## **APPENDIX F**

BALD HEAD CREEK BORROW SITE EXPANSION AND GEOTECHNICAL ANALYSIS (OLSEN AND ASSOCIATES, INC. APRIL 2014)

**Final Environmental Impact Statement** Village of Bald Head Island Shoreline Protection Project Brunswick County, North Carolina



# Village of Bald Head Island Terminal Groin Project

Bald Head Creek Borrow Site Expansion Geotechnical Analysis

Bald Head Island, N.C.

**Prepared for:** Village of Bald Head Island

#### Prepared by:

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### April 2014



#### VILLAGE OF BALD HEAD ISLAND TERMINAL GROIN PROJECT

#### BALD HEAD CREEK BORROW SITE EXPANSION GEOTECHNICAL ANALYSES

#### PURPOSE

The Village of Bald Head Island (Village) is permitting the construction of a terminal groin (ref: SAW-2012-00040) to be located at the westernmost portion of South Beach immediately abutting the federal navigation project located within the entrance to the Cape Fear River. The Public Notice for a federal DEIS required by the project was issued by the Wilmington District, USACOE on 10 January 2014. The terminal groin project necessitates the identification and permitting of ancillary sand sources required for initial groin fillet construction and future maintenance, as well as potential mitigation to the downdrift shoreline of West Beach, if necessary.

The Permit Application referenced above includes two (2) identifiable local sand sources: 1.) the unused portion of a borrow site (i.e. about 1 Mcy+) within Jay Bird Shoals as previously developed for a 2009/10 beach restoration project constructed by the Village, and 2.) an "expansion" of a prior borrow site developed (and dredged) located on the ebb shoals of Bald Head Creek. The current terminal groin Permit application likewise identifies the federal navigation channel as a potential sand source although the latter project is maintenance dredged by the Wilmington District, USACOE every two to three years. This geotechnical investigation addresses solely the proposed Bald Head Creek borrow site expansion which necessitated the acquisition of additional field data and subsequent analyses of the soils encountered via Vibracoring.

#### BACKGROUND

A 21.34 acre ebb shoal borrow site (see Figure 1) was previously permitted at the mouth of Bald Head Creek in 2010 (ref. CAMA 139-10; DWQ #040561V3; COE-2009-02334). In



REF: CAMA 139-10

FIGURE 1 - ORIGINAL BALD HEAD CREEK BORROW SITE (PRE-DREDGE CONDITION)

2006, approximately 47,800 cy had been dredged from the Creek mouth and placed along West Beach as a small scale beach restoration project located between baseline Sta. 16+00 and Sta. 34+00 (CAMA 02-05).

In 2012, following the offshore passage of Hurricane Irene, an *emergency* level beach fill operation partially funded by F.E.M.A. was performed along both West Beach and the westernmost segment of South Beach utilizing the 2010 permitted Bald Head Creek borrow site material. The total amount dredged at that time was 137,990 cy. This essentially depleted the majority of the sand potentially available within the limits of the 21.34 acre ebb shoal borrow site (see **Figure 2**).

A detailed description of the Bald Head Creek ebb tidal shoal environmental setting, the requisite geotechnical investigation by Olsen Associates, Inc. and the project specific Archaeological Report for the 2010 borrow area by Tidewater Atlantic Research, Inc., are all addressed within the original project *Environmental Assessment*, (LMG, Inc. 2013 and 2014). Certain design precepts associated with the use of the 2012 Bald Head Creek borrow site – intended to minimize environmental impacts of the permitted activity – included the following:

- A borrow site dredge depth limited to -8ft NGVD (+ 1 ft overdredge). This allowed for post-construction seabed sediment composition to remain unchanged. This factor served to facilitate rapid post-excavation benthic recolonization (LMG, Inc. 2013 and 2014),
- No SAVs were excavated, or located proximate to the proposed work,
- The borrow site configuration was selected in such a way to avoid supratidal and intertidal impacts to avian habitat, and
- Only high quality beach compatible material (with a low fines content) was identified for excavation so as to greatly minimize project related turbidity – at both the borrow and beach fill sites.

Since the 2012 Post-Irene dredging project, both physical and biological monitoring of the permitted original 21.34 acre borrow site has been performed by the Village. The Year-1 and Year 2 Biological Monitoring Reports (LMG, Inc. 2013 and 2014) indicated that at the borrow



REF: CAMA 139-10

FIGURE 2 - ORIGINAL BALD HEAD CREEK BORROW SITE (POST-DREDGE CONDITION)

site, many of the same species that were dominant in pre-construction sampling were also dominant in the year-1 and 2 sampling. Diversity and richness were both significantly greater at the borrow site then at the reference sites during both the post- and year-1 and year-2 monitoring events. Physical monitoring surveys of the excavation has shown only limited shoaling (or recovery) resulting from sediment transport from Bald Head Creek, the Row Boat Row shorefront and the adjustment of side slopes. As a result, the 2012 borrow area has been recommended for expansion in a northward direction – with any near term excavation associated with terminal groin post-construction sand requirements being limited to *solely* that area (see **Figure 3**).

#### **EXPANDED BORROW SITE - JUSTIFICATION**

The designation of the proposed expanded 65.1 acre borrow area was predicated on the previously discussed design precepts associated with the original 21.34 acre borrow area permitted in 2010 as CAMA 139-10. In the near term, Contracts will *only* address the undredged 37.6 acre shoal area described by the boundary ABEFA, shown in **Figure 3**. That is to say, the 2012 original dredged borrow area in its entirety will remain undisturbed and be allowed to continue to physically recover over time. As noted above, however, biological recovery of the seabed is essentially complete at this time. Agency consent would be sought for purposes of its *future* reuse as a sand source.

An expanded borrow area is necessary to comply with the Terms and Conditions of S.B. 110 (as amended) in order to plan for the mitigation of any potential adverse impacts to the downdrift shoreline of West Beach and/or to address terminal groin fillet maintenance. The location and configuration of the Bald Head Creek borrow area – as expanded – allows for the use of a small hydraulic cutter suction dredge most suitable for low volume excavation type projects (i.e. less than 200,000 cy mol.). It likewise facilitates the use of a smaller, non-ocean certified dredge plant which allows for both better availability and shorter time from delineation of need – to excavation – to actual sand placement. Moreover, the very shallow nature of the proposed borrow site (i.e. to -8ft NGVD, mol), limits the size of dredge plant which can successfully access the site and comply with this important Permit Condition intended to foster



rapid post-construction physical as well as biological recovery. As with the 2012 project, a +1 ft. overdredge tolerance is requested in the Permit application.

In 2008, Athena Technologies, Inc. (ATI) acquired fifteen (15) Vibracores (designated as BHC-1 through BHC-15) located principally within the ebb tidal shoal formation of Bald Head Creek. Subsequent to laboratory analyses, all sediments located within the study area, above elevation -8 ft NGVD (or slightly deeper in many instances), were determined to be beach compatible (ref. LMG, 2010). This included some five (5) Vibracores located northward of the 21.34 acre permitted borrow area (see **Figure 1**). As a direct result, additional Vibracores were commissioned by the Village in 2014 for purposes of expanding the original borrow site permitted in 2010 and subsequently dredged in 2012.

#### 2014 GEOTECHNICAL INVESTIGATION – EXPANDED BORROW AREA

In January 2014, ATI was contracted by Olsen Associates, Inc. to collect additional geotechnical Vibracore samples for the Village northward of the entrance to Bald Head Creek. More specifically, the firm was directed to acquire seven (7) additional cores (designated as BHC-16 through BHC-22) at predetermined locations to a depth of ten (10) ft., mol below the existing seabed. Subsequently the Vibracores were logged, photographed and sub-sampled for grain size and carbonate content. A depiction of the twenty two (22) locations representing both the 2008 and 2014 Vibracores sampling programs are represented by **Figure 4**.

Subsequent to photography and logging, ATI was requested to sample each core at the top and at the absolute elevation of -8ft. NGVD. The firm was also directed to formulate a continuous "composite" sample extending from the top of core to -8ft NGVD. As a result, each core provided three (3) samples for laboratory analysis. For each sample a grain size distribution (GSD) was plotted. A percentage fines passing a #200 sieve was recorded and a carbonate test performed for each sample. The results of the ATI investigation for 2014, including lab results color core photography and a geologic log for each Vibracore are included as **Appendix A**. The average percentage of fine-grained material (i.e. silt and clay) passing a #200 sieve (based upon the composite samples) was 1.4% with a maximum reported value of 2%. The average grain size was



FIGURE 4 - LOCATION OF VIBRACORES

.37mm. The average carbonate percentage for the composite samples was 10.7% with a maximum reported value of 21.3%. All of the core analyses reported relatively clean fine grained sand (SP) above elevation -8ft (NGVD 29). A few minor layers of SP-SM were noted in several cores above the depths of interest but numerous cores showed SP material to depths of -10 to -12 ft., (NVGD 29) or greater.

#### SUITABILITY ANALYSES

As depicted by **Figure 3**, the presently proposed borrow area defined as ABEFA, to be utilized in conjunction with the VBHI terminal groin project, is typified by the thirteen (13) cores numbered, 9,11,12,13,14,15, 16,17,18,19,20,21 and 22. Vibracores 9-16 were acquired in 2008. Vibracores 17-22 were taken in 2014. **Table 1** summarizes both carbonate and fines content for the composite samples derived from each of the thirteen Vibracores. As shown, carbonate averaged about 10%, whereas the fines content is *very low* at about 1.5%.

**Table 2** presents additional geotechnical parameters of interest for the 13 Vibracore composite samples representing the expanded ebb shoal borrow area (see **Figure 3**). **Table 3** depicts the grain size characteristics which form the basis for the evaluation of sediment suitability in North Carolina – for the use intended, i.e. beach fill. Pursuant to Rule, the "sediment" size categories" and definitional scheme for Vibracore sediment analyzed are defined as follows:

Gravel: 4.76mm – 76mm Granular: 2mm – less than 4.76mm Sand: .0625mm – less than 2mm Fines: Less than .0625mm

Core (Comp)	%CO3	% Passing #200	% Passing #230
9	8.0	1.3	1.2
11	12.0	2.4	1.6
12	6.0	.9	.8
13	10.0	2.2	2.2
14	8.0	3.2	3.2
15	13.0	1.3	1.2
16	11.8	1.8	1.8
17	8.5	1.3	1.3
18	8.4	0.9	0.9
19	17.6	1.4	1.3
20	11.7	1.0	1.0
21	10.7	1.2	1.1
22	6.0	2.0	1.9
Average	9.9	1.6	1.5

### **Table 1 Carbonate and Fines Content**

**Comp** – A continuous composite soil sample from surface of seabed to the proposed depth-of-excavation, i.e. approximately -8.0 ft (NVGD).

Carbonate %	8.00	12.0	6.0	10.0	8.0	13.0	11.8	8.5	8.4	17.6	11.7	10.7	6.0
sisotuX	3.06	3.30	2.46	3.46	3.21	3.87	4.85	8.05	4.22	3.06	4.12	3.72	2.63
ssəuwəyS	55	52	51	79	89	83	-1.28	-1.79	91	36	84	62	48
Standard Deviation	1.04	1.25	1.01	1.11	<i>T6</i> .	1.32	1.05	.86	.91	<u>%</u>	1.11	1.09	<i>L6</i> .
(ihq) <sub>02</sub> U	1.51	1.46	1.73	1.78	2.04	1.11	2.02	2.05	1.82	1.00	1.59	1.40	1.83
(idq) asəM	1.32	1.36	1.50	1.45	1.69	1.08	1.65	1.81	1.64	1.55	1.39	1.27	1.66
Percent Fines (#200 Sieve)	1.3	2.4	6.	2.2	3.2	1.3	1.8	1.3	6.	1.4	1.0	1.2	2.0
Length of Core (Composite (Vino	5.0	6.7	5.7	5.2	5.6	3.6	4.1	4.0	5.0	6.2	6.6	5.4	4.9
(NGAD) Mater Depth	2.8	1.1	2.1	2.6	2.2	4.2	3.9	4.0	3.0	1.8	1.4	2.6	3.1
Sample ID	COMP	COMP	COMP	COMP	COMP	COMP	COMP	COMP	COMP	COMP	COMP	COMP	COMP
dI mio4	BHC-09	BHC-11	BHC-12	BHC-13	BHC-14	BHC-15	BHC-16	BHC-17	BHC-18	BHC-19	BHC-20	BHC-21	BHC-22

TABLE 2: BALD HEAD CREEK Grain Size Data Summary

Core No.	Gravel	Granular	Sand	Fines	CaCO3		
BHC-09	1	19	96.8	1 16	8.0		
(Comp)	.1	1.9	70.0	1.10	0.0		
BHC-11	5	2.5	95.4	1.60	12.0		
(Comp)		2.0	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		12.0		
BHC-12	0	.5	98.7	.83	6.0		
(Comp)	-				0.0		
BHC-13	.1	14	96.4	2.15	10.0		
(Comp)	••		2011	2.10	10.0		
BHC-14	0	9	96.0	3 1 5	8.0		
(Comp)	0	.,	20.0	5.15	0.0		
BHC-15	25	2.6	93.1	13	13.0		
(Comp)	2.5	2.0	23.1	1.5	15.0		
BHC-16	41	1 33	96 5	1 81	11.8		
(Comp)		1.55	70.5	1.01	11.0		
BHC-17	35	48	97.9	1 29	85		
(Comp)	.55	.+0	51.5	1.27	0.5		
BHC-18	2	55	98.3	91	84		
(Comp)	.2	.55	70.5	.91	0.7		
BHC-19	69	1 75	90.0	1 3/	17.6		
(Comp)	0.7	1.75	70.0	1.54	17.0		
BHC-20	66	1 35	07.0	00	11 7		
(Comp)	.00	1.55	77.0	.))	11.7		
BHC-21	65	11	07.2	1 1 1	10.7		
(Comp)	.05	1.1	91.2	1.11	10.7		
BHC-22	0	1	08.0	1.0/	60		
(Comp)	0	.4	90.0	1.74	0.0		
AVERAGE	.95%	1.29%	95.5%	1.51%	10.1%		

 Table 3. Bald Head Creek Borrow Site – Vibracore Sediment Characterization

 Size Classification (%)

• Composite core sections only – expanded borrow site.

Definition:

Gravel: 4.76mm – 76mm Granular: 2mm – less than 4.76mm Sand: .0625mm – less than 2mm Fines: less than .0625mm Not unexpectedly, the sediment size category results for the 2014 Bald Head Creek borrow site expansion, are *very self-similar* to those calculated for the most recent 2012 Bald Head Creek dredged borrow area. A comparison of the two is as follows:

Year	Gravel	Granular	Sand	Fines	Carbonates	No. of Cores
2014	.95%	1.29%	95.5%	1.51%	10.1%	13
2012	1.4%	1.8%	95.6%	1.2%	9.8%	10

% In Category By Weight

#### **RECIPIENT BEACH SITES**

The June 2010 geotechnical analyses associated with the 2012 dredging of the 21.34 A borrow site located on the Bald Head Creek ebb tidal platform are detailed in LMG (2010). That project design evaluated three (3) alternate disposal sites: a.) West Beach; b.) South Beach (west end) and c.) Rowboat Row shorefront to the north of marine channel entrance. The current sand disposal plan associated with the terminal groin project will consider *only* West Beach and the west end of South Beach.

With respect to the characterization of the areas of proposed fill placement, each of the two (2) recipient beaches has been the location of multiple sand placement projects – with sediment derived from Bald Head Creek, the federal navigation project, and Jay Bird Shoals. Sediment characterizations for South Beach (SB) were performed in coordination with CAMA for purposes of permitting the 2009/2010 1.5 Mcy beach restoration project (CAMA #67-09). In addition, per the request of CAMA, sediment samples had been acquired from West Beach along two (2) transects – one near the Point and one northward of the western limit of beach fill placement which occurred in 2009/10.

It is important to note that full beach sampling transects beyond the approximate mean low water line were *not* feasible at these locations due to the anomalous nature of the profile slopes where the Cape Fear River gorge affects the shoreline configuration. That is to say depths plummet to -20 to -50 ft. in a very short distance seaward of the MLWL as the (man-altered) channel literally impinges upon the shoreline at this location. None-the-less, the sampling protocol utilized was accepted by DCM for the shorefronts intended for sand placement.

A comparison of the expanded portion of the Bald Head Creek borrow site sediment characteristics typified by 13 Vibracores (see **Table 3**) – relative to the sediment characteristics for the two candidate beach fill sites – are described by **Table 4** below.

Composite	Composite Gravel Gra		Sand	Fines	Carbonate		
Sample							
Bald Head Creek							
Borrow Site (Av)	.95	1.29	95.5	1.51	10.3%		
South Beach (Av)							
Fill Site	.07	1.08	98.10	.75	7.57%		
West Beach (Av)							
Fill Site	0	.09	99.65	.26	3.18%		

 Table 4 – Sediment Characteristics

#### **BORROW SITE ANALYSES/FINDINGS**

If one evaluates "compatibility" by the existing N.C. Rule for the currently proposed Bald Head Creek borrow source expanded area and the sediment characteristics associated with West Beach (WB) and South Beach (SB), it is clear that the proposed 37.6 A borrow area meets the State standards – as follows:

#### Requirement

- a.) The average percentage (by weight) of *fine* grained sediment (less than 0.0625mm) shall not exceed the average percentage (by weight) of fine grained sediment of the recipient beach characterization by five (5%) percent.
  - Determination
    - Bald Head Creek Borrow Site Av 1.51%
    - Recipient Beach
      - SB Mean .75%
        WB Mean .26%
  - Result Borrow Site complies with standard for each of the two beach segments considered.

#### Requirement

- b.) The average percentage (by weight) of *granular* sediment (greater than 2mm and less than 4.76mm) in the borrow site shall not exceed the average percentage (by weight) of coarse-sand sediment of the recipient beach characterization plus five (5%) percent.
  - Determination
    - Bald Head Creek Borrow Site Av 1.29%
    - Recipient Beach
      - SB Mean
        WB Mean
        .09%
  - Result Borrow Site complies with standard for each of the two beach segments considered.

#### Requirement

c.) The average percentage (by weight) of *gravel* sediment (greater than or equal to 4.76mm) in the borrow site shall not exceed the average percentage (by weight) of gravel-sized sediment of the recipient beach characterization plus five (5%) percent.

• Determination

•	Bald Head Creek Borrow Site Av	.95%
---	--------------------------------	------

- Recipient Beach
  - SB Mean .07 %
    WB Mean 0%
- Result Borrow Site complies with standard for each of the two beach segments considered.

#### Requirement

d.) The average percentage (by weight) of *calcium carbonate* in the borrow site shall not exceed the average percentage (by weight) of calcium carbonate sediment of the recipient beach characterization plus fifteen (15%) percent.

#### • Determination

- Bald Head Creek Borrow Site Av 10.3%
- Recipient Beach
  - SB Mean 7.57 %
  - WB Mean 3.18%
- Result Borrow Site complies with standard for each of the two beach segments considered.

#### CONCLUSION

In conclusion, the 37.6 acre segment of the expanded Bald Head Creek borrow site to be permitted as part of the terminal groin project, as described by thirteen (13) cores of interest (see **Table 3**), meets the State of N.C.'s standards for borrow site compatibility relative to known beach conditions typifying the two (2) alternate beach fill sites considered: 1.) the west end of South Beach and, 2.) West Beach.

#### REFERENCES

ATI (2014). "Geotechnical Investigation of Bald Head Creek," McClellanville, S.C., 6 March 2014.

L.M.G., Inc. (2014), "Environmental Assessment, Bald Head Creek Dredging Project," Wilmington, N.C., July 2010.

L.M.G., Inc. (2013), "Village of Bald Head Island – Bald Head Creek Dredge Project – Biological Monitoring Report No. 2," Wilmington, N.C., April 2013.

L.M.G., Inc. (2014), "Village of Bald Head Island – Bald Head Creek Dredge Project – Biological Monitoring Report No. 3," Wilmington, N.C., April 2014.

## **APPENDIX** A

2014 ATI Investigation Bald Head Creek Bald Head Island, N.C.

PROJECT: BORROW SITE EXPANSION



#### Geotechnical Investigation of Bald Head Creek Bald Head Island, North Carolina

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#### **APPENDICES**

Appendix A: Bald Head Creek Core Logs, Photographs, Sieve Analysis Curves, and Granularmetric Reports



#### Section 1: Investigation Scope

Athena Technologies, Inc. (Athena) was contracted by Olsen Associates, Inc. (Olsen) in January, 2014 to collect geotechnical vibracore samples for the Village of Bald Head Island. The purpose of the geotechnical investigation was to characterize sediments in a potential borrow area for beneficial use.

The scope of work for the geotechnical sampling project consisted of the collection of seven (7) vibracore samples to a depth of ten (10) feet below sediment surface. The vibracores were collected from the entrance of Bald Head Creek and were sub-sampled for grain size and carbonate analyses.

#### Section 2: Geological Setting

The project site is located adjacent to Bald Head Island in Brunswick County, North Carolina. The site is positioned between the Cape Fear River to the west and the Smith Island backbarrier marsh sequence to the east and north. The Village of Bald Head Island borders the site to the south. A map of the study area has been included as **Figure 1**.

The feature of interest is a subaqueous and intertidal shoal complex associated with a recurve spit feature located at the entrance to Bald Head Creek. The shoal complex exhibits large scale, flood oriented sand waves and shallow tidal channels. One such tidal channel, located along the eastern extent of the shoal complex, likely represents the natural orientation and position of Bald Head Creek. The setting experiences semidiurnal tides with a mean range of 4.5 feet (NOAA).

#### Section 3: Site Conditions

Athena mobilized to Southport, NC on February 3, 2014 in preparation for field sampling. Field sampling commenced and concluded on February 4. Sampling was schedule around a flooding tidal cycle in order to ensure that the sample locations could be accessed via vessel. Water depths at the sample sites averaged 4.6 feet, with a maximum depth of 6.4 feet at BHC-16, and a minimum of 3.0 feet at BHC-18. The wind direction was approximately 10 miles per hour (mph), with gusts to 20 mph, out of the North. The shallow water depths and predominant wind direction resulted in choppy conditions on top of the shoal complex. The average vibracore penetration and recovery for the Bald Head Creek cores was 10.4 and 8.6 feet, respectively. A map outlining the Bald Head Creek vibracore locations has been included as **Figure 2**.

#### Section 4: Field Sampling Methodology

Athena utilized our twenty-four (24) foot research vessel as the sampling platform for this investigation. The vessel 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 (DGPS, sub-meter accuracy) interfaced with HYPACK was utilized for primary navigation. Horizontal coordinates were recorded in North American Datum of 1983 (NAD83) State Plane, North Carolina (Zone 3200), U.S. Survey Feet. The vessel was immobilized over the desired sample sites using spuds or a triple-point anchor system. Once on station, the coordinates at the current location were verified with the desired station coordinates to ensure accuracy. At this point, a water depth was collected via lead line.



### Figure 1: Bald Head Creek Site Map





Figure 2: Bald Head Creek Vibracore Location Map





A custom-designed and built vibracore system was utilized in order 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 three-inch (3") diameter, galvanized sample barrel. The sample barrel was lowered until the bottom of the barrel touched the sediment surface, at which point the barrel was raised until directly above the sediment surface. The vibracore machine was turned on and the sample barrel was allowed to penetrate to a depth of ten (10) feet below sediment surface, or to refusal. In certain cases (e.g., BHC-16 and BHC-22), the sample barrel was allowed to penetrate to a deeper depth in an attempt to counteract sediment loss during sample barrel retrieval. Once the sample barrel reached the desired depth, the machine was turned off and the sample barrel was retrieved using an electric winch. Once the sample was on deck, the recovered core length was measured to ensure at least eighty (80) percent recovery. Once recovery was verified, the core was then capped, labeled, and cut into five (5) foot sections. A vibracore summary, outlining penetration, recovery, etc., can be found in **Table 1**.

The completed vibracore samples were then transported to Athena's facility in McClellanville, SC and were cut open longitudinally. Once opened, one half of the core was transferred to labeled PVC, wrapped in plastic wrap, and inserted into a protective 6-mm plastic liner that was also labeled. The remaining half of the core was then scraped (to show sedimentary structures), logged, and photographed. The core logs were input into gINT and forwarded, as draft versions, to Olsen for sample interval determination. Sediment surface elevations were submitted by Olsen to Athena and are represented in National Geodetic Vertical Datum of 1929 (NGVD29). At this time, the digital core photographs were processed in order to develop a photo-mosaic image of the core, and those were also forwarded to Olsen. Once the photo-mosaic images and logs for each core were reviewed, Olsen forwarded a list of desired sample intervals to Athena for processing. The core logs, photo-mosaic images, sieve analysis curves, and granularmetric tables for Bald Head Creek have been provided in **Appendix A**.

#### Section 5: Laboratory Testing & Results

Physical samples were collected from the photographed half of the Bald Head Creek vibracores. The samples were delivered to Terracon Consultants, Inc. (Terracon) in Jacksonville, FL, a USACE certified laboratory. One (1) composite sample and two (2) discrete samples were collected from each vibracore for a total of twenty-one (21) physical samples. The discrete samples were collected from the top of each core, and from a depth of minus eight (-8) feet relative to NGVD29. The composite sample was comprised of the entire interval between the top of core to minus eight (-8) feet relative to NGVD29. The physical samples were analyzed using the following methods: grain size (ASTM D 422) and carbonate analysis (after Twenhofel & Tyler, 1941).

The average percent of fine-grained material (i.e., silt and clay passing the # 200 sieve) as reported from the composite samples from the Bald Head Creek cores was 1.4%, with a maximum value of 2.0% from BHC-22. The average grain size for the composite samples was 0.37 mm (fine sand); however that data is coarsely skewed due to the presence of bioclastic (i.e., shell) material in the physical samples. The actual grain size of the clastic fraction of the physical samples is likely smaller. The average carbonate percentage for the composite samples was 10.7%, with a maximum value of 21.3% at BHC-19-2. A summary of the laboratory data has been included as **Table 2**.

The average percent of fine-grained material from the top and bottom discrete samples was 1.0 and 1.5%, respectively. The average mean grain size for the top and bottom discrete samples



#### Table 1: Vibracore Summary

#### Olsen Associates, Inc. Bald Head Creek Geotechnical Investigation Village of Bald Head Island, North Carolina February 2014

Boring ID	Date	Time	East (x)	North (y)	Water Depth (feet)	Penetration (feet)	Recovery (feet)	Notes
BHC-16	2/4/14	12:05:00	2304445.65	50959.48	6.4	11.7	9.8	
BHC-17	2/4/14	7:56:35	2304616.09	51419.38	3.2	10.0	8.2	
BHC-18	2/4/14	8:51:12	2304962.05	51262.48	3.0	10.0	8.3	
BHC 10	2/4/14	11.34.07	2305197 27	50952.09	4.7	9.0	7.3	Vibrated out first attempt - made second attempt.
BIIC-19	2/4/14	11.34.07	2303197.27	30932.09	4.7	9.0	7.4	Retained second core.
BHC-20	2/4/14	11:01:31	2305531.69	51170.35	4.0	10.0	8.1	
BHC-21	2/4/14	9:42:25	2305156.25	51562.81	5.2	10.0	8.1	
BHC-22	2/4/14	10:36:45	2305707.27	51478.88	5.8	12.0	10.3	
Project Notes	Coordinates were re	corded in NAD83, S	tate Plane Coordinate	e System, North Caro	olina (Zone 3200), US	S Survey Feet.		
Tiojeet Notes	NAD83 - North An	nerican Datum of 19	83					



#### Table 2: Grain Size Data Summary

Olsen Associates, Inc. Bald Head Creek Geotechnical Investigation Village of Bald Head Island, North Carolina February 2014

Boring ID	Sample ID	Sample Interval (feet)	Mean Grain Size (mm)	Percent Passing #200 Sieve (Fines)	Percent Carbonate	USCS Classification
	BHC-16-1	0.0 - 0.4'	0.28	0.9	8.0	SP
BHC-16	BHC-16-2	3.7 - 4.1'	0.25	1.7	8.9	SP
	Comp-1	0.0 - 4.1'	0.32	1.8	11.8	SP
	BHC-17-1	0.0 - 0.4'	0.28	0.8	7.5	SP
BHC-17	BHC-17-2	3.6 - 4.0'	0.41	1.0	13.7	SP
	Comp-1	0.0 - 4.0'	0.29	1.3	8.5	SP
	BHC-18-1	0.0 - 0.4'	0.37	0.8	8.9	SP
BHC-18	BHC-18-2	4.6 - 5.0'	0.38	1.4	12.4	SP
	Comp-1	0.0 - 5.0'	0.32	0.9	8.4	SP
	BHC-19-1	0.0 - 0.4'	0.34	1.1	8.7	SP
BHC-19	BHC-19-2	5.8 - 6.2'	0.53	1.5	21.3	SP
	Comp-1	0.0 - 6.2'	0.53	1.4	17.6	SP
	BHC-20-1	0.0 - 0.4'	0.42	0.7	8.3	SP
BHC-20	BHC-20-2	6.2 - 6.6'	0.35	1.3	12.6	SP
	Comp-1	0.0 - 6.6'	0.38	1.0	11.7	SP
	BHC-21-1	0.0 - 0.4'	0.31	1.2	8.9	SP
BHC-21	BHC-21-2	5.0 - 5.4'	0.49	1.1	15.3	SP
	Comp-1	0.0 - 5.4'	0.41	1.2	10.7	SP
	BHC-22-1	0.0 - 0.4'	0.31	1.3	8.3	SP
BHC-22	ВНС-22-2	4.5 - 4.9'	0.35	2.3	2.7	SP
	Comp-1	0.0 - 4.9'	0.32	2.0	6.0	SP
Percent Carbonate - Anal USCS - Unified Soil Classif	ysis was performed accord fication System	ing to the following method	: Twenhofel and Tyler, 1941			



was 0.33 and 0.39 mm, respectively. Average carbonate percentages for the top and bottom samples were 8.4 and 12.4%, respectively.

#### Section 6: Investigation Findings

In general, two lithologic units were commonly identified in the geotechnical vibracores collected from the Bald Head Creek project site. The top unit typically consisted of sub-rounded, fine quartz sand, with occasional layers of medium quartz sand and bioclastic (i.e., shell) material. The lower unit was similar to the top, however increased fine grained (i.e., silt and clay) material was noted in this interval. The fine grained material was typically incorporated into the cores via bioturbation, although occasional fine-grained flaser beds and rip-up clasts were also noted from this interval.

Four (4) of the cores, BHC-19 through BHC-22, terminated in, or encountered, a silty medium quartz sand with approximately 30 to 45% coarse sand to fine gravel size shell bioclastic material. In most cases, this shell rich interval acted as refusal, however BHC-22 was able to penetrate through this interval and terminated in a bioturbated, fine to medium quartz sand interval with silt percentages greater than 5%. The silty, shell rich interval was encountered at depths of approximately minus nine (-9) and minus eleven (-11) feet relative to NGVD29.

Discrete samples collected from six (6) of the Bald Head Creek cores reported carbonate percentages that increased between the top and bottom samples. On average, the carbonate percentages increased by approximately 60%. The exception is in core BHC-22, which reported a decrease in carbonate percentage between the top and bottom discrete samples. Silt percentages also increased slightly between the top and bottom discrete samples, however the increase was minimal and silt percentages in all samples were reported to be well below 5%.

Common marine bivalve and gastropod species identified in the cores consisted of the following: coquina clam (*Donax variabilis*), eastern oyster (*Crassostrea virginica*), lightning whelk (*Busycon contrarium*), and ponderous ark clam (*Noetia ponderosa*). In general, the bioclastic material in the cores appears to have been transported to the study area and does not necessarily reflect in-situ bioturbation by the abovementioned species. Mud shrimp (*Callianassa major*) burrow traces, which are commonly lined by fine-grained material, were commonly identified (e.g., BHC-16) in the Bald Head Creek cores and do represent in-situ bioturbation. Mud shrimp are common in relatively high energy marine settings. BHC-22 reported the highest level of bioturbation and, consequently, the highest silt percentage of 2.3%.

#### Section 7: References

United States Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Ocean Service, Tides & Currents, Station ID: 8659084 (Southport, NC), <u>http://tidesandcurrents.noaa.gov/stationhome.html?id=8659084</u> (March 4, 2014).



## Appendix A

Bald Head Creek Core Logs, Photographs, Sieve Analysis Curves, and Granularmetric Reports



Boring Designation BHC-16

ווסח			DIVISION	IN	ISTAL	LATIC	N SHEET 1	
		200	Olsen Associates, Inc.	+-	Jacks	sonvil	e, Florida OF 1 SHE	EETS
1. PROJ	LCT	ld Hee	d Island	9.	SIZE	AND	TYPE OF BIT 3.0 In.	
VII Ci	eotechnica	uu ⊓ea al Inves	stigation of Bald Head Creek	10	). CO	ORDII	VATE SYSTEM/DATUM HORIZONTAL VERTICAL	a
2. BORII				11	I. MA			.9 
Bł	HC-16		X = 2,304,446 Y = 50,959					-N MER
3. DRILL	ING AGEN	ICY	CONTRACTOR FILE NO.	12	, то	τΔι ς	AMPLES DISTURBED UNDISTURBED	) (UD)
At	hena Tech	nologi	es, Inc.				1 2	
4. NAME	E OF DRILL	ER		13	з. то	TALN	IUMBER CORE BOXES	
5. DIRE(			G DEG. FROM BEARING	- 14	4. ELI	EVATI	ON GROUND WATER 6.4 Ft.	
	ERTICAL		VERTICAL	15	5. DA	TE BC	STARTED         COMPLETED           02-04-14         12:05         02-04-14         1	2:55
6. THICH	KNESS OF	OVERB	BURDEN 0.0 Ft.	16	5. ELI	EVATI	ON TOP OF BORING -3.9 Ft.	
7. DEPT	H DRILLED		<b>коск</b> 0.0 Ft.	17	7. то	TAL R	ECOVERY FOR BORING 9.8 Ft.	
8. TOTA		F BOP	ING 11.7 Ft.	18	3. SI	NAT	JRE AND TITLE OF INSPECTOR	
						. ⊢re	626 	
<b>ELEV</b> . (ft) -3.9	<b>DEPTH</b> (ft) 0.0	LEGENI	CLASSIFICATION OF MATERIALS Depths and elevations based on measured val	ues	REC.	BOX OR SAMPLE	REMARKS	
T		$ \cdots $				~	Sample #1, Depth = 0.0' - 0.4'	
			Fine to medium quartz SAND, few fine to				Mean (mm): 0.28, Phi Sorting: 0.80	
Ļ			medium sand size shell, trace silt, poorly				Carbonale. 0.0%, Filles (230). 0.00% (SP)	
		[····]	graded, subrounded, light brownish gray (2.5Y-6/2), (SP).					
		<b>  </b>					Sample #Comp. Dopth = 0.01 4.41	
-5.8	1.9					dm	Mean (mm): 0.32, Phi Sorting: 1.05	
			Medium quartz SAND, few medium sand sizes shell, trace silt, poorly graded subrounded li	ze aht		ပိ	Carbonate: 11.8%, Fines (230): 1.81% (SP)	
-6.8	29	$ \cdots $	brownish gray (2.5Y-6/2), (SP).	9.11				
- 0.0	2.3				1			
		$ \cdots $	Fine to medium quartz SAND, trace silt (ir	I				
			purrows), trace tine sand size shell, poorly graded, subrounded, bioturbated 3.0' =				Sample #2, Depth = 3.7' - 4.1'	
┝		$ \cdots $	Callianassa major burrow trace, light gray			2	Mean (mm): 0.25, Phi Sorting: 0.85	
	A 7	<b>[</b> ⊡]	(2.5Y-7/2), (SP).				Carbunate. 0.3%, Filles (230). 1.08% (SP)	
-8.6	4.7	<b>¦∷:</b>			-			
┝	-	$ \cdots $	Fine quartz SAND, trace silt (in layers), trac	e				
			tine sand size shell, poorly graded, subround 5.35' = layer of medium quartz SAND with lit	ed, tle				
		$\left  \cdots \right $	medium to coarse sand size shell, gray	-				
-10.2	6.3	····	(2.5Y-6/1), (SP).					
	0.0	$\left  \cdots \right $			1			
		·…						
ſ								
		$ \cdots $	Medium quartz SAND, few medium sand size	ze				
		[:···]	shell, fine sand in layers, poorly graded, subrounded, bi-directional bedding present of	rav				
Γ		<b>∷</b> .	(2.5Y-6/1), (SP).	, ay				
		[ <b>∷</b> ]						
L								
-13.2	9.3							
10 7	0.0	$ \cdots $	Fine to medium quartz SAND, trace silt (in	ed				
-13./	9.8	<u> ···</u>	subrounded, gray (2.5Y-6/1), (SP).		1			
Ļ								
		1			1			



# Bald Head Island North Carolina BHC-16

# February 2014

## Scale in Feet Photo Mosaic Image



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



Granularmetric Report Depths and elevations based on measured values													
Project Name:	Village of	Bald Hea	ad Island				<u>_</u>	ECHNO	LUGIES, IN	<u>ic.</u>			
Sample Name:	BHC-16 #	#1					Ather 1293	na Teo Graha	chnologi€ am Farm	es, Inc. NRoad			
Analysis Date:	02-17-14						McC	lellany	ville, SC 2	29458			
Analyzed By: C	RM Sr.						fa	x (843	) 887-38	301			
Easting (ft):		Northing (ft):			Cool								
2,304,446 50,959						North Ca	arolina State	e Plar	ne	-3	8.9 NC	GVD 29	
0505.	Munse			Johnmenns.									
SP Dry Weight (g):	Wash Weight	(q): Pa	Pan Retained (n): Sie			s (%):	Fines (%):	Orgar	nics (%):	Carbonat	es (%):	Shells (%):	
114 79	113 9	32	(0)	, 		. ,	#200 - 0.93	#200 - 0.93		8	00		
114.75	Sieve S	Size	Sieve Si	70	G	rams	% Weig	bt	Cum	Grams		% Passing	
Sieve Number	(Phi	i)	(Millimete	ers)	Re	tained	Retaine	ed	Reta	ained	<b>`</b>	Sieve	
3/4"	-4.2	5	19.03	6			0.00		0	.00		100.00	
5/8"	-4.0	0	16.00	)	(	0.00	0.00		0	.00		100.00	
#3.5	-2.5	0	5.66		(	0.00	0.00		0	.00		100.00	
#4	-2.2	5	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		(	).24	0.21		0	0.24		99.79	
#10	-1.0	0	2.00		(	).24	0.21		0	.48		99.58	
#14	-0.5	0	1.41		(	).98	0.85		1	.46		98.73	
#18	0.00	0	1.00		2	2.60 2.1			4	4.06		96.46	
#25	0.50	0	0.71		2	4.79 4.17			8	.85	92.29		
#35	1.00	о –	0.50		7	7.74	6.74		16.59			85.55	
#45	1.50	0	0.35		1	0.73	9.35		27	7.32		76.20	
#60	2.00	2	0.25		2	5.45	22.17		52	2.77		54.03	
#80	2.50	D	0.18		4	2.06	36.64		94	1.83		17.39	
#120	3.00	о –	0.13		1	7.74	15.45		11:	2.57		1.94	
#170	3.50	2	0.09			1.13	0.98		11	3.70		0.96	
#200	3.75	5	0.07		(	).04	0.03		11	3.74		0.93	
#230	4.00	0	0.06		(	.08	0.07		11	3.82		0.86	
Phi 5	Phi 1	16	Phi 25	5	Ρ	hi 50	Phi 75	5	Ph	ni 84	Phi 95		
2.90	2.54	4	2.40		2	2.05	1.53		1.08		0.18		
Moment	Mea	n Phi	Me	an mm		Sor	rting	Skewness		s	Kurtosis		
Statistics	1.	85		0.28		0.8		-1.23			4.7		



<b>Gra</b> Depths and	ATHENA										
Project Name:	Village of	Bald Head	d Island		-		TECHNOL	OGIES, IN	<u>IC.</u>		
Sample Name:	BHC-16 #	#Comp				Athe	ena Tech 3 Graha	nnologie m Farm	s, Inc. Road		
Analysis Date: (	)2-17-14					Mc		lle, SC 2	9458		
Analyzed By: C	RM Sr.					f	ax (843)	887-38	00		
Easting (ft):		Northing (ft):			Coordinate System	:		E	Elevation (ft):		
2,304,44	6		50,959		North C	arolina Sta	te Plane	e	-3.9	) NG	SVD 29
0505:	Munse			omments:							
SP Dry Weight (g):	Wash Weight (g): Pan Retaine			Siev	/e Loss (%):	Fines (%):	Organio	cs (%):	Carbonates	(%):	Shells (%):
128.60	126 (	26.27			#200 - 1.8	1	()	11.8	0		
120.00	Sieve 9	Size	Siava Si	70	Grame	#230 - 1.0 % \\/oi	ht	Cum	Grame	0   0	/ V Passing
Sieve Number	(Phi	) (	Millimete	ers)	Retained	Retain	ed	Reta	ained		Sieve
3/4"	-4.2	5	19.03			0.00		0.	.00		100.00
5/8"	-4.0	0	16.00		0.00	0.00		0.	.00		100.00
#3.5	-2.5	0	5.66		0.53	0.41		0.	.53		99.59
#4	-2.2	5	4.76		0.00	0.00		0.	.53	99.59	
#5	-2.0	-2.00			0.28	0.22		0.81			99.37
#7	-1.5	0	2.83		0.42	0.33		1.23			99.04
#10	-1.0	0	2.00		1.00	0.78		2.23			98.26
#14	-0.5	0	1.41		2.40	1.87	,	4.	63		96.39
#18	0.00	)	1.00		5.78	4.49		10	.41		91.90
#25	0.50	)	0.71		10.37	8.06		20.78			83.84
#35	1.00	)	0.50		9.81	7.63		30.59		76.21	
#45	1.50	)	0.35		10.08	7.84	,	40	.67		68.37
#60	2.00	)	0.25		21.68	16.8	3	62	.35		51.51
#80	2.50	)	0.18		41.63	32.3	7	103	3.98		19.14
#120	3.00	)	0.13		21.03	16.3	5	125	5.01		2.79
#170	3.50	)	0.09		1.18	0.92		126	5.19		1.87
#200	3.75	5	0.07		0.08	0.06		126	6.27		1.81
#230	4.00	)	0.06		0.00	0.00		126	6.27		1.81
Phi 5	Phi 1	6	Phi 25		Phi 50	Phi 7	5	Ph	i 84		Phi 95
2.93	2.60	)	2.41		2.02	1.08	0.49		49	-0.35	
Moment	Mea	n Phi	Me	an mm	So	rting	Skewness		s Kurtosis		Curtosis
Statistics	1.	65		0.32	1	.05		-1.28 4.85			4.85


<b>Gra</b> Depths and	elevations ba	etric Rep ased on meas	es			ATHE					
Project Name:	Village of	Bald Head	d Island				TECHNOLO	GIES, INC	<u>c.</u>		
Sample Name:	BHC-16 #	<b>#</b> 2				Ath 129	ena Techn 3 Graham	ologies Farm	s, Inc. Road		
Analysis Date: (	02-17-14				]	Mc	Clellanville	, SC 29	9458		
Analyzed By: C	RM Sr.					f	ax (843) 8	87-380	D0 D1		
Easting (ft):		Northing (ft):			Coordinate System	1:		EI	levation (ft):		
2,304,44	16		50,959		North C	arolina Sta	te Plane		-7.6	NGVD 29	
USCS:	Munse	ll:	C	Comments:							
SP	Wash Waight		Poteined (a)	· Sio	(9/):	Fines (%):	Organica	(0/).	Carbonatao (9		<u>.</u>
		y). Pan	Retained (g)	. 3161	ve Loss (%).	#200 - 1.	74	(70).		o). Shelis (%)	).
115.78	113.8	36	0:		0	Grams % Weight Cum Grams				0( D = = = =	
Sieve Number	Sieve : (Phi	) (	Sieve Si Millimete	ze ers)	Retained	Retair	ined Ret		ined	% Passi Sieve	ng
3/4"	-4.2	5	19.03			0.00	)	0.0	00	100.00	3
5/8"	-4.0	0	16.00		0.00	0.00	)	0.0	00	100.00	2
#3.5	-2.5	50 5.66			0.00	0.00	)	0.0	00	100.00	<u>ა</u>
#4	-2.2	5	4.76		0.00	0.00	)	0.0	00	100.00	3
#5	-2.00 4.00				0.00	0.00 0.00 0.00				100.00	<u>ა</u>
#7	-1.5	0	2.83		0.45	0.39 0.4			45	99.61	
#10	-1.0	0	2.00		0.70	0.60	)	1.1	15	99.01	
#14	-0.5	0	1.41		0.92	0.79	)	2.0	07	98.22	•
#18	0.00	)	1.00		1.83	1.58	3	3.9	90	96.64	•
#25	0.50	)	0.71		4.15	3.58	3	8.0	05	93.06	;
#35	1.00	)	0.50		6.73	5.8		14.	78	87.25	,
#45	1.50	)	0.35		7.25	6.26	6	22.	.03	80.99	)
#60	2.00	)	0.25		15.97	13.7	9	38.	.00	67.20	)
#80	2.50	)	0.18		42.67	36.8	5	80.	67	30.35	;
#120	3.00	)	0.13		31.18	26.9	3	111	.85	3.42	
#170	3.50	)	0.09		1.94	1.68	3	113	5.79	1.74	
#200	3.7	5	0.07		0.00	0.00	)	113	5.79	1.74	
#230	4.00	)	0.06		0.07	0.06	6	113	.86	1.68	
Phi 5	Phi 1	6	Phi 25	5	Phi 50	Phi 7	5	Phi	84	Phi 95	5
2.97	2.7	7	2.60		2.23	1.72	72 1		26	0.23	
Moment	Mea	n Phi	Me	an mm	So	orting	Ske	wness		Kurtosis	
Statistics	3 2.01 0.25			0.25	5 0.85 -1.59				5.85		

			511/10101		0 T A I I			
DR	ILLING	LOC	Olsen Associates. Inc.		Jacks	Sonvill	e. Florida OF 1 SHEET 1	s
1. PRC	JECT			9.	SIZE	AND	TYPE OF BIT 3.0 ln.	-
١	/illage of Ba	ld Hea	ad Island	10	. CO	ORDI	VATE SYSTEM/DATUM HORIZONTAL VERTICAL	-
(	Geotechnica	l Inve	stigation of Bald Head Creek		Ν	lorth	Carolina State Plane NAD 1983 NGVD 29	
2. BOR	NING DESIGN BHC-17	ΙΑΤΙΟΙ	x <b>LOCATION COORDINATES</b> X = 2,304.616 Y = 51,419	11	. MA	NUFA	CTURER'S DESIGNATION OF DRILL DAUTO HAMMER	R
3. DRI	LLING AGEN	СҮ	CONTRACTOR FILE NO.	12	то		DISTURBED UNDISTURBED (U	ID)
/	Athena Tech	nologi	ies, Inc.	12	. 10	TAL 3	1 2	
4. NAN		ER		13	. то	TAL N	UMBER CORE BOXES	
5. DIR	ECTION OF E	BORIN	G DEG. FROM BEARING	14	. ELI	EVATI	on ground water 3.2 Ft.	
	VERTICAL INCLINED		VERTICAL	15	5. DA	TE BC	RING STARTED COMPLETED 02-04-14 07:56 02-04-14 08:4	11
6. THI	CKNESS OF	OVER	BURDEN 0.0 Ft.	16	. ELI	EVATI	ON TOP OF BORING -4.0 Ft.	
7. DEF			<b>воск</b> 0.0 Ft	17	. то	TAL R	ECOVERY FOR BORING 8.2 Ft.	
				18	. SIG	SNATU	JRE AND TITLE OF INSPECTOR	
8. TOT	AL DEPTH C		RING 10.0 Ft.	L	A	. Fre	eze	
ELEV. (ft) -4.0	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured value	es	REC.	BOX OR SAMPLE	REMARKS	
	0.0					-	Sample #1, Depth = 0.0' - 0.4'	╉
		$ \cdots $					Mean (mm): 0.28, Phi Sorting: 0.68	
							Carbonate: 7.5%, Fines (230): 0.77% (SP)	
	Γ	$ \cdots $	Fine to medium quartz SAND, few fine sand size shell, trace silt, poorly graded, subrounded	d.				ſ
		[::::	bioturbated, light brownish gray (2.5Y-6/2),	,				
		.∷.	(SP).			du	Sample #Comp, Depth = 0.0' - 4.0'	
	Γ	····				Co	Carbonate: 8.5%, Fines (230): 1.29% (SP)	ſ
-6.8	2.8	…						
-0.0	2.0		Fine to medium quartz SAND, few medium					
		$ \cdots $	sand size shell, trace silt, poorly graded,					ſ
-1.5	3.5		(2.5Y-6/2), (SP).				Sample #2, Depth = 3.6' - 4.0'	
-8.0	4.0		Medium quartz SAND, little medium sand size	e hr		2	Mean (mm): 0.41, Phi Sorting: 1.26	Ļ
		$ \cdots $					Carbonate: 13.7%, FINES (230): 0.96% (SP)	
-8.8	4.8	[····]	Fine quartz SAND, trace silt (in burrows), trac	e 1				
-0.2	<b>5</b> 0	$ \cdots $	4.1' = burrow trace, gray (2.5Y-6/1), (SP).	<u>,</u> ,				F
-3.2	<u>J.Z</u>		Medium quartz SAND, little fine sand size she	<sup>II,</sup> Г				
		$ \cdots $	brownish gray (2.5Y-6/2), (SP).					
	$\vdash$	···	Fine to medium quartz SAND, few medium	2				╞
-10.3	6.3		silt (in layers/burrows), poorly graded,	Г				
		[····]	subrounded, bioturbated, $6.25' = \text{organic SILT}$	「				
	ŀ	$ \cdots $	Fine to medium quartz SAND, trace fine sand	1				┠
		····	size shell, trace silt, poorly graded, subrounded $6.9' = \text{organic SILT}(OL) \text{ rin-up} \text{ grav}(2.5\times-6/1)$	d, )				
-11.9	79	$\left  \cdots \right $	(SP).	,,				
-12.2	<u> </u>		Silty fine to medium quartz SAND, little silt,	_				┢
			trace fine sand size shell, subrounded, bioturbated, gray (2.5Y-5/1) (SM)	$\int$				
				_				
	ŀ							ŀ
	┝							┢
			End of Boring					
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	1	I						



# February 2014

#### Scale in Feet Photo Mosaic Image





<b>Gra</b> Depths and	elevations ba	etric Rep used on meas	s	TECHNOLOGIES, INC.							
Project Name:	Village of	Bald Head	d Island				TECHNOL	OGIES, IN	<u>C.</u>		
Sample Name:	BHC-17 #	<i>‡</i> 1				Atho 129	ena Tech 3 Graha	nnologie m Farm	s, Inc. Road		
Analysis Date: (	)2-17-14					Mc	Clellanvil	lle, SC 2	9458		
Analyzed By: C	RM Sr.					1	ax (843)	887-38	01		
Easting (ft):		Northing (ft):			Coordinate System	:		E	Elevation (ft):		
2,304,61	6		51,419		North C	GVD 29					
USCS:	Munse	11:		omments:							
SP Dry Weight (g):	Wash Weight (	g): Pan	Retained (q):	Siev	e Loss (%):	Fines (%):	Organio	nics (%): Carbonates			Shells (%):
124.87	123 (				()	#200 - 0.7	79	()	7.5	0	
124.07	123.8 Siovo S	Sizo	Siovo Si-	70	Grame	#230 - 0.77			7.0 Grame		A Passing
Sieve Number	(Phi	) (	Millimete	ers)	Retained	Retain	ined Reta		ained		Sieve
3/4"	-4.2	5	19.03			0.00	)	0.	00		100.00
5/8"	-4.00	0	16.00		0.00	0.00	)	0.	00		100.00
#3.5	-2.50	5.66			0.06	0.05	5	0.	06		99.95
#4	-2.2	5	4.76		0.20	0.16	6	0.	26		99.79
#5	-2.00 4.00				0.00	0.00 0.00 0.26					99.79
#7	-1.50	50 2.83			0.13	0.10	0.10 0.39		39		99.69
#10	-1.00	D C	2.00		0.10	0.08 0		0.	49		99.61
#14	-0.50	D C	1.41		0.42	0.34	•	0.	.91		99.27
#18	0.00	)	1.00		1.36	1.09	)	2.	27		98.18
#25	0.50	)	0.71		3.27	2.62	2	5.	54		95.56
#35	1.00	)	0.50		7.95	6.37	·	13	.49		89.19
#45	1.50	)	0.35		12.59	10.0	8	26	.08		79.11
#60	2.00	)	0.25		37.20	29.7	9	63	.28		49.32
#80	2.50	)	0.18		49.78	39.8	7	113	3.06		9.45
#120	3.00	)	0.13		10.25	8.21		123	3.31		1.24
#170	3.50	)	0.09		0.51	0.41		123	3.82		0.83
#200	3.75	5	0.07		0.05	0.04	•	123	3.87		0.79
#230	4.00	)	0.06		0.03	0.02	2	123	3.90		0.77
Phi 5	Phi 1	6	Phi 25		Phi 50	Phi 7	5	Ph	i 84		Phi 95
2.77	2.42	2	2.30		1.99	1.57	,	1.	26		0.54
Moment	Mear	n Phi	Me	an mm	So	rting	Sk	ewness	6	k	Kurtosis
Statistics	1.8	84	(	0.28	0	.68	-	-1.67			8.54



Gra Depths and	Granularmetric Report Depths and elevations based on measured values Project Name: Village of Bald Head Island						-	ATH		<b>\</b>			
Project Name:	Village of	Bald Hea	d Island		1		1	ECHNC	LOGIES, IN	<u>1C.</u>			
Sample Name:	BHC-17 ;	#Comp					Athe 1293	na Teo 3 Grah	chnologie am Farm	es, Inc. Road			
Analysis Date: 0	02-17-14						McC		/ille, SC 2	29458			
Analyzed By: C	RM Sr.						fa	ax (843	3) 887-38 3) 887-38	301			
Easting (ft):		Northing (ft):			Coord	inate System:			1	Elevation (	ft):		
2,304,61	16		51,419			North Ca	4.0 NC	GVD 29					
	Munse			omments:									
SP Dry Weight (g):	Wash Weight	(g): Pa	n Retained (g):	Sie	eve Loss	(%):	Fines (%):	Orga	nics (%):	Carbona	ates (%):	Shells (%):	
121 14	110	50	(0)				#200 - 1.3	3	()	8	50		
121.14	Sieve S	Size	Sieve Siz		Gra	ams	% Weic	uht	Cum	Gram		// % Passing	
Sieve Number	(Ph	i) (	(Millimeter	rs)	Reta	ained	Retained Re			ained		Sieve	
3/4"	-4.2	5	19.03				0.00		0	.00		100.00	
5/8"	-4.00 16.00				0.	00	0.00		0	.00		100.00	
#3.5	-2.50 5.66				0.	42	0.35		0	.42		99.65	
#4	-2.25 4.76				0.	00	0.00		0	.42		99.65	
#5	-2.0	0	4.00		0.	00	0.00		0	.42		99.65	
#7	-1.5	0	2.83		0.	22	0.18		0	.64		99.47	
#10	-1.0	0	2.00		0.	36	0.30		1	.00		99.17	
#14	-0.5	0	1.41		1.	29	1.06		2	.29		98.11	
#18	0.0	0	1.00		3.	22	2.66		5	.51		95.45	
#25	0.50	0	0.71		4.	93	4.07		10	).44		91.38	
#35	1.00	0	0.50		7.	54	6.22		17	7.98		85.16	
#45	1.50	D	0.35		9.	33	7.70		27	7.31		77.46	
#60	2.00	0	0.25		28	.51	23.53	6	55	5.82		53.93	
#80	2.50	0	0.18		47	.38	39.11		10	3.20		14.82	
#120	3.00	0	0.13		15	.42	12.73	6	11	8.62		2.09	
#170	3.50	0	0.09		0.	92	0.76		11	9.54		1.33	
#200	3.7	5	0.07		0.	00	0.00		11	9.54		1.33	
#230	4.00	0	0.06		0.	05	0.04		11	9.59		1.29	
Phi 5	Phi 1	16	Phi 25		Ph	i 50	Phi 7	5	Ph	ni 84		Phi 95	
2.89	2.89 2.48 2.37				2.	05	1.55	1		1.08		0.06	
Moment	Mea	n Phi	Mea	an mm		Sor	ting	S	Skewness		ł	Kurtosis	
Statistics	1.81         0.29			.29		0.	86	6 -1.79			8.05		



<b>Gra</b> Depths and	elevations ba	etric Rep used on meas	<b>SORT</b> Sured value	es						
Project Name:	Village of	Bald Head	d Island		-		TECHNOLOGI	es, inc.		
Sample Name:	BHC-17 #	<b>#</b> 2				Athe 129	ena Technol 3 Graham F	ogies, Inc arm Road	1	
Analysis Date: (	)2-17-14					Mc	Clellanville, S	SC 29458	•	
Analyzed By: C	RM Sr.					t	ax (843) 88	7-3801		
Easting (ft):		Northing (ft):			Coordinate System	1:		Elevation	n (ft):	
2,304,61	6		51,419		North C	arolina Sta	te Plane		-7.6 NC	GVD 29
USCS:	Munse	11:		comments:						
SP Dry Weight (g):	Wash Weight (	g): Pan	Retained (g)	: Siev	ve Loss (%):	Fines (%):	Organics (%	): Carbo	nates (%):	Shells (%):
120.83	110 6	37				#200 - 0.9	8	, 1	3 70	
120.05	Siovo 9	Sizo	Siava Si	70	Grams	#230 - 0.96				% Passing
Sieve Number	(Phi	) (	(Millimeters)			Retain	ed Retained		15	Sieve
3/4"	-4.2	5	19.03			0.00	)	0.00		100.00
5/8"	-4.00	2	16.00		0.42	0.35	5	0.42		99.65
#3.5	-2.50	D C	5.66		0.62	0.51		1.04		99.14
#4	-2.2	5	4.76		0.45	0.37	,	1.49		98.77
#5	-2.00 4.00				0.27	0.27 0.22 1.76				98.55
#7	-1.50	2.83			0.66	0.55	0.55 2.42			98.00
#10	-1.00	D C	2.00		1.36	1.13	1.13 3.7			96.87
#14	-0.50	D C	1.41		5.43	4.49	)	9.21		92.38
#18	0.00	)	1.00		11.65	9.64	۱	20.86		82.74
#25	0.50	)	0.71		14.37	11.8	9	35.23		70.85
#35	1.00	)	0.50		11.45	9.48	3	46.68		61.37
#45	1.50	)	0.35		8.19	6.78	3	54.87		54.59
#60	2.00	)	0.25		14.58	12.0	7	69.45		42.52
#80	2.50	)	0.18		33.82	27.9	9	103.27		14.53
#120	3.00	)	0.13		15.73	13.0	2	119.00		1.51
#170	3.50	)	0.09		0.61	0.50	)	119.61		1.01
#200	3.75	5	0.07		0.04	0.03	3	119.65		0.98
#230	4.00	)	0.06		0.02	0.02	2	119.67		0.96
Phi 5	Phi 5 Phi 16 Phi 25				Phi 50	Phi 7	5	Phi 84		Phi 95
2.87	2.47	7	2.31		1.69	0.33		-0.07		-0.79
Moment	Mear	n Phi	Me	an mm	Sc	orting	Skewr	ness	ŀ	Kurtosis
Statistics	1.29 0.41			0.41	1	.26	-0.9	92		3.84

000		. ~~	DIVISION	INSTALLATION SHEET 1
DR	LLING	LUG	Olsen Associates, Inc.	Jacksonville, Florida OF 1 SHEETS
1. PRO				9. SIZE AND TYPE OF BIT 3.0 In.
\	/illage of Ba	ld Hea	d Island	10. COORDINATE SYSTEM/DATUM HORIZONTAL VERTICAL
2 808				North Carolina State Plane NAD 1983 NGVD 29
z. bok	BHC-18	Arron	X = 2,304,962 $Y = 51,262$	
3. DRII	LING AGEN	СҮ	CONTRACTOR FILE NO.	12 TOTAL SAMPLES DISTURBED UNDISTURBED (UD)
4	Athena Tech	nologie	es, Inc.	1 2
4. NAN	P. McClellan	ER		13. TOTAL NUMBER CORE BOXES
5. DIRI	ECTION OF E	BORING	B DEG. FROM BEARING	14. ELEVATION GROUND WATER 3.0 Ft.
	VERTICAL		VERTICAL	STARTED         COMPLETED           15. DATE BORING         02-04-14         08:51         02-04-14         09:31
<u> </u>	CKNESS OF	OVERB	BURDEN 0.0 Ft.	16. ELEVATION TOP OF BORING -3.0 Ft.
				17. TOTAL RECOVERY FOR BORING 8.3 Ft
7. DEP	TH DRILLED		ROCK 0.0 Ft.	18. SIGNATURE AND TITLE OF INSPECTOR
8. ТОТ	AL DEPTH C	F BOR	ING 10.0 Ft.	A. Freeze
<b>ELEV</b> . (ft) -3.0	DEPTH (ft) 0.0	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured va	ues REC.
				- Sample #1, Depth = 0.0' - 0.4'
				Mean (mm): 0.37, Phi Sorting: 0.85
	-		Modium quartz SAND fow find cand size sh	Carbonate. 6.9%, Filles (230). 0.73% (SF)
			trace silt (in rip-ups), poorly graded,	511,
		$ \cdots $	subrounded, light brownish gray (2.5Y-6/2	
	-			Controls #Control Donth - 0.01 - 5.01
		$ \cdots $		Sample #Comp, Deptn = $0.0 - 5.0^{\circ}$ Mean (mm): 0.32. Phi Sorting: 0.91
-5.8	2.8			Carbonate: 8.4%, Fines (230): 0.91% (SP)
	-	· . · . · · · · · · · · · · · · · · · ·	Fine to medium quartz SAND, trace silt (ir burrows), trace fine sand size shell, poorly graded, subrounded, bioturbated, gray (2.5Y-6/1), (SP).	
-7.3	4.3			
-8.6	- 5.6	· · · · · · · · · · · · · · · · · · ·	Medium quartz SAND, little medium sand si shell, poorly graded, subrounded, gravel siz shell present, 4.55 - 4.85' = fine to mediur quartz SAND layer with trace silt, pale yello (2.5Y-7/3), (SP).	2e       Sample #2, Depth = 4.6' - 5.0'         e       N         N       Mean (mm): 0.38, Phi Sorting: 1.19         Carbonate: 12.4%, Fines (230): 1.31% (SP)
	0.0		Fine grading to medium quartz SAND, fev	
	F		medium sand size shell, poorly graded,	
-97	67		(SP).	, , , , , , , , , , , , , , , , , , , ,
	-	· · · · · · · · · · · · · · · · · · ·	Fine to medium quartz SAND, few mediur sand size shell, trace silt, poorly graded, subrounded, bioturbated, gray (2.5Y-6/1), (S	).
-10.9	7.9	$\left  \cdots \right $	Medium quartz SAND little medium to coar	
-11.3	8.3		sand size shell, trace gravel size shell, poor	
			graded, subrounded, grayish brown (2.5Y-5/	<), /
	ŀ		<u> </u>	
	-			
			End of Boring	
	Γ			



# February 2014

#### Scale in Feet Photo Mosaic Image





Gra Depths and	elevations ba	etric Rep ased on meas	;			АТН					
Project Name:	Village of	Bald Head	d Island				TECHNOL	OGIES, IN	<u>C.</u>		
Sample Name:	BHC-18 #	<i>‡</i> 1				Atho 129	ena Tech 3 Graha	nnologie m Farm	es, Inc. Road		
Analysis Date: 0	02-17-14					Mc	Clellanvi	lle, SC 2	29458		
Analyzed By: C	RM Sr.					1	ax (843)	887-38	00 01		
Easting (ft):		Northing (ft):			Coordinate System	:		E	Elevation (ft)	):	
2,304,96	62		51,262		North C	arolina Sta	te Plan	e	-3	.0 NG	GVD 29
USCS:	Munse	ll:	Co	mments:							
SP Dr. Waight (g):	Wash Waight		Poteined (a):	Siov	2 L 222 (%):	Finon (%):	Organi	oo (%):	Carbonat	00 (9/):	Shalla (%):
		y). Pan	Retained (g).	Siev	e Loss (70).	#200 - 0.7	75	US (70).	Carbonate	25 (%).	Sileiis (%).
124.39	123.4	+/	0:		0	ms % Weight Cum Gram				JO	
Sieve Number	Sieve Sie	) (	Sieve Siz	e rs)	Grams Retained	% Wei Retair	ed Cum. Grams			% Passing Sieve	
3/4"	-4.2	5	19.03			0.00	)	0.	.00		100.00
5/8"	-4.0	0	16.00		0.00	0.00	)	0.	.00		100.00
#3.5	-2.5	0	5.66		0.28	0.23	3	0.	28		99.77
#4	-2.25 4.76				0.00	0.00	)	0.	28		99.77
#5	5 -2.00 4.00				0.00	0.00	)	0.	28		99.77
#7	-1.5	0	2.83		0.02	0.02 0.30			.30		99.75
#10	-1.0	0	2.00		0.39	0.31 0.6		69		99.44	
#14	-0.5	0	1.41		1.22	0.98	3	1.	.91		98.46
#18	0.00	)	1.00		4.22	3.39	3.39 6		.13		95.07
#25	0.50	)	0.71		10.85	8.72	2	16	.98		86.35
#35	1.00	)	0.50		17.95	14.4	3	34.93			71.92
#45	1.50	)	0.35		21.51	17.2	9	56	6.44		54.63
#60	2.00	)	0.25		31.25	25.1	2	87	.69		29.51
#80	2.50	)	0.18		27.04	21.7	4	114	4.73		7.77
#120	3.00	)	0.13		8.29	6.66	6	123	3.02		1.11
#170	3.50	)	0.09		0.42	0.34	ł	123	3.44		0.77
#200	3.75	5	0.07		0.03	0.02	2	123	3.47		0.75
#230	4.00	)	0.06		0.00	0.00	)	123	3.47		0.75
		4.00 0.00									
Phi 5	Phi 1	6	Phi 25		Phi 50	Phi 7	5	Ph	i 84		Phi 95
2.71	2.71 2.31 2.10				1.59	0.89	89 0		58		0.00
Moment	Mea	n Phi	Mea	n mm	So	rting	Sk	Skewness		ŀ	Kurtosis
Statistics	1.45 0.37			.37	0.85				-0.82 4.62		4.62



Gra Depths and	elevations ba				ATH		<b>\</b>				
Project Name:	Village of	Bald Hea	d Island			<u>1</u>	ECHNO	LOGIES, IN	1C.		
Sample Name:	BHC-18 #	#Comp				Ather 1293	na Teo Graha	chnologie am Farm	es, Inc. NRoad		
Analysis Date:	02-17-14					McC	lellanv	ville, SC 2	29458		
Analyzed By: C	RM Sr.					p fa	ix (843	) 887-38	301		
Easting (ft):		Northing (ft):			Coordinate System	:			Elevation (f	ft):	
2,304,96	52 Munse	   ·	51,262	ments:	North C	arolina Stat	e Plar	ne	-3	3.0 NC	GVD 29
SD	Walloc		0011	inchio.							
Dry Weight (g):	Wash Weight	(g): Par	n Retained (g):	Siev	e Loss (%):	Fines (%):	Orgar	nics (%):	Carbona	ites (%):	Shells (%):
124.80	123.6	67				#200 - 0.94	4 1		8.	40	
Sieve Number	Sieve S (Phi	Size ) (	Sieve Size Millimeters	e 6)	Grams Retained	% Weight C Retained			Grams	S	% Passing Sieve
3/4"	-4.2	5	19.03			0.00		0	.00		100.00
5/8"	-4.00 16.00				0.00	0.00		0	.00		100.00
#3.5	-2.50 5.66				0.14	0.11		0	.14		99.89
#4	-2.25 4.76				0.09	0.07		0	.23		99.82
#5	-2.00 4.00				0.21	0.21 0.17 0.44					99.65
#7	-1.50 2.83				0.11 0.09			0	0.55		99.56
#10	-1.0	0	2.00		0.36	0.29		0	.91		99.27
#14	-0.5	0	1.41		1.02	0.82		1	.93		98.45
#18	0.00	)	1.00		3.90	3.13		5	.83		95.33
#25	0.50	)	0.71		9.26	7.42		15.09			87.91
#35	1.00	)	0.50		14.41	11.55		29.5			76.36
#45	1.50	)	0.35		16.60	13.30	0 40		6.10		63.06
#60	2.00	)	0.25		25.75	20.63		71	1.85		42.43
#80	2.50	)	0.18		32.59	26.11		10	4.44		16.32
#120	3.00	)	0.13		17.91	14.35		12	2.35		1.97
#170	3.50	)	0.09		1.23	0.99		12	3.58		0.98
#200	3.75	5	0.07		0.05	0.04		12	3.63		0.94
#230	4.00	)	0.06		0.04	0.03		12	3.67		0.91
Phi 5	Phi 5 Phi 16 Phi 25				Phi 50	Phi 75	5	Ph	Phi 84		Phi 95
2.89	2.5	1	2.33		1.82	1.05		0.67		0.02	
Moment	nt Mean Phi Mean mm			n mm	So	rting	S	Skewness		ł	Kurtosis
Statistics	1.64 0.32			32	0	-0.91				4.22	



Gra Depths and	Granularmetric Report Depths and elevations based on measured values Project Name: Village of Bald Head Island					4			<b>\</b>			
Project Name:	Village of	Bald Hea	d Island			<u>1</u>	ECHNOL	LOGIES, IN	<u>IC.</u>			
Sample Name:	BHC-18 #	<b>#</b> 2				Ather 1293	na Tec Graha	hnologie am Farm	es, Inc. Road			
Analysis Date: 0	02-17-14					McC	lellanvi	ille, SC 2	29458			
Analyzed By: C	RM Sr.					fa	x (843	) 887-38	801			
Easting (ft):		Northing (ft):		Coc	rdinate System:			E	Elevation (f	t):		
2,304,96	52 Munsel	·	51,262	nte:	North Carolina State Plane -7.6 NGVI							
	Wanse		Comme	110.								
Dry Weight (g):	Wash Weight (	g): Par	Retained (g):	Sieve Los	ss (%):	Fines (%):	Organi	ics (%):	Carbona	tes (%):	Shells (%):	
129.85	128.1	15			#230 - 1.38				12	.40		
Sieve Number	Sieve S (Phi	Size ) (	Sieve Size Millimeters)	G Re	Grams % Weight Cum. Grams Retained Retained Retained				3	% Passing Sieve		
3/4"	-4.2	5	19.03			0.00		0.	.00		100.00	
5/8"	-4.00 16.00				0.00	0.00		0.	.00		100.00	
#3.5	-2.50 5.66				2.67	2.06		2	.67		97.94	
#4	-2.25 4.76				0.03	0.02		2	.70		97.92	
#5	-2.00 4.00				0.05	0.04		2	.75		97.88	
#7	-1.50	0	2.83		0.33 0.25 3.08				.08		97.63	
#10	-1.00	0	2.00		0.57	0.44		3.	.65		97.19	
#14	-0.50	0	1.41		2.31	1.78		5.	.96		95.41	
#18	0.00	)	1.00		7.51	5.78		13	13.47		89.63	
#25	0.50	)	0.71	1	3.34	10.27	26.81			79.36		
#35	1.00	)	0.50	1	6.67	12.84		43.48			66.52	
#45	1.50	)	0.35	1	2.19	9.39		55	5.67		57.13	
#60	2.00	)	0.25	2	2.69	17.47		78	8.36		39.66	
#80	2.50	)	0.18	3	3.16	25.54		11	1.52		14.12	
#120	3.00	)	0.13	1	5.60	12.01		12	7.12		2.11	
#170	3.50	)	0.09	(	0.93	0.72		128	8.05		1.39	
<u>t</u> #200	3.75	5	0.07		0.01	0.01		128	8.06		1.38	
#230	4.00	)	0.06		0.09	0.07		12	8.15		1.31	
Phi 5	Phi 5 Phi 16 Phi 25				hi 50	Phi 75	75		ii 84		Phi 95	
2.88	2.88 2.46 2.29			,	1.70	0.67	7 0.27			-0.46		
Moment	Moment Mean Phi Mean mm			าฑ	m Sorting			Skewness			Kurtosis	
Statistics	1.39         0.38				1.	19 -1.		-1.4			5.96	

DRILLING	LOG	DIVISION Olsen Associates Inc	INS <sup>®</sup>	TALL	ATIO	N SHEET 1	т в
. PROJECT			9. 9	SIZE	AND	TYPE OF BIT 3.0 In.	
Village of Ba	ald Head	Island	10.	coc	DRDI	IATE SYSTEM/DATUM HORIZONTAL VERTICAL	
Geotechnica	al Investig	gation of Bald Head Creek		Ν	orth	Carolina State Plane NAD 1983 NGVD 29	
	NATION	LOCATION COORDINATES $X = 2,205,107$ $X = 50,052$	11.	MAN	NUFA	CTURER'S DESIGNATION OF DRILL AUTO HAMMER	
DRILLING AGEN	ICY	CONTRACTOR FILE NO.					UD)
Athena Tech	nnologies	s, Inc.	12.	тот	TAL S	AMPLES 1 2	
. NAME OF DRILL	ER		13.	тот		UMBER CORE BOXES	
P. McClellar			14.	ELE	VATI	on ground water 4.7 Ft.	
	BORING	VERTICAL	15.	DAT	E BC	RING STARTED COMPLETED 02-04-14 11:34 02-04-14 11:	:55
. THICKNESS OF	OVERBU	JRDEN 0.0 Ft.	16.	ELE	VATI	ON TOP OF BORING -1.8 Ft.	
. DEPTH DRILLED		оск 0.0 Ft	17.	тот	AL R	ECOVERY FOR BORING 7.4 Ft.	
			18.	SIG	ΝΑΤΙ	IRE AND TITLE OF INSPECTOR	
		NG 9.0 Ft.		A	. Fre	eze	_
ELEV. DEPTH (ft) (ft)		CLASSIFICATION OF MATERIALS Depths and elevations based on measured value	es R	REC.	BOX OR SAMPLE	REMARKS	
			$\neg$		-	Sample #1, Depth = 0.0' - 0.4'	
				ŀ		Mean (mm): 0.34, Phi Sorting: 0.80	
Ļ						Carbonate: 8.7%, Fines (230): 0.98% (SP)	
		Medium quartz SAND, few medium sand size					
		shell, trace silt, poorly graded, subrounded, high turbated $2.8 - 3.0' = layer of fine guartz$					
F		SAND with trace fine sand size shell, color					
		grades to light gray (2.5Y 7/2), light brownish					
		gray (2.01 0/2), (01).			_	Sample #Comp. Depth = $0.0' - 6.2'$	
-					dmc	Mean (mm): 0.53, Phi Sorting: 1.08	
					ö	Carbonate: 17.6%, Fines (230): 1.34% (SP)	
-5.5 3.7		Fine to medium quartz SAND, few silt (in					
-6.1 4.3		layers), few fine sand size shell, poorly graded subrounded, gray (2.5Y-5/1), (SP-SM).	,				ſ
-							
		Medium quartz SAND, few medium to coarse					
	$ \cdots $	gravel size shell, poorly graded, subrounded,		-		Sample #2, Depth = 5.8' - 6.2'	
ŀ		bioturbated, $6.2' = $ Callianassa major burrow trace grav (2.5Y-6/1) (SP)			2	Mean (mm): 0.53, Phi Sorting: 1.50	
	$ \cdots $	(1000, gray (2.01-0/1), (OF).				Carbonate: 21.3%, Fines (230): 1.47% (SP)	
	[ <b>⊡</b> ]						
-9.0 7.2		Silty medium quartz SAND, como coorco coor					
-3.2 1.4	<u>†⁺''†</u> ∖	to gravel size shell, little silt, subrounded, dark	: /				
Ļ	/	gray (2.5Y-4/1), (SM).	_				
ŀ							
		End of Boring					
		-					
-							
F							ĺ
	1			- 1			



# February 2014

#### Scale in Feet Photo Mosaic Image





<b>Gra</b> Depths and	elevations ba	etric Rep ased on meas	s			АТН	ENA				
Project Name:	Village of	Bald Head	d Island				TECHNOLO	GIES, IN	<u>C.</u>		
Sample Name:	BHC-19 #	¥1				Athe 129	ena Techr 3 Grahan	nologie: n Farm	s, Inc. Road		
Analysis Date: (	)2-17-14					Mc	Clellanville	e, SC 2	9458		
Analyzed By: C	RM Sr.					1	ax (843) 8	887-38	01		
Easting (ft):		Northing (ft):			Coordinate System	:		E	levation (ft):		
2,305,19	)7		50,952		North C	GVD 29					
USCS:	Munse	ll:	C	omments:							
SP		0									
Dry weight (g):	wash weight i	(g): Pan	i Retained (g):	Siev	/e Loss (%):	#200 - 1.0	)5	\$ (%):	Carbonates	s (%):	Shells (%):
122.31	121.1	10				#230 - 0.98				)	
Sieve Number	Sieve S (Phi	Size i) (	Sieve Siz Millimete	ze rs)	Grams Retained	% Wei Retair	% Weight Cum Retained Retained		Grams iined		% Passing Sieve
3/4"	-4.2	5	19.03			0.00	)	0.0	00		100.00
5/8"	-4.0	-4.00 16.00				0.00	)	0.	00		100.00
#3.5	-2.5	0	5.66		0.00	0.00	)	0.	00		100.00
#4	-2.25 4.76				0.04	0.03	3	0.	04		99.97
#5	#5 -2.00 4.00				0.00	0.00 0.00 0.04					
#7	-1.5	0	2.83		0.11 0.09 (				15		99.88
#10	-1.0	0	2.00		0.10	30.0	3	0.2	25		99.80
#14	-0.5	0	1.41		0.67	0.55	5	0.9	.92		99.25
#18	0.00	)	1.00		2.54	2.08			3.46		97.17
#25	0.50	)	0.71		7.80	6.38	3	11.	.26		90.79
#35	1.00	)	0.50		19.23	15.7	2	30.	.49		75.07
#45	1.50	)	0.35		24.43	19.9	7	54	.92		55.10
#60	2.00	0	0.25		28.74	23.5	0	83.	.66		31.60
#80	2.50	)	0.18		23.76	19.4	3	107	<b>'</b> .42		12.17
#120	3.00	0	0.13		12.40	10.1	4	119	9.82		2.03
#170	3.50	<b>D</b>	0.09		1.20	0.98	3	121	.02		1.05
#200	3.75	5	0.07		0.00	0.00	)	121	.02		1.05
#230	4.00	)	0.06		0.08	0.07	7	121	.10		0.98
Phi 5	Phi 1	6	Phi 25		Phi 50	Phi 7	5	Phi	84		Phi 95
2.85	2.85 2.40 2.17				1.61	1.00		0.72			0.17
Moment	Mea	n Phi	Mea	an mm	So	rting	Ske	wness	;	k	Kurtosis
Statistics	atistics 1.55 0.34				34 0.8 -0.36 3.				3.06		



<b>Gra</b> Depths and	elevations bas				ATH		<b>\</b>				
Project Name:	Village of E	Bald Head	d Island				TECHNO	LOGIES, IN	<u>C.</u>		
Sample Name:	BHC-19 #	Comp				Athe	ena Tec	hnologie m Earm	s, Inc. Road		
Analysis Date: (	02-17-14					Mc	Clellany	ille, SC 2	29458		
Analyzed By: C	RM Sr.					1	ax (843	) 887-38 ) 887-38	00		
Easting (ft):	1	Northing (ft):			Coordinate System	::		E	Elevation (ft):		
2,305,19	97		50,952		North C	GVD 29					
USCS:	Munsell:	:	Con	nments:							
SP	Wash Weight (g	) <sup>.</sup> Pan	Retained (g):	Siev	e Loss (%) <sup>.</sup>	Fines (%) <sup>.</sup>	Organ	ics (%):	Carbonate	s (%) <sup>.</sup>	Shells (%) <sup>.</sup>
135.60	122.8	0	riotaniou (g).		0 2000 (70).	#200 - 1.4	41 24		176	s(,,,).	
135.09	133.03 Siovo Si		Siovo Sizo		Grame	#230 - 1.	oht	Cum	Grame		A Passing
Sieve Number	(Phi)	(I	Millimeters	s)	Retained	Retain	ined Retained				Sieve
3/4"	-4.25		19.03			6.93	3	9.	40		93.07
5/8"	-4.00 16.00				0.00	0.00	)	9.	40		93.07
#3.5	-2.50 5.66				0.00	0.00	)	9.	40		93.07
#4	-2.25 4.76				0.01	0.01	l	9.	41		93.06
#5	#5 -2.00 4.00				0.33	0.24	ŀ	9.	74		92.82
#7	-1.50 2.83				0.72	0.53	3	10	.46		92.29
#10	-1.00		2.00		1.33	0.98	3	11	.79		91.31
#14	-0.50		1.41		2.93	2.16	6	14	.72		89.15
#18	0.00		1.00		8.55	6.30	)	23	.27		82.85
#25	0.50		0.71		15.61	11.5	0	38	.88		71.35
#35	1.00		0.50		19.43	14.3	2	58	.31		57.03
#45	1.50		0.35		15.80	11.6	4	74	.11		45.39
#60	2.00		0.25		21.40	15.7	7	95	.51		29.62
#80	2.50		0.18		23.02	16.9	7	118	3.53		12.65
#120	3.00		0.13		13.48	9.93	3	132	2.01		2.72
#170	3.50		0.09		1.77	1.30	)	133	3.78		1.42
#200	3.75		0.07		0.01	0.01	l	133	3.79		1.41
#230	4.00		0.06		0.10	0.07	7	133	3.89		1.34
Phi 5	Phi 16	6	Phi 25		Phi 50	Phi 7	5	Ph	i 84		Phi 95
2.89	2.40		2.14		1.30	0.34	ŀ	-0	.09		
Moment	Mean	Phi	Mear	n mm	So	rting	Sk	kewness	6	ŀ	Kurtosis
Statistics	Statistics 0.91 0.53				1	.08		0.66			2.4



Gra Depths and	elevations ba	etric Re ased on mea	port asured values	3		4							
Project Name: Village of Bald Head Island					IECHNOLOGIES, INC.								
Sample Name: BHC-19 #2					Athena Technologies, Inc. 1293 Graham Farm Road								
Analysis Date: 02-17-14					McClellanville, SC 29458								
Analyzed By: CRM Sr. Easting (ft): Northing (ft):					fax (843) 887-3801								
Easting (ft):	Easting (ft): Northing (ft):				Coordinate System: Elevation (ft):								
2,305,19	97		50,952		North C	arolina Stat	e Plan	e	-7	.6 NC	GVD 29		
0505.	Munse	11.		mments.									
Dry Weight (g):	Wash Weight	(q): Pa	n Retained (g):	Siev	/e Loss (%):	Fines (%):	Organi	cs (%):	Carbonate	es (%):	Shells (%):		
134.88	132 8	30	(0)			#200 - 1.5 #230 - 1.4	1 °	. ,	21	30			
104.00	Sieve S	Size	Sieve Siz	<u>م</u>	Grams	% Weic	ht	Cum	Grams		% Passing		
Sieve Number	(Phi	i) (	(Millimeter	rs)	Retained	Retaine	ed	Reta	ained		Sieve		
3/4"	-4.2	5	19.03			0.00		0.	.00		100.00		
5/8"	-4.0	0	16.00		0.00	0.00		0.	.00		100.00		
#3.5	-2.5	0	5.66		2.70	2.00		2.	.70		98.00		
#4	-2.25		4.76		0.55	0.41		3.	.25	97.59			
#5	-2.00		4.00		1.39	1.03		4.64			96.56		
#7	-1.5	0	2.83		2.45	1.82		7.	.09		94.74		
#10	-1.0	0	2.00		5.46	4.05		12	2.55		90.69		
#14	-0.5	0	1.41		11.65	8.64		24	.20		82.05		
#18	0.00	)	1.00		17.74	13.15		41	.94		68.90		
#25	0.50	)	0.71		16.02	11.88		57	.96		57.02		
#35	1.00	)	0.50		8.73	6.47		66	6.69		50.55		
#45	1.50	D	0.35		5.31	3.94		72	2.00		46.61		
#60	2.00	D	0.25		12.72	9.43		84	.72		37.18		
#80	2.50	)	0.18		29.82	22.11		114	4.54		15.07		
#120	3.00	<b>)</b>	0.13		17.02	12.62		13 <sup>-</sup>	1.56		2.45		
#170	3.50	D	0.09		1.21	0.90		132	2.77		1.55		
#200	3.7	5	0.07		0.06	0.04		132	2.83		1.51		
#230	4.00	)	0.06		0.06	0.04		132	2.89		1.47		
Phi 5	Phi 1	6	Phi 25		Phi 50	Phi 75	5 P		Phi 84		Phi 95		
2.90	2.48	3	2.28		1.07	-0.23		-0	.61		-1.57		
Moment	Mea	n Phi	Mea	in mm	So	rting	Sk	ewness	s	ŀ	Kurtosis		
Statistics	0.	91	0	.53	1	.5		-0.52			2.5		

			DUMOION					
DRI	LLING	LOG	Olsen Associates Inc		Jacks	ATIC	DN SHEET 1 I.e. Florida OF 1 SHEET	<sub>ts</sub>
1. PRO	JECT			9	SIZE		TYPE OF BIT 3.0 In	.3
V	/illage of Ba	Id Hea	d Island	10	). CO	ORDI	NATE SYSTEM/DATUM HORIZONTAL VERTICAL	-
C	Geotechnica	l Inves	tigation of Bald Head Creek		۰. دو ۱	lorth	Carolina State Plane NAD 1983 NGVD 29	
2. BOR	ING DESIGN	ATION	LOCATION COORDINATES	11	. MA	NUFA	CTURER'S DESIGNATION OF DRILL AUTO HAMMER	
E	3HC-20		X = 2,305,532 Y = 51,170					ER
3. DRIL A	LING AGEN	I <b>CY</b> Inologie	es, Inc.	12	2. то	TAL S	AMPLES DISTURBED UNDISTURBED (	UD)
4. NAM	IE OF DRILL	ER		13	в. то	TAL N	IUMBER CORE BOXES	
F	P. McClellar	1	· · · · · · · · · · · · · · · · · · ·	- 14	I. ELI	EVATI	ON GROUND WATER 4.0 Ft.	
	CTION OF E VERTICAL INCLINED	BORING	G DEG. FROM BEARING	15	5. DA	те вс	DRING 02-04-14 11:01 02-04-14 11:	21
6. тніс	KNESS OF	OVERB	BURDEN 0.0 Ft.	16	b. ELI	EVATI	ON TOP OF BORING -1.4 Ft.	21
7. DEP	TH DRILLED		<b>коск</b> 0.0 Ft.	17	. то	TAL R	ECOVERY FOR BORING 8.1 Ft.	
				- 18	B. SIG	NAT	JRE AND TITLE OF INSPECTOR	
8. 101	AL DEPTH C		ING 10.0 Ft.		A	. Fre	eze	
<b>ELEV</b> . (ft) -1.4	DEPTH (ft) 0.0	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured val	ues	REC.	BOX OR SAMPLE	REMARKS	
		$ \cdots $				~	Sample #1, Depth = 0.0' - 0.4'	
							Mean (mm): 0.42, Phi Sorting: 0.83	
							Carbonate: 8.3%, Fines (230): 0.66% (SP)	
			Medium quartz SAND, few medium sand si	ze				
			shell, trace silt (in burrows), poorly graded	,				
			subrounded, bioturbated, light brownish gra	iy				
	_						Sample #Comp. Dopth $= 0.0'$ 6.6'	
						dmo	Mean (mm): 0.38. Phi Sorting: 1.11	
5.0	2.0					ö	Carbonate: 11.7%, Fines (230): 0.99% (SP)	
-0.2	- 3.0							
	_		Fine to medium quartz SAND, few fine to	\ \				
			poorly graded, subrounded, gray (2.5Y-6/1	), ).				
			(SP).					
	-						Sample #2 Depth $-62' - 66'$	⊦
		<b> </b>				2	Mean (mm): 0.35, Phi Sorting: 1.15	
-8.1	6.7		Medium quartz SAND, few medium to coard	se	1		Carbonate: 12.6%, Fines (230): 1.27% (SP)	
-8.4	7.0	╏┊┊┊╏	sand size shell, few silt, poorly graded,	Γ	1			
-9.0	76		subrounded, bioturbated, gray (2.5Y-5/1), (SP-SM).					
0.0	7.0	tiit	Medium quartz SAND, little coarse sand siz	e.ſ	1			
-9.5	- 8.1	┟┵┵╂╷	shell, trace silt / gravel size shell, poorly grad subrounded, grav (2,5Y-6/1) (SP)	ed,	-			
			Silty medium quartz SAND, some coarse sa	nd				
			to gravel size shell, little silt, subrounded, da $aray (2.5Y-4/1)$ (SM)	rk				
	_							
	<b>-</b>							
			End of Boring					
	_							



### February 2014

#### Scale in Feet Photo Mosaic Image





Granularmetric Report Depths and elevations based on measured values														
Project Name:	Village of	Bald Hea	d Islan	b		IECHNOLOGIES, INC.								
Sample Name: BHC-20 #1						Athena Technologies, Inc. 1293 Graham Farm Road								
Analysis Date: 02-17-14						McClellanville, SC 29458								
Analyzed By: CRM Sr.						fax (843) 887-3801								
Easting (ft):		Northing (ft):			Coo	Coordinate System: Elevation (ft):								
2,305,53	32		51,170	) Commontor		North Ca	arolina State	Plane		-1.4 N	IGVD 29			
	Munse	11.		Comments:										
SP Dry Weight (g):	Wash Weight	(q): Par	n Retained	(q): S	ieve Los	s (%):	Fines (%):	Organics (%)	Car	bonates (%)	): Shells (%):			
136 30	135 /	11				- ()	#200 - 0.67			8 30				
130.30	Sieve S	Size	Sieve	Size	G	rams	% Weiat	nt Cu	m Gra	o.su ams	% Passing			
Sieve Number	(Phi	i) (	(Millime	eters)	Re	tained	Retained		Retaine	ed	Sieve			
3/4"	-4.2	5	19.0	3			0.00		0.00		100.00			
5/8"	-4.0	0	16.0	0	(	0.00	0.00		0.00		100.00			
#3.5	-2.5	0	5.66	6	(	0.00	0.00		0.00		100.00			
#4	-2.2	5	4.76		0.00		0.00		0.00		100.00			
#5	-2.00		4.00		0.00		0.00		0.00		100.00			
#7	-1.5	0	2.83	3	(	0.29	0.21		0.29		99.79			
#10	-1.00		2.00		(	0.45	0.33		0.74		99.46			
#14	-0.5	0	1.4	1		1.84	1.35		2.58		98.11			
#18	0.00	<b>D</b>	1.00	C	Ę	5.55	4.07		8.13		94.04			
#25	0.50	)	0.7	1	1	5.69	11.51		23.82		82.53			
#35	1.00	)	0.50	0	2	9.23	21.45		53.05		61.08			
#45	1.50	)	0.3	5	3	0.10	22.08		83.15		39.00			
#60	2.00	)	0.2	5	2	4.89	18.26		108.04	1	20.74			
#80	2.50	)	0.18	3	1	9.66	14.42		127.70	)	6.32			
#120	3.00	)	0.13	3	-	7.15	5.25		134.85	5	1.07			
#170	3.50	)	0.0	9	(	0.52	0.38		135.37	7	0.69			
#200	3.75	5	0.0	7	(	0.03	0.02		135.40	)	0.67			
#230	4.00	)	0.0	6	(	0.01	0.01		135.41		0.66			
Phi 5	Phi 1	6	Phi 2	25	P	hi 50	Phi 75		Phi 84	.	Phi 95			
2.63	2.16	6	1.88	8		1.25	0.68		0.44		-0.12			
Moment	Mea	n Phi	N	lean mm	1	Sorting Skewness			Kurtosis					
Statistics	1.:	25		0.42		0.	83	-0.2	2		2.89			



Gra Depths and	Granularmetric Report Depths and elevations based on measured values				ATHENA								
Project Name: Village of Bald Head Island					IECHNOLOGIES, INC.								
Sample Name: BHC-20 #Comp					Athena Technologies, Inc. 1293 Graham Farm Road								
Analysis Date: 02-17-14					McClellanville, SC 29458								
Analyzed By: C	RM Sr.						fa	x (843	3) 887-38	301			
Easting (ft):		Northing (ft):			Coordinate System: Elevation (ft):								
2,305,53	32		51,170		No	rth Ca	arolina State	e Plar	ne	-	1.4 NC	GVD 29	
	Munse			omments:									
Dry Weight (g):	Wash Weight	(g): Pa	an Retained (q):	Sie	ve Loss (%):		Fines (%):	Orgar	nics (%):	Carbona	ates (%):	Shells (%):	
149.48	1/18 (	n2			(,		#200 - 1.02 #230 - 0.99	2	()	11	70		
143.40	Sieve	Size	Sieve Siz	<b>7</b> 0	Grame	2	% Weia	bt	Cum	Gram	s	% Passing	
Sieve Number	(Ph	i)	(Millimete	rs)	Retaine	, ed	Retaine	ed	Ret	ained		Sieve	
3/4"	-4.2	5	19.03				0.00		0	.00		100.00	
5/8"	-4.0	0	16.00		0.00		0.00		0	.00		100.00	
#3.5	-2.5	0	5.66		0.98		0.66		0	.98		99.34	
#4	-2.25		4.76		0.00		0.00		0.98		99.34		
#5	-2.00		4.00		0.44		0.29		1.42			99.05	
#7	-1.50		2.83		0.56		0.37		1.98			98.68	
#10	-1.00		2.00		1.03		0.69		3.01			97.99	
#14	-0.50		1.41		3.49		2.33		6	.50		95.66	
#18	0.00	0	1.00		8.97		6.00		15	5.47		89.66	
#25	0.50	0	0.71		16.70		11.17		32	2.17		78.49	
#35	1.00	0	0.50		19.77		13.23		51	1.94		65.26	
#45	1.50	0	0.35		18.29		12.24		70	).23		53.02	
#60	2.00	D	0.25		24.66		16.50		94	4.89		36.52	
#80	2.50	0	0.18		30.78		20.59		12	5.67		15.93	
#120	3.00	0	0.13		19.66		13.15		14	5.33		2.78	
#170	3.50	0	0.09		2.53		1.69		14	7.86		1.09	
#200	3.7	5	0.07		0.11		0.07		14	7.97		1.02	
#230	4.00	0	0.06		0.05		0.03		14	8.02		0.99	
Phi 5	Phi 1	16	Phi 25		Phi 50		Phi 75		Ph			Phi 95	
2.92	2.50	0	2.28		1.59		0.63		0	.25		-0.44	
Moment	Mea	n Phi	Mea	an mm		Sorting Skewness Kurt		Kurtosis					
Statistics	1.	39	C	).38		1.	11		-0.84		-	4.12	



Granularmetric Report Depths and elevations based on measured values				ATHENA									
Project Name: Village of Bald Head Island					TECHNOLOGIES, INC.								
Sample Name: BHC-20 #2					Athena Technologies, Inc. 1293 Graham Farm Road								
Analysis Date: 02-17-14					McClellanville, SC 29458								
Analyzed By: CRM Sr.					pn (843) 887-3800 fax (843) 887-3801								
Easting (ft):		Northing (ft):			Coordinate System: Elevation (ft):								
2,305,53	32		51,170		North C	arolina State	e Plan	e	-7	.6 NC	GVD 29		
USCS:	Munse		Com	iments:									
SP Dry Weight (g):	Wash Weight	(g): Pa	n Retained (a):	Siev	ve Loss (%):	Fines (%):	Organi	cs (%):	Carbonat	es (%):	Shells (%):		
126.67	125		(3)			#200 - 1.30	) 7	()	12	60			
120.07	Sieve	Size	Sieve Size	<u> </u>	Grams	% Weig	ht	Cum	Grams		% Passing		
Sieve Number	(Ph	i) (	(Millimeters	, 3)	Retained	Retaine	ed	Reta	ained	<b>`</b>	Sieve		
3/4"	-4.2	5	19.03			0.00		0.	.00		100.00		
5/8"	-4.0	0	16.00		0.00	0.00		0	.00		100.00		
#3.5	-2.5	0	5.66		1.11	0.88		1.	.11	99.12			
#4	-2.2	5	4.76		0.43	0.34		1.	.54		98.78		
#5	-2.0	0	4.00		0.17	0.13		1.	.71		98.65		
#7	-1.5	0	2.83		1.23	0.97		2	.94		97.68		
#10	-1.0	0	2.00		1.95	1.54		4	.89		96.14		
#14	-0.5	0	1.41		2.89	2.28		7.	.78		93.86		
#18	0.0	D	1.00		5.71	4.51		13	3.49		89.35		
#25	0.5	0	0.71		8.32	6.57		21	.81		82.78		
#35	1.0	0	0.50		11.15	8.80		32	2.96		73.98		
#45	1.5	0	0.35		11.86	9.36		44	1.82		64.62		
#60	2.0	D	0.25		24.27	19.16		69	9.09		45.46		
#80	2.5	0	0.18		39.60	31.26		10	8.69		14.20		
#120	3.0	D	0.13		15.43	12.18		124	4.12		2.02		
#170	3.5	0	0.09		0.90	0.71		125.02			1.31		
#200	3.7	5	0.07		0.01	0.01		12	5.03		1.30		
#230	4.0	0	0.06		0.04	0.03		12	5.07		1.27		
Phi 5	Phi '	16	Phi 25		Phi 50	Phi 75		Ph	ni 84		Phi 95		
2.88	2.4	7	2.33		1.88	0.94		0.	.41		-0.75		
Moment	Mea	n Phi	Mear	n mm	So	1.00   0.94   0.41     Sorting   Skewness		ŀ	Kurtosis				
Statistics	1.	51	0.3	35	1	.15		-1.45			5.39		

			DIVISION	INS	STAL	LATIC	N C	SHEET 1
			Olsen Associates, Inc.	<u> </u>	Jacks	sonvill	e, Florida	OF 1 SHEETS
1. PROJECT	of Rold L	-lood l	sland	9.	SIZE	AND	TYPE OF BIT 3.0 In.	
Geotec	on Daiur hnical In		istanu ation of Bald Head Creek	10.	. CO		NATE SYSTEM/DATUM	
2. BORING D	ESIGNAT			11.	. МА		CATOINA State Plane I NAD 1963	
BHC-2	1		X = 2,305,156 Y = 51,563					] MANUAL HAMMER
3. DRILLING Athena	AGENCY a Technol	ogies,	CONTRACTOR FILE NO.	12.	. то	TAL S	AMPLES DISTURBED	UNDISTURBED (UD) 2
4. NAME OF I	DRILLER			13.	. то	TAL N	IUMBER CORE BOXES	
P. McC	Clellan			14.	. ELI	EVATI	ON GROUND WATER 5.2 Ft.	
	CAL NED	ang	VERTICAL	15.	. DA	TE BC	ORING STARTED 02-04-14 09:42	сомрьетер 02-04-14 10:27
5. THICKNES	S OF OVI	ERBUR	RDEN 0.0 Ft.	16.	. ELI	EVATI	ON TOP OF BORING -2.6 Ft.	
				17.	. то	TAL R	ECOVERY FOR BORING 8.1 Ft.	
. DEPTH DR	ILLED IN		0.0 Ft.	18.	. SIG	NATU	JRE AND TITLE OF INSPECTOR	
B. TOTAL DE	PTH OF B		G 10.0 Ft.		A	. Fre	eze	
ELEV. DEF (ft) (f -2.6 0.0			CLASSIFICATION OF MATERIALS lepths and elevations based on measured value	s	REC.	BOX OR SAMPLE	REMARKS	
						Υ.	Sample #1, Depth = 0.0' - 0.4'	
							Mean (mm): 0.31, Phi Sorting: 0.97	
Ĺ							Carbonate: 8.9%, Fines (230): 1.16%	(SP)
	.  .		Medium quartz SAND, few fine sand size shell trace silt, poorly graded, subrounded	,				
			bioturbated, color grades to gray $(2.5Y 6/1)$ ,					
L	÷:-	$\left  \cdot \right $	light brownish gray (2.5Y-6/2), (SP).					
	··							
5.4						dm	Sample #Comp, Depth = $0.0' - 5.4'$ Mean (mm): 0.41 Phi Sorting: 1.09	
-5.4	<u>2.0</u>	<u>.</u>				0 C	Carbonate: 10.7%, Fines (230): 1.11	% (SP)
								· · /
	:  :		Medium quartz SAND, little medium sand size					
Ļ		:   `	to light gray (2.5Y 7/2), light brownish gray					
	l:		(2.5Y-6/2), (SP).					
-7.4	4.8							
			Medium quartz SAND, few medium sand size				Sample #2, Depth = 5.0' - 5.4'	
	l.	. s	shell, trace silt, poorly graded, subrounded, gra	y		2	Mean (mm): 0.49, Phi Sorting: 1.19	% (SP)
-8.4	5.8	<u>il</u>	(2.5Y-6/1), (SP).				Carbonale. 13.3%, Filles (230): 1.06	/0 (OF)
	:  :	F	Fine quartz SAND, little medium quartz sand (i	n				
-9.0	6.4	÷	layers), poorly graded, subrounded, gray	ہ				
	··	:: \_	(2.5Y-6/1), (SP).	]				
-9.7	7.1	<u>і</u>	gravel size shell, trace silt, poorly graded,	Ĺ				
		\_ <sub>i</sub>	subrounded, gray (2.5Y-6/1), (SP).	-/				
	ļ‡ł		to gravel size shell, little silt, subrounded, dark					
-10.7 -	8.1	<u> </u>	grayish brown (2.5Y-4/2), (SM).					
ŀ								
⊢								
			End of Boring					
			č					
╞								
	1	1						



### February 2014

#### Scale in Feet Photo Mosaic Image




Granularmetric Report Depths and elevations based on measured values															
Project Name: V	Project Name: Village of Bald Head Island														
Sample Name:	Athena Technologies, Inc. 1293 Graham Farm Road														
Analysis Date: (	02-17-14				McClellanville, SC 29458 ph (843) 887-3800										
Analyzed By: C	RM Sr.				fax (843) 887-3801										
Easting (ft):		Northing (ft):			Coordinate System	:		E	levation (ft):						
2,305,15	56		51,563		North C	North Carolina State Plane -2.6 NGVD 29									
USCS:	Munse	11:	C	comments:											
SP	Mach Maight		Detained (a)	Cier	(0/)	Fines (0())	Organia	a (0/.):	Carbonataa	(0/)	Shalla (0/)				
bly weight (g).		y). Fail	r Retained (g).		/e LOSS (%).	#200 - 1.2	23	5 (70).	Carbonates	s ( <i>7</i> 0).	Shelis (%).				
141.96	140.3	34	<u> </u>			#230 - 1.	16		8.90	)					
Sieve Number	Sieve Sie	) (	Sieve Siz Millimete	ze ers)	Retained	% Wei Retair	ght ied	Cum. Reta	Grams ained		% Passing Sieve				
3/4"	-4.2	5	19.03			0.00	)	0.00			100.00				
5/8"	-4.0	о	16.00		0.00	0.00	)	0.	00	100.00					
#3.5	-2.5	C	5.66		0.18	0.13	3	0.	18		99.87				
#4	-2.2	5	4.76		0.00	0.00		0.	18	99.87					
#5	-2.0	D C	4.00		0.17	0.12	2	0.35			99.75				
#7	-1.5	0 2.83			0.22	0.15	5	0.	0.57		99.60				
#10	-1.0	D C	2.00		0.43	0.30	)	1.	00		99.30				
#14	-0.5	D C	1.41		1.46	1.03	3	2.	46		98.27				
#18	0.00	)	1.00		5.33	3.75	5	7.79		94.52					
#25	0.50	)	0.71		11.13	7.84	1	18.92			86.68				
#35	1.00	)	0.50		15.96	11.2	4	34.88		75.44					
#45	1.50	)	0.35		14.47	10.1	9	49.35		65.25					
#60	2.00	)	0.25		23.49	16.5	5	72.84		48.70					
#80	2.50	)	0.18		36.53	25.7	3	109.37		22.97					
#120	3.00	)	0.13		27.53	19.3	9	136.90			3.58				
#170	3.50	)	0.09		3.31	2.33	3	140.21		1.25					
#200	3.75	5	0.07		0.03	0.02	2	140.24		1.23					
#230	4.00	)	0.06		0.10	0.07	7	140	).34		1.16				
Phi 5	Phi 1	6	Phi 25		Phi 50	Phi 7	75	5 Ph			Phi 95				
2.96	2.68	3	2.46		1.96	1.02	2	0.	0.62		-0.06				
Moment	Mea	n Phi	Me	an mm	So	rting	Ske	ewness	3	k	Curtosis				
Statistics	1	.7	(	0.31	0	.97	_	-0.85			3.65				



Granularmetric Report Depths and elevations based on measured values														
Project Name: Village of Bald Head Island							1	ECHNC	LOGIES, IN	<u>1C.</u>				
Sample Name: BHC-21 #Comp							Athe	na Teo Grah	chnologie am Farm	es, Inc. N Road				
Analysis Date:	02-17-14						McC		ville, SC 2	29458				
Analyzed By: C	RM Sr.						p fa	n (843 1x (843	8) 887-36 8) 887-38	301				
Easting (ft):		Northing (ft):			Cool	dinate System:			1	Elevation (	ft):			
2,305,15	2,305,156 51,563						arolina Stat	e Plai	ne	-2	2.6 NC	GVD 29		
USCS:	Munse	ell:		Comments:										
SP Dry Weight (g):	Wash Weight	(g): Pa	an Retained (g)	): Sie	eve Los	s (%):	Fines (%):	Orgai	nics (%):	Carbona	ates (%):	Shells (%):		
130.23	179 -	79		, , , , , , , , , , , , , , , , , , , ,			#200 - 1.1	6		10.70				
130.23	Sieve 9	Sizo	Siovo Si	70	G	rame	#230 - 1.1 % Woic	ı ıht	Cum	Gram	s.70	% Passing		
Sieve Number	(Phi	i)	(Millimete	ers)	Re	tained	Retaine	ed	Reta	ained	5	Sieve		
3/4"	-4.2	5	19.03				0.00		0	.00		100.00		
5/8"	-4.0	0	16.00	)	(	0.00	0.00		0	.00		100.00		
#3.5	-2.5	0	5.66		(	).82	0.63		0	.82		99.37		
#4	-2.2	5	4.76		(	0.03	0.02		0	.85		99.35		
#5	-2.0	0	4.00		(	).18	0.14		1.03			99.21		
#7	-1.50 2.83			(	).28	0.22		1.31			98.99			
#10	-1.00 2.00			(	).93	0.71		2	.24		98.28			
#14	-0.5	0	1.41		2	2.72	2.09		4	.96		96.19		
#18	0.00	כ	1.00		ę	9.92	7.62		14	1.88		88.57		
#25	0.50	כ	0.71		1	8.47	14.18		33	3.35		74.39		
#35	1.00	כ	0.50		2	0.84	16.00		54	1.19		58.39		
#45	1.50	כ	0.35		1	3.70	10.52		67.89			47.87		
#60	2.00	0	0.25		2	0.47	15.72		88.36			32.15		
#80	2.50	כ ב	0.18		2	4.65	18.93		113.01			13.22		
#120	3.00	D	0.13		1	4.46	11.10		12	7.47		2.12		
#170	3.50	כ	0.09			.24	0.95		12	8.71	1.17			
#200	3.75	5	0.07		(	).01	0.01		128.72			1.16		
#230	4.00	D	0.06		(	).06	0.05		12	8.78		1.11		
Phi 5	Phi 1	16	Phi 25	25		hi 50	Phi 75	5	Ph			Phi 95		
2.87	2.43	3	2.19			.40	0.48		0			-0.42		
Moment	Mea	n Phi	Me	an mm		Sor	rting	S	Skewness			Kurtosis		
Statistics	1.	27	0.41			1.09			-0.62			3.72		



Granularmetric Report Depths and elevations based on measured values													
Project Name:	Athena Technologies, Inc. 1293 Graham Farm Road												
Sample Name:													
Analysis Date: (	02-17-14				McClellanville, SC 29458 nb (843) 887-3800								
Analyzed By: C	RM Sr.				fax (843) 887-3801								
Easting (ft):		Northing (ft):			Coordinate System	:		EI	evation (ft):				
2,305,15	56		51,563		North C	arolina Sta	te Plane		-7.6	NGVD 29			
USCS:	Munse	11:	C	omments:									
SP Dry Weight (g):	Wash Weight (	a): Pan	Retained (g):	Siev	e Loss (%):	Fines (%):	Organics	(%):	Carbonates (%	(i): Shells (%):			
127 42	125.0		(g)		0 2000 (70).	#200 - 1.0	)9		15.20				
137.43	Siovo S	Sizo	Siovo Si-	70	Grame	#230 - 1.0 % W/oi	abt (		- 10.00 Grame	% Passing			
Sieve Number	(Phi	) (	Millimete	rs)	Retained	Retain	ied	Reta	ined	Sieve			
3/4"	-4.2	5	19.03			0.00	)	0.00		100.00			
5/8"	-4.00	C	16.00		0.00	0.00	)	0.0	00	100.00			
#3.5	-2.50	D C	5.66		1.04	1.04 0.76		1.0	04	99.24			
#4	-2.2	5	4.76		0.21	0.15	5	1.2	25	99.09			
#5	-2.00	D C	4.00		0.71	0.52	.52		96	98.57			
#7	-1.50	0	2.83		1.21	0.88	3 3		17	97.69			
#10	-1.00	0	2.00		2.10	1.53	3	5.2	27	96.16			
#14	-0.50	D C	1.41		6.04	4.39	)	11.	31	91.77			
#18	0.00	)	1.00		14.03	10.2	1	25.	34	81.56			
#25	0.50	)	0.71		22.94	16.6	9	48.28		64.87			
#35	1.00	)	0.50		20.73	15.0	8	69.	01	49.79			
#45	1.50	)	0.35		14.13	10.2	8	83.14		39.51			
#60	2.00	)	0.25		16.31	11.8	7	99.45		27.64			
#80	2.50	)	0.18		23.15	16.8	4	122.60		10.80			
#120	3.00	)	0.13		12.56	9.14	1	135.16		1.66			
#170	3.50	)	0.09		0.73	0.53	3	135.89		1.13			
#200	3.75	5	0.07		0.06	0.04	1	135.95		1.09			
#230	4.00	)	0.06		0.04	0.03	3	135	.99	1.06			
Phi 5	Phi 1	6	Phi 25		Phi 50	Phi 7	75	Phi 8		Phi 95			
2.82	2.35	5	2.08		0.99	0.20	)	-0.	12	-0.87			
Moment	Mear	n Phi	Mea	an mm	So	rting	Skev	wness		Kurtosis			
Statistics	1.(	02	0	).49	1	.19	-0	.48		3.21			

Boring Designation BHC-22

DRILLING LOG     Division     INSTALLATION     INSTALLATION       1. PROJECT     Using of Buil Addad Island     of 1 SHET 1       . PROJECT     Using of Buil Addad Island     . Size Allow TYPE of BIT     3.0 In.       . Construction of Buil Addad Island     . Size Allow in Hostzontral, IVERTOAL     IVERTOAL       . Derkine Stackmark     LOCATION CORDENINTS     1. MANUFACTURER'S DESIGNATION of DRILL     AUTO MANUER       . DRILING AGENCY     LOCATION CORDENINTS     1. MANUFACTURER'S DESIGNATION of DRILL     AUTO MANUER       . DRILING AGENCY     CONTRACTOR FILE NO.     .     IVERTOAL     MANUFACTURER'S DESIGNATION of DRILL     AUTO MANUER       . DRILING AGENCY     CONTRACTOR FILE NO.     .     .     .     .     MANUFACTURER'S DESIGNATION OF DRILL     .     .       . DRILING AGENCY     VERTOAL     OCATION CONDENNITE     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .     . <td< th=""><th></th><th></th><th></th><th></th><th>-</th><th></th></td<>					-							
I. PROJECT     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10     10 </td <td>DRILLING LOC</td> <td>DIVISION</td> <td>INSTAL</td> <td>LATIC</td> <td>N SHEET 1</td> <td>TS</td>	DRILLING LOC	DIVISION	INSTAL	LATIC	N SHEET 1	TS						
Willage of Baid Head Listed Gestexhnical Investigation of Baid Head Creek     10. COORDINATE SYSTEMDATUM (Anth Carolina State Pipene)     NAD FOR 22 NAD 29 NAD 20       2. BORING DESIGNATION EDECTOR OF COORDINATES BHC-22     1. CONTRACTOR FLE MO.     12. TOTAL SAMPLES     INSUE MARKER (Interest Section Root De Reill] (Interest Section Root Root Interest Section Root Interest Section Root Interest Section Root Root Interest Section Root Interest Section Root Root Interest Section Root Root Interest Section Root Root Interest Section Root Interest Section Root Root Interest Section Root	1. PROJECT		9. SIZE AND TYPE OF BIT 3.0 ln.									
Genetechnical Investigation of Bald Head Creek       North Carolina State Plane       NAU 23       NAV0 23         Bell Lines Addition of Bell Lines Corting Coordina State Plane       IN AMUFER Corting State Plane       IN AMUFER Corting State Plane       IN AMUFER         Bell Lines Addition of Bell Lines Additing Additing Addition of Bell Lines Addition of Bell L	Village of Bald Hea	d Island	10. CO	ORDI	NATE SYSTEM/DATUM HORIZONTAL VERTICAL							
2. BORNO CESIGNATION       LOCATION COORDINATES       11.       MANUFACTUREE'S DESIGNATION OF DEIL       AUTO HAMMER BIC/22         3. DRILLING AGENCY       X = 230,707 Y = 51,479       11.       MANUFACTUREE'S DESIGNATION OF DIATUREED       UNDISTUREED (UD) X Hen Technologies, Inc.       UNDISTUREED (UD) 2         4. MARC OF DRILLER P. MCC/Ellon       11.       TOTAL SAMPLES       11.       TOTAL SAMPLES       2         5. DIRECTION OF BORING OF VERTICAL       IDEC. FROM VERTICAL       IDEC. FROM VERTICAL       13.       TOTAL NUMBER CORE BOXES       COMPLETED         6. MULLINED       VERTICAL       IDEC. FROM VERTICAL	Geotechnical Inves	tigation of Bald Head Creek	North Carolina State Plane NAD 1983 NGVD 29									
3. RELINE ACENCY     CONTRACTOR FILE NO.     12. TOTAL SAMPLES     DISTUREED     UNDISTUREED (UD)       4. MARE OF DENLER     13. TOTAL NUMBER CORE BOXES     2       9. MC-Biologies, Inc.     13. TOTAL NUMBER CORE BOXES     2       10. MECTION OF DORING     IDEC. FROM.     IBEARING     14. ELEVATION OROUND WATER     5.8 Ft.       20 VERTICAL     INCLINED     0.0 Ft.     14. ELEVATION OROUND WATER     5.8 Ft.       21. THORNESS OF OVERBURBOEN     0.0 Ft.     15. DATE BORING     02-04-14 10:51       22. DEPTH OF BORING     10.0 Ft.     16. ELEVATION TO PO FE BORING     10.3 Ft.       2. DEPTH OF BORING     12.0 Ft.     16. SIGNATUBE AND ITLE OF INSPECTOR     A. Freezo       3.1 00.0     0.0 Ft.     16. SIGNATUBE AND ITLE OF INSPECTOR     A. Freezo       3.1 00.0     0.0 Ft.     16. SIGNATUBE AND ITLE OF INSPECTOR     A. Freezo       4.0.0     0.0 Ft.     16. SIGNATUBE AND ITLE OF INSPECTOR     A. Freezo       5.0 1.9	2. BORING DESIGNATION BHC-22	LOCATION COORDINATES X = 2,305,707 Y = 51,479	11. MA	NUFA	CTURER'S DESIGNATION OF DRILL DAUTO HAMMER	ER						
4. MME OF DEILLER       13. TOTAL NUMBER CORE BOXES         9. MCC010n       100 ECE FROM WENTCAL       14. ELEVATION OROUND WATER       5.8 Ft.         10. DECENTION OF BORING Carbonates       100 ECE FROM WENTCAL       15. DATE BORING       15. DATE BORING       10.0 Ft.         14. ELEVATION OROUND WATER       5.8 Ft.       02-04-14 10:36       002-04-14 10:36       02-04-14 10:36         2. DIRCHNESS OF OVERBURDEN       0.0 Ft.       15. ELEVATION TO POR BORING       10.3 Ft.         2. DEPTH DRILLED INTO ROCK       0.0 Ft.       15. TOTAL NUMBER AND TITLE OF INSPECTOR         3.1 TOTAL NUMBER       10.0 Ft.       15. TOTAL NUMBER AND TITLE OF INSPECTOR         3.1 OLO       0.0 Ft.       15. TOTAL NUMBER AND TITLE OF INSPECTOR         4.0 0.0       10.0 Ft.       16. ELEVATION OF MATERIALS         10.0 HIGH       12.0 FL       16. Stemark S.         3.1 0.0       Calsstrication of MATERIALS       16. Stemark S.         3.1 0.0       Calsstrication St. providy graded. subrounded. Discurdated.       16. Ft.         4.0 0.0       Wedium quartz SAND. few line to medium sand size shell, providy graded. subrounded. Discurdated.       17. Get Maan (mm. 03.1 Phi Sorting: 0.89 Carbonate: 8.3%, Fines (230): 1.04% (SP)         4.0 0.2 .9       Medium quartz SAND. few silt, trace fine sand size shell provid graded. subrounded. Discurdated.       17. Nortal. NUMBER<	<ol> <li>DRILLING AGENCY Athena Technologi</li> </ol>	CONTRACTOR FILE NO.	12. TO	TAL S	AMPLES 1 2	JD)						
P. McClailan       H4. ELEVATION GROUND WATER 5.8 Ft.         DIECTON OF BORING       DEG. FEOM VERTICAL       IS. DATE BORING       STAPETD (22-04-14 10:3)       COMPLETED (22-04-14 10:3)         10.0       HICKINES OF OVERBURDEN       0.0 Ft.       15. DATE BORING       3.1 Ft.         2. DEPTH DRILLED INTO ROCK       0.0 Ft.       15. DATE BORING       10.3 Ft.         3. TOTAL DEPTH DRILLED INTO ROCK       0.0 Ft.       15. DATE BORING       10.3 Ft.         3. TOTAL DEPTH OF BORING       12.0 Ft.       15. Starting Complexity FOR BORING       10.3 Ft.         3. TOTAL DEPTH OF BORING       12.0 Ft.       15. Starting Complexity For BORING       10.0 Ft.         3.1 0.0       Hedum quartz SAND, few fine to medum sand size shell, risce silt, poorly graded, subrounded, bioutnated, BORDERLINE SP-SM, grayish brown (SP)       Sample #1. Depth = 0.0 ° - 0.4 Mean (rmm): 0.31, Phi Sorting: 0.99 Carbonate: 8.3%, Fines (230): 1.20% (SP)         5.0 1.9       Hedum quartz SAND, few silt, trace fine sand size shell, poorly graded, subrounded, bioutnated, bioutnated, gray (2.5Y-57), (SP-SM), (SP)       -       -         -       Medum quartz SAND, few silt, trace fine sand size shell, poorly graded, subrounded, bioutnated, bioutnated, gray (2.5Y-57), (SP)       -       -         -       Medum quartz SAND, trace silt (n layers), biourback, bioutnated, graded, subrounded, bioutnated, graded, subrounded, bioutnated, graded, subrounded, bioutnated, grade, subrounded, bioutn	4. NAME OF DRILLER		13. TO		IUMBER CORE BOXES							
BITCLINE       DECLASSIFICATION OF BORING       DEC. FROM CERTICAL       DECAMPLETED       COMPLETED         INCLINES OF OVERBURDEN       0.0 FL       15. DATE BORING       3.1 FL       0.2-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36       02-04-14 10:36	P. McClellan		14. ELI	EVAT	ON GROUND WATER 5.8 Ft.							
Sumple #2, Depth     0.0 Ft.     16. ELEVATION TOP OF BORING     0.0 Ft.       17. TOTAL DEPTH OF BORING     12.0 Ft.     17. TOTAL RECOVERY FOR BORING     10.3 Ft.       18. TOTAL DEPTH OF BORING     12.0 Ft.     17. TOTAL RECOVERY FOR BORING     10.3 Ft.       19. STORATURE AND TITLE OF INSPECTOR     A. Freeze       23.0 0.0     10.3 Ft.     18. STORATURE AND TITLE OF INSPECTOR       A. Freeze     A. Freeze       ELEV.     Depth and elevations based on measured values based on measured values bottounded, bioturbated, light brownish gray (2.5Y-62), (SP).       5.0     1.9	5. DIRECTION OF BORING	DEG. FROM BEARING VERTICAL	15. DA	TE BO	STARTED         COMPLETED           ORING         02-04-14         10:36         02-04-14         10:4	51						
DEPTH DRILLED INTO ROCK         0.0 Ft.         17. TOTAL RECOVERY FOR BORING         10.3 Ft.           3. TOTAL DEPTH OF BORING         12.0 Ft.         18. SIGNATURE AND TITLE OF INSPECTOR           3. 00         0.0 Ft.         18. SIGNATURE AND TITLE OF INSPECTOR           3. 00         0.0 Ft.         19. Standards           3. 00         0.0 Ft.         18. SIGNATURE AND TITLE OF INSPECTOR           3. 00         0.0 Ft.         10.3 Ft.           3. 00         0.0 Ft.         10.3 Str.           4. 0.0 Ft.         Medium quartz SAND, few fine to medium sand size shell, poorly graded, subrounded, bioturbated, BORDENLINE SP.M, graysh brown (2.5Y-5/2), (SP).         Sample #Comp, Depth = 0.0 - 4.9'           5.0         1.9         Medium quartz SAND, few silt, trace fine sand size shell, poorly graded, subrounded, bioturbated, bioturbated, gray (2.5Y-5/1), (SP-SM).         Sample #2, Depth = 4.5 - 4.9'           Mean (mm): 0.32, Phi Sorting: 0.38         Carbonate: 2.7%, Flines (230): 2.20% (SP)           9.1         6.0         10.3 Ft.         10.3 Ft.           9.3         6.7         10.0 Fthe quartz	6. THICKNESS OF OVERE	urden 0.0 Ft.	16. EL	EVAT	ON TOP OF BORING -3.1 Ft.	<u> </u>						
B     TOTAL DEPTH OF BORING     12.0 FL     18. SIGNATURE AND TITLE OF INSPECTOR A. Freeze       a     DEPTH (0)     g (0)     Depths and elevations based on measured values (0)     REC.     A. Freeze       a     0.0     Redum quartz SAND, few fine to medium sand (1) coordy graded subrounded, bioturbated, light brownish gray (2.5Y-6/2), (SP).     Sample #1, Depth = 0.0' - 0.4' Medium quartz SAND, few fine to medium sand (2) coord (2) (SP)       -5.0     1.9     Medium quartz SAND, frace silt / fine sand size shell, poorty graded, subrounded, bioturbated, light brownish (2,5Y-5/2), (SP).     Sample #Comp, Depth = 0.0' - 4.9' Medium quartz SAND, frace silt / fine sand size shell, poorty graded, subrounded, bioturbated, bioturbated, gray (2,5Y-5/1), (SP-SM).     Sample #Comp, Depth = 0.0' - 4.9' Mean (mm): 0.32, Phi Sorting: 0.97 Carbonate: 6.0%, Fines (230): 1.94% (SP)       -9.1     6.0     Medium quartz SAND, frace silt (in layers), poorty graded, subrounded, bioturbated, bioturbated, gray (2,5Y-5/1), (SP-SM).     Neal (mm): 0.35, Phi Sorting: 0.88 Carbonate: 2.7%, Fines (230): 2.20% (SP)       -9.1     6.0     Medium quartz SAND, frace silt (organic silt, poorty graded, subrounded, bioturbated, gray (2,5Y-6/1), (SP).     Neal (mm): 0.35, Phi Sorting: 0.88 Carbonate: 2.7%, Fines (230): 2.20% (SP)       -10.4     7.3	7. DEPTH DRILLED INTO	<b>госк</b> 0.0 Ft.	17. TO	TAL F	ECOVERY FOR BORING 10.3 Ft.							
ELEW     DETTH (M)     Q method (M)     CLASSFICATION OF MATERIALS Depths and elevations based on measured values as the shell, trace sit, poorly graded, subrounded, bicturbated, light brownis, gray (2.5Y-6/2), (SP).     Sample #1, Depth = 0.0' - 0.4' Mealum quartz SAND, few fine to medium sand size shell, trace sit, poorly graded, subrounded, bicturbated, light brownis, gray (2.5Y-6/2), (SP).     Sample #2, Depth = 0.0' - 4.9' Mealum quartz SAND, few siti, trace fine sand size shell, poorly graded, subrounded, bicturbated, bicturbated, gray (2.5Y-5/2), (SP).       -6.0     2.9     Medium quartz SAND, few siti, trace fine sand size shell, poorly graded, subrounded, bicturbated, gray (2.5Y-5/1), (SP-SM).     Sample #2, Depth = 4.5' - 4.9' Mean (mm): 0.35, Phi Sorting: 0.88 Carbonate: 2.7%, Fines (230): 2.20% (SP)       -9.1     6.0     Medium quartz SAND, trace siti (in layers), bicturbated, gray (2.5Y-5/1), (SP-SM).     N       -9.3     6.7     Medium quartz SAND, trace siti (in layers), bicturbated, gray (2.5Y-5/1), (SP-SM).     N       -9.1     6.0     Medium quartz SAND, trace siti (ring sand size shell, poorly graded, subrounded, light gray (2.5Y-6/1), (SP).     N       -10.4     7.3     Medium quartz SAND, trace siti, gray (2.5Y-6/1), graded, subrounded, light gray (2.5Y-6/1), (SP).     N       -11.4     -0.0     -1.1.4     -1.1.4     -1.1.4       -1.2.7     9.6     -1.1.4     -1.1.4       -1.2.7     9.6     -1.1.4     -1.1.4       -1.2.4     -0.0     -1.1.4     -1.1.4       -1.2.7<	8. TOTAL DEPTH OF BOR	ING 12.0 Ft.	18. SIC	NAT	JRE AND TITLE OF INSPECTOR							
<ul> <li>a. b. b.</li></ul>	ELEV. DEPTH U	CLASSIFICATION OF MATERIALS Depths and elevations based on measured value	s REC.	BOX OR SAMPLE	REMARKS							
				~	Sample #1, Depth = 0.0' - 0.4'							
-5.0       1.9          -5.0       1.9          Medium quartz SAND, trace silt / fine sand size shell, poorly graded, subrounded, bioturbated, BORDERLINE SP-SM, grayish brown (2.5Y-5/2), (SP).       Sample #Comp, Depth = 0.0' - 4.9' Mean (mm): 0.32, Phi Sorting: 0.97 Carbonate: 6.0%, Fines (230): 1.94% (SP)         -6.0       2.9        Medium quartz SAND, few silt, trace fine sand size shell, poorly graded, subrounded, bioturbated, gray (2.5Y-5/1), (SP-SM).       Sample #2, Depth = 4.5' - 4.9' Mean (mm): 0.35, Phi Sorting: 0.88 Carbonate: 2.7%, Fines (230): 2.20% (SP)         -9.1       6.0        Medium quartz SAND, trace silt (in layers), poorly graded, subrounded, bioturbated, bi-directional bedding present, gray (2.5Y-5/1), (SP).       N         -10.4       7.3        Fine quartz SAND, trace fine sand size shell / silt, poorly graded, subrounded, gray (2.5Y-6/1), (SP).         -10.4       7.3        Medium quartz SAND, trace fine sand size shell / silt, poorly graded, subrounded, color grades to gray (2.5Y 5/1), dark gray (2.5Y-6/1), (SP).         -12.1       9.0       Medium quartz SAND, few silt, trace fine sand size shell, poorly graded, subrounded, bioturbated, bioturbated, gray (2.5Y 5/1), mark gray (2.5Y-6/1), (SP).         -12.7       9.6       Medium quartz SAND, few silt, trace fine sand size shell, poorly graded, subrounded, bioturbated, bioturbated, gray (2.5Y-6/1), (SP).         -13.4       10.3       Ine quartz SAND, few silt, trace fine sand size shell, poor		Medium quartz SAND, few fine to medium sand size shell, trace silt, poorly graded, subrounded bioturbated, light brownish gray (2.5Y-6/2), (SP).	d ,		Mean (mm): 0.31, Phi Sorting: 0.99 Carbonate: 8.3%, Fines (230): 1.20% (SP)							
-6.0       2.9       Medium quartz SAND, trace silt / fine sand size shell, poorly graded, subrounded, bioturbated, BORDERLINE SP-SM, grayish brown (2.5Y-5/2), (SP).       Sample #Comp, Depth = 0.0' - 4.9' Mean (mm): 0.32, Phi Sorting: 0.97 Carbonate: 6.0%, Fines (230): 1.94% (SP)         -6.0       2.9       Medium quartz SAND, few silt, trace fine sand size shell, poorly graded, subrounded, bioturbated, gray (2.5Y-5/1), (SP-SM).       Sample #2, Depth = 4.5' - 4.9' Mean (mm): 0.35, Phi Sorting: 0.88 Carbonate: 2.7%, Fines (230): 2.20% (SP)         -9.1       6.0       Medium quartz SAND, trace silt (in layers), poorly graded, subrounded, bioturbated, bi-directional bedding present, gray (2.5Y-5/1), (SP).       N         -10.4       7.3       Fine quartz SAND, trace fine sand size shell / sitt, poorly graded, subrounded, light gray /(2.5Y-47/1), (SP).       N         -12.1       9.0       Medium quartz SAND, trace fine sand size shell / sitt, poorly graded, subrounded, color grades to gray (2.5Y 5/1), trace fine sand size shell / sitt, poorly graded, subrounded, color grades to gray (2.5Y 5/1), trace fine sand size shell, poorly graded, subrounded, color grades to gray (2.5Y 5/1), trace fine sand size shell, poorly graded, subrounded, color grades to gray (2.5Y 5/1), trace fine sand size shell, poorly graded, subrounded, color grades to gray (2.5Y 5/1), trace fine sand size shell, poorly graded, subrounded, color grades to gray (2.5Y 5/1), (SP-SM).	-5.0 1.9											
-6.0       2.9       ::::       Deficiency of the gray (2.5Y-5/2), (SP).         -6.0       2.9       ::::       Medium quartz SAND, few silt, trace fine sand size shell, poorly graded, subrounded, bioturbated, gray (2.5Y-5/1), (SP-SM).       Sample #2, Depth = 4.5' - 4.9'         -9.1       6.0       .:::       Medium quartz SAND, trace silt (in layers), poorly graded, subrounded, bioturbated, bi-directional bedding present, gray (2.5Y-5/1), (SP-SM).       Nean (mm): 0.35, Phi Sorting: 0.88         -9.8       6.7       .:::       Fine quartz SAND, trace silt (organic silt, poorly graded, subrounded, bioturbated, gray (2.5Y-5/1), (SP).       Sample #2, Depth = 4.5' - 4.9'         -10.4       7.3       .:::       poorly graded, subrounded, bioturbated, gray (2.5Y-5/1), (SP).       Sample #2, Depth = 4.5' - 4.9'         -10.4       7.3       .:::       Fine quartz SAND, trace silt (organic silt, poorly graded, subrounded, bioturbated, gray (2.5Y-5/1), (SP).       Sample #2, Depth = 4.5' - 4.9'         -10.4       7.3       .:::       .:::       .:::       .:::       .:::         -10.4       7.3       .:::       .::::       .::::       .::::       .:::::         -11.4       7.6       .::::::::::::::::::::::::::::::::::::		Medium quartz SAND, trace silt / fine sand size shell, poorly graded, subrounded, bioturbated, BORDERI INE SP-SM, gravish brown	•	dmo	Sample #Comp, Depth = 0.0' - 4.9' Mean (mm): 0.32. Phi Sorting: 0.97							
-9.1       6.0         -9.1       6.0         -9.8       6.7         -9.8       6.7         -10.4       7.3         -10.7       7.6         -11       Medium quartz SAND, trace silt (in layers), poorly graded, subrounded, bioturbated, bi-directional bedding present, gray (2.5Y-5/1), (SP-SM).         -10.4       7.3         -10.7       7.6         -11       Medium quartz SAND, trace fine sand size shell / silt, poorly graded, subrounded, bioturbated, gray (2.5Y-6/1), (SP).         -11.7       7.6         -12.7       9.0         -12.7       9.6         -12.7       9.6         -12.7       9.6         -12.7       9.6         -12.7       9.6         -12.7       9.6         -12.7       9.6         -12.7       9.6         -12.7       9.6         -12.7       9.6         -12.7       9.6         -12.7       9.6         -12.7       9.6         -12.7       9.6         -12.7       9.6         -12.7       9.6         -12.7       9.6         -12.7       9.6         -	-6.0 2.9	(2.5Y-5/2), (SP).		ŏ	Carbonate: 6.0%, Fines (230): 1.94% (SP)							
-9.1 6.0 -9.8 6.7 -10.4 7.3 -10.7 7.6 -12.7 9.6 -13.4 10.3 -13.4 10.3 -9.8 10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -10.7 -		Medium quartz SAND, few silt, trace fine sand size shell, poorly graded, subrounded, bioturbated, gray (2.5Y-5/1), (SP-SM).		2	Sample #2, Depth = 4.5' - 4.9' Mean (mm): 0.35, Phi Sorting: 0.88 Carbonato: 2.7% Einec (220): 2.20% (SP)							
-9.8       6.7       imedual quartz SAND, trace silt (in layers), poorly graded, subrounded, bioturbated, bi-directional bedding present, gray (2.5Y-5/1), (SP).         -10.4       7.3       imedual grave silt / organic silt, poorly graded, subrounded, bioturbated, gray (2.5Y-6/1), (SP).         -10.7       7.6       imedual quartz SAND, trace fine sand size shell / silt, poorly graded, subrounded, light gray (2.5Y-6/1), (SP).         -10.7       7.6       imedual quartz SAND, trace fine sand size shell / silt, poorly graded, subrounded, light gray (2.5Y-6/1), (SP).         -12.1       9.0       imedia quartz SAND, few silt, trace fine sand size shell / size shell, little silt, subrounded, color grades to gray (2.5Y 5/1), dark gray (2.5Y-4/1), (SM).         -12.7       9.6       imedia quartz SAND, few silt, trace fine sand size shell poorly graded, subrounded, bioturbated, gray (2.5Y-6/1), (SP-SM).         -13.4       10.3       imedia quartz SAND, few silt, trace fine sand size shell poorly graded, subrounded, bioturbated, gray (2.5Y-5/1), (SP-SM).	-9.1 6.0				Carbonate. 2.7 /0, 1 mes (230). 2.20 /0 (Sr )							
-10.4       7.3          -10.7       7.6          -10.7       7.6          -10.7       7.6          -10.7       7.6          -10.7       7.6          -10.7       7.6          -10.7       7.6          -10.7       7.6          -10.7       7.6          -10.7       7.6          -10.7       7.6          -10.7       7.6          Medium quartz SAND, trace fine sand size shell          / silt, poorly graded, subrounded, light gray          2.5Y-7/1), (SP).          Silty medium quartz SAND, some coarse sand       to gravel size shell, little silt, subrounded, color         grades to gray (2.5Y 5/1), dark gray (2.5Y-4/1),          (SM).       Medium quartz SAND, few silt, trace fine sand         size shell, poorly graded, subrounded, bioturbated, gray (2.5Y-6/1), (SP-SM).         Fine quartz SAND, few silt, trace fine sand size         shell, poorly graded, subrounded, disturbated, gray (2.5Y-5/1), (SP-SM).	-9.8 67	poorly graded, subrounded, bioturbated, bi-directional bedding present grav (2.52-5/1)										
-10.7       7.6          -10.7       7.6          -10.7       7.6          -10.7       7.6          -10.7       7.6          -10.7       7.6          -10.7       7.6          -10.7       7.6          -10.7       7.6          -10.7       7.6          -10.7       7.6          -10.7        Medium quartz SAND, trace fine sand size shell         / silt, poorly graded, subrounded, color       grades to gray (2.5Y -5/1), dark gray (2.5Y -4/1),         -12.7       9.6          -12.7       9.6          -13.4       10.3          -13.4       10.3          -13.4       10.3          -13.4       10.3          -13.4       10.3          -13.4       10.3          -13.4       10.3          -13.4       10.3          -13.4       10.3          -13.4       10.3 <td></td> <td>(SP). Fine quartz SAND, trace silt / organic silt, poor</td> <td><math>\overline{\mathbf{x}}</math></td> <td></td> <td></td> <td></td>		(SP). Fine quartz SAND, trace silt / organic silt, poor	$\overline{\mathbf{x}}$									
-10.7       7.0        Medium quartz SAND, trace fine sand size shell / silt, poorly graded, subrounded, light gray (2.5Y-7/1), (SP).         -12.1       9.0       Silty medium quartz SAND, some coarse sand to gravel size shell, little silt, subrounded, color grades to gray (2.5Y 5/1), dark gray (2.5Y-4/1), (SM).         -12.7       9.6       Medium quartz SAND, few silt, trace fine sand size shell, poorly graded, subrounded, bioturbated, gray (2.5Y-6/1), (SP-SM).         -13.4       10.3       Fine quartz SAND, few silt, trace fine sand size shell, poorly graded, subrounded, gray (2.5Y-5/1), (SP-SM).	10.7 7.0	graded, subrounded, bioturbated, gray	Л									
-12.1       9.0       Silty medium quartz SAND, some coarse sand to gravel size shell, little silt, subrounded, color grades to gray (2.5Y 5/1), dark gray (2.5Y-4/1), (SM).         -12.7       9.6       Medium quartz SAND, few silt, trace fine sand size shell, poorly graded, subrounded, bioturbated, gray (2.5Y-6/1), (SP-SM).         -13.4       10.3       Fine quartz SAND, few silt, trace fine sand size shell, poorly graded, subrounded, jeray (2.5Y-5/1), (SP-SM).		Medium quartz SAND, trace fine sand size she / silt, poorly graded, subrounded, light gray	Ĩ/									
-12.1       9.0       I		Silty medium quartz SAND, some coarse sand to gravel size shell, little silt, subrounded, color grades to gravel (2 EV 5(4)										
-12.7 9.6 Medium quartz SAND, few silt, trace fine sand size shell, poorly graded, subrounded, bioturbated, gray (2.5Y-6/1), (SP-SM). -13.4 10.3 Fine quartz SAND, few silt, trace fine sand size shell, poorly graded, subrounded, bioturbated, gray (2.5Y-5/1), (SP-SM).	<u>-12.1 9.0      </u>	(SM).	'A									
-13.4 10.3 - Fine quartz SAND, few silt, trace fine sand size shell, poorly graded, subrounded, bioturbated, aray (2.5Y-5/1), (SP-SM).	-12.7 9.6	Medium quartz SAND, few silt, trace fine sand size shell, poorly graded, subrounded,										
	-13.4 10.3	Fine quartz SAND, few silt, trace fine sand size shell, poorly graded, subrounded, bioturbated, grav (2.5Y-5/1). (SP-SM).										



## Bald Head Island North Carolina BHC-22

## February 2014

## Scale in Feet Photo Mosaic Image



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



Granularmetric Report Depths and elevations based on measured values													
Project Name: Village of Bald Head Island							10	CHNO	LOGIES, IN	<u>.</u>			
Sample Name: BHC-22 #1							Athen 1293	a Tec Graha	hnologie am Farm	es, Inc. NRoad			
Analysis Date:	02-17-14						McCl	ellanv	ille, SC 2	29458 800			
Analyzed By: C	RM Sr.	1					fax	(843	) 887-38	301			
Easting (ft):		Northing (ft):			Coor	dinate System:				Elevation (	ft):		
2,305,70	2,305,707 51,479					North Ca	arolina State	Plan	e	-(	3.1 NC	GVD 29	
00000.	Mulise			somments.									
Dry Weight (g):	Wash Weight	(g): Pa	In Retained (g)	): Sie	eve Loss	s (%):	Fines (%):	Organics (%):		Carbona	ates (%):	Shells (%):	
131 05	129 !	50					#200 - 1.31 #230 - 1.20			8	30		
	Sieve	Size	Sieve Si	ze	Gr	ams	% Weigl	nt	Cum.	Grams		% Passing	
Sieve Number	(Phi	i) (	(Millimete	ers)	Ret	ained	Retaine	d	Ret	ained		Sieve	
3/4"	-4.2	5	19.03				0.00		0	.00		100.00	
5/8"	-4.0	0	16.00		C	.00	0.00		0	.00		100.00	
#3.5	-2.5	0	5.66		0	.00	0.00		0	.00		100.00	
#4	-2.2	5	4.76		0	.13	0.10		0	.13		99.90	
#5	-2.0	0	4.00		0	.04	0.03		0.17			99.87	
#7	-1.50 2.83			0	.15	0.11		0	.32		99.76		
#10	-1.00 2.00			0	.30	0.23		0	.62		99.53		
#14	-0.5	0	1.41		1	.43	1.09		2	.05		98.44	
#18	0.00	2	1.00		4	.77	3.64		6	.82		94.80	
#25	0.50	)	0.71		1	1.55	8.81		18	3.37		85.99	
#35	1.00	)	0.50		1	7.09	13.04		35	5.46		72.95	
#45	1.50	D	0.35		10	5.32	12.45		51.78		60.50		
#60	2.00	2	0.25		18	3.73	14.29		70.51		46.21		
#80	2.50	2	0.18		2	6.11	19.92		96.62		26.29		
#120	3.00	)	0.13		2	7.84	21.24	4 12		4.46		5.05	
#170	3.50	0	0.09		4	.68	3.57		12	9.14	1.48		
#200	3.75	5	0.07		0	.22	0.17	129.36			1.31		
#230	4.00	0	0.06		0	.14	0.11		12	9.50		1.20	
Phi 5	Phi 1	6	Phi 25	5	Pł	ni 50	Phi 75	Ph		ni 84		Phi 95	
3.01	2.74	4	2.53		1	.87	0.92	C		.58		-0.03	
Moment	Mea	n Phi	Me	an mm		Sor	rting	Sł	Skewness		ŀ	Kurtosis	
Statistics	1.	68		0.31		0.	99		-0.53			2.66	



Granularmetric Report Depths and elevations based on measured values												
Project Name:	Project Name: Village of Bald Head Island						ECHNOL	ogies, in	<u>1C.</u>			
Sample Name:		Ather 1293	ia Tech Graha	nologie m Farm	es, Inc. NRoad							
Analysis Date:	02-17-14					McC	lellanvil	lle, SC 2	29458			
Analyzed By: C	RM Sr.	1				fa	x (843)	887-38	301			
Easting (ft):		Northing (ft):			Coordinate System	1:		1	Elevation (ft	):		
2,305,70	)7	North C	arolina State	Plane	e	-3	5.1 NC	GVD 29				
	Munse			mments:								
Dry Weight (g):	Wash Weight	(q): Pa	n Retained (q):	Siev	ve Loss (%):	Fines (%): Ora		cs (%):	Carbonat	es (%):	Shells (%):	
135 53	132 8	87				#200 - 2.03 #230 - 1.94	3  L	( )	6	າດ		
100.00	Sieve	Size	Sieve Siz	<u> </u>	Grams	-2.0 - 1.9 % Weia	r ht	Cum	Grams			
Sieve Number	(Ph	i) (	(Millimeter	rs)	Retained	Retaine	d	Reta	ained	, 	Sieve	
3/4"	-4.2	5	19.03			0.00		0	.00		100.00	
5/8"	-4.0	0	16.00		0.00	0.00		0	.00		100.00	
#3.5	-2.5	0	5.66		0.00	0.00		0	.00		100.00	
#4	-2.2	5	4.76		0.04	0.03		0	.04		99.97	
#5	-2.0	0	4.00		0.04	0.03		0.08			99.94	
#7	-1.50 2.83			0.14	0.10		0.22			99.84		
#10	-1.00 2.00			0.37	0.27		0	.59		99.57		
#14	-0.5	0	1.41		1.35	1.00		1	.94		98.57	
#18	0.00	D	1.00		5.20	3.84		7	.14		94.73	
#25	0.50	D	0.71		11.88	8.77		19	9.02		85.96	
#35	1.00	0	0.50		16.49	12.17		35	5.51	73.79		
#45	1.50	D	0.35		17.26	12.74		52.77		61.05		
#60	2.00	D	0.25		22.68	16.73		75.45		44.32		
#80	2.50	D	0.18		28.19	20.80		103.64		23.52		
#120	3.00	0	0.13		23.44	17.30		127.08			6.22	
#170	3.50	0	0.09		5.35	3.95		13	132.43		2.27	
#200	3.7	5	0.07		0.32	0.24		132.75			2.03	
#230	4.00	0	0.06		0.12	0.09		13	2.87		1.94	
Phi 5	Phi 1	16	Phi 25		Phi 50	Phi 75	Ph		ni 84		Phi 95	
3.15	2.72	2	2.46		1.83	0.95	0		.58		-0.04	
Moment	Mea	n Phi	Mea	n mm	So	orting	Sk	Skewness			Kurtosis	
Statistics	1.	66	0	.32	0	97		-0.48			2.63	



Granularmetric Report Depths and elevations based on measured values												
Project Name:			1	ECHNO	LOGIES, IN	<u>1C.</u>						
Sample Name:			Ather 1293	na Teo Graha	chnologie am Farm	es, Inc. NRoad						
Analysis Date:	02-17-14					McC	lellanv	ville, SC 2	29458			
Analyzed By: C	RM Sr.					fa	x (843	) 887-38 ) 887-38	301			
Easting (ft):		Northing (ft):		Coo	rdinate System:				Elevation (f	ft):		
2,305,70	2,305,707 51,479					arolina State	e Plar	ne	-7	7.6 NC	GVD 29	
	Munse		Commer	115:								
Dry Weight (g):	Wash Weight	(q): Pa	n Retained (g):	Sieve Los	s (%):	Fines (%):	Orgar	nics (%):	Carbona	ites (%):	Shells (%):	
132 10	120 1	20	(3)			#200 - 2.3 #230 - 2.2	1  ר		2	70		
152.10	Sieve S	Size	Sieve Size	G	rams	% Weig	bt	Cum	Grame		% Passing	
Sieve Number	(Phi	i)	(Millimeters)	Re	tained	Retaine	ed	Ret	ained		Sieve	
3/4"	-4.2	5	19.03			0.00		0	.00		100.00	
5/8"	-4.0	0	16.00		00.0	0.00		0	.00		100.00	
#3.5	-2.5	0	5.66		0.00	0.00		0	.00		100.00	
#4	-2.2	5	4.76		00.0	0.00		0	.00		100.00	
#5	-2.0	0	4.00		00.0	0.00		0.00			100.00	
#7	-1.50 2.83		2.83		0.07	0.05		0	.07		99.95	
#10	-1.00 2.00		2.00		0.22	0.17		0	.29		99.78	
#14	-0.5	0	1.41		1.10	0.83		1	.39		98.95	
#18	0.00	D	1.00		5.30	4.01		6	.69		94.94	
#25	0.50	0	0.71	1	1.52	8.72		18	3.21		86.22	
#35	1.00	0	0.50	2	0.44	15.47		38	3.65		70.75	
#45	1.50	0	0.35	2	1.64	16.38		60.29		54.37		
#60	2.00	D	0.25	2	7.54	20.85		87.83		33.52		
#80	2.50	0	0.18	2	4.92	18.86		112.75		14.66		
#120	3.00	0	0.13	1	4.66	11.10		127.41			3.56	
#170	3.50	0	0.09		1.63	1.23		12	9.04	2.33		
#200	3.75	5	0.07		0.02	0.02		129.06			2.31	
#230	4.00	0	0.06		0.14	0.11		12	9.20		2.20	
Phi 5	Phi 1	16	Phi 25	P	hi 50	Phi 75	;	Ph			Phi 95	
2.94	2.46	6	2.23		1.60	0.86	0		0.57		-0.01	
Moment	Mea	n Phi	Mean m	ım	Sor	ting	S	Skewness			Kurtosis	
Statistics	1	.5	0.35		0.88			-0.32		2.56		