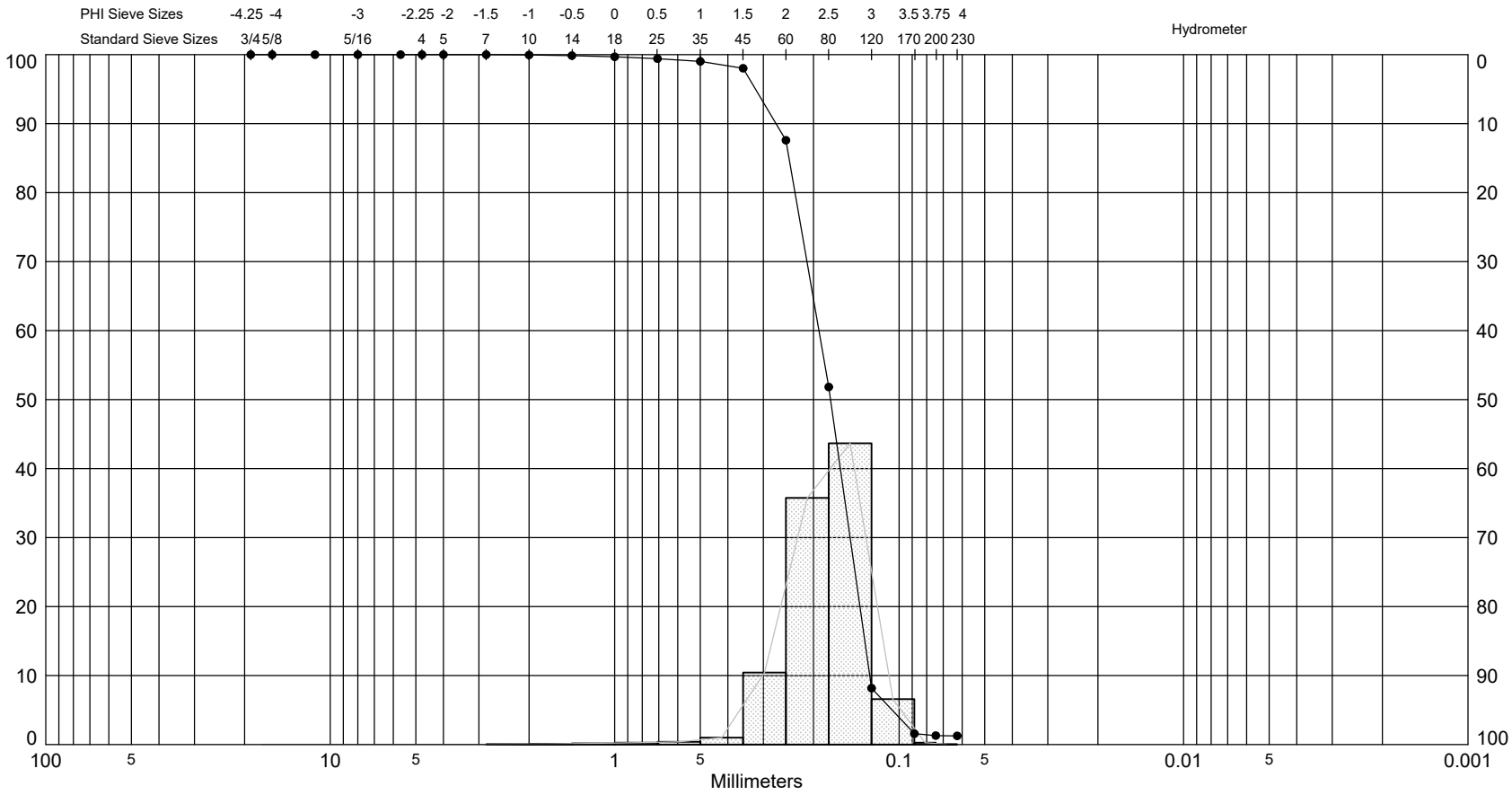
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
137.32	135.59			#200 - 1.30 #230 - 1.26			2

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.00	0.00	0.00	100.00
#5	-2.00	4.00	0.00	0.00	0.00	100.00
#7	-1.50	2.83	0.00	0.00	0.00	100.00
#10	-1.00	2.00	0.07	0.05	0.07	99.95
#14	-0.50	1.41	0.12	0.09	0.19	99.86
#18	0.00	1.00	0.23	0.17	0.42	99.69
#25	0.50	0.71	0.37	0.27	0.79	99.42
#35	1.00	0.50	0.55	0.40	1.34	99.02
#45	1.50	0.35	1.36	0.99	2.70	98.03
#60	2.00	0.25	14.33	10.44	17.03	87.59
#80	2.50	0.18	49.11	35.76	66.14	51.83
#120	3.00	0.13	59.96	43.66	126.10	8.17
#170	3.50	0.09	9.05	6.59	135.15	1.58
#200	3.75	0.07	0.38	0.28	135.53	1.30
#230	4.00	0.06	0.06	0.04	135.59	1.26

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.24	2.91	2.81	2.52	2.18	2.05	1.65

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.46	0.18	0.47	-1.42	9.55

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-07 #S1	—●—	-15.1	SP	#200 - 1.30 #230 - 1.26			2.52	2.46	-1.42	9.55	0.47

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,295,127
Northing (Y, ft):	44,142
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-07 #S2

Analysis Date: 08-12-22

Analyzed By: CRM

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Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,295,127	44,142	NC State Plane	-17.6 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 5Y-4/1	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

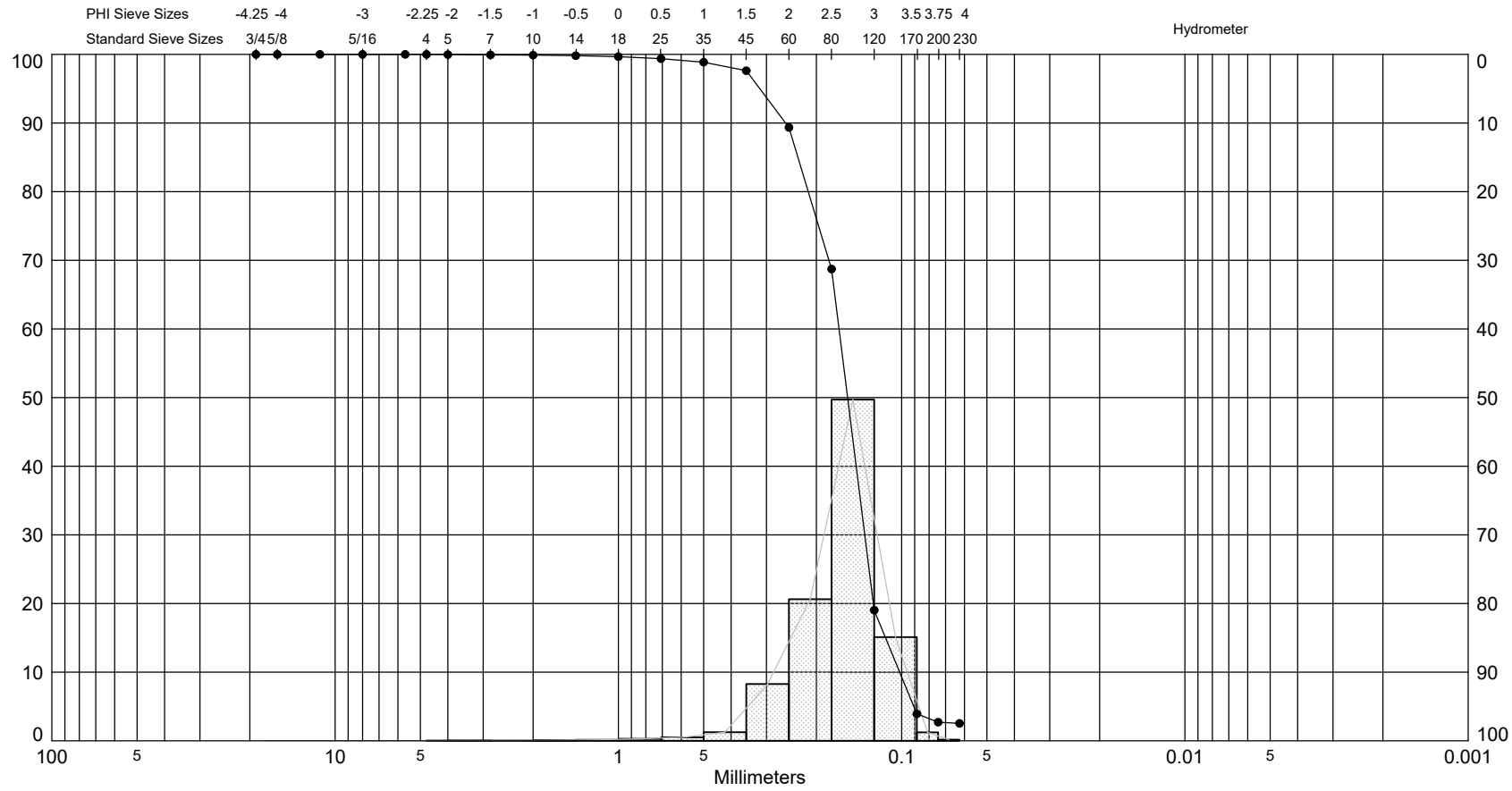
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
122.30	119.20			#200 - 2.71 #230 - 2.54			3

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.00	0.00	0.00	100.00
#5	-2.00	4.00	0.04	0.03	0.04	99.97
#7	-1.50	2.83	0.06	0.05	0.10	99.92
#10	-1.00	2.00	0.04	0.03	0.14	99.89
#14	-0.50	1.41	0.10	0.08	0.24	99.81
#18	0.00	1.00	0.17	0.14	0.41	99.67
#25	0.50	0.71	0.37	0.30	0.78	99.37
#35	1.00	0.50	0.62	0.51	1.40	98.86
#45	1.50	0.35	1.52	1.24	2.92	97.62
#60	2.00	0.25	10.11	8.27	13.03	89.35
#80	2.50	0.18	25.22	20.62	38.25	68.73
#120	3.00	0.13	60.78	49.70	99.03	19.03
#170	3.50	0.09	18.47	15.10	117.50	3.93
#200	3.75	0.07	1.49	1.22	118.99	2.71
#230	4.00	0.06	0.21	0.17	119.20	2.54

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.46	3.10	2.94	2.69	2.35	2.13	1.66

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.6	0.16	0.53	-1.78	11.53

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-07 #S2	—●—	-17.6	SP	#200 - 2.71 #230 - 2.54			2.69	2.6	-1.78	11.53	0.53

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,295,127
Northing (Y, ft):	44,142
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-08 #C1

Analysis Date: 08-12-22

Analyzed By: CRM

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Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,295,745	43,656	NC State Plane	-17.6 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 2.5Y-5/3	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

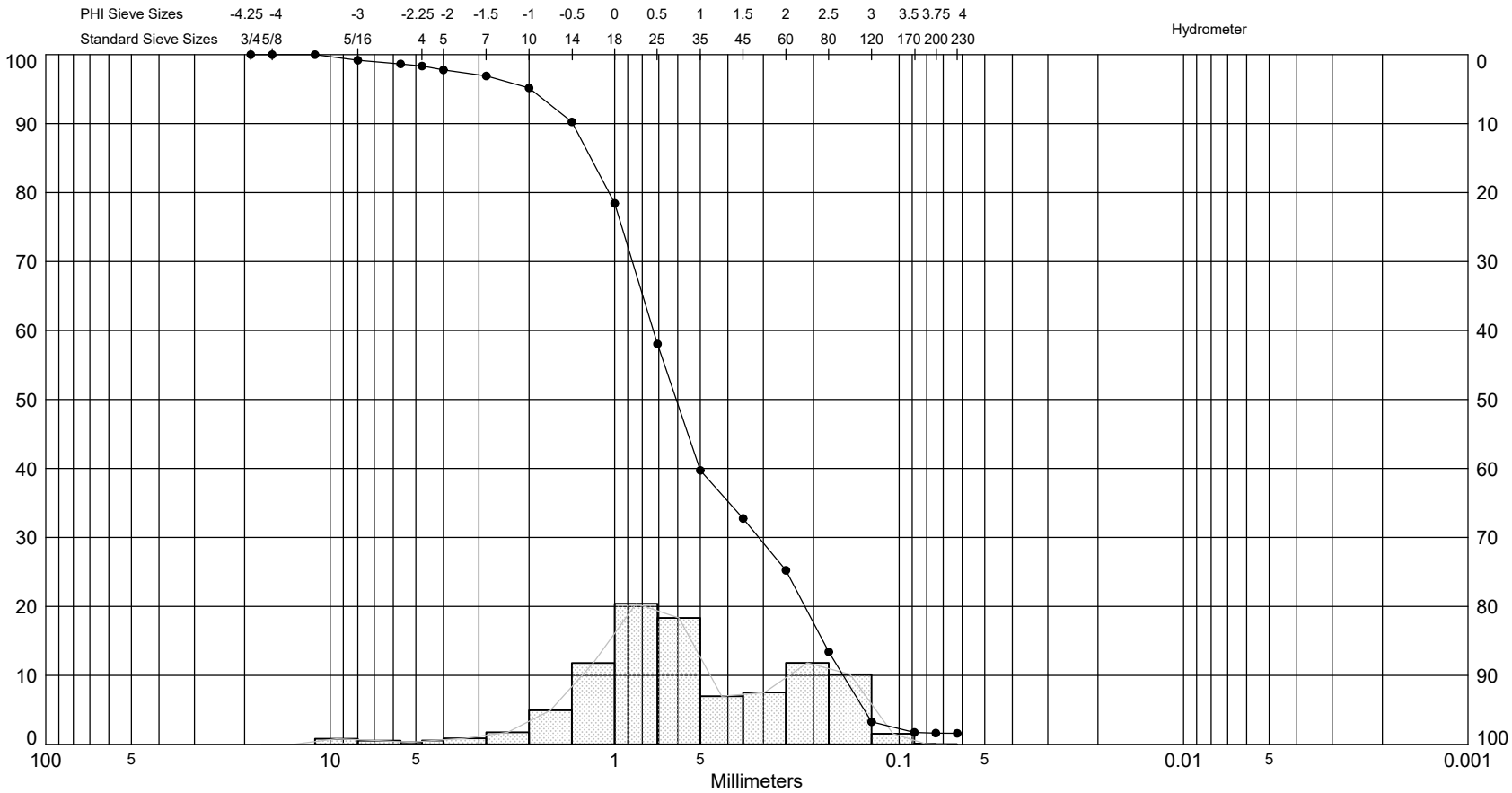
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
147.23	144.87			#200 - 1.63 #230 - 1.60		19.8	15

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	1.19	0.81	1.19	99.19
#3.5	-2.50	5.66	0.79	0.54	1.98	98.65
#4	-2.25	4.76	0.44	0.30	2.42	98.35
#5	-2.00	4.00	0.82	0.56	3.24	97.79
#7	-1.50	2.83	1.30	0.88	4.54	96.91
#10	-1.00	2.00	2.56	1.74	7.10	95.17
#14	-0.50	1.41	7.26	4.93	14.36	90.24
#18	0.00	1.00	17.38	11.80	31.74	78.44
#25	0.50	0.71	30.02	20.39	61.76	58.05
#35	1.00	0.50	26.99	18.33	88.75	39.72
#45	1.50	0.35	10.26	6.97	99.01	32.75
#60	2.00	0.25	11.07	7.52	110.08	25.23
#80	2.50	0.18	17.40	11.82	127.48	13.41
#120	3.00	0.13	14.93	10.14	142.41	3.27
#170	3.50	0.09	2.27	1.54	144.68	1.73
#200	3.75	0.07	0.14	0.10	144.82	1.63
#230	4.00	0.06	0.05	0.03	144.87	1.60

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.91	2.39	2.01	0.72	0.08	-0.24	-0.98

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	0.86	0.55	1.25	-0.25	3.19

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-08 #C1	—●—	-17.6	SP	#200 - 1.63 #230 - 1.60		19.8	0.72	0.86	-0.25	3.19	1.25

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,295,745
Northing (Y, ft):	43,656
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-08 #S1

Analysis Date: 08-12-22

Analyzed By: CRM

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Office: 843-887-3800

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,295,745	43,656	NC State Plane	-19.7 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 2.5Y-5/3	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

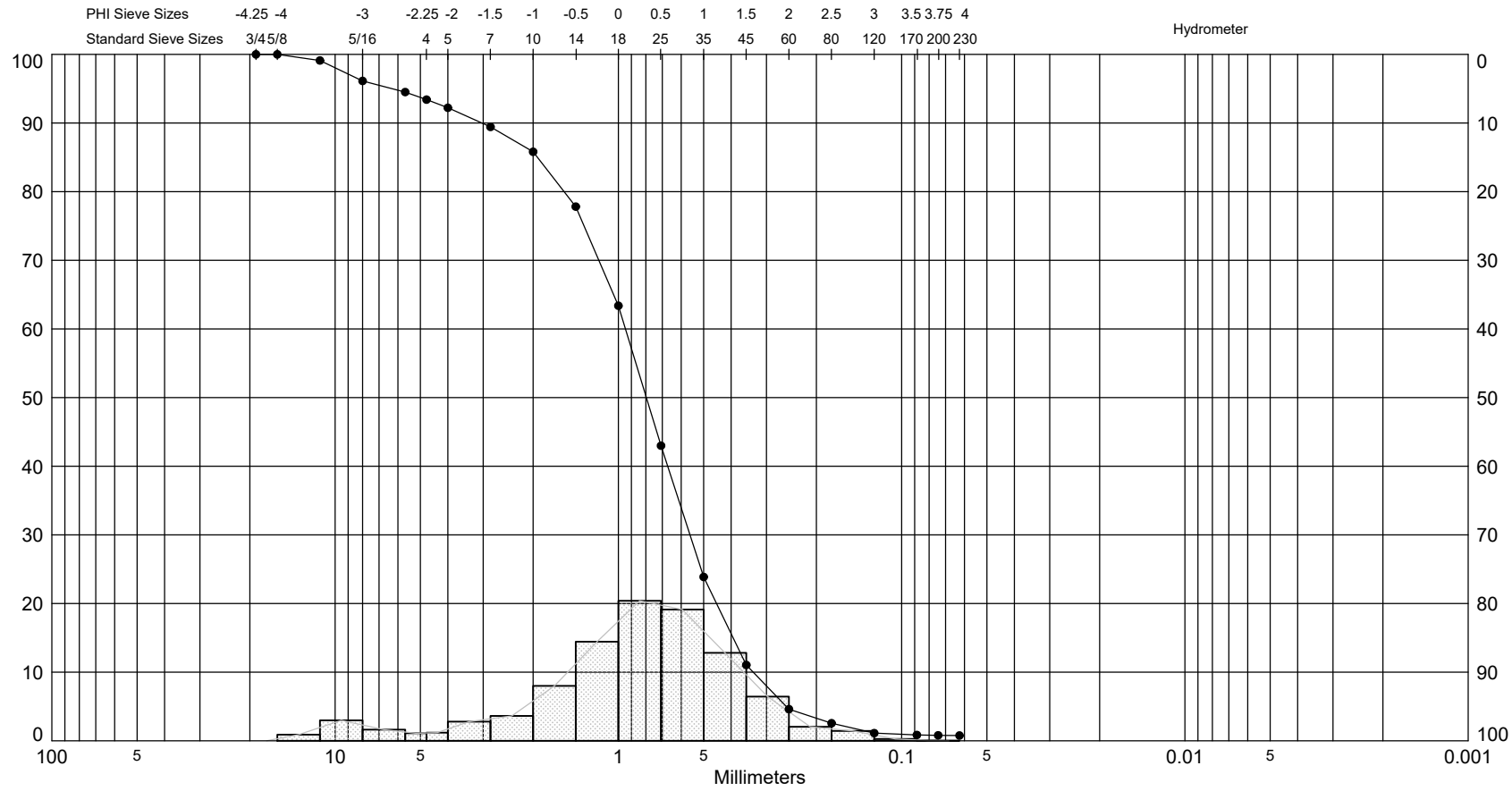
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
156.57	155.39			#200 - 0.80 #230 - 0.77			26

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	1.39	0.89	1.39	99.11
5/16	-3.00	8.00	4.66	2.98	6.05	96.13
#3.5	-2.50	5.66	2.53	1.62	8.58	94.51
#4	-2.25	4.76	1.73	1.10	10.31	93.41
#5	-2.00	4.00	1.87	1.19	12.18	92.22
#7	-1.50	2.83	4.37	2.79	16.55	89.43
#10	-1.00	2.00	5.67	3.62	22.22	85.81
#14	-0.50	1.41	12.51	7.99	34.73	77.82
#18	0.00	1.00	22.61	14.44	57.34	63.38
#25	0.50	0.71	31.93	20.39	89.27	42.99
#35	1.00	0.50	29.94	19.12	119.21	23.87
#45	1.50	0.35	20.07	12.82	139.28	11.05
#60	2.00	0.25	10.09	6.44	149.37	4.61
#80	2.50	0.18	3.21	2.05	152.58	2.56
#120	3.00	0.13	2.26	1.44	154.84	1.12
#170	3.50	0.09	0.42	0.27	155.26	0.85
#200	3.75	0.07	0.08	0.05	155.34	0.80
#230	4.00	0.06	0.05	0.03	155.39	0.77

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
1.97	1.31	0.97	0.33	-0.40	-0.89	-2.65

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	0.15	0.90	1.28	-0.83	3.99

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-08 #S1	—●—	-19.7	SP	#200 - 0.80 #230 - 0.77			0.33	0.15	-0.83	3.99	1.28

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,295,745
Northing (Y, ft):	43,656
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-08 #S2

Analysis Date: 08-12-22

Analyzed By: CRM

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1293 Graham Farm Road
McClellanville, SC 29458
Office: 843-887-3800

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,295,745	43,656	NC State Plane	-21.9 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 2.5Y-6/2	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

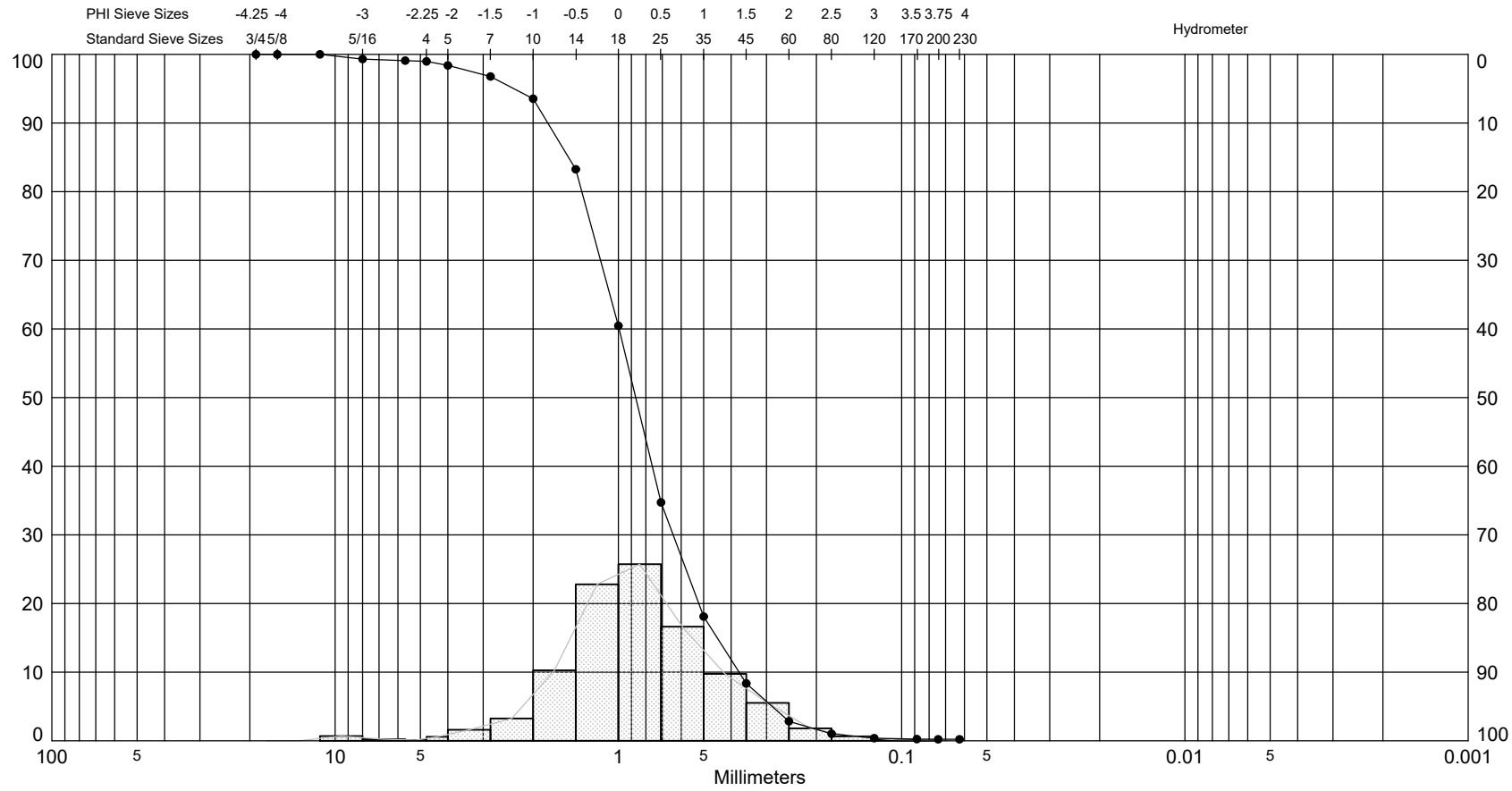
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
151.03	150.65			#200 - 0.22 #230 - 0.22			24

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	1.03	0.68	1.03	99.32
#3.5	-2.50	5.66	0.34	0.23	1.37	99.09
#4	-2.25	4.76	0.16	0.11	1.53	98.98
#5	-2.00	4.00	0.89	0.59	2.42	98.39
#7	-1.50	2.83	2.43	1.61	4.85	96.78
#10	-1.00	2.00	4.89	3.24	9.74	93.54
#14	-0.50	1.41	15.52	10.28	25.26	83.26
#18	0.00	1.00	34.43	22.80	59.69	60.46
#25	0.50	0.71	38.86	25.73	98.55	34.73
#35	1.00	0.50	25.12	16.63	123.67	18.10
#45	1.50	0.35	14.71	9.74	138.38	8.36
#60	2.00	0.25	8.33	5.52	146.71	2.84
#80	2.50	0.18	2.75	1.82	149.46	1.02
#120	3.00	0.13	0.96	0.64	150.42	0.38
#170	3.50	0.09	0.19	0.13	150.61	0.25
#200	3.75	0.07	0.04	0.03	150.65	0.22
#230	4.00	0.06	0.00	0.00	150.65	0.22

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
1.80	1.11	0.79	0.20	-0.32	-0.54	-1.23

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	0.23	0.85	0.91	-0.22	4.37

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-08 #S2	—●—	-21.9	SP	#200 - 0.22 #230 - 0.22			0.2	0.23	-0.22	4.37	0.91

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,295,745
Northing (Y, ft):	43,656
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-09 #C1

Analysis Date: 08-12-22

Analyzed By: CRM

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McClellanville, SC 29458
Office: 843-887-3800

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,294,677	43,797	NC State Plane	-12.9 NGVD 29

USCS:	Munsell:	Comments:
SP-SM	Moist - 2.5Y-5/2	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

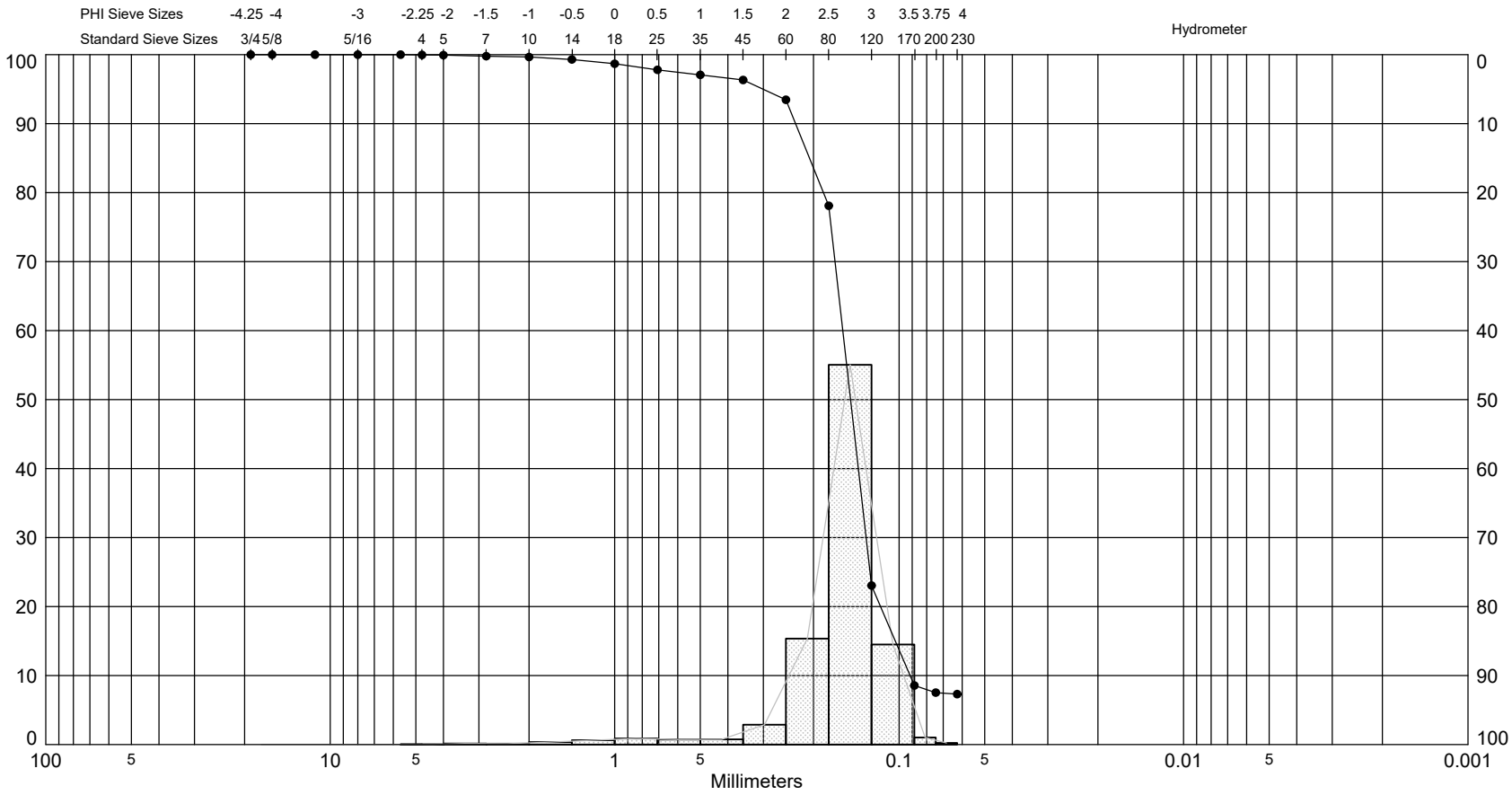
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
144.05	133.54			#200 - 7.53 #230 - 7.31		8.5	9

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.06	0.04	0.06	99.96
#5	-2.00	4.00	0.05	0.03	0.11	99.93
#7	-1.50	2.83	0.22	0.15	0.33	99.78
#10	-1.00	2.00	0.18	0.12	0.51	99.66
#14	-0.50	1.41	0.52	0.36	1.03	99.30
#18	0.00	1.00	0.89	0.62	1.92	98.68
#25	0.50	0.71	1.27	0.88	3.19	97.80
#35	1.00	0.50	1.05	0.73	4.24	97.07
#45	1.50	0.35	1.07	0.74	5.31	96.33
#60	2.00	0.25	4.13	2.87	9.44	93.46
#80	2.50	0.18	22.12	15.36	31.56	78.10
#120	3.00	0.13	79.30	55.05	110.86	23.05
#170	3.50	0.09	20.88	14.49	131.74	8.56
#200	3.75	0.07	1.49	1.03	133.23	7.53
#230	4.00	0.06	0.31	0.22	133.54	7.31

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	3.24	2.98	2.76	2.53	2.31	1.73

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.62	0.16	0.63	-3.15	17.73

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-09 #C1	—●—	-12.9	SP-SM	#200 - 7.53 #230 - 7.31		8.5	2.76	2.62	-3.15	17.73	0.63

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,294,677
Northing (Y, ft):	43,797
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-09 #S1

Analysis Date: 08-12-22

Analyzed By: CRM

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McClellanville, SC 29458
Office: 843-887-3800

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,294,677	43,797	NC State Plane	-16.6 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 2.5Y-5/2	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

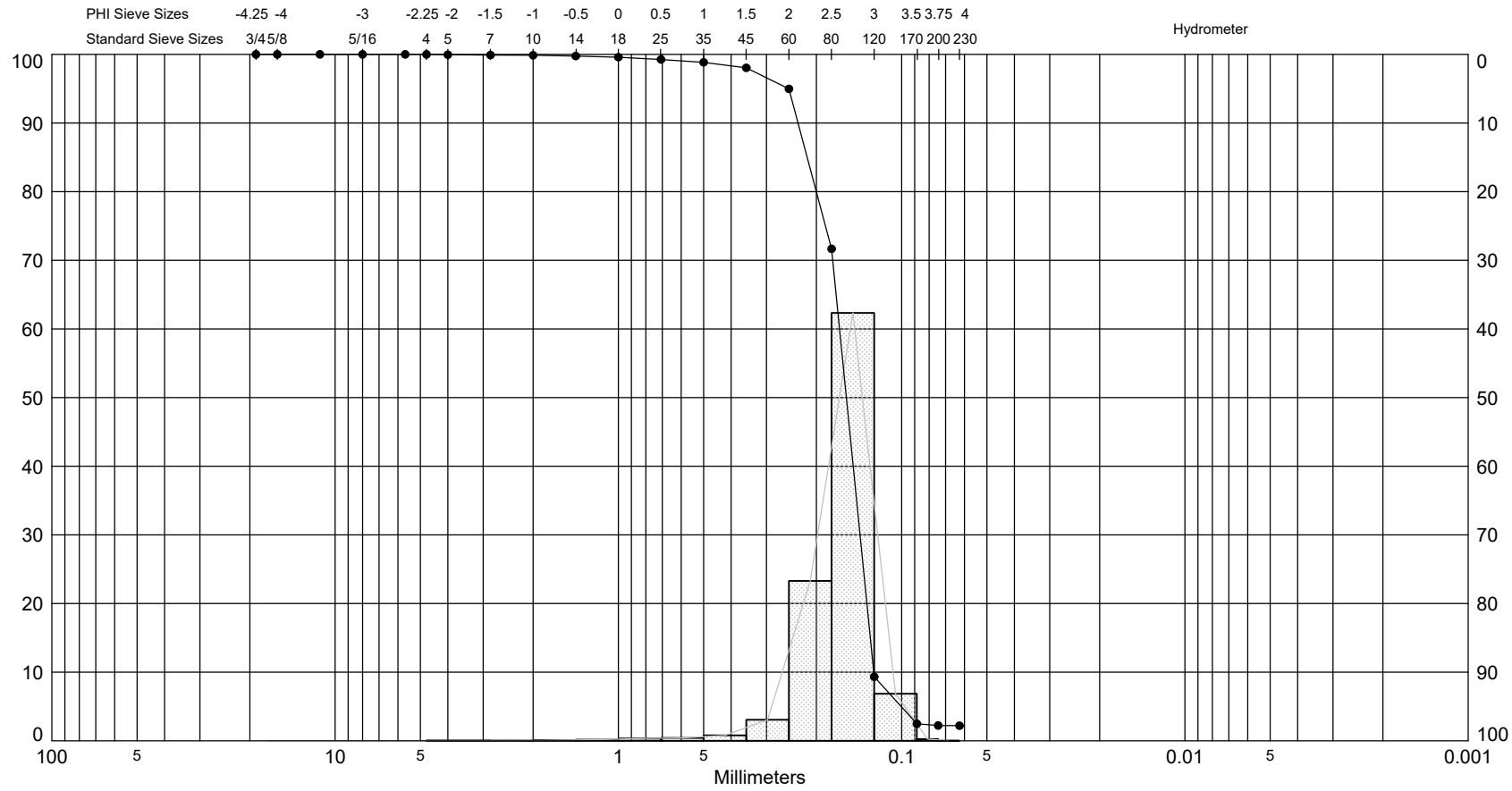
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
150.19	146.91			#200 - 2.23 #230 - 2.20			4

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.00	0.00	0.00	100.00
#5	-2.00	4.00	0.08	0.05	0.08	99.95
#7	-1.50	2.83	0.08	0.05	0.16	99.90
#10	-1.00	2.00	0.05	0.03	0.21	99.87
#14	-0.50	1.41	0.17	0.11	0.38	99.76
#18	0.00	1.00	0.26	0.17	0.64	99.59
#25	0.50	0.71	0.49	0.33	1.13	99.26
#35	1.00	0.50	0.63	0.42	1.76	98.84
#45	1.50	0.35	1.20	0.80	2.96	98.04
#60	2.00	0.25	4.61	3.07	7.57	94.97
#80	2.50	0.18	35.00	23.30	42.57	71.67
#120	3.00	0.13	93.63	62.34	136.20	9.33
#170	3.50	0.09	10.29	6.85	146.49	2.48
#200	3.75	0.07	0.37	0.25	146.86	2.23
#230	4.00	0.06	0.05	0.03	146.91	2.20

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.32	2.95	2.87	2.67	2.43	2.24	2.00

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.59	0.17	0.45	-3.27	24.8

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-09 #S1	—●—	-16.6	SP	#200 - 2.23 #230 - 2.20			2.67	2.59	-3.27	24.8	0.45

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,294,677
Northing (Y, ft):	43,797
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-09 #S2

Analysis Date: 08-12-22

Analyzed By: CRM

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Office: 843-887-3800

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,294,677	43,797	NC State Plane	-20.3 NGVD 29

USCS:	Munsell:	Comments:
SP-SM	Moist - 2.5Y-5/1	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

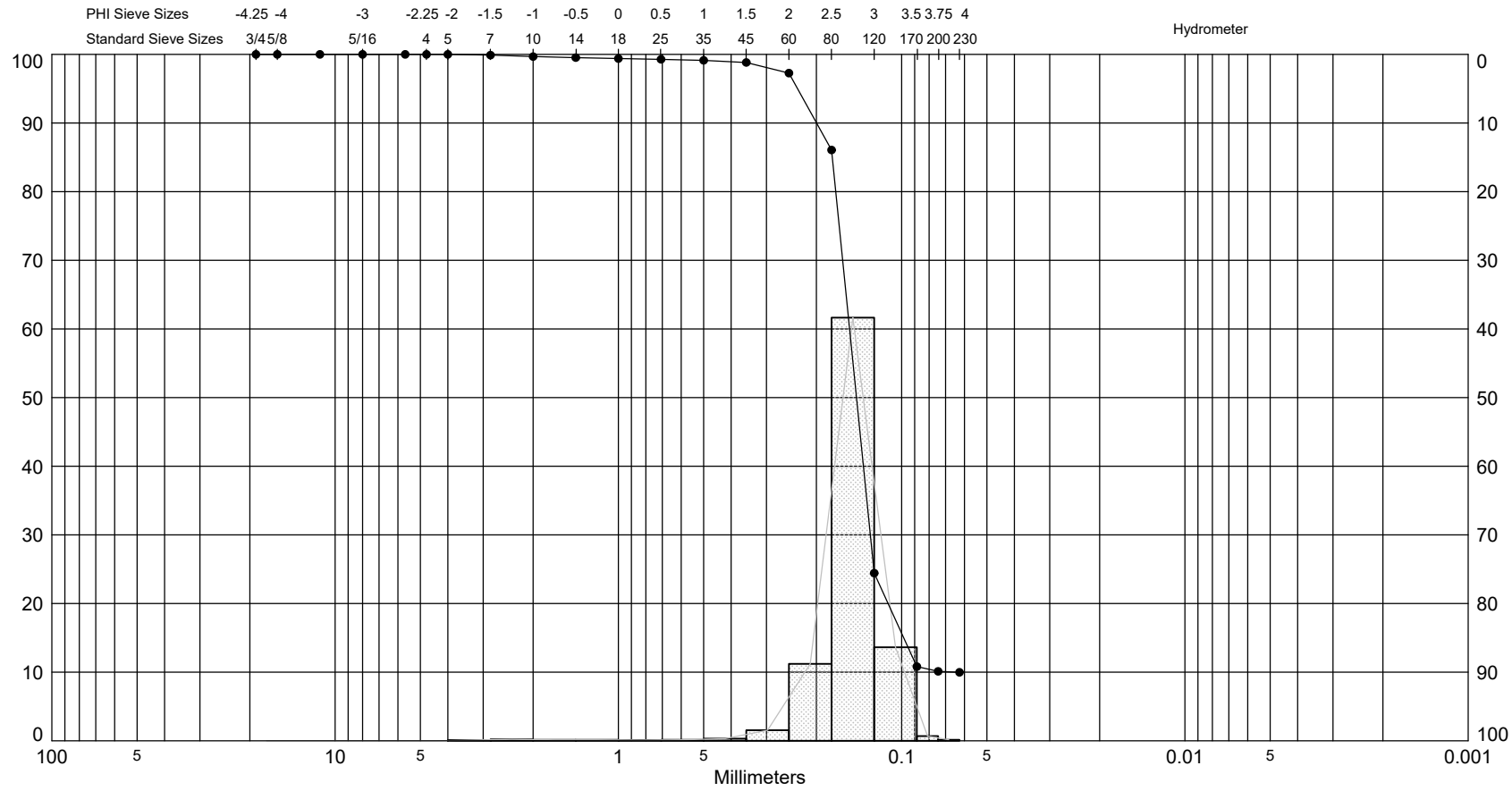
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
129.75	116.79			#200 - 10.12 #230 - 9.98			2

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.00	0.00	0.00	100.00
#5	-2.00	4.00	0.00	0.00	0.00	100.00
#7	-1.50	2.83	0.14	0.11	0.14	99.89
#10	-1.00	2.00	0.27	0.21	0.41	99.68
#14	-0.50	1.41	0.19	0.15	0.60	99.53
#18	0.00	1.00	0.18	0.14	0.78	99.39
#25	0.50	0.71	0.14	0.11	0.92	99.28
#35	1.00	0.50	0.20	0.15	1.12	99.13
#45	1.50	0.35	0.40	0.31	1.52	98.82
#60	2.00	0.25	2.01	1.55	3.53	97.27
#80	2.50	0.18	14.53	11.20	18.06	86.07
#120	3.00	0.13	79.98	61.64	98.04	24.43
#170	3.50	0.09	17.67	13.62	115.71	10.81
#200	3.75	0.07	0.90	0.69	116.61	10.12
#230	4.00	0.06	0.18	0.14	116.79	9.98

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	3.31	3.00	2.79	2.59	2.52	2.10

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.72	0.15	0.46	-4.14	34.74

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-09 #S2	—●—	-20.3	SP-SM	#200 - 10.12 #230 - 9.98			2.79	2.72	-4.14	34.74	0.46

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,294,677
Northing (Y, ft):	43,797
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-10 #C1

Analysis Date: 08-12-22

Analyzed By: CRM

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Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,295,333	43,294	NC State Plane	-17.7 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 5Y-6/2	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

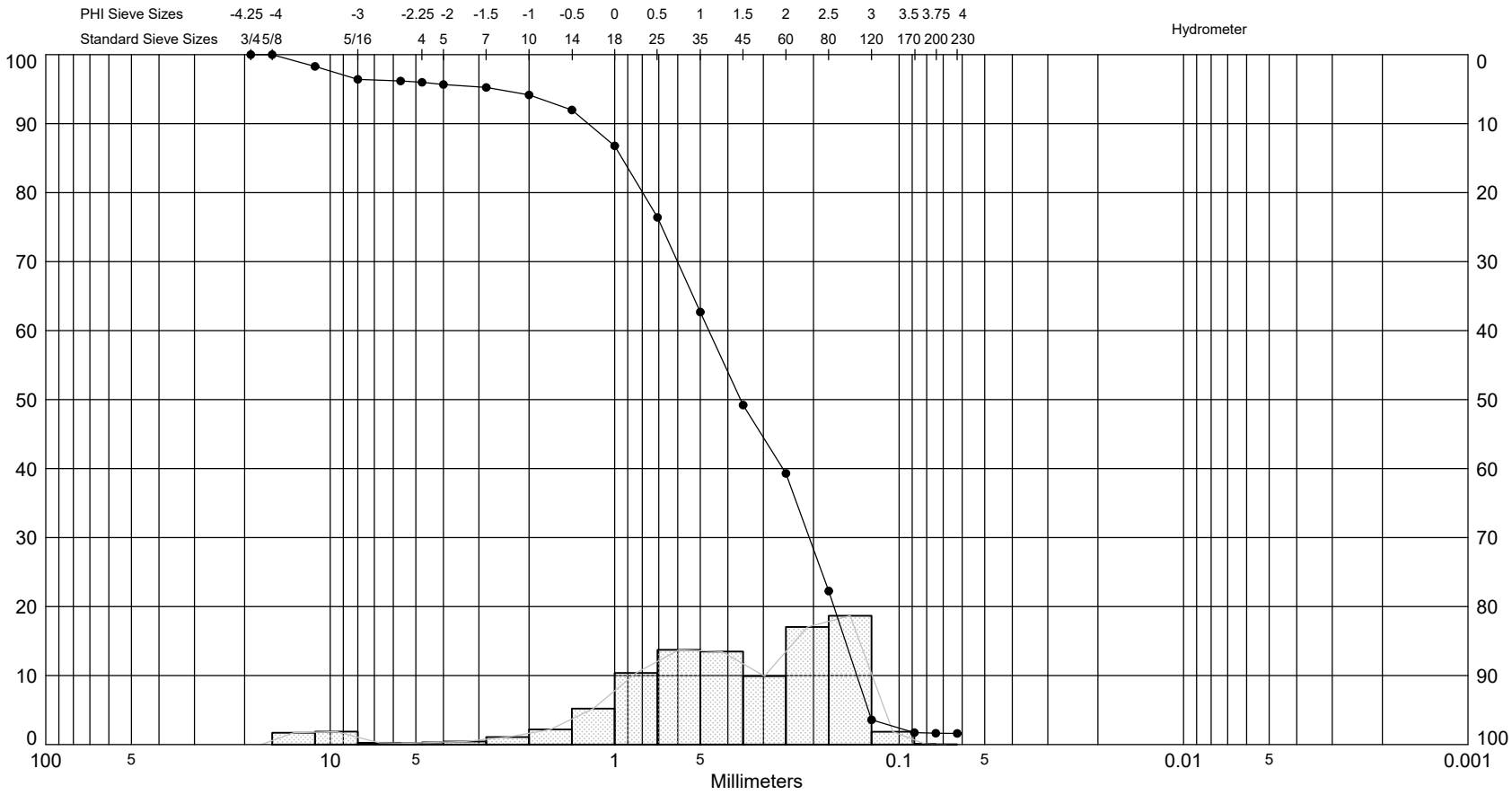
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
143.30	140.99			#200 - 1.64 #230 - 1.61		14.8	12

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	2.43	1.70	2.43	98.30
5/16	-3.00	8.00	2.69	1.88	5.12	96.42
#3.5	-2.50	5.66	0.35	0.24	5.47	96.18
#4	-2.25	4.76	0.27	0.19	5.74	95.99
#5	-2.00	4.00	0.46	0.32	6.20	95.67
#7	-1.50	2.83	0.61	0.43	6.81	95.24
#10	-1.00	2.00	1.55	1.08	8.36	94.16
#14	-0.50	1.41	3.13	2.18	11.49	91.98
#18	0.00	1.00	7.45	5.20	18.94	86.78
#25	0.50	0.71	14.86	10.37	33.80	76.41
#35	1.00	0.50	19.66	13.72	53.46	62.69
#45	1.50	0.35	19.32	13.48	72.78	49.21
#60	2.00	0.25	14.20	9.91	86.98	39.30
#80	2.50	0.18	24.43	17.05	111.41	22.25
#120	3.00	0.13	26.76	18.67	138.17	3.58
#170	3.50	0.09	2.65	1.85	140.82	1.73
#200	3.75	0.07	0.13	0.09	140.95	1.64
#230	4.00	0.06	0.04	0.03	140.99	1.61

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.96	2.67	2.42	1.47	0.55	0.13	-1.39

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.26	0.42	1.44	-1.36	5.34

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-10 #C1	—●—	-17.7	SP	#200 - 1.64 #230 - 1.61		14.8	1.47	1.26	-1.36	5.34	1.44

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,295,333
Northing (Y, ft):	43,294
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-10 #S1

Analysis Date: 08-12-22

Analyzed By: CRM

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Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,295,333	43,294	NC State Plane	-19.8 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 5Y-7/1	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

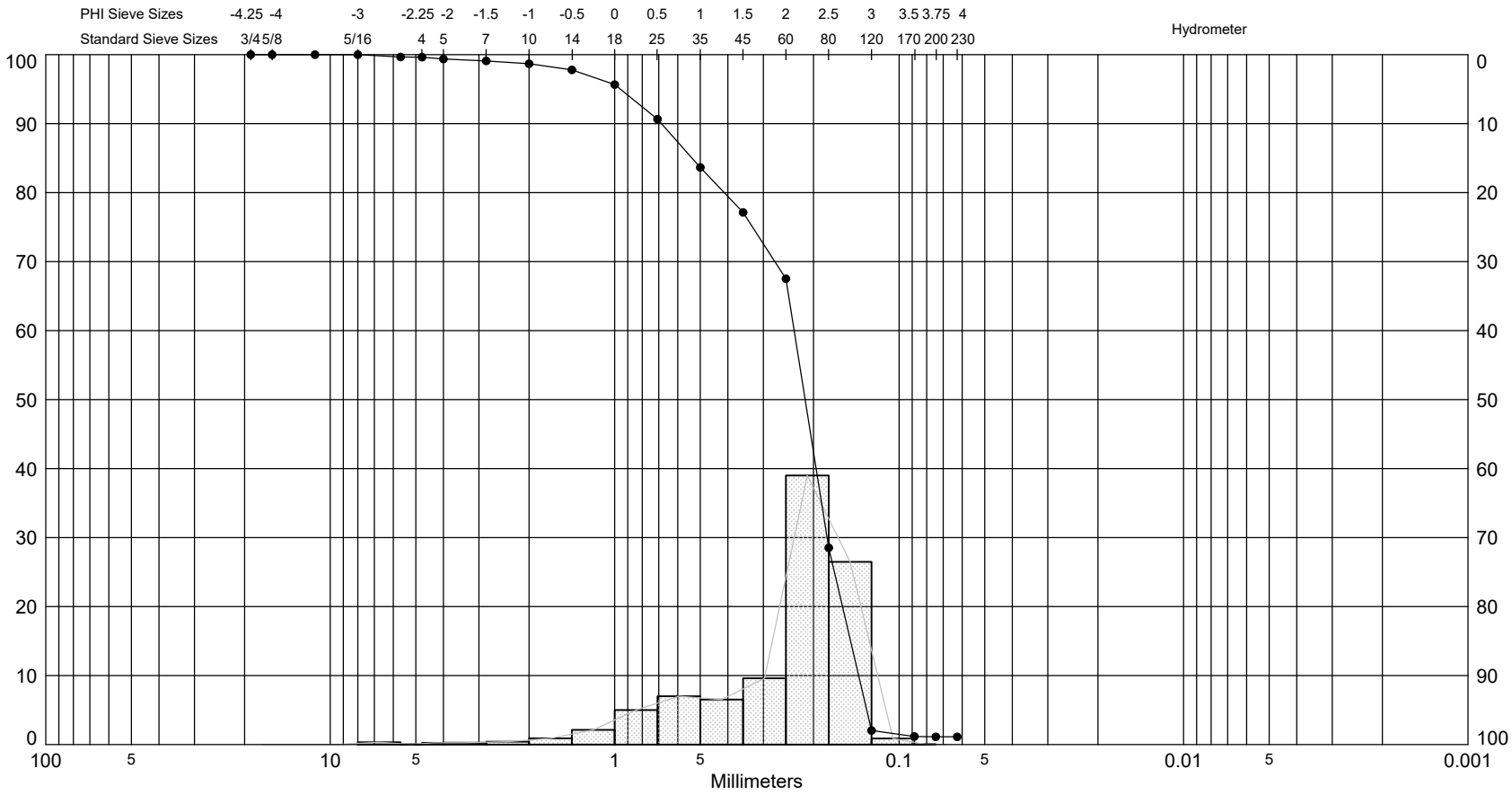
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
155.11	153.38			#200 - 1.12 #230 - 1.12			7

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.53	0.34	0.53	99.66
#4	-2.25	4.76	0.05	0.03	0.58	99.63
#5	-2.00	4.00	0.41	0.26	0.99	99.37
#7	-1.50	2.83	0.43	0.28	1.42	99.09
#10	-1.00	2.00	0.64	0.41	2.06	98.68
#14	-0.50	1.41	1.38	0.89	3.44	97.79
#18	0.00	1.00	3.31	2.13	6.75	95.66
#25	0.50	0.71	7.77	5.01	14.52	90.65
#35	1.00	0.50	10.85	7.00	25.37	83.65
#45	1.50	0.35	10.11	6.52	35.48	77.13
#60	2.00	0.25	14.90	9.61	50.38	67.52
#80	2.50	0.18	60.50	39.00	110.88	28.52
#120	3.00	0.13	41.07	26.48	151.95	2.04
#170	3.50	0.09	1.35	0.87	153.30	1.17
#200	3.75	0.07	0.08	0.05	153.38	1.12
#230	4.00	0.06	0.00	0.00	153.38	1.12

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.94	2.74	2.57	2.22	1.61	0.98	0.07

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.93	0.26	0.94	-1.72	6.53

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-10 #S1	—●—	-19.8	SP	#200 - 1.12 #230 - 1.12			2.22	1.93	-1.72	6.53	0.94

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,295,333
Northing (Y, ft):	43,294
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

Granularmetric Report

Depths and elevations based on measured values

Project Name: Jay Bird Shoals Borrow Area Expansion

Sample Name: JBS-22-10 #S2

Analysis Date: 08-12-22

Analyzed By: CRM

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Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
2,295,333	43,294	NC State Plane	-21.9 NGVD 29

USCS:	Munsell:	Comments:
SP	Moist - 2.5Y-6/3	Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

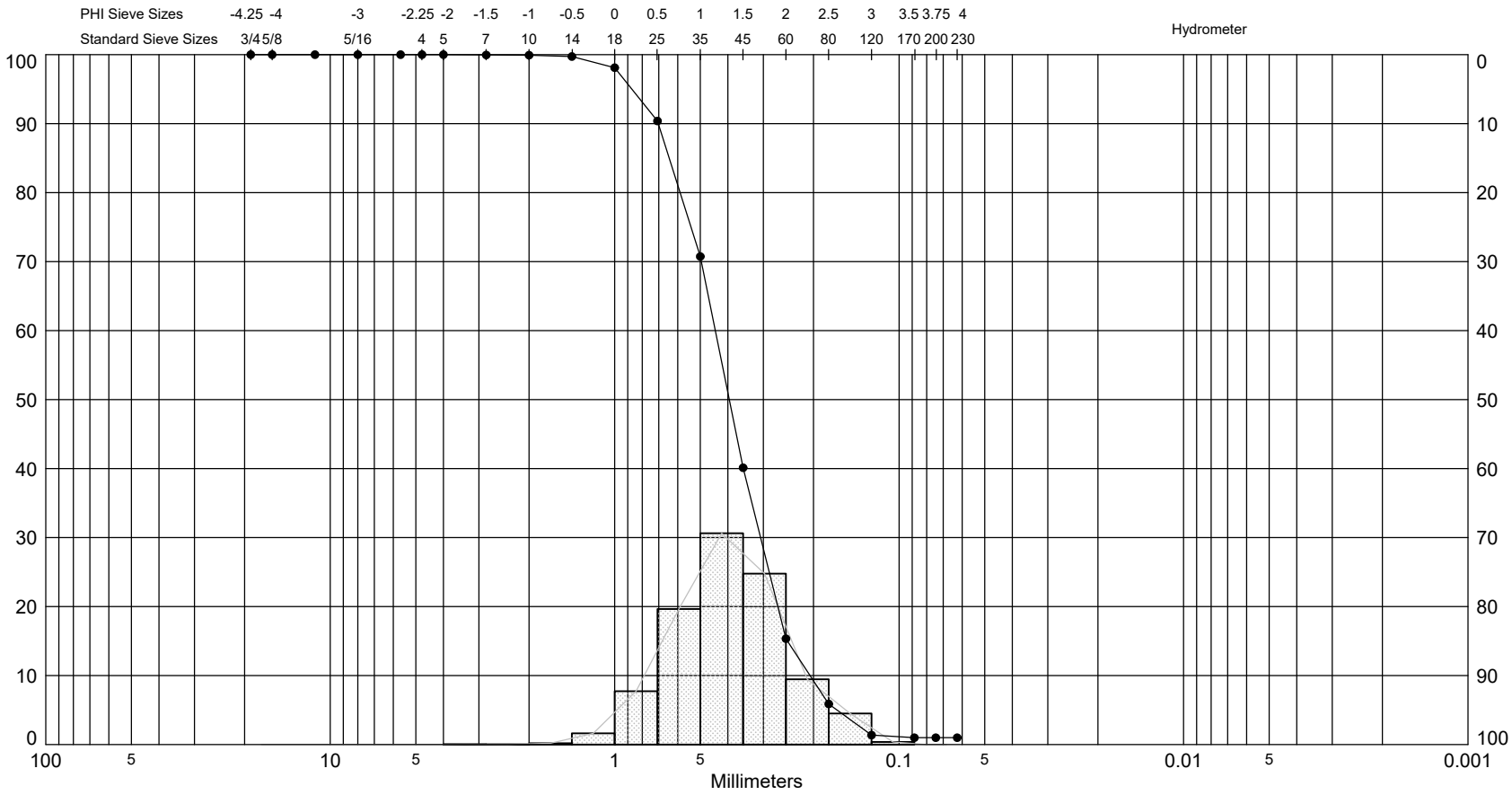
Dry Weight (g):	Wash Weight (g):	Pan Retained (g):	Sieve Loss (%):	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
161.92	160.33			#200 - 0.99 #230 - 0.99			8

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4	-4.25	19.03	0.00	0.00	0.00	100.00
5/8	-4.00	16.00	0.00	0.00	0.00	100.00
7/16	-3.50	11.31	0.00	0.00	0.00	100.00
5/16	-3.00	8.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.00	0.00	0.00	100.00
#5	-2.00	4.00	0.00	0.00	0.00	100.00
#7	-1.50	2.83	0.08	0.05	0.08	99.95
#10	-1.00	2.00	0.05	0.03	0.13	99.92
#14	-0.50	1.41	0.31	0.19	0.44	99.73
#18	0.00	1.00	2.62	1.62	3.06	98.11
#25	0.50	0.71	12.52	7.73	15.58	90.38
#35	1.00	0.50	31.80	19.64	47.38	70.74
#45	1.50	0.35	49.58	30.62	96.96	40.12
#60	2.00	0.25	40.13	24.78	137.09	15.34
#80	2.50	0.18	15.32	9.46	152.41	5.88
#120	3.00	0.13	7.31	4.51	159.72	1.37
#170	3.50	0.09	0.61	0.38	160.33	0.99
#200	3.75	0.07	0.00	0.00	160.33	0.99
#230	4.00	0.06	0.00	0.00	160.33	0.99

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.60	1.99	1.81	1.34	0.89	0.66	0.20

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.34	0.40	0.67	0	3.2

GRANULARMETRIC REPORT OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22



Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
JBS-22-10 #S2	—●—	-21.9	SP	#200 - 0.99 #230 - 0.99			1.34	1.34	0	3.2	0.67

Comments: Analysis conducted by Terracon Consultants, Inc. of Jacksonville, FL

Depths and elevations based on measured values

Sample Information	
Project Name:	Jay Bird Shoals Borrow Area Expansion
Analysis Date:	08-12-22
Analyzed By:	CRM
Easting (X, ft):	2,295,333
Northing (Y, ft):	43,294
Horizontal System:	NAD 1983
Vertical System:	NGVD 29

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SIEVE ANALYSIS OAI, JAY BIRD SHOALS BORROW AREA EXPANSION, NC (2022).GPJ FL DEP ROSS.GDT 8/31/22

APPENDIX C
Grain Size Data Summary Graphs

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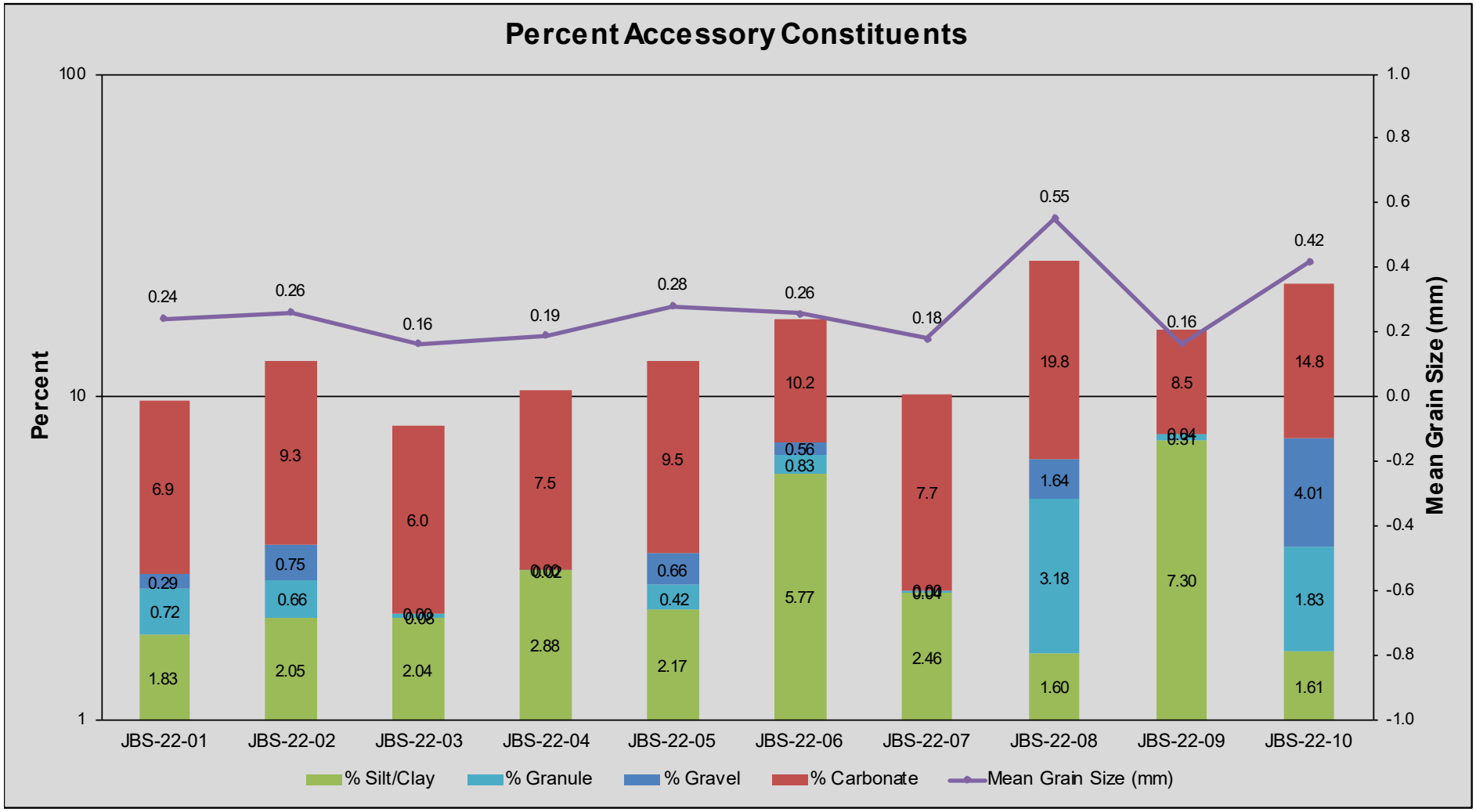
APPENDIX C - Grain Size Data Summary Graphs
Olsen Associates, Inc.
2022 Geotechnical Investigation
Jay Bird Shoals Borrow Area Expansion
Brunswick County, North Carolina



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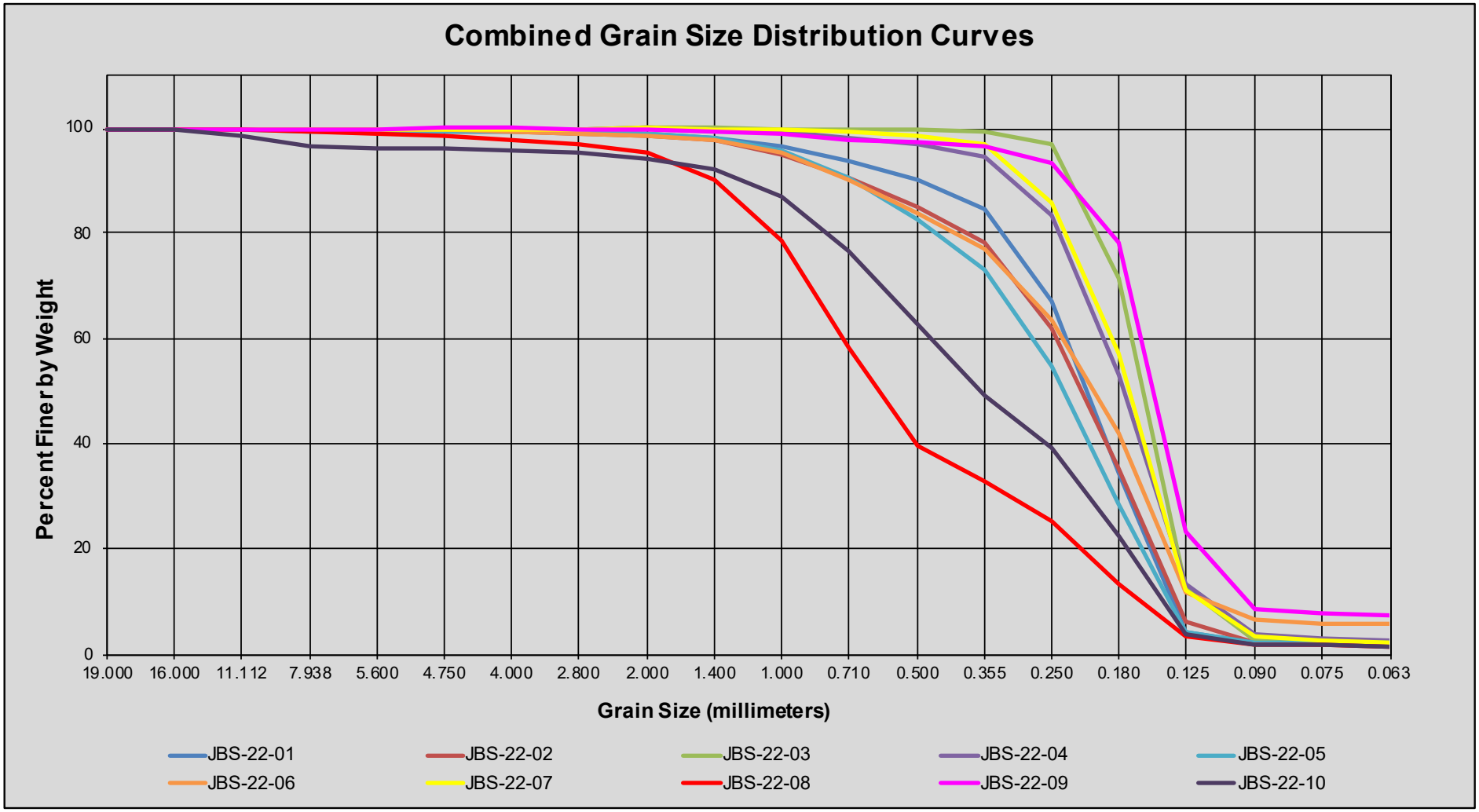
2022 Geotechnical Investigation
Jay Bird Shoals Borrow Area Expansion
Brunswick County, North Carolina



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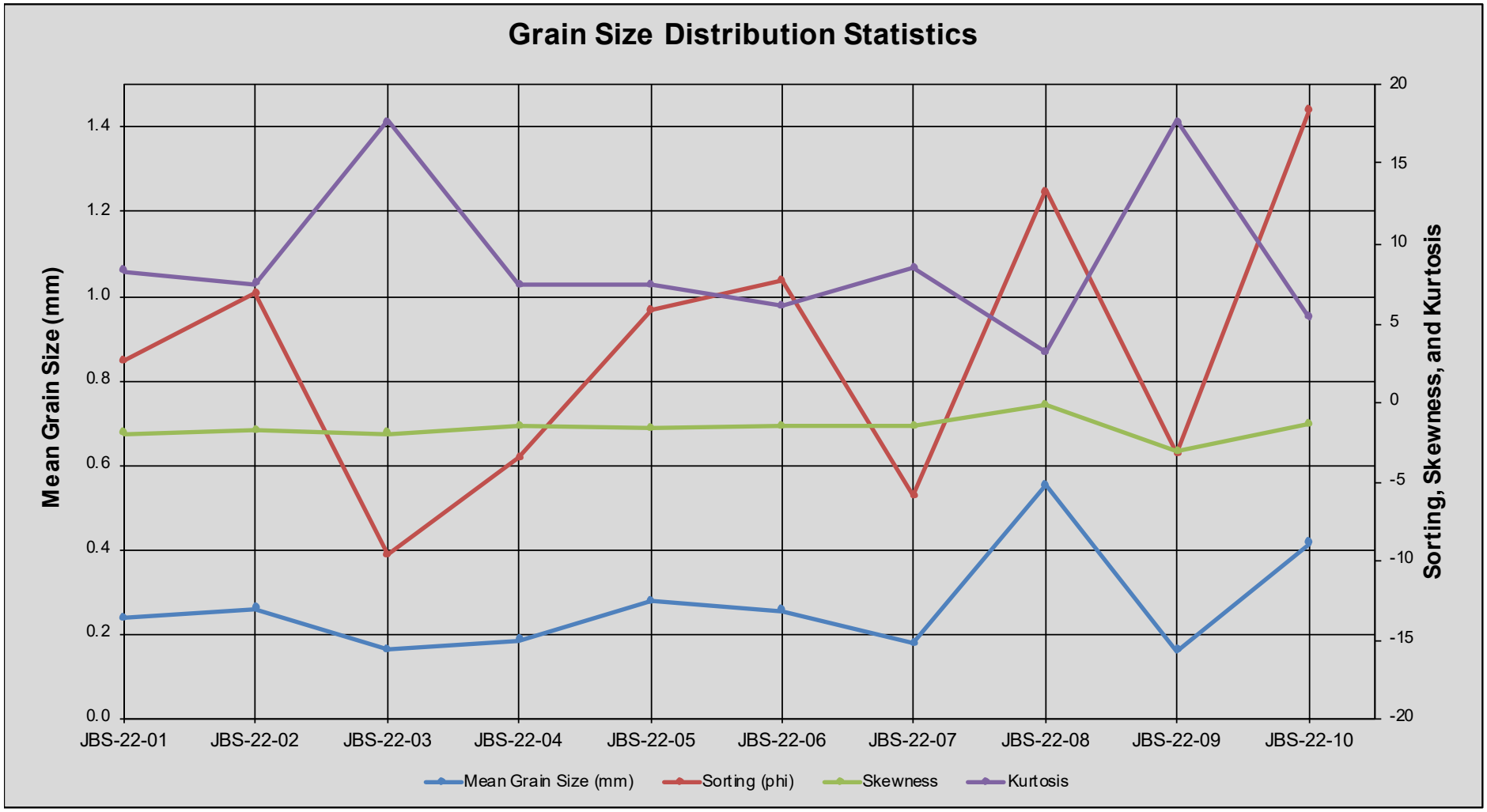
2022 Geotechnical Investigation
Jay Bird Shoals Borrow Area Expansion
Brunswick County, North Carolina



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