

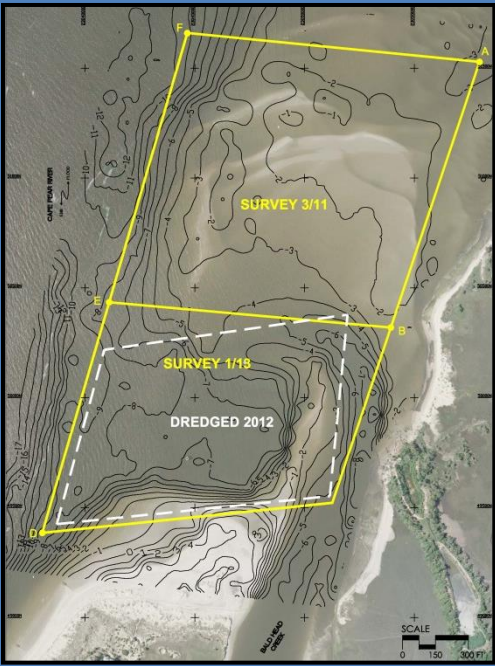
APPENDIX F

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

Village of Bald Head Island Terminal Groin Project

Bald Head Creek Borrow Site Expansion Geotechnical Analysis

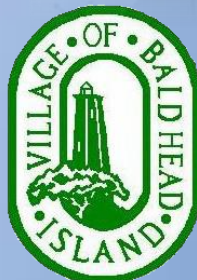
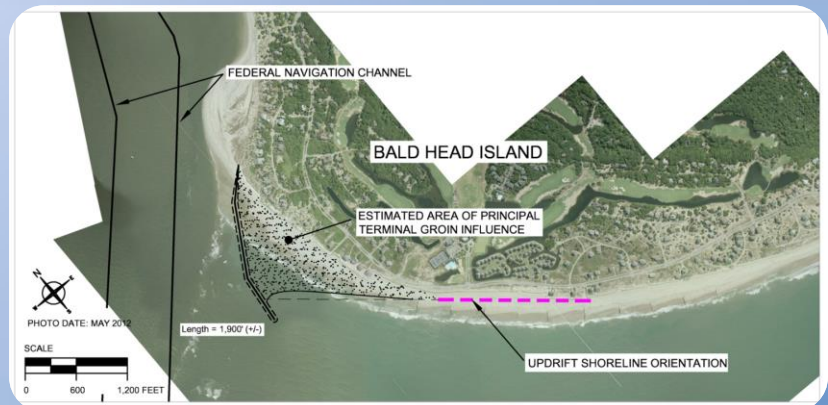
Bald Head Island, N.C.



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April 2014



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associates, inc.

VILLAGE OF BALD HEAD ISLAND TERMINAL GROIN PROJECT

BALD HEAD CREEK BORROW SITE EXPANSION GEOTECHNICAL ANALYSES

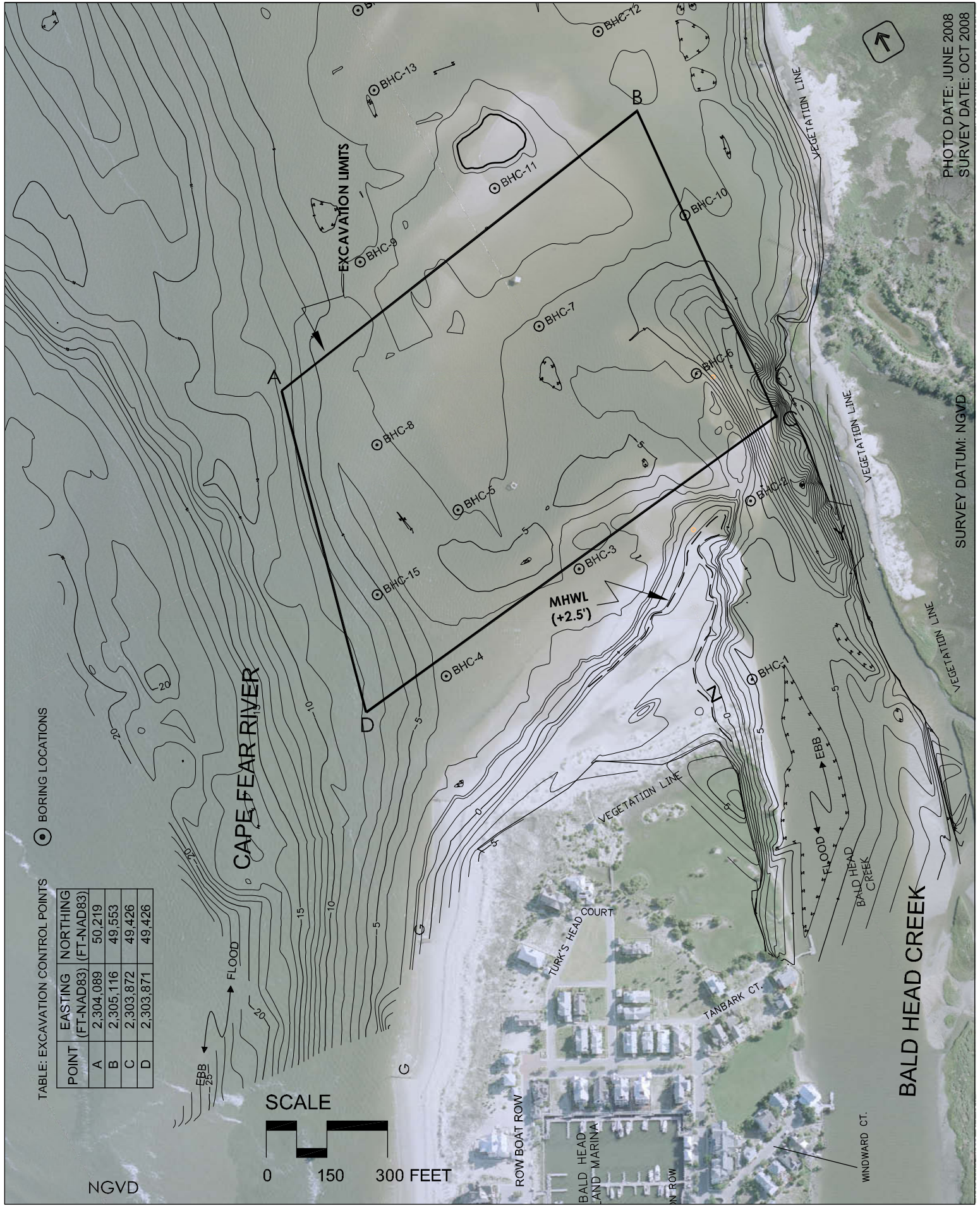
PURPOSE

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)

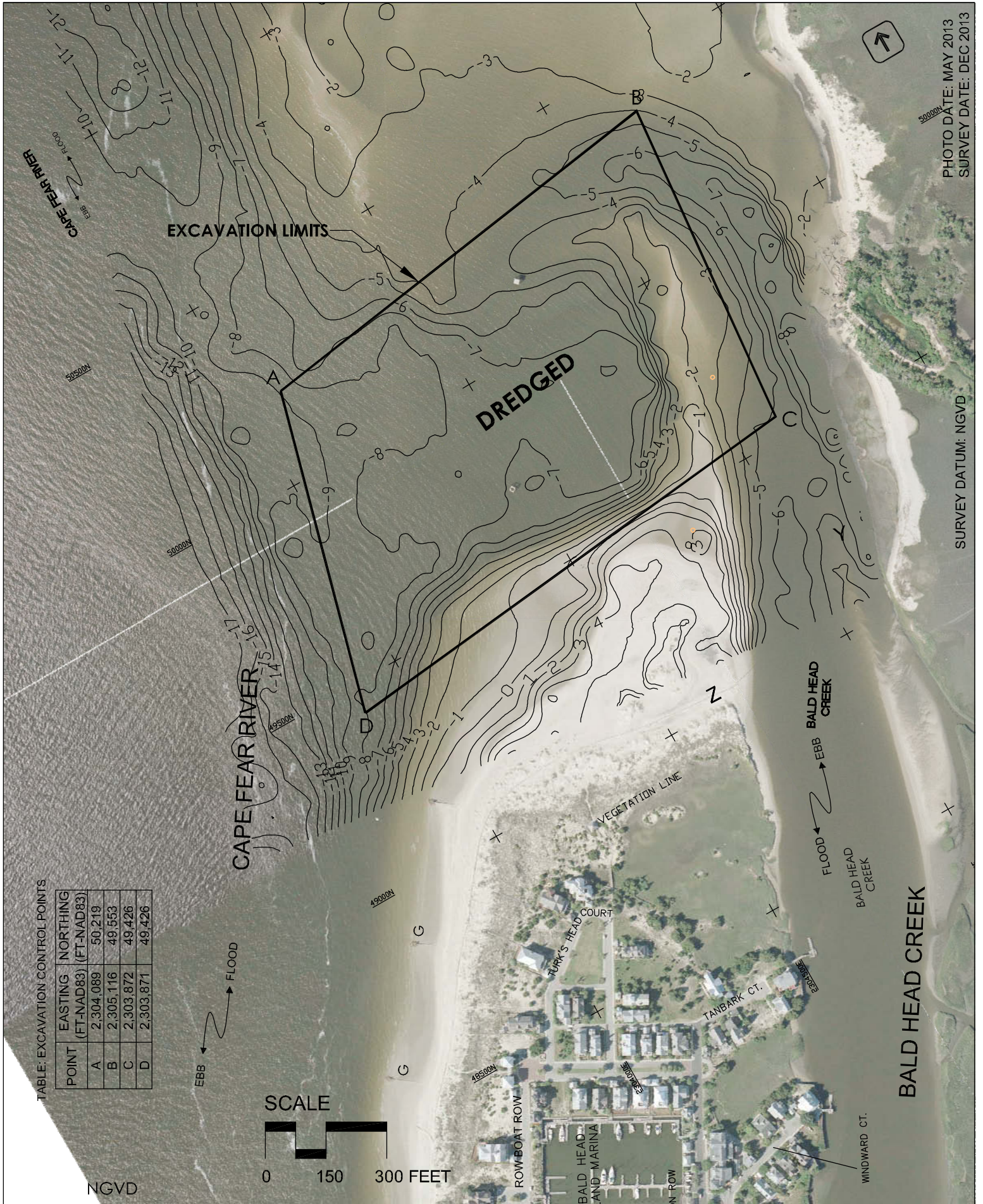
2006, approximately 47,800 cy had been dredged from the Creek mouth and placed along West Beach as a small scale beach restoration project located between baseline Sta. 16+00 and Sta. 34+00 (CAMA 02-05).

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 than 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

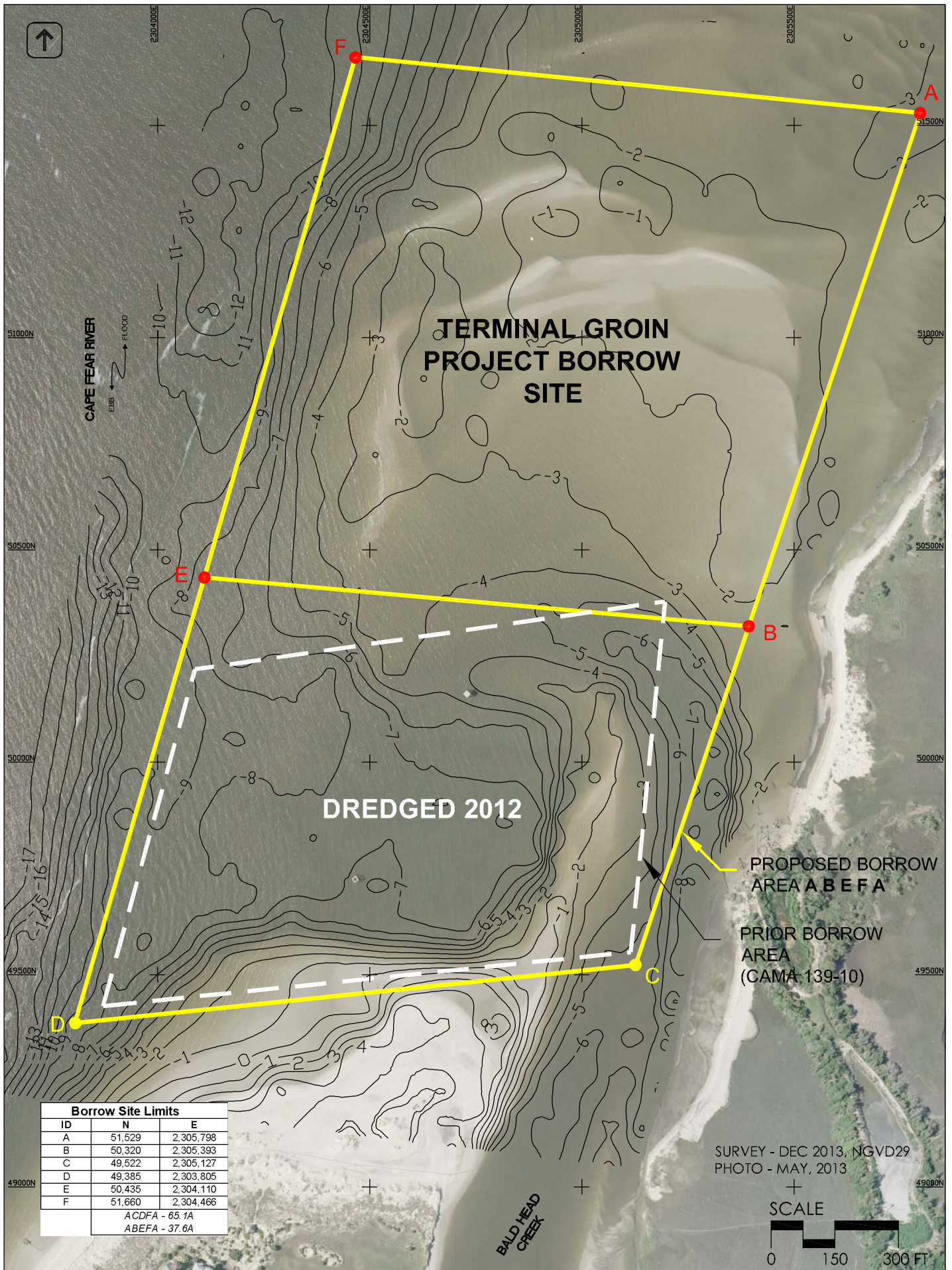


FIGURE 3 - EXPANDED BALD HEAD CREEK BORROW SITE (A,C,D,F,A)

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

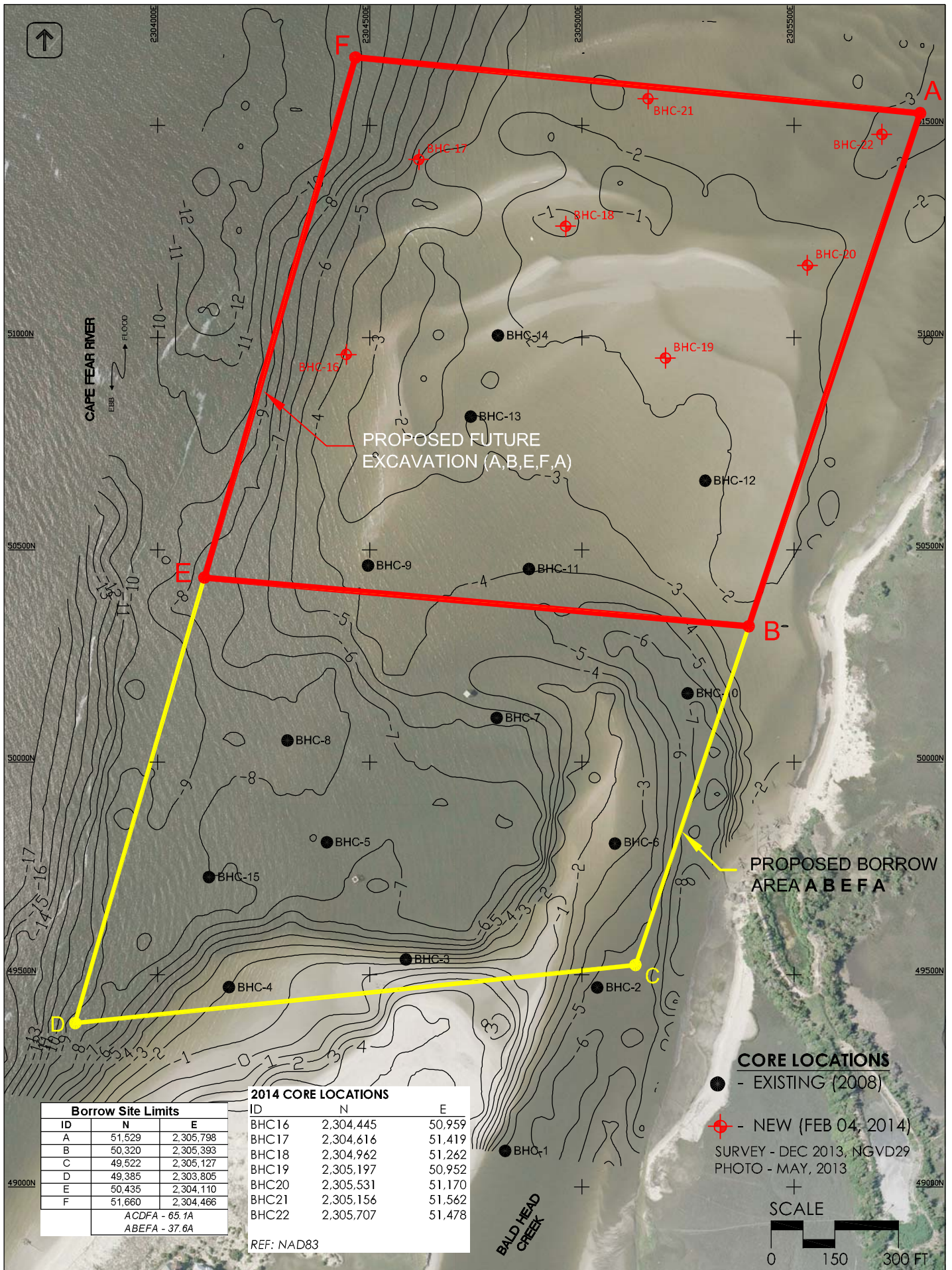


FIGURE 4 - LOCATION OF VIBRACORES

.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

Table 1 Carbonate and Fines Content

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

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

TABLE 2: BALD HEAD CREEK Grain Size Data Summary

Point ID	Sample ID	Water Depth (NGVD)	Length of Core (Composite only)	Percent Fines (#200 Sieve)	Mean (phi)	D ₅₀ (phi)	Standard Deviation	Skewness	Kurtosis	Carbonate %
BHC-09	COMP	2.8	5.0	1.3	1.32	1.51	1.04	-.55	3.06	8.00
BHC-11	COMP	1.1	6.7	2.4	1.36	1.46	1.25	-.52	3.30	12.0
BHC-12	COMP	2.1	5.7	.9	1.50	1.73	1.01	-.51	2.46	6.0
BHC-13	COMP	2.6	5.2	2.2	1.45	1.78	1.11	-.79	3.46	10.0
BHC-14	COMP	2.2	5.6	3.2	1.69	2.04	.97	-.89	3.21	8.0
BHC-15	COMP	4.2	3.6	1.3	1.08	1.11	1.32	-.83	3.87	13.0
BHC-16	COMP	3.9	4.1	1.8	1.65	2.02	1.05	-1.28	4.85	11.8
BHC-17	COMP	4.0	4.0	1.3	1.81	2.05	.86	-1.79	8.05	8.5
BHC-18	COMP	3.0	5.0	.9	1.64	1.82	.91	-.91	4.22	8.4
BHC-19	COMP	1.8	6.2	1.4	1.55	1.00	.8	-.36	3.06	17.6
BHC-20	COMP	1.4	6.6	1.0	1.39	1.59	1.11	-.84	4.12	11.7
BHC-21	COMP	2.6	5.4	1.2	1.27	1.40	1.09	-.62	3.72	10.7
BHC-22	COMP	3.1	4.9	2.0	1.66	1.83	.97	-.48	2.63	6.0

**Table 3. Bald Head Creek Borrow Site – Vibracore Sediment Characterization
Size Classification (%)**

Core No.	Gravel	Granular	Sand	Fines	CaCO₃
BHC-09 (Comp)	.1	1.9	96.8	1.16	8.0
BHC-11 (Comp)	.5	2.5	95.4	1.60	12.0
BHC-12 (Comp)	0	.5	98.7	.83	6.0
BHC-13 (Comp)	.1	1.4	96.4	2.15	10.0
BHC-14 (Comp)	0	.9	96.0	3.15	8.0
BHC-15 (Comp)	2.5	2.6	93.1	1.3	13.0
BHC-16 (Comp)	.41	1.33	96.5	1.81	11.8
BHC-17 (Comp)	.35	.48	97.9	1.29	8.5
BHC-18 (Comp)	.2	.55	98.3	.91	8.4
BHC-19 (Comp)	6.9	1.75	90.0	1.34	17.6
BHC-20 (Comp)	.66	1.35	97.0	.99	11.7
BHC-21 (Comp)	.65	1.1	97.2	1.11	10.7
BHC-22 (Comp)	0	.4	98.0	1.94	6.0
AVERAGE	.95%	1.29%	95.5%	1.51%	10.1%

- **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:

% In Category By Weight

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

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.

Table 4 – Sediment Characteristics

Composite Sample	Gravel	Granular	Sand	Fines	Carbonate
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%

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 1.08 %
 - 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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March 6, 2014

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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 back-barrier 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**.

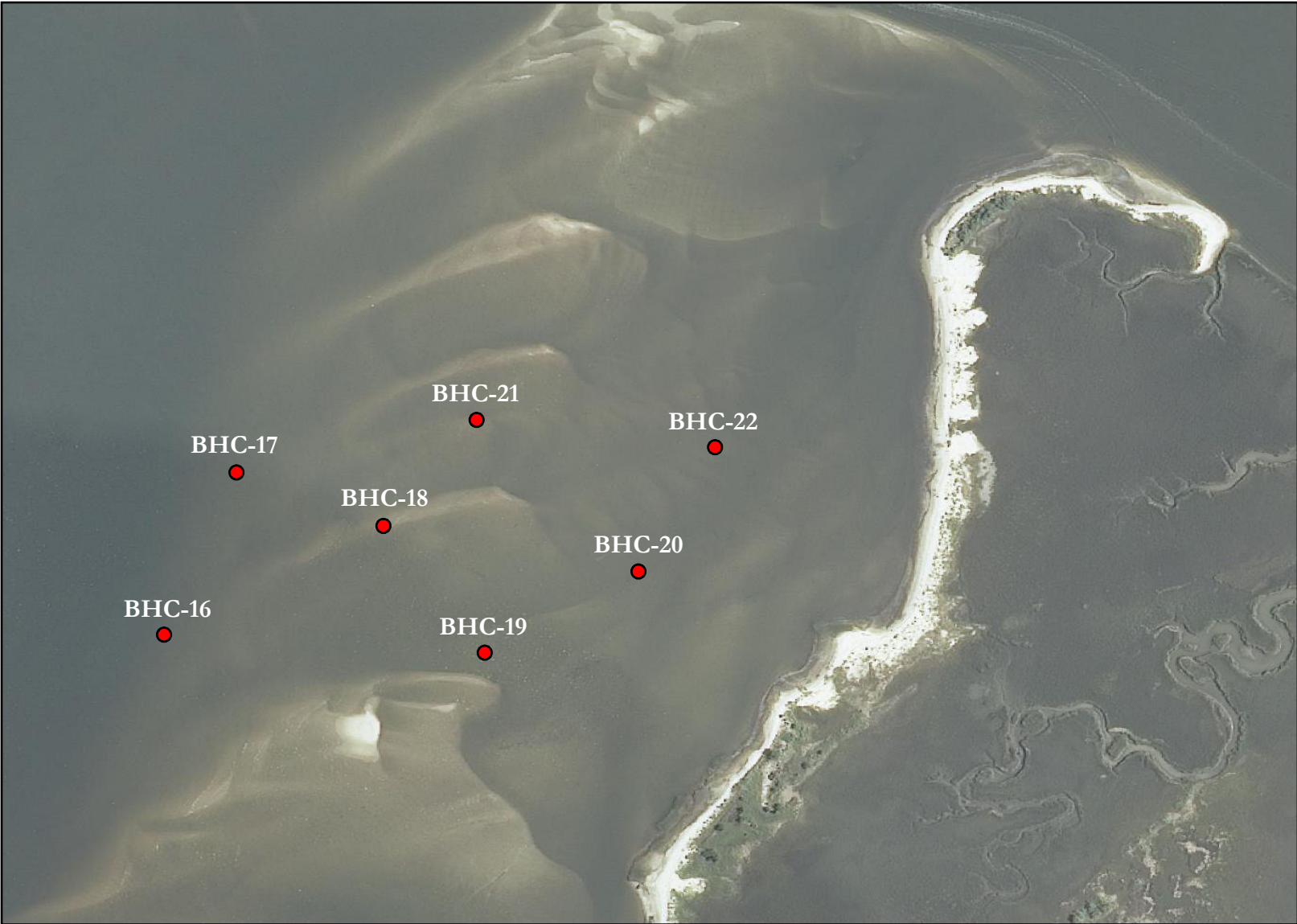
Section 4: Field Sampling Methodology

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 granulometric 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-19	2/4/14	11:34:07	2305197.27	50952.09	4.7	9.0	7.3	Vibrated out first attempt - made second attempt.
						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 recorded in NAD83, State Plane Coordinate System, North Carolina (Zone 3200), US Survey Feet.							
	NAD83 - North American Datum of 1983							



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	BHC-16-1	0.0 - 0.4'	0.28	0.9	8.0	SP
	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	BHC-17-1	0.0 - 0.4'	0.28	0.8	7.5	SP
	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	BHC-18-1	0.0 - 0.4'	0.37	0.8	8.9	SP
	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	BHC-19-1	0.0 - 0.4'	0.34	1.1	8.7	SP
	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	BHC-20-1	0.0 - 0.4'	0.42	0.7	8.3	SP
	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	BHC-21-1	0.0 - 0.4'	0.31	1.2	8.9	SP
	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	BHC-22-1	0.0 - 0.4'	0.31	1.3	8.3	SP
	BHC-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 - Analysis was performed according to the following method: Twenhofel and Tyler, 1941

USCS - Unified Soil Classification System



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 (*Callinassa 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), <http://tidesandcurrents.noaa.gov/stationhome.html?id=8659084> (March 4, 2014).

Appendix A

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

Boring Designation BHC-16

DRILLING LOG		DIVISION Olsen Associates, Inc.	INSTALLATION Jacksonville, Florida	SHEET 1 OF 1 SHEETS
1. PROJECT Village of Bald Head Island Geotechnical Investigation of Bald Head Creek		9. SIZE AND TYPE OF BIT 3.0 In.		
2. BORING DESIGNATION BHC-16		LOCATION COORDINATES X = 2,304,446 Y = 50,959	10. COORDINATE SYSTEM/DATUM North Carolina State Plane	HORIZONTAL NAD 1983
3. DRILLING AGENCY Athena Technologies, Inc.		CONTRACTOR FILE NO.	11. MANUFACTURER'S DESIGNATION OF DRILL <input type="checkbox"/> AUTO HAMMER <input type="checkbox"/> MANUAL HAMMER	
4. NAME OF DRILLER P. McClellan		12. TOTAL SAMPLES DISTURBED 1 UNDISTURBED (UD) 2		
5. DIRECTION OF BORING <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		DEG. FROM VERTICAL	13. TOTAL NUMBER CORE BOXES	
6. THICKNESS OF OVERBURDEN 0.0 Ft.		BEARING	14. ELEVATION GROUND WATER 6.4 Ft.	
7. DEPTH DRILLED INTO ROCK 0.0 Ft.		15. DATE BORING STARTED 02-04-14 12:05 COMPLETED 02-04-14 12:55		
8. TOTAL DEPTH OF BORING 11.7 Ft.		16. ELEVATION TOP OF BORING -3.9 Ft.		
		17. TOTAL RECOVERY FOR BORING 9.8 Ft.		
		18. SIGNATURE AND TITLE OF INSPECTOR A. Freeze		

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-3.9	0.0					
-5.8	1.9		Fine to medium quartz SAND, few fine to medium sand size shell, trace silt, poorly graded, subrounded, light brownish gray (2.5Y-6/2), (SP).		1	Sample #1, Depth = 0.0' - 0.4' Mean (mm): 0.28, Phi Sorting: 0.80 Carbonate: 8.0%, Fines (230): 0.86% (SP)
-6.8	2.9		Medium quartz SAND, few medium sand size shell, trace silt, poorly graded, subrounded, light brownish gray (2.5Y-6/2), (SP).		Comp	Sample #Comp, Depth = 0.0' - 4.1' Mean (mm): 0.32, Phi Sorting: 1.05 Carbonate: 11.8%, Fines (230): 1.81% (SP)
-8.6	4.7		Fine to medium quartz SAND, trace silt (in burrows), trace fine sand size shell, poorly graded, subrounded, bioturbated, 3.0' = Callianassa major burrow trace, light gray (2.5Y-7/2), (SP).			2
-10.2	6.3		Fine quartz SAND, trace silt (in layers), trace fine sand size shell, poorly graded, subrounded, 5.35' = layer of medium quartz SAND with little medium to coarse sand size shell, gray (2.5Y-6/1), (SP).			
-13.2	9.3		Medium quartz SAND, few medium sand size shell, fine sand in layers, poorly graded, subrounded, bi-directional bedding present, gray (2.5Y-6/1), (SP).			
-13.7	9.8		Fine to medium quartz SAND, trace silt (in layers), trace fine sand size shell, poorly graded, subrounded, gray (2.5Y-6/1), (SP).			
			End of Boring			

FLORIDA DEP ROSS BALD HEAD CREEK, NC, FEB. '14, GRJ FL DEP ROSS.GDT 3/3/14



**Bald Head Island
North Carolina
BHC-16**

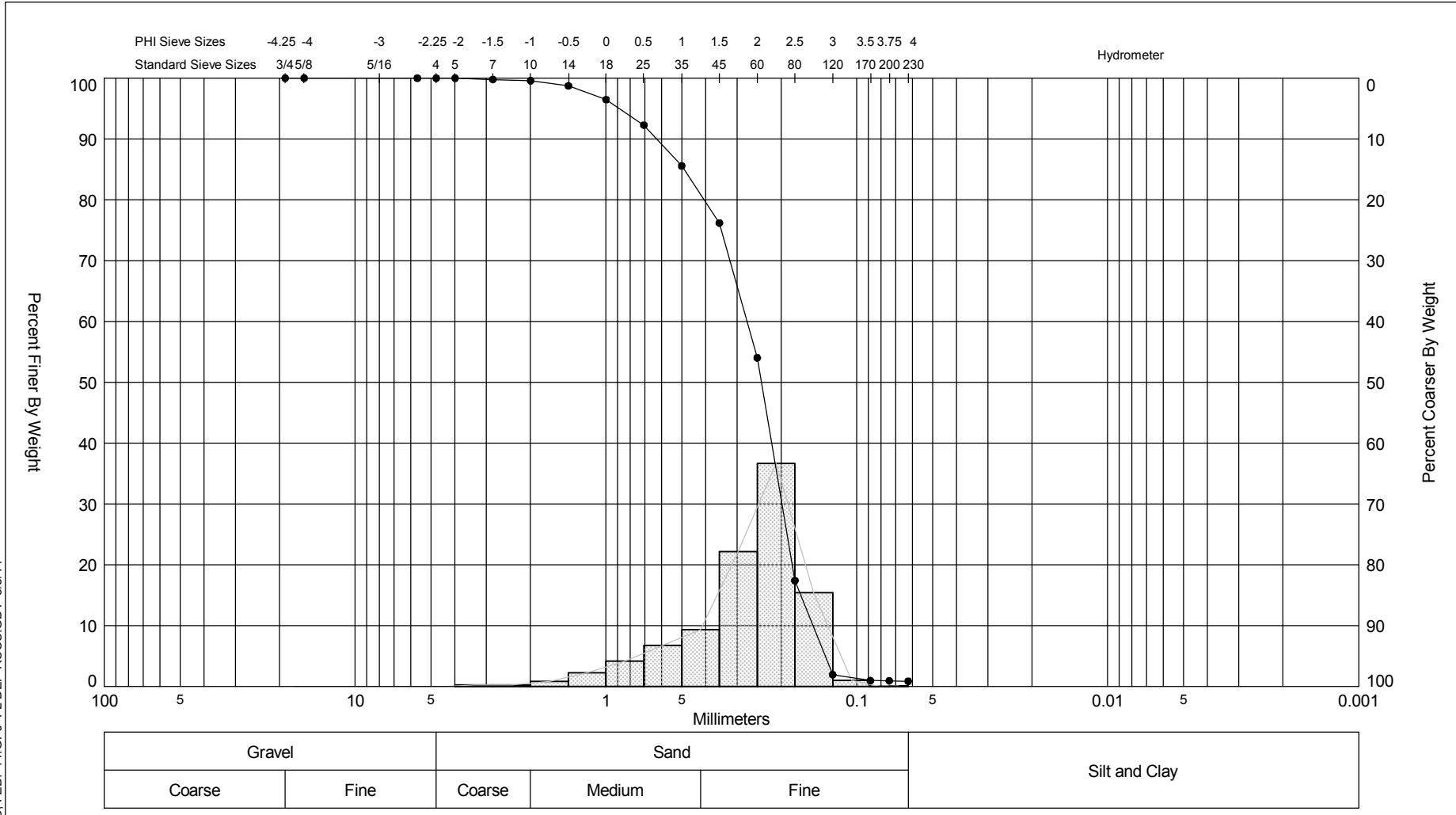
February 2014


**Scale in Feet
Photo Mosaic Image**



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

SIEVE ANALYSIS: BALD HEAD CREEK, NC, FEB. '14.GPJ FL DEP ROSS.GDT 3/3/14



Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort	Sample Information	
BHC-16 #1	—●—	-3.9	SP	#200 - 0.93 #230 - 0.86		8.00	2.05	1.85	-1.23	4.7	0.8	Project Name:	Village of Bald Head Island
Comments:												Analysis Date:	02-17-14
Depths and elevations based on measured values												Analyzed By:	CRM Sr.
						Athena Technologies, Inc. 1293 Graham Farm Road McClellanville, SC 29458 ph (843) 887-3800 fax (843) 887-3801						Easting (X, ft):	2,304,446
												Northing (Y, ft):	50,959
												Horizontal System:	NAD 1983
												Vertical System:	NGVD 29

Granulometric Report

Depths and elevations based on measured values



Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
ph (843) 887-3800
fax (843) 887-3801

Project Name: Village of Bald Head Island

Sample Name: BHC-16 #1

Analysis Date: 02-17-14

Analyzed By: CRM Sr.

Easting (ft): 2,304,446	Northing (ft): 50,959	Coordinate System: North Carolina State Plane	Elevation (ft): -3.9 NGVD 29
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USCS: SP	Munsell:	Comments:
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Dry Weight (g): 114.79	Wash Weight (g): 113.82	Pan Retained (g):	Sieve Loss (%):	Fines (%): #200 - 0.93 #230 - 0.86	Organics (%):	Carbonates (%): 8.00	Shells (%):
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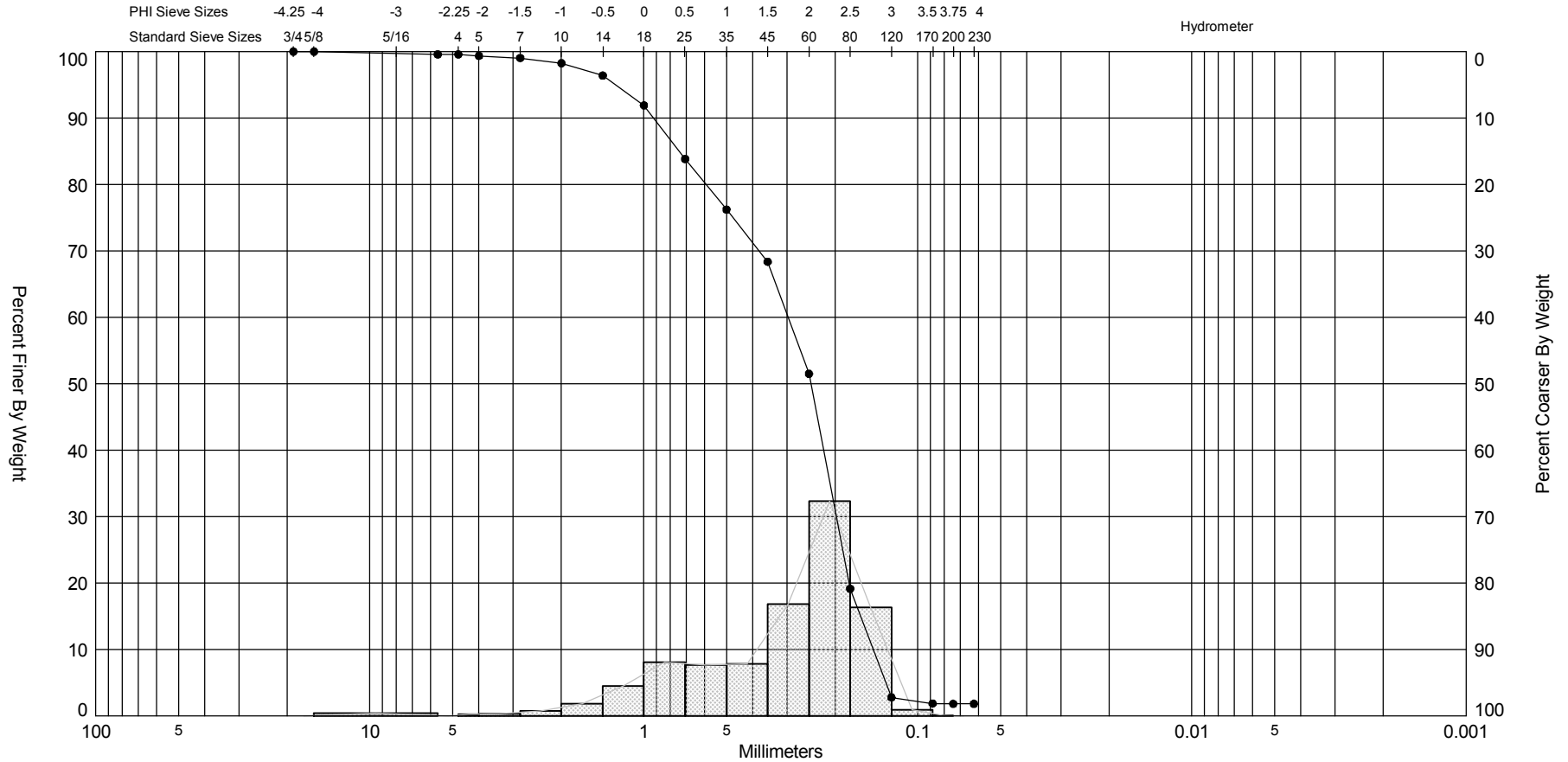
Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4"	-4.25	19.03		0.00	0.00	100.00
5/8"	-4.00	16.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.00	0.00	0.00	100.00
#5	-2.00	4.00	0.00	0.00	0.00	100.00
#7	-1.50	2.83	0.24	0.21	0.24	99.79
#10	-1.00	2.00	0.24	0.21	0.48	99.58
#14	-0.50	1.41	0.98	0.85	1.46	98.73
#18	0.00	1.00	2.60	2.27	4.06	96.46
#25	0.50	0.71	4.79	4.17	8.85	92.29
#35	1.00	0.50	7.74	6.74	16.59	85.55
#45	1.50	0.35	10.73	9.35	27.32	76.20
#60	2.00	0.25	25.45	22.17	52.77	54.03
#80	2.50	0.18	42.06	36.64	94.83	17.39
#120	3.00	0.13	17.74	15.45	112.57	1.94
#170	3.50	0.09	1.13	0.98	113.70	0.96
#200	3.75	0.07	0.04	0.03	113.74	0.93
#230	4.00	0.06	0.08	0.07	113.82	0.86

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Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.90	2.54	2.40	2.05	1.53	1.08	0.18
Moment Statistics	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis	
	1.85	0.28	0.8	-1.23	4.7	

GRANULARMETRIC REPORT BALD HEAD CREEK, NC, FEB. '14.GPJ FL DEP ROSS.GDT 3/3/14

SIEVE ANALYSIS: BALD HEAD CREEK, NC., FEB. '14, GPJ, FL DEP ROSS.GDT 3/3/14



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort	Sample Information	
BHC-16 #Comp	—●—	-3.9	SP	#200 - 1.81 #230 - 1.81		11.80	2.02	1.65	-1.28	4.85	1.05	Project Name:	Village of Bald Head Island
Comments:												Analysis Date:	02-17-14
Depths and elevations based on measured values												Analyzed By:	CRM Sr.
						Athena Technologies, Inc. 1293 Graham Farm Road McClellanville, SC 29458 ph (843) 887-3800 fax (843) 887-3801						Easting (X, ft):	2,304,446
												Northing (Y, ft):	50,959
												Horizontal System:	NAD 1983
												Vertical System:	NGVD 29

Granulometric Report

Depths and elevations based on measured values



Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
ph (843) 887-3800
fax (843) 887-3801

Project Name: Village of Bald Head Island

Sample Name: BHC-16 #Comp

Analysis Date: 02-17-14

Analyzed By: CRM Sr.

Easting (ft): 2,304,446	Northing (ft): 50,959	Coordinate System: North Carolina State Plane	Elevation (ft): -3.9 NGVD 29
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USCS: SP	Munsell:	Comments:
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Dry Weight (g): 128.60	Wash Weight (g): 126.27	Pan Retained (g):	Sieve Loss (%):	Fines (%): #200 - 1.81 #230 - 1.81	Organics (%):	Carbonates (%): 11.80	Shells (%):
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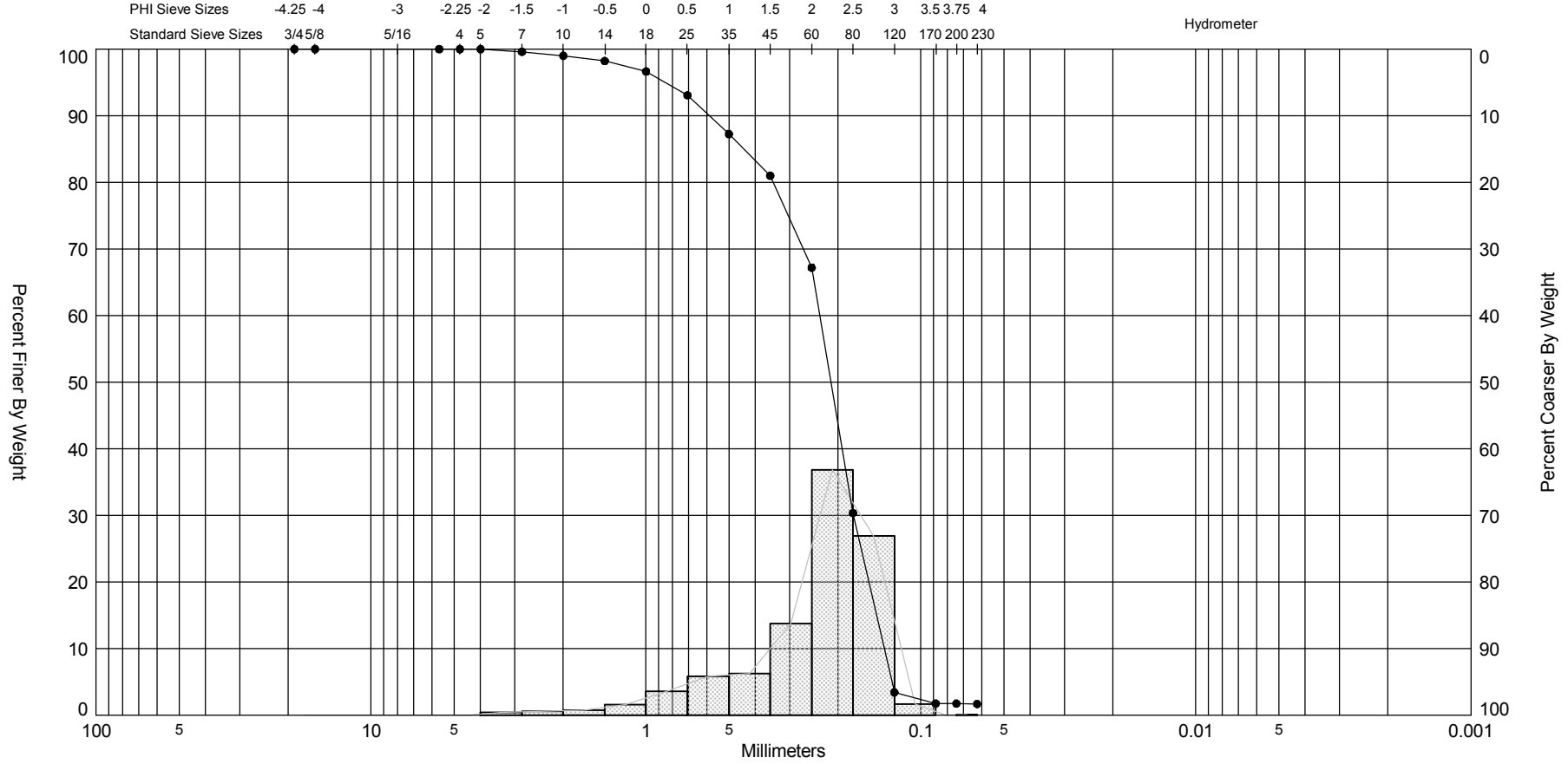
Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4"	-4.25	19.03		0.00	0.00	100.00
5/8"	-4.00	16.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.53	0.41	0.53	99.59
#4	-2.25	4.76	0.00	0.00	0.53	99.59
#5	-2.00	4.00	0.28	0.22	0.81	99.37
#7	-1.50	2.83	0.42	0.33	1.23	99.04
#10	-1.00	2.00	1.00	0.78	2.23	98.26
#14	-0.50	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	16.86	62.35	51.51
#80	2.50	0.18	41.63	32.37	103.98	19.14
#120	3.00	0.13	21.03	16.35	125.01	2.79
#170	3.50	0.09	1.18	0.92	126.19	1.87
#200	3.75	0.07	0.08	0.06	126.27	1.81
#230	4.00	0.06	0.00	0.00	126.27	1.81

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.93	2.60	2.41	2.02	1.08	0.49	-0.35


Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.65	0.32	1.05	-1.28	4.85

GRANULARMETRIC REPORT BALD HEAD CREEK, NC, FEB. '14.GPJ FL DEP ROSS.GDT 3/3/14

SIEVE ANALYSIS: BALD HEAD CREEK, NC., FEB. '14, GPJ, FL DEP ROSS.GDT 3/3/14



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort	Sample Information	
BHC-16 #2	—●—	-7.6	SP	#200 - 1.74 #230 - 1.68		8.90	2.23	2.01	-1.59	5.85	0.85	Project Name:	Village of Bald Head Island
Comments:												Analysis Date:	02-17-14
Depths and elevations based on measured values												Analyzed By:	CRM Sr.
						Athena Technologies, Inc. 1293 Graham Farm Road McClellanville, SC 29458 ph (843) 887-3800 fax (843) 887-3801						Easting (X, ft):	2,304,446
												Northing (Y, ft):	50,959
												Horizontal System:	NAD 1983
												Vertical System:	NGVD 29

Granulometric Report

Depths and elevations based on measured values



Athena Technologies, Inc.
1293 Graham Farm Road
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ph (843) 887-3800
fax (843) 887-3801

Project Name: Village of Bald Head Island

Sample Name: BHC-16 #2

Analysis Date: 02-17-14

Analyzed By: CRM Sr.

Easting (ft): 2,304,446	Northing (ft): 50,959	Coordinate System: North Carolina State Plane	Elevation (ft): -7.6 NGVD 29
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USCS: SP	Munsell:	Comments:
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Dry Weight (g): 115.78	Wash Weight (g): 113.86	Pan Retained (g):	Sieve Loss (%):	Fines (%): #200 - 1.74 #230 - 1.68	Organics (%):	Carbonates (%): 8.90	Shells (%):
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Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4"	-4.25	19.03		0.00	0.00	100.00
5/8"	-4.00	16.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.00	0.00	0.00	100.00
#5	-2.00	4.00	0.00	0.00	0.00	100.00
#7	-1.50	2.83	0.45	0.39	0.45	99.61
#10	-1.00	2.00	0.70	0.60	1.15	99.01
#14	-0.50	1.41	0.92	0.79	2.07	98.22
#18	0.00	1.00	1.83	1.58	3.90	96.64
#25	0.50	0.71	4.15	3.58	8.05	93.06
#35	1.00	0.50	6.73	5.81	14.78	87.25
#45	1.50	0.35	7.25	6.26	22.03	80.99
#60	2.00	0.25	15.97	13.79	38.00	67.20
#80	2.50	0.18	42.67	36.85	80.67	30.35
#120	3.00	0.13	31.18	26.93	111.85	3.42
#170	3.50	0.09	1.94	1.68	113.79	1.74
#200	3.75	0.07	0.00	0.00	113.79	1.74
#230	4.00	0.06	0.07	0.06	113.86	1.68

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.97	2.77	2.60	2.23	1.72	1.26	0.23

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.01	0.25	0.85	-1.59	5.85

GRANULARMETRIC REPORT BALD HEAD CREEK, NC, FEB. '14.GPJ FL DEP ROSS.GDT 3/3/14

Boring Designation BHC-17

DRILLING LOG		DIVISION Olsen Associates, Inc.	INSTALLATION Jacksonville, Florida	SHEET 1 OF 1 SHEETS
1. PROJECT Village of Bald Head Island Geotechnical Investigation of Bald Head Creek		9. SIZE AND TYPE OF BIT 3.0 In.		
2. BORING DESIGNATION BHC-17		10. COORDINATE SYSTEM/DATUM North Carolina State Plane		
3. DRILLING AGENCY Athena Technologies, Inc.		11. MANUFACTURER'S DESIGNATION OF DRILL <input type="checkbox"/> AUTO HAMMER <input type="checkbox"/> MANUAL HAMMER		
4. NAME OF DRILLER P. McClellan		12. TOTAL SAMPLES DISTURBED 1 UNDISTURBED (UD) 2		
5. DIRECTION OF BORING <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		13. TOTAL NUMBER CORE BOXES		
6. THICKNESS OF OVERBURDEN 0.0 Ft.		14. ELEVATION GROUND WATER 3.2 Ft.		
7. DEPTH DRILLED INTO ROCK 0.0 Ft.		15. DATE BORING STARTED 02-04-14 07:56 COMPLETED 02-04-14 08:41		
8. TOTAL DEPTH OF BORING 10.0 Ft.		16. ELEVATION TOP OF BORING -4.0 Ft.		
		17. TOTAL RECOVERY FOR BORING 8.2 Ft.		
		18. SIGNATURE AND TITLE OF INSPECTOR A. Freeze		

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-4.0	0.0					
			Fine to medium quartz SAND, few fine sand size shell, trace silt, poorly graded, subrounded, bioturbated, light brownish gray (2.5Y-6/2), (SP).		1	Sample #1, Depth = 0.0' - 0.4' Mean (mm): 0.28, Phi Sorting: 0.68 Carbonate: 7.5%, Fines (230): 0.77% (SP)
			Fine to medium quartz SAND, few medium sand size shell, trace silt, poorly graded, subrounded, bioturbated, light brownish gray (2.5Y-6/2), (SP).		Comp	Sample #Comp, Depth = 0.0' - 4.0' Mean (mm): 0.29, Phi Sorting: 0.86 Carbonate: 8.5%, Fines (230): 1.29% (SP)
-6.8	2.8					
			Medium quartz SAND, little medium sand size shell, poorly graded, subrounded, light brownish gray (2.5Y-6/2), (SP).		2	Sample #2, Depth = 3.6' - 4.0' Mean (mm): 0.41, Phi Sorting: 1.26 Carbonate: 13.7%, Fines (230): 0.96% (SP)
-7.5	3.5					
			Fine quartz SAND, trace silt (in burrows), trace fine sand size shell, poorly graded, subrounded, 4.1' = burrow trace, gray (2.5Y-6/1), (SP).			
-8.0	4.0					
			Medium quartz SAND, little fine sand size shell, trace silt, poorly graded, subrounded, light brownish gray (2.5Y-6/2), (SP).			
-8.8	4.8					
			Fine to medium quartz SAND, few medium sand and fine sand size shell (in layers), trace silt (in layers/burrows), poorly graded, subrounded, bioturbated, 6.25' = organic SILT (OL) layer, gray (2.5Y-6/1), (SP).			
-9.2	5.2					
			Fine to medium quartz SAND, trace fine sand size shell, trace silt, poorly graded, subrounded, 6.9' = organic SILT (OL) rip-up, gray (2.5Y-6/1), (SP).			
-10.3	6.3					
			Silty fine to medium quartz SAND, little silt, trace fine sand size shell, subrounded, bioturbated, gray (2.5Y-5/1), (SM).			
-11.9	7.9					
-12.2	8.2					
			End of Boring			

FLORIDA DEP ROSS BALD HEAD CREEK, NC, FEB. '14, GRJ FL DEP ROSS.GDT 3/3/14



**Bald Head Island
North Carolina
BHC-17**

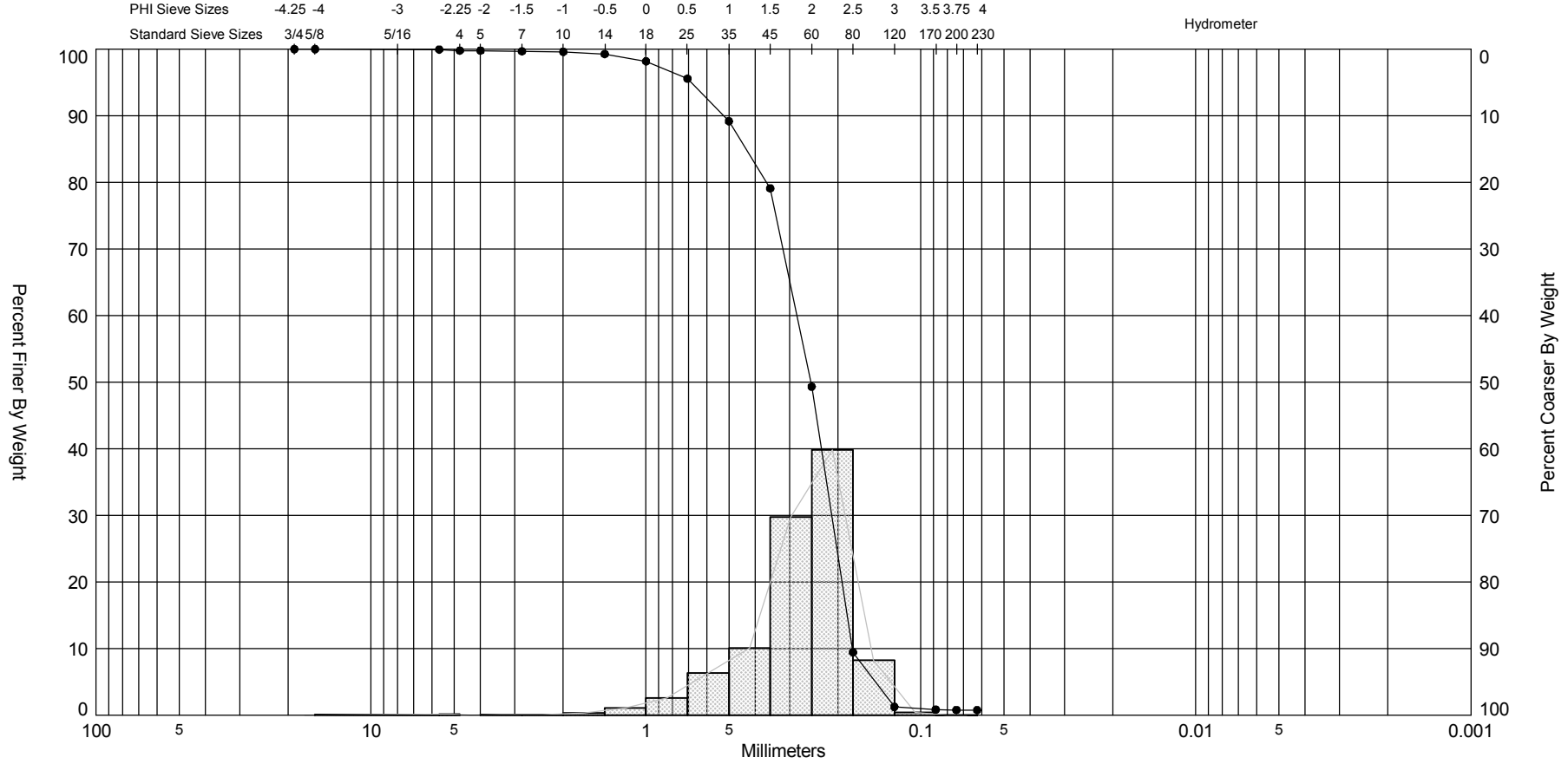
February 2014

**Scale in Feet
Photo Mosaic Image**




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

SIEVE ANALYSIS: BALD HEAD CREEK, NC., FEB. '14, GPJ, FL DEP ROSS.GDT 3/3/14



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort	Sample Information	
BHC-17 #1	—●—	-4.0	SP	#200 - 0.79 #230 - 0.77		7.50	1.99	1.84	-1.67	8.54	0.68	Project Name:	Village of Bald Head Island
Comments:												Analysis Date:	02-17-14
Depths and elevations based on measured values												Analyzed By:	CRM Sr.
						Athena Technologies, Inc. 1293 Graham Farm Road McClellanville, SC 29458 ph (843) 887-3800 fax (843) 887-3801						Easting (X, ft):	2,304,616
												Northing (Y, ft):	51,419
												Horizontal System:	NAD 1983
												Vertical System:	NGVD 29

Granularmetric Report

Depths and elevations based on measured values



Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
ph (843) 887-3800
fax (843) 887-3801

Project Name: Village of Bald Head Island

Sample Name: BHC-17 #1

Analysis Date: 02-17-14

Analyzed By: CRM Sr.

Easting (ft): 2,304,616	Northing (ft): 51,419	Coordinate System: North Carolina State Plane	Elevation (ft): -4.0 NGVD 29
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USCS: SP	Munsell:	Comments:
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Dry Weight (g): 124.87	Wash Weight (g): 123.90	Pan Retained (g):	Sieve Loss (%):	Fines (%): #200 - 0.79 #230 - 0.77	Organics (%):	Carbonates (%): 7.50	Shells (%):
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Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4"	-4.25	19.03		0.00	0.00	100.00
5/8"	-4.00	16.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.06	0.05	0.06	99.95
#4	-2.25	4.76	0.20	0.16	0.26	99.79
#5	-2.00	4.00	0.00	0.00	0.26	99.79
#7	-1.50	2.83	0.13	0.10	0.39	99.69
#10	-1.00	2.00	0.10	0.08	0.49	99.61
#14	-0.50	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	5.54	95.56
#35	1.00	0.50	7.95	6.37	13.49	89.19
#45	1.50	0.35	12.59	10.08	26.08	79.11
#60	2.00	0.25	37.20	29.79	63.28	49.32
#80	2.50	0.18	49.78	39.87	113.06	9.45
#120	3.00	0.13	10.25	8.21	123.31	1.24
#170	3.50	0.09	0.51	0.41	123.82	0.83
#200	3.75	0.07	0.05	0.04	123.87	0.79
#230	4.00	0.06	0.03	0.02	123.90	0.77

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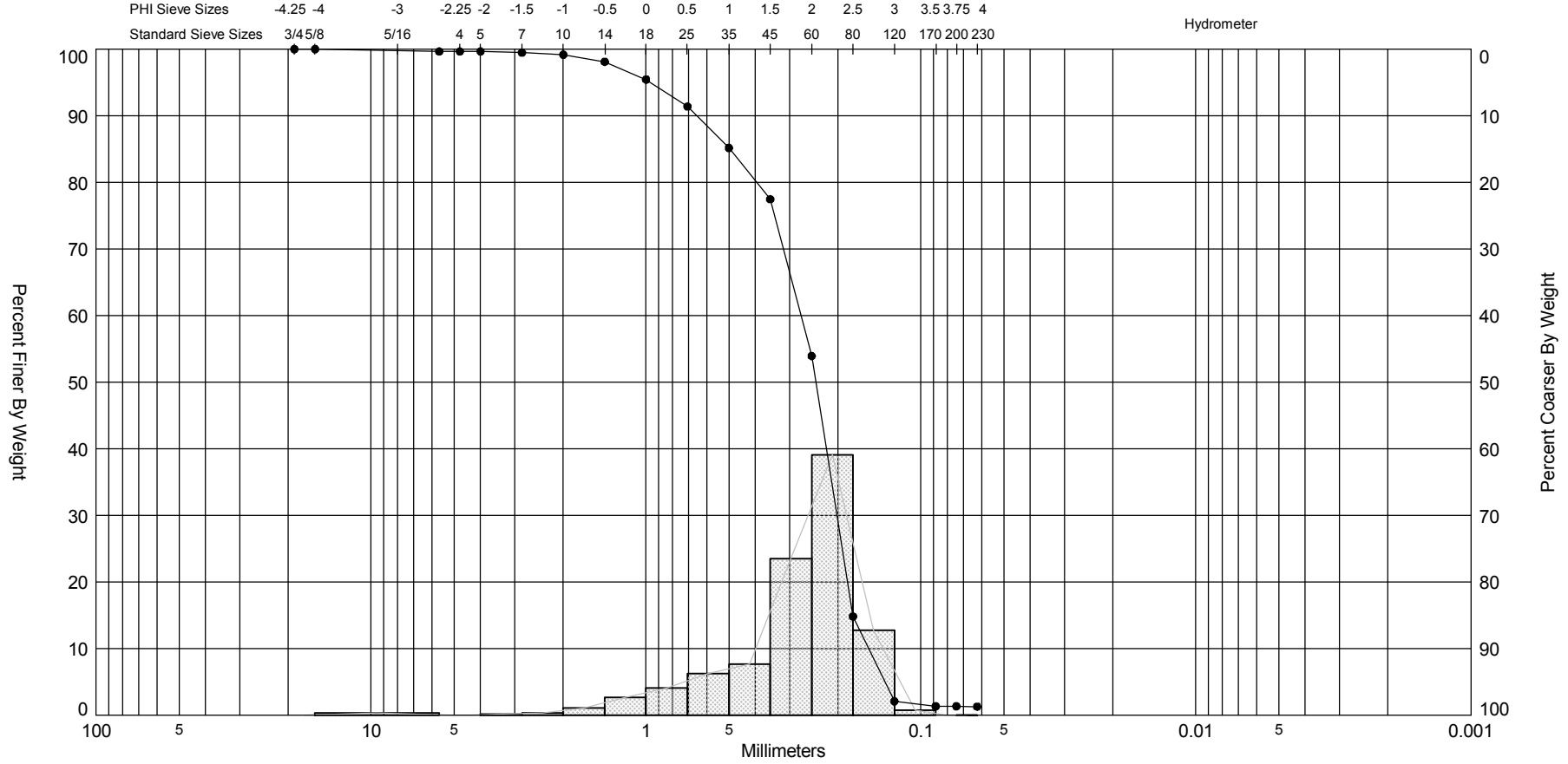
Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
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2.77	2.42	2.30	1.99	1.57	1.26	0.54
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Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.84	0.28	0.68	-1.67	8.54

GRANULARMETRIC REPORT BALD HEAD CREEK, NC, FEB. '14.GPJ FL DEP ROSS.GDT 3/3/14

SIEVE ANALYSIS: BALD HEAD CREEK, NC., FEB. '14, GPJ, FL DEP ROSS.GDT 3/3/14



Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort	Sample Information	
BHC-17 #Comp	—●—	-4.0	SP	#200 - 1.33 #230 - 1.29		8.50	2.05	1.81	-1.79	8.05	0.86	Project Name:	Village of Bald Head Island
Comments:												Analysis Date:	02-17-14
Depths and elevations based on measured values												Analyzed By:	CRM Sr.
						Athena Technologies, Inc. 1293 Graham Farm Road McClellanville, SC 29458 ph (843) 887-3800 fax (843) 887-3801						Easting (X, ft):	2,304,616
												Northing (Y, ft):	51,419
												Horizontal System:	NAD 1983
												Vertical System:	NGVD 29

Granularmetric Report

Depths and elevations based on measured values



Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
ph (843) 887-3800
fax (843) 887-3801

Project Name: Village of Bald Head Island

Sample Name: BHC-17 #Comp

Analysis Date: 02-17-14

Analyzed By: CRM Sr.

Easting (ft): 2,304,616	Northing (ft): 51,419	Coordinate System: North Carolina State Plane	Elevation (ft): -4.0 NGVD 29
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USCS: SP	Munsell:	Comments:
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Dry Weight (g): 121.14	Wash Weight (g): 119.59	Pan Retained (g):	Sieve Loss (%):	Fines (%): #200 - 1.33 #230 - 1.29	Organics (%):	Carbonates (%): 8.50	Shells (%):
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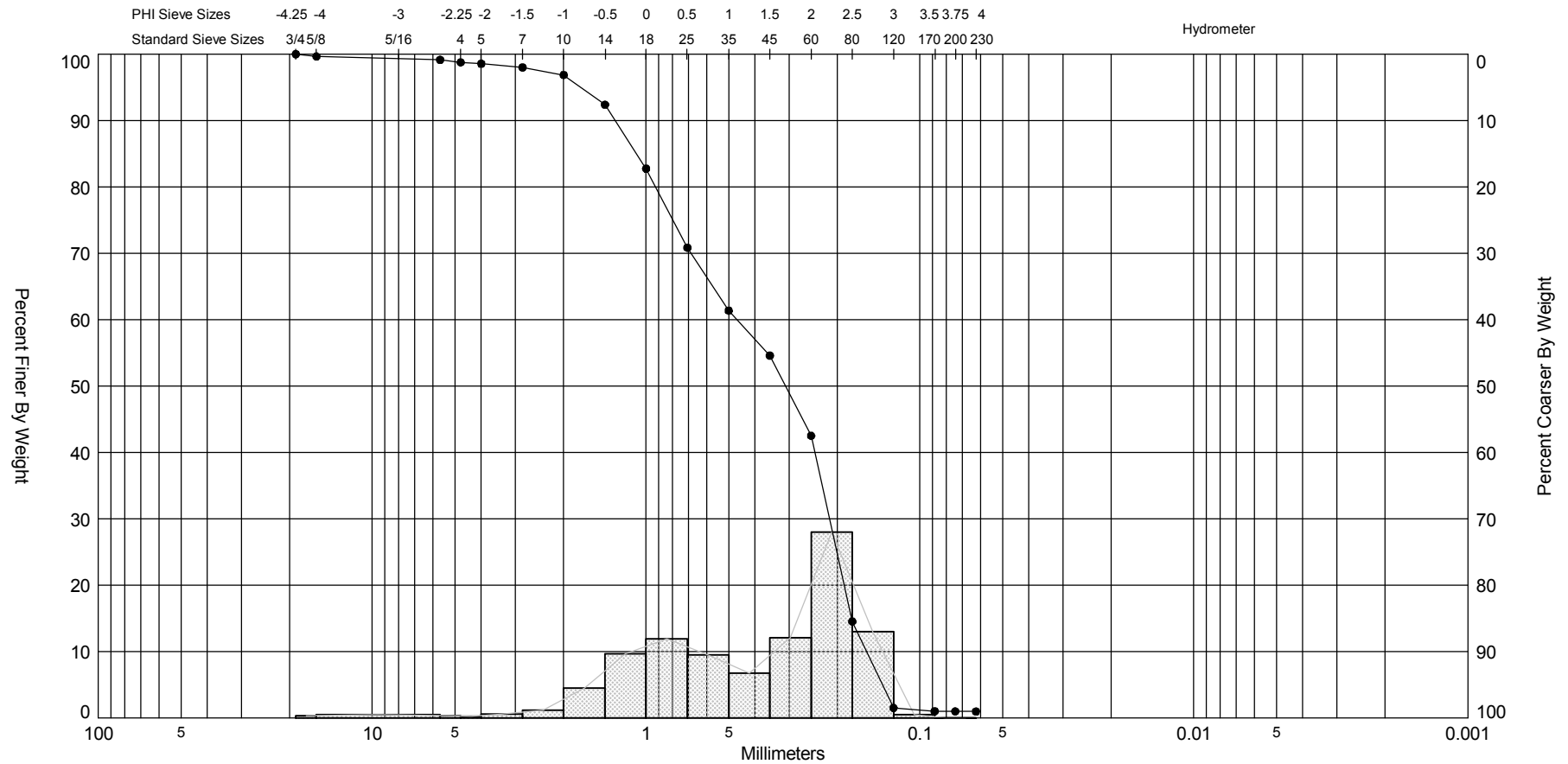
Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4"	-4.25	19.03		0.00	0.00	100.00
5/8"	-4.00	16.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.42	0.35	0.42	99.65
#4	-2.25	4.76	0.00	0.00	0.42	99.65
#5	-2.00	4.00	0.00	0.00	0.42	99.65
#7	-1.50	2.83	0.22	0.18	0.64	99.47
#10	-1.00	2.00	0.36	0.30	1.00	99.17
#14	-0.50	1.41	1.29	1.06	2.29	98.11
#18	0.00	1.00	3.22	2.66	5.51	95.45
#25	0.50	0.71	4.93	4.07	10.44	91.38
#35	1.00	0.50	7.54	6.22	17.98	85.16
#45	1.50	0.35	9.33	7.70	27.31	77.46
#60	2.00	0.25	28.51	23.53	55.82	53.93
#80	2.50	0.18	47.38	39.11	103.20	14.82
#120	3.00	0.13	15.42	12.73	118.62	2.09
#170	3.50	0.09	0.92	0.76	119.54	1.33
#200	3.75	0.07	0.00	0.00	119.54	1.33
#230	4.00	0.06	0.05	0.04	119.59	1.29

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Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.89	2.48	2.37	2.05	1.55	1.08	0.06
Moment Statistics	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis	
	1.81	0.29	0.86	-1.79	8.05	

GRANULARMETRIC REPORT BALD HEAD CREEK, NC, FEB. '14.GPJ FL DEP ROSS.GDT 3/3/14

SIEVE ANALYSIS: BALD HEAD CREEK, NC., FEB. '14, GPJ, FL DEP ROSS.GDT 3/3/14



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort	Sample Information	
BHC-17 #2	—●—	-7.6	SP	#200 - 0.98 #230 - 0.96		13.70	1.69	1.29	-0.92	3.84	1.26	Project Name:	Village of Bald Head Island
Comments:												Analysis Date:	02-17-14
Depths and elevations based on measured values												Analyzed By:	CRM Sr.
						Athena Technologies, Inc. 1293 Graham Farm Road McClellanville, SC 29458 ph (843) 887-3800 fax (843) 887-3801						Easting (X, ft):	2,304,616
												Northing (Y, ft):	51,419
												Horizontal System:	NAD 1983
												Vertical System:	NGVD 29

Granularmetric Report

Depths and elevations based on measured values



Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
ph (843) 887-3800
fax (843) 887-3801

Project Name: Village of Bald Head Island

Sample Name: BHC-17 #2

Analysis Date: 02-17-14

Analyzed By: CRM Sr.

Easting (ft): 2,304,616	Northing (ft): 51,419	Coordinate System: North Carolina State Plane	Elevation (ft): -7.6 NGVD 29
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USCS: SP	Munsell:	Comments:
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Dry Weight (g): 120.83	Wash Weight (g): 119.67	Pan Retained (g):	Sieve Loss (%):	Fines (%): #200 - 0.98 #230 - 0.96	Organics (%):	Carbonates (%): 13.70	Shells (%):
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Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4"	-4.25	19.03		0.00	0.00	100.00
5/8"	-4.00	16.00	0.42	0.35	0.42	99.65
#3.5	-2.50	5.66	0.62	0.51	1.04	99.14
#4	-2.25	4.76	0.45	0.37	1.49	98.77
#5	-2.00	4.00	0.27	0.22	1.76	98.55
#7	-1.50	2.83	0.66	0.55	2.42	98.00
#10	-1.00	2.00	1.36	1.13	3.78	96.87
#14	-0.50	1.41	5.43	4.49	9.21	92.38
#18	0.00	1.00	11.65	9.64	20.86	82.74
#25	0.50	0.71	14.37	11.89	35.23	70.85
#35	1.00	0.50	11.45	9.48	46.68	61.37
#45	1.50	0.35	8.19	6.78	54.87	54.59
#60	2.00	0.25	14.58	12.07	69.45	42.52
#80	2.50	0.18	33.82	27.99	103.27	14.53
#120	3.00	0.13	15.73	13.02	119.00	1.51
#170	3.50	0.09	0.61	0.50	119.61	1.01
#200	3.75	0.07	0.04	0.03	119.65	0.98
#230	4.00	0.06	0.02	0.02	119.67	0.96

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.87	2.47	2.31	1.69	0.33	-0.07	-0.79

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.29	0.41	1.26	-0.92	3.84

GRANULARMETRIC REPORT BALD HEAD CREEK, NC, FEB. '14.GPJ FL DEP ROSS.GDT 3/3/14

Boring Designation BHC-18

DRILLING LOG		DIVISION Olsen Associates, Inc.	INSTALLATION Jacksonville, Florida	SHEET 1 OF 1 SHEETS
1. PROJECT Village of Bald Head Island Geotechnical Investigation of Bald Head Creek		9. SIZE AND TYPE OF BIT 3.0 In.		
2. BORING DESIGNATION BHC-18		10. COORDINATE SYSTEM/DATUM North Carolina State Plane		
3. DRILLING AGENCY Athena Technologies, Inc.		11. MANUFACTURER'S DESIGNATION OF DRILL <input type="checkbox"/> AUTO HAMMER <input type="checkbox"/> MANUAL HAMMER		
4. NAME OF DRILLER P. McClellan		12. TOTAL SAMPLES DISTURBED 1 UNDISTURBED (UD) 2		
5. DIRECTION OF BORING <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		13. TOTAL NUMBER CORE BOXES		
6. THICKNESS OF OVERBURDEN 0.0 Ft.		14. ELEVATION GROUND WATER 3.0 Ft.		
7. DEPTH DRILLED INTO ROCK 0.0 Ft.		15. DATE BORING STARTED 02-04-14 08:51 COMPLETED 02-04-14 09:31		
8. TOTAL DEPTH OF BORING 10.0 Ft.		16. ELEVATION TOP OF BORING -3.0 Ft.		
		17. TOTAL RECOVERY FOR BORING 8.3 Ft.		
		18. SIGNATURE AND TITLE OF INSPECTOR A. Freeze		

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-3.0	0.0					
			Medium quartz SAND, few fine sand size shell, trace silt (in rip-ups), poorly graded, subrounded, light brownish gray (2.5Y-6/2), (SP).		1	Sample #1, Depth = 0.0' - 0.4' Mean (mm): 0.37, Phi Sorting: 0.85 Carbonate: 8.9%, Fines (230): 0.75% (SP)
-5.8	2.8		Fine to medium quartz SAND, trace silt (in burrows), trace fine sand size shell, poorly graded, subrounded, bioturbated, gray (2.5Y-6/1), (SP).		Comp	Sample #Comp, Depth = 0.0' - 5.0' Mean (mm): 0.32, Phi Sorting: 0.91 Carbonate: 8.4%, Fines (230): 0.91% (SP)
-7.3	4.3		Medium quartz SAND, little medium sand size shell, poorly graded, subrounded, gravel size shell present, 4.55 - 4.85' = fine to medium quartz SAND layer with trace silt, pale yellow (2.5Y-7/3), (SP).			2
-8.6	5.6		Fine grading to medium quartz SAND, few medium sand size shell, poorly graded, subrounded, light brownish gray (2.5Y-6/2), (SP).			
-9.7	6.7		Fine to medium quartz SAND, few medium sand size shell, trace silt, poorly graded, subrounded, bioturbated, gray (2.5Y-6/1), (SP).			
-10.9	7.9		Medium quartz SAND, little medium to coarse sand size shell, trace gravel size shell, poorly graded, subrounded, grayish brown (2.5Y-5/2), (SP).			
-11.3	8.3					
			End of Boring			

FLORIDA DEP ROSS BALD HEAD CREEK, NC, FEB. '14, GPJ FL DEP ROSS.GDT 3/3/14



**Bald Head Island
North Carolina
BHC-18**

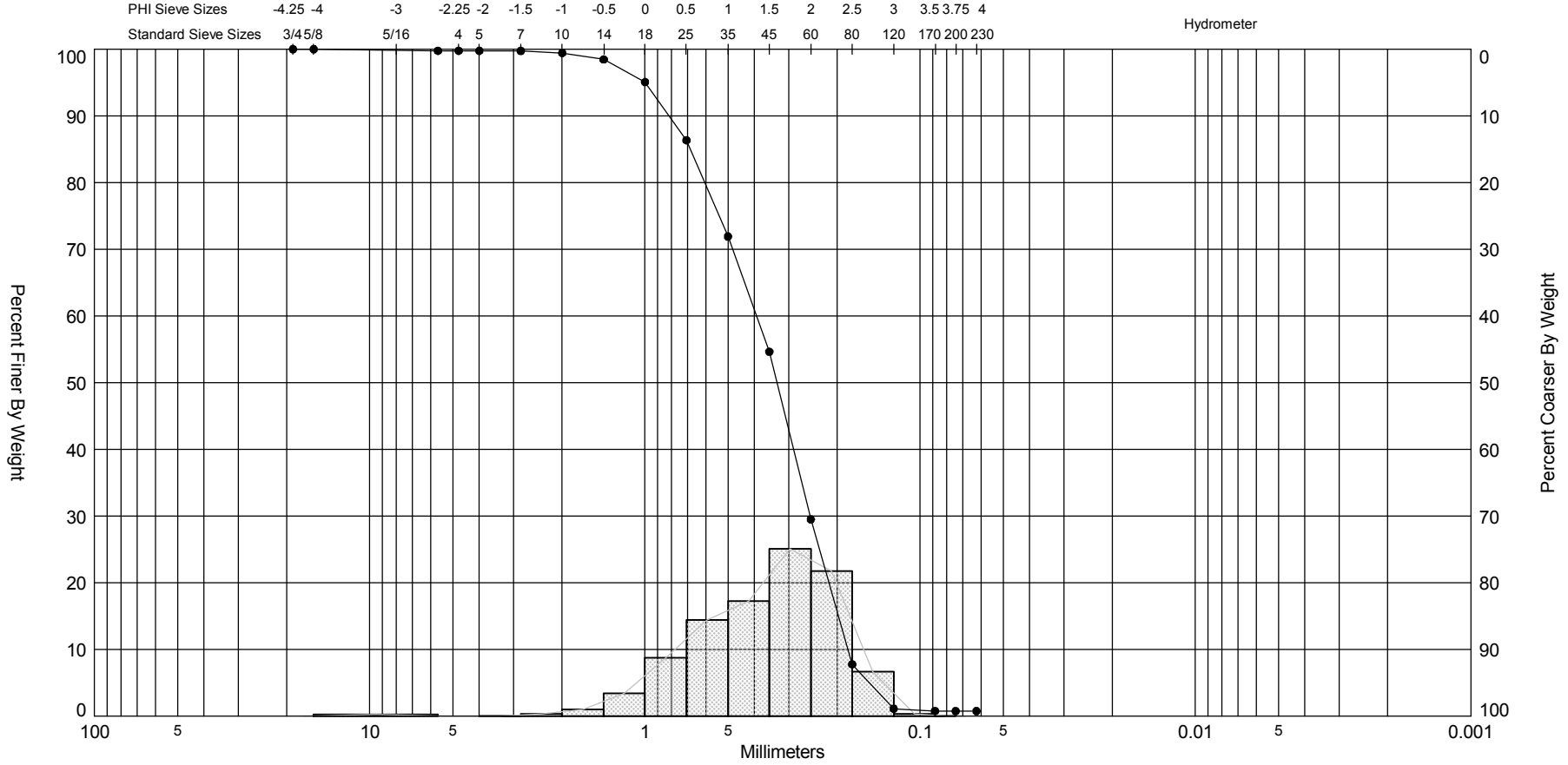
February 2014

**Scale in Feet
Photo Mosaic Image**




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(843) 887-3800

SIEVE ANALYSIS BALD HEAD CREEK, NC., FEB. '14, GPJ, FL DEP ROSS.GDT 3/3/14



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort	Sample Information	
BHC-18 #1	●—	-3.0	SP	#200 - 0.75 #230 - 0.75		8.90	1.59	1.45	-0.82	4.62	0.85	Project Name:	Village of Bald Head Island
Comments:												Analysis Date:	02-17-14
Depths and elevations based on measured values												Analyzed By:	CRM Sr.
 <p>Athena Technologies, Inc. 1293 Graham Farm Road McClellanville, SC 29458 ph (843) 887-3800 fax (843) 887-3801</p>												Easting (X, ft):	2,304,962
												Northing (Y, ft):	51,262
												Horizontal System:	NAD 1983
												Vertical System:	NGVD 29

Granularmetric Report

Depths and elevations based on measured values



Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
ph (843) 887-3800
fax (843) 887-3801

Project Name: Village of Bald Head Island

Sample Name: BHC-18 #1

Analysis Date: 02-17-14

Analyzed By: CRM Sr.

Easting (ft): 2,304,962	Northing (ft): 51,262	Coordinate System: North Carolina State Plane	Elevation (ft): -3.0 NGVD 29
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USCS: SP	Munsell:	Comments:
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Dry Weight (g): 124.39	Wash Weight (g): 123.47	Pan Retained (g):	Sieve Loss (%):	Fines (%): #200 - 0.75 #230 - 0.75	Organics (%):	Carbonates (%): 8.90	Shells (%):
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Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4"	-4.25	19.03		0.00	0.00	100.00
5/8"	-4.00	16.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.28	0.23	0.28	99.77
#4	-2.25	4.76	0.00	0.00	0.28	99.77
#5	-2.00	4.00	0.00	0.00	0.28	99.77
#7	-1.50	2.83	0.02	0.02	0.30	99.75
#10	-1.00	2.00	0.39	0.31	0.69	99.44
#14	-0.50	1.41	1.22	0.98	1.91	98.46
#18	0.00	1.00	4.22	3.39	6.13	95.07
#25	0.50	0.71	10.85	8.72	16.98	86.35
#35	1.00	0.50	17.95	14.43	34.93	71.92
#45	1.50	0.35	21.51	17.29	56.44	54.63
#60	2.00	0.25	31.25	25.12	87.69	29.51
#80	2.50	0.18	27.04	21.74	114.73	7.77
#120	3.00	0.13	8.29	6.66	123.02	1.11
#170	3.50	0.09	0.42	0.34	123.44	0.77
#200	3.75	0.07	0.03	0.02	123.47	0.75
#230	4.00	0.06	0.00	0.00	123.47	0.75

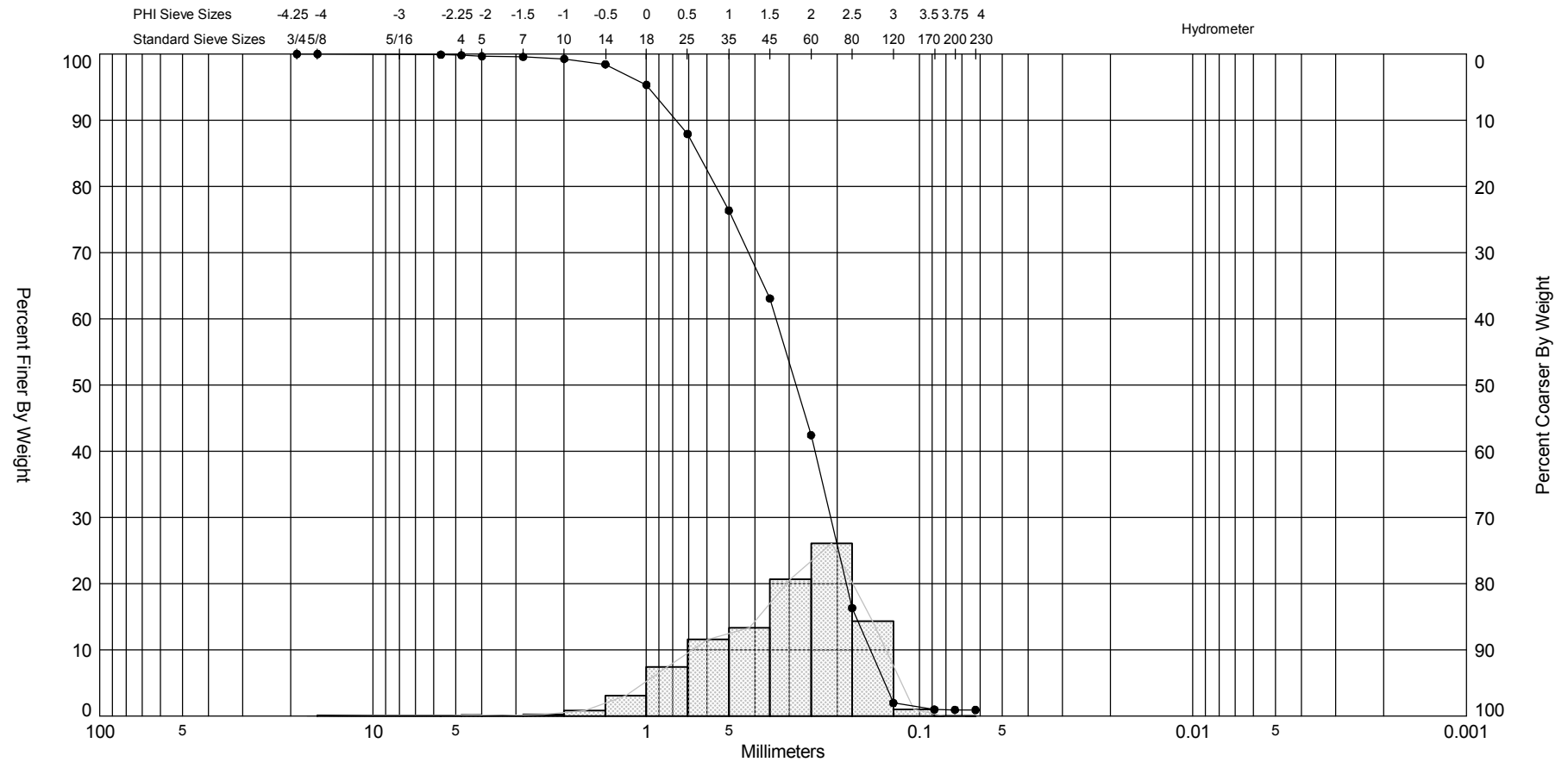
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Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.71	2.31	2.10	1.59	0.89	0.58	0.00


Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.45	0.37	0.85	-0.82	4.62

GRANULARMETRIC REPORT BALD HEAD CREEK, NC, FEB. '14.GPJ FL DEP ROSS.GDT 3/3/14

SIEVE ANALYSIS BALD HEAD CREEK, NC, FEB. '14, GPJ, FL DEP ROSS.GDT 3/3/14



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort	Sample Information	
BHC-18 #Comp	—●—	-3.0	SP	#200 - 0.94 #230 - 0.91		8.40	1.82	1.64	-0.91	4.22	0.91	Project Name:	Village of Bald Head Island
Comments:												Analysis Date:	02-17-14
Depths and elevations based on measured values												Analyzed By:	CRM Sr.
						Athena Technologies, Inc. 1293 Graham Farm Road McClellanville, SC 29458 ph (843) 887-3800 fax (843) 887-3801						Easting (X, ft):	2,304,962
												Northing (Y, ft):	51,262
												Horizontal System:	NAD 1983
												Vertical System:	NGVD 29

Granulometric Report

Depths and elevations based on measured values



Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
ph (843) 887-3800
fax (843) 887-3801

Project Name: Village of Bald Head Island

Sample Name: BHC-18 #Comp

Analysis Date: 02-17-14

Analyzed By: CRM Sr.

Easting (ft): 2,304,962	Northing (ft): 51,262	Coordinate System: North Carolina State Plane	Elevation (ft): -3.0 NGVD 29
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USCS: SP	Munsell:	Comments:
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Dry Weight (g): 124.80	Wash Weight (g): 123.67	Pan Retained (g):	Sieve Loss (%):	Fines (%): #200 - 0.94 #230 - 0.91	Organics (%):	Carbonates (%): 8.40	Shells (%):
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Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4"	-4.25	19.03		0.00	0.00	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	0.17	0.44	99.65
#7	-1.50	2.83	0.11	0.09	0.55	99.56
#10	-1.00	2.00	0.36	0.29	0.91	99.27
#14	-0.50	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	29.50	76.36
#45	1.50	0.35	16.60	13.30	46.10	63.06
#60	2.00	0.25	25.75	20.63	71.85	42.43
#80	2.50	0.18	32.59	26.11	104.44	16.32
#120	3.00	0.13	17.91	14.35	122.35	1.97
#170	3.50	0.09	1.23	0.99	123.58	0.98
#200	3.75	0.07	0.05	0.04	123.63	0.94
#230	4.00	0.06	0.04	0.03	123.67	0.91

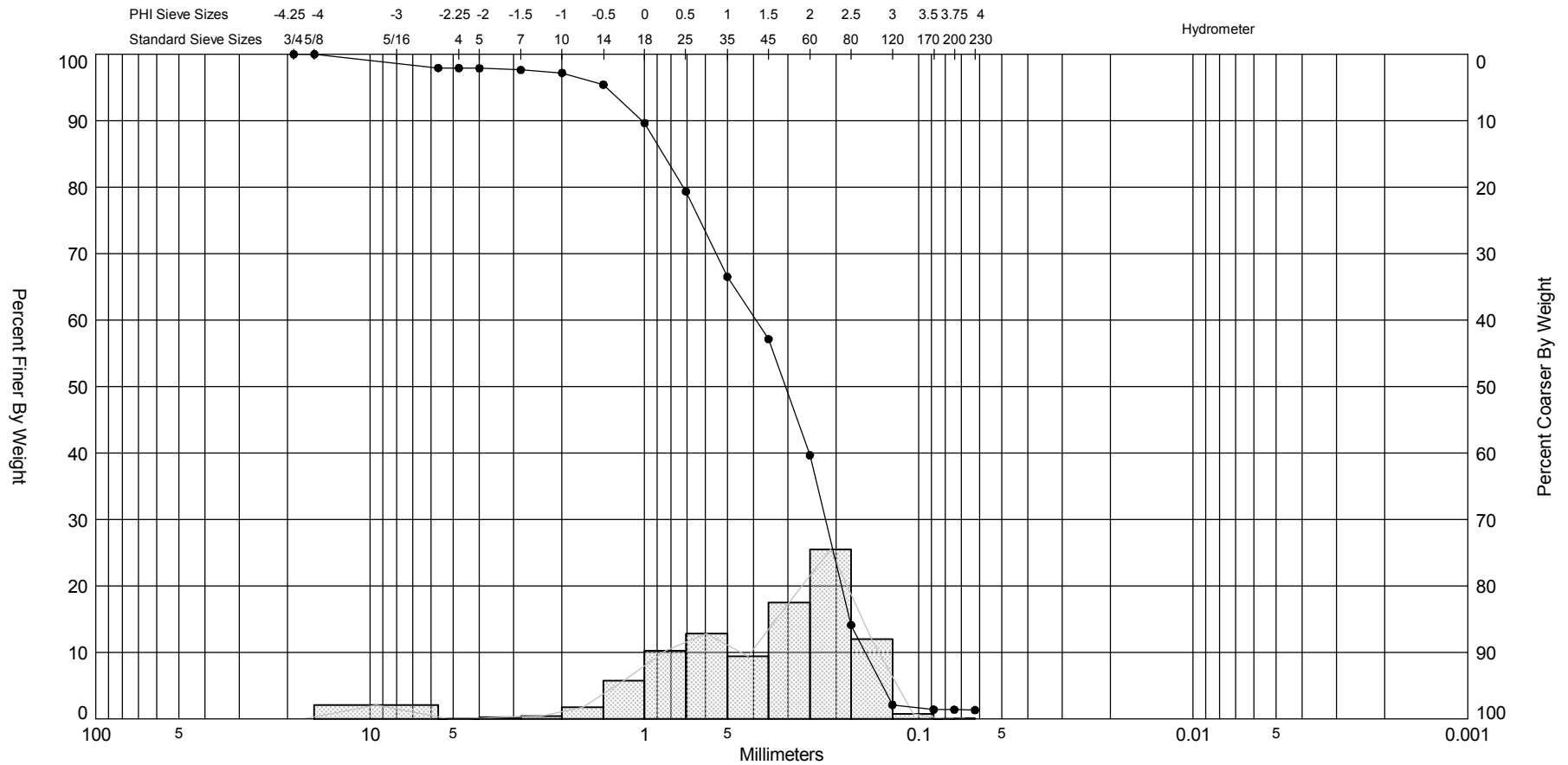
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Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.89	2.51	2.33	1.82	1.05	0.67	0.02


Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.64	0.32	0.91	-0.91	4.22

GRANULARMETRIC REPORT BALD HEAD CREEK, NC, FEB. '14.GPJ FL DEP ROSS.GDT 3/3/14

SIEVE ANALYSIS: BALD HEAD CREEK, NC., FEB. '14, GPJ, FL DEP ROSS.GDT 3/3/14



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort	Sample Information	
BHC-18 #2	—●—	-7.6	SP	#200 - 1.38 #230 - 1.31		12.40	1.7	1.39	-1.4	5.96	1.19	Project Name:	Village of Bald Head Island
Comments:												Analysis Date:	02-17-14
Depths and elevations based on measured values												Analyzed By:	CRM Sr.
						Athena Technologies, Inc. 1293 Graham Farm Road McClellanville, SC 29458 ph (843) 887-3800 fax (843) 887-3801						Easting (X, ft):	2,304,962
												Northing (Y, ft):	51,262
												Horizontal System:	NAD 1983
												Vertical System:	NGVD 29

Granulometric Report

Depths and elevations based on measured values



Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
ph (843) 887-3800
fax (843) 887-3801

Project Name: Village of Bald Head Island

Sample Name: BHC-18 #2

Analysis Date: 02-17-14

Analyzed By: CRM Sr.

Easting (ft): 2,304,962	Northing (ft): 51,262	Coordinate System: North Carolina State Plane	Elevation (ft): -7.6 NGVD 29
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USCS: SP	Munsell:	Comments:
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Dry Weight (g): 129.85	Wash Weight (g): 128.15	Pan Retained (g):	Sieve Loss (%):	Fines (%): #200 - 1.38 #230 - 1.31	Organics (%):	Carbonates (%): 12.40	Shells (%):
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Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4"	-4.25	19.03		0.00	0.00	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	2.83	0.33	0.25	3.08	97.63
#10	-1.00	2.00	0.57	0.44	3.65	97.19
#14	-0.50	1.41	2.31	1.78	5.96	95.41
#18	0.00	1.00	7.51	5.78	13.47	89.63
#25	0.50	0.71	13.34	10.27	26.81	79.36
#35	1.00	0.50	16.67	12.84	43.48	66.52
#45	1.50	0.35	12.19	9.39	55.67	57.13
#60	2.00	0.25	22.69	17.47	78.36	39.66
#80	2.50	0.18	33.16	25.54	111.52	14.12
#120	3.00	0.13	15.60	12.01	127.12	2.11
#170	3.50	0.09	0.93	0.72	128.05	1.39
#200	3.75	0.07	0.01	0.01	128.06	1.38
#230	4.00	0.06	0.09	0.07	128.15	1.31

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
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2.88	2.46	2.29	1.70	0.67	0.27	-0.46
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Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.39	0.38	1.19	-1.4	5.96

GRANULARMETRIC REPORT BALD HEAD CREEK, NC, FEB. '14.GPJ FL DEP ROSS.GDT 3/3/14

Boring Designation BHC-19

DRILLING LOG	DIVISION Olsen Associates, Inc.	INSTALLATION Jacksonville, Florida	SHEET 1 OF 1 SHEETS
1. PROJECT Village of Bald Head Island Geotechnical Investigation of Bald Head Creek		9. SIZE AND TYPE OF BIT 3.0 In.	10. COORDINATE SYSTEM/DATUM HORIZONTAL: North Carolina State Plane VERTICAL: NAD 1983 NGVD 29
2. BORING DESIGNATION BHC-19		LOCATION COORDINATES X = 2,305,197 Y = 50,952	
3. DRILLING AGENCY Athena Technologies, Inc.		CONTRACTOR FILE NO.	
4. NAME OF DRILLER P. McClellan		11. MANUFACTURER'S DESIGNATION OF DRILL <input type="checkbox"/> AUTO HAMMER <input type="checkbox"/> MANUAL HAMMER	
5. DIRECTION OF BORING <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		DEG. FROM VERTICAL	
6. THICKNESS OF OVERBURDEN 0.0 Ft.		BEARING	
7. DEPTH DRILLED INTO ROCK 0.0 Ft.		12. TOTAL SAMPLES DISTURBED: 1 UNDISTURBED (UD): 2	
8. TOTAL DEPTH OF BORING 9.0 Ft.		13. TOTAL NUMBER CORE BOXES	
		14. ELEVATION GROUND WATER 4.7 Ft.	
		15. DATE BORING STARTED: 02-04-14 11:34 COMPLETED: 02-04-14 11:55	
		16. ELEVATION TOP OF BORING -1.8 Ft.	
		17. TOTAL RECOVERY FOR BORING 7.4 Ft.	
		18. SIGNATURE AND TITLE OF INSPECTOR A. Freeze	

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-1.8	0.0					
		●●●●●	Medium quartz SAND, few medium sand size shell, trace silt, poorly graded, subrounded, bioturbated, 2.8 - 3.0' = layer of fine quartz SAND with trace fine sand size shell, color grades to light gray (2.5Y 7/2), light brownish gray (2.5Y-6/2), (SP).		1	Sample #1, Depth = 0.0' - 0.4' Mean (mm): 0.34, Phi Sorting: 0.80 Carbonate: 8.7%, Fines (230): 0.98% (SP)
-5.5	3.7	●●●●●			Comp	Sample #Comp, Depth = 0.0' - 6.2' Mean (mm): 0.53, Phi Sorting: 1.08 Carbonate: 17.6%, Fines (230): 1.34% (SP)
-6.1	4.3		Fine to medium quartz SAND, few silt (in layers), few fine sand size shell, poorly graded, subrounded, gray (2.5Y-5/1), (SP-SM).			
		●●●●●	Medium quartz SAND, few medium to coarse sand size shell, few silt (in burrows), trace gravel size shell, poorly graded, subrounded, bioturbated, 6.2' = Callianassa major burrow trace, gray (2.5Y-6/1), (SP).		2	Sample #2, Depth = 5.8' - 6.2' Mean (mm): 0.53, Phi Sorting: 1.50 Carbonate: 21.3%, Fines (230): 1.47% (SP)
-9.0	7.2					
-9.2	7.4		Silty medium quartz SAND, some coarse sand to gravel size shell, little silt, subrounded, dark gray (2.5Y-4/1), (SM).			
			End of Boring			

FLORIDA DEP ROSS BALD HEAD CREEK, NC, FEB. '14, GRJ, FL DEP ROSS.GDT 3/3/14



**Bald Head Island
North Carolina
BHC-19**

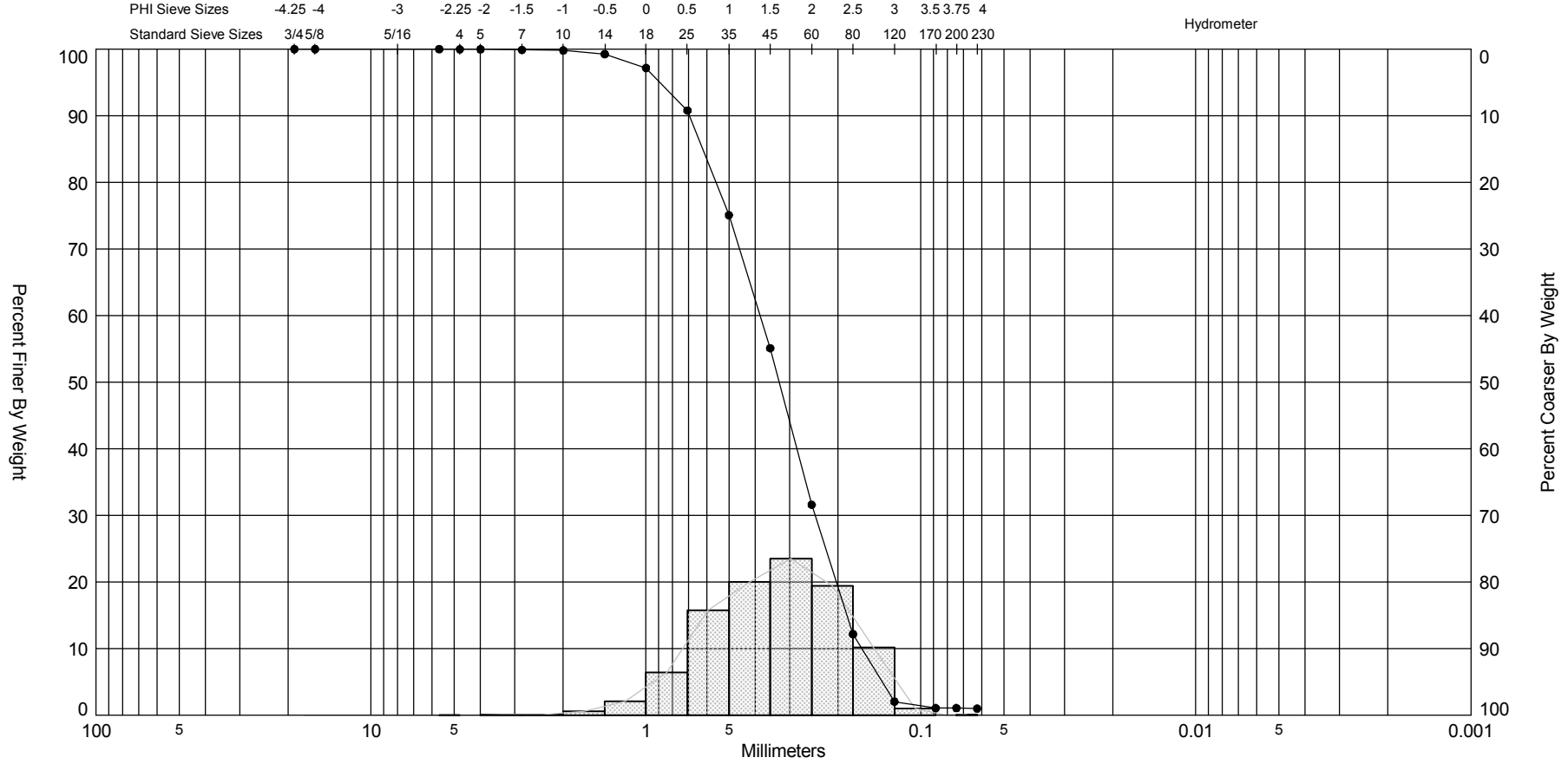
February 2014

**Scale in Feet
Photo Mosaic Image**




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

SIEVE ANALYSIS: BALD HEAD CREEK, NC., FEB. '14, GPJ, FL DEP ROSS.GDT 3/3/14



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort	Sample Information	
BHC-19 #1	—●—	-1.8	SP	#200 - 1.05 #230 - 0.98		8.70	1.61	1.55	-0.36	3.06	0.8	Project Name:	Village of Bald Head Island
Comments:												Analysis Date:	02-17-14
Depths and elevations based on measured values												Analyzed By:	CRM Sr.
						Athena Technologies, Inc. 1293 Graham Farm Road McClellanville, SC 29458 ph (843) 887-3800 fax (843) 887-3801						Easting (X, ft):	2,305,197
												Northing (Y, ft):	50,952
												Horizontal System:	NAD 1983
												Vertical System:	NGVD 29

Granulometric Report

Depths and elevations based on measured values



Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
ph (843) 887-3800
fax (843) 887-3801

Project Name: Village of Bald Head Island

Sample Name: BHC-19 #1

Analysis Date: 02-17-14

Analyzed By: CRM Sr.

Easting (ft): 2,305,197	Northing (ft): 50,952	Coordinate System: North Carolina State Plane	Elevation (ft): -1.8 NGVD 29
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USCS: SP	Munsell:	Comments:
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Dry Weight (g): 122.31	Wash Weight (g): 121.10	Pan Retained (g):	Sieve Loss (%):	Fines (%): #200 - 1.05 #230 - 0.98	Organics (%):	Carbonates (%): 8.70	Shells (%):
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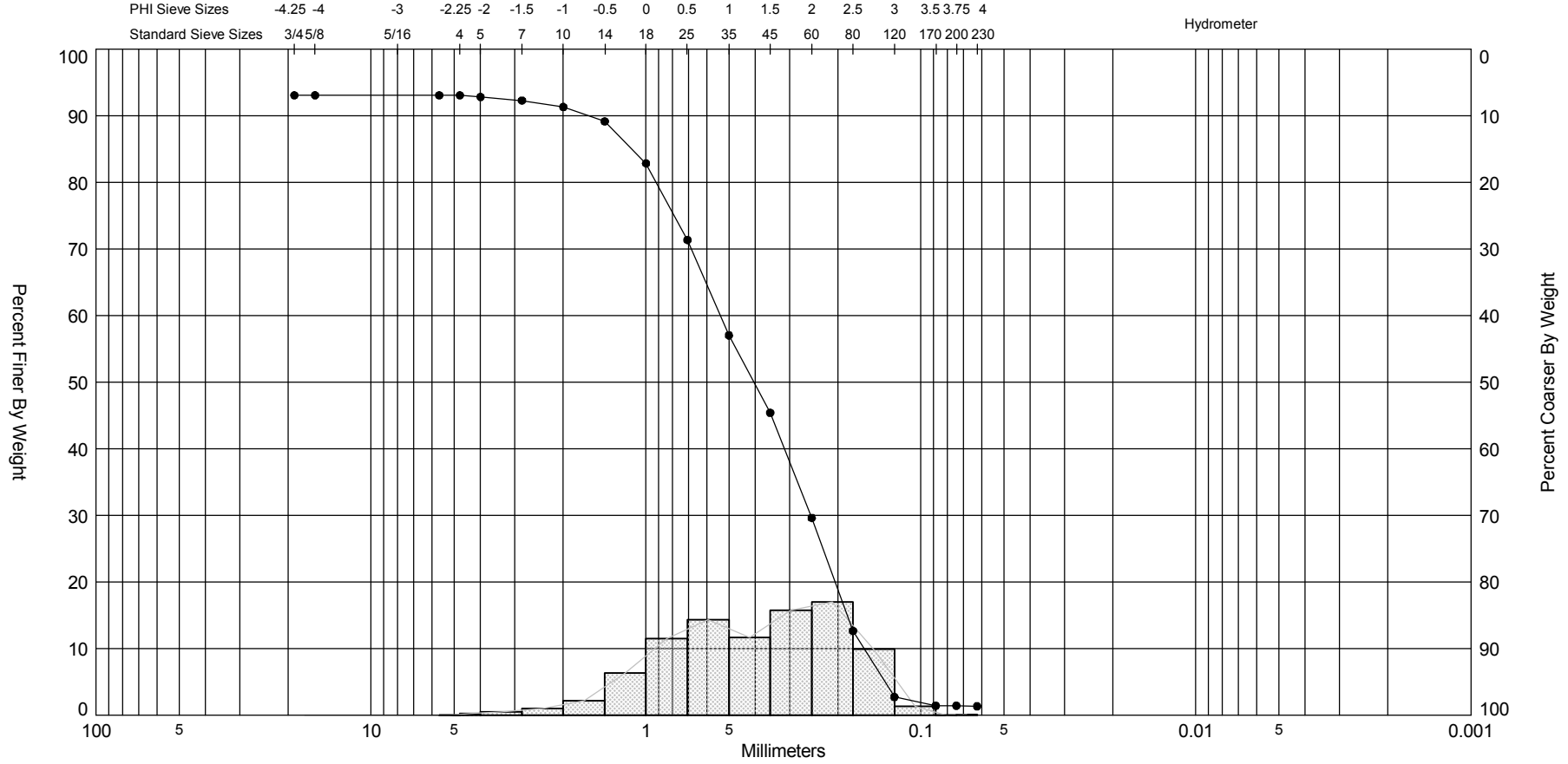
Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4"	-4.25	19.03		0.00	0.00	100.00
5/8"	-4.00	16.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.04	0.03	0.04	99.97
#5	-2.00	4.00	0.00	0.00	0.04	99.97
#7	-1.50	2.83	0.11	0.09	0.15	99.88
#10	-1.00	2.00	0.10	0.08	0.25	99.80
#14	-0.50	1.41	0.67	0.55	0.92	99.25
#18	0.00	1.00	2.54	2.08	3.46	97.17
#25	0.50	0.71	7.80	6.38	11.26	90.79
#35	1.00	0.50	19.23	15.72	30.49	75.07
#45	1.50	0.35	24.43	19.97	54.92	55.10
#60	2.00	0.25	28.74	23.50	83.66	31.60
#80	2.50	0.18	23.76	19.43	107.42	12.17
#120	3.00	0.13	12.40	10.14	119.82	2.03
#170	3.50	0.09	1.20	0.98	121.02	1.05
#200	3.75	0.07	0.00	0.00	121.02	1.05
#230	4.00	0.06	0.08	0.07	121.10	0.98

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.85	2.40	2.17	1.61	1.00	0.72	0.17


Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.55	0.34	0.8	-0.36	3.06

GRANULARMETRIC REPORT BALD HEAD CREEK, NC, FEB. '14.GPJ FL DEP ROSS.GDT 3/3/14

SIEVE ANALYSIS BALD HEAD CREEK, NC, FEB. '14.GPJ FL DEP ROSS.GDT 3/3/14



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort	Sample Information	
BHC-19 #Comp	—●—	-1.8	SP	#200 - 1.41 #230 - 1.34		17.60	1.3	0.91	0.66	2.4	1.08	Project Name:	Village of Bald Head Island
Comments:												Analysis Date:	02-17-14
Depths and elevations based on measured values												Analyzed By:	CRM Sr.
						Athena Technologies, Inc. 1293 Graham Farm Road McClellanville, SC 29458 ph (843) 887-3800 fax (843) 887-3801						Easting (X, ft):	2,305,197
												Northing (Y, ft):	50,952
												Horizontal System:	NAD 1983
												Vertical System:	NGVD 29

Granulometric Report

Depths and elevations based on measured values



Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
ph (843) 887-3800
fax (843) 887-3801

Project Name: Village of Bald Head Island

Sample Name: BHC-19 #Comp

Analysis Date: 02-17-14

Analyzed By: CRM Sr.

Easting (ft): 2,305,197	Northing (ft): 50,952	Coordinate System: North Carolina State Plane	Elevation (ft): -1.8 NGVD 29
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USCS: SP	Munsell:	Comments:
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Dry Weight (g): 135.69	Wash Weight (g): 133.89	Pan Retained (g):	Sieve Loss (%):	Fines (%): #200 - 1.41 #230 - 1.34	Organics (%):	Carbonates (%): 17.60	Shells (%):
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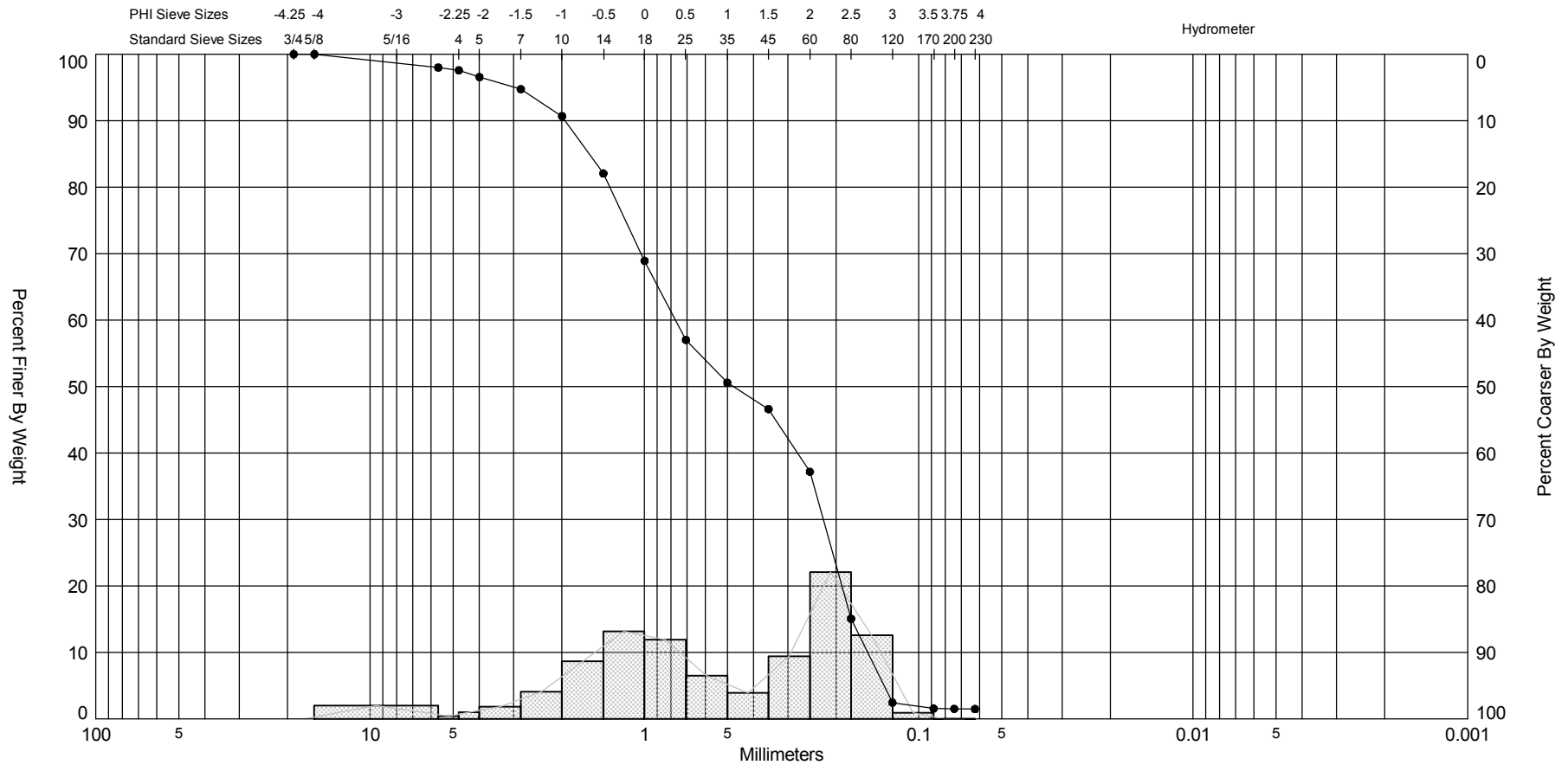
Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4"	-4.25	19.03		6.93	9.40	93.07
5/8"	-4.00	16.00	0.00	0.00	9.40	93.07
#3.5	-2.50	5.66	0.00	0.00	9.40	93.07
#4	-2.25	4.76	0.01	0.01	9.41	93.06
#5	-2.00	4.00	0.33	0.24	9.74	92.82
#7	-1.50	2.83	0.72	0.53	10.46	92.29
#10	-1.00	2.00	1.33	0.98	11.79	91.31
#14	-0.50	1.41	2.93	2.16	14.72	89.15
#18	0.00	1.00	8.55	6.30	23.27	82.85
#25	0.50	0.71	15.61	11.50	38.88	71.35
#35	1.00	0.50	19.43	14.32	58.31	57.03
#45	1.50	0.35	15.80	11.64	74.11	45.39
#60	2.00	0.25	21.40	15.77	95.51	29.62
#80	2.50	0.18	23.02	16.97	118.53	12.65
#120	3.00	0.13	13.48	9.93	132.01	2.72
#170	3.50	0.09	1.77	1.30	133.78	1.42
#200	3.75	0.07	0.01	0.01	133.79	1.41
#230	4.00	0.06	0.10	0.07	133.89	1.34

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.89	2.40	2.14	1.30	0.34	-0.09	


Moment Statistics	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
	0.91	0.53	1.08	0.66	2.4

GRANULARMETRIC REPORT BALD HEAD CREEK, NC, FEB. '14.GPJ FL DEP ROSS.GDT 3/3/14

SIEVE ANALYSIS: BALD HEAD CREEK, NC., FEB. '14, GPJ, FL DEP ROSS.GDT 3/3/14



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort	Sample Information	
BHC-19 #2	—●—	-7.6	SP	#200 - 1.51 #230 - 1.47		21.30	1.07	0.91	-0.52	2.5	1.5	Project Name:	Village of Bald Head Island
Comments:												Analysis Date:	02-17-14
Depths and elevations based on measured values												Analyzed By:	CRM Sr.
						Athena Technologies, Inc. 1293 Graham Farm Road McClellanville, SC 29458 ph (843) 887-3800 fax (843) 887-3801						Easting (X, ft):	2,305,197
												Northing (Y, ft):	50,952
												Horizontal System:	NAD 1983
												Vertical System:	NGVD 29

Granulometric Report

Depths and elevations based on measured values



Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
ph (843) 887-3800
fax (843) 887-3801

Project Name: Village of Bald Head Island

Sample Name: BHC-19 #2

Analysis Date: 02-17-14

Analyzed By: CRM Sr.

Easting (ft): 2,305,197	Northing (ft): 50,952	Coordinate System: North Carolina State Plane	Elevation (ft): -7.6 NGVD 29
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USCS: SP	Munsell:	Comments:
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Dry Weight (g): 134.88	Wash Weight (g): 132.89	Pan Retained (g):	Sieve Loss (%):	Fines (%): #200 - 1.51 #230 - 1.47	Organics (%):	Carbonates (%): 21.30	Shells (%):
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Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4"	-4.25	19.03		0.00	0.00	100.00
5/8"	-4.00	16.00	0.00	0.00	0.00	100.00
#3.5	-2.50	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	-1.50	2.83	2.45	1.82	7.09	94.74
#10	-1.00	2.00	5.46	4.05	12.55	90.69
#14	-0.50	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	66.69	50.55
#45	1.50	0.35	5.31	3.94	72.00	46.61
#60	2.00	0.25	12.72	9.43	84.72	37.18
#80	2.50	0.18	29.82	22.11	114.54	15.07
#120	3.00	0.13	17.02	12.62	131.56	2.45
#170	3.50	0.09	1.21	0.90	132.77	1.55
#200	3.75	0.07	0.06	0.04	132.83	1.51
#230	4.00	0.06	0.06	0.04	132.89	1.47

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Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.90	2.48	2.28	1.07	-0.23	-0.61	-1.57
Moment Statistics	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis	
	0.91	0.53	1.5	-0.52	2.5	

GRANULARMETRIC REPORT BALD HEAD CREEK, NC, FEB. '14.GPJ FL DEP ROSS.GDT 3/3/14

Boring Designation BHC-20

DRILLING LOG		DIVISION Olsen Associates, Inc.	INSTALLATION Jacksonville, Florida	SHEET 1 OF 1 SHEETS
1. PROJECT Village of Bald Head Island Geotechnical Investigation of Bald Head Creek		9. SIZE AND TYPE OF BIT 3.0 In.		
2. BORING DESIGNATION BHC-20		LOCATION COORDINATES X = 2,305,532 Y = 51,170	10. COORDINATE SYSTEM/DATUM North Carolina State Plane	HORIZONTAL NAD 1983
3. DRILLING AGENCY Athena Technologies, Inc.		CONTRACTOR FILE NO.	11. MANUFACTURER'S DESIGNATION OF DRILL <input type="checkbox"/> AUTO HAMMER <input type="checkbox"/> MANUAL HAMMER	
4. NAME OF DRILLER P. McClellan		12. TOTAL SAMPLES DISTURBED 1 UNDISTURBED (UD) 2		
5. DIRECTION OF BORING <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		DEG. FROM VERTICAL	13. TOTAL NUMBER CORE BOXES	
6. THICKNESS OF OVERBURDEN 0.0 Ft.		BEARING	14. ELEVATION GROUND WATER 4.0 Ft.	
7. DEPTH DRILLED INTO ROCK 0.0 Ft.		15. DATE BORING STARTED 02-04-14 11:01 COMPLETED 02-04-14 11:21		
8. TOTAL DEPTH OF BORING 10.0 Ft.		16. ELEVATION TOP OF BORING -1.4 Ft.		
		17. TOTAL RECOVERY FOR BORING 8.1 Ft.		
		18. SIGNATURE AND TITLE OF INSPECTOR A. Freeze		

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-1.4	0.0					
			Medium quartz SAND, few medium sand size shell, trace silt (in burrows), poorly graded, subrounded, bioturbated, light brownish gray (2.5Y-6/2), (SP).		1	Sample #1, Depth = 0.0' - 0.4' Mean (mm): 0.42, Phi Sorting: 0.83 Carbonate: 8.3%, Fines (230): 0.66% (SP)
-5.2	3.8		Fine to medium quartz SAND, few fine to medium sand size shell, trace silt (in layers), poorly graded, subrounded, gray (2.5Y-6/1), (SP).		Comp	Sample #Comp, Depth = 0.0' - 6.6' Mean (mm): 0.38, Phi Sorting: 1.11 Carbonate: 11.7%, Fines (230): 0.99% (SP)
-8.1	6.7				2	Sample #2, Depth = 6.2' - 6.6' Mean (mm): 0.35, Phi Sorting: 1.15 Carbonate: 12.6%, Fines (230): 1.27% (SP)
-8.4	7.0		Medium quartz SAND, few medium to coarse sand size shell, few silt, poorly graded, subrounded, bioturbated, gray (2.5Y-5/1), (SP-SM).			
-9.0	7.6		Medium quartz SAND, little coarse sand size shell, trace silt / gravel size shell, poorly graded, subrounded, gray (2.5Y-6/1), (SP).			
-9.5	8.1		Silty medium quartz SAND, some coarse sand to gravel size shell, little silt, subrounded, dark gray (2.5Y-4/1), (SM).			
			End of Boring			

FLORIDA DEP ROSS BALD HEAD CREEK, NC, FEB. '14, GRJ FL DEP ROSS.GDT 3/3/14



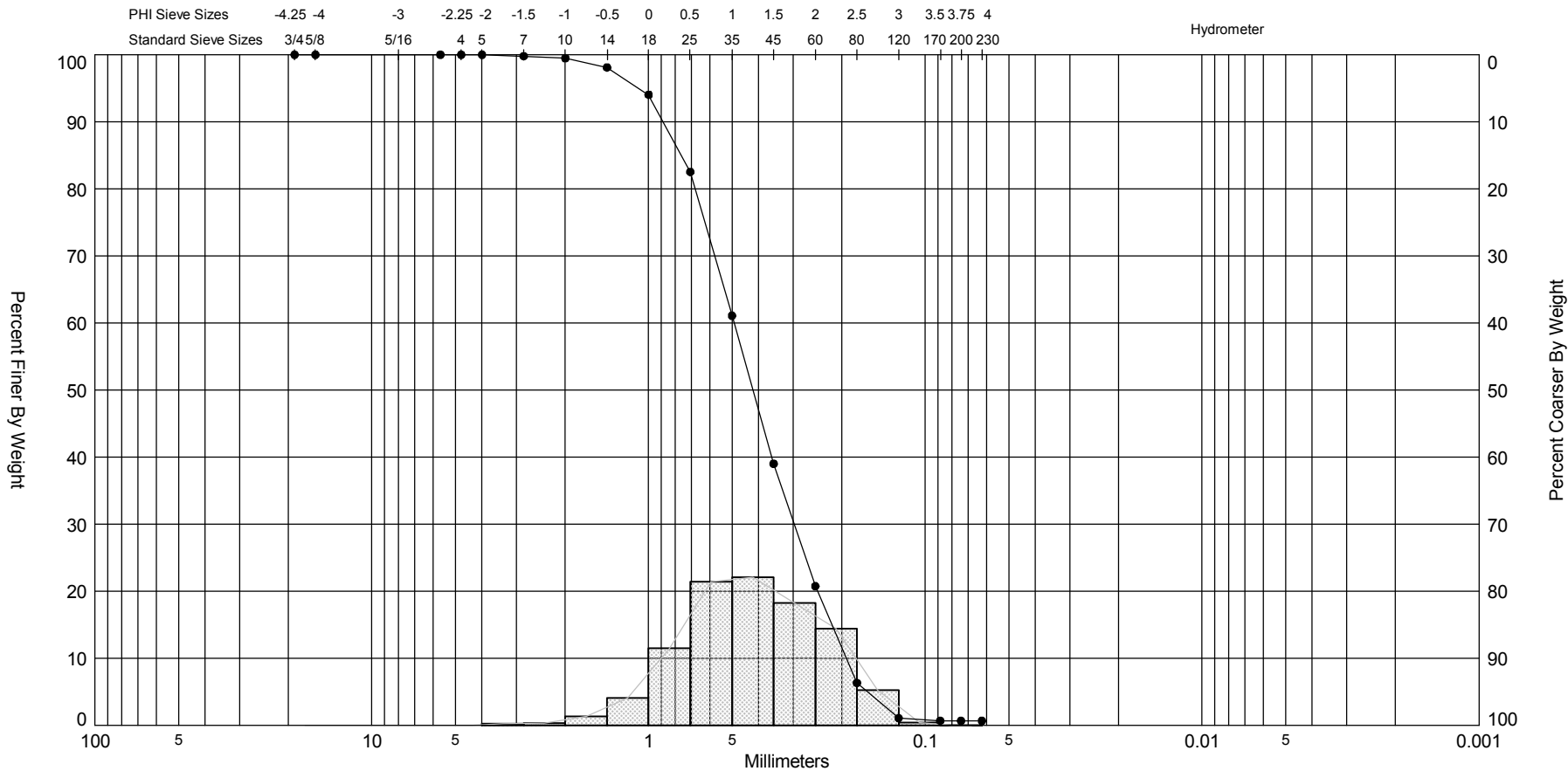
**Bald Head Island
North Carolina
BHC-20**

February 2014

**Scale in Feet
Photo Mosaic Image**



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



Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort	Sample Information	
BHC-20 #1	—●—	-1.4	SP	#200 - 0.67 #230 - 0.66		8.30	1.25	1.25	-0.2	2.89	0.83	Project Name:	Village of Bald Head Island
Comments:												Analysis Date:	02-17-14
Depths and elevations based on measured values												Analyzed By:	CRM Sr.
						Athena Technologies, Inc. 1293 Graham Farm Road McClellanville, SC 29458 ph (843) 887-3800 fax (843) 887-3801						Easting (X, ft):	2,305,532
												Northing (Y, ft):	51,170
												Horizontal System:	NAD 1983
												Vertical System:	NGVD 29

Granulometric Report

Depths and elevations based on measured values



Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
ph (843) 887-3800
fax (843) 887-3801

Project Name: Village of Bald Head Island

Sample Name: BHC-20 #1

Analysis Date: 02-17-14

Analyzed By: CRM Sr.

Easting (ft): 2,305,532	Northing (ft): 51,170	Coordinate System: North Carolina State Plane	Elevation (ft): -1.4 NGVD 29
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USCS: SP	Munsell:	Comments:
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Dry Weight (g): 136.30	Wash Weight (g): 135.41	Pan Retained (g):	Sieve Loss (%):	Fines (%): #200 - 0.67 #230 - 0.66	Organics (%):	Carbonates (%): 8.30	Shells (%):
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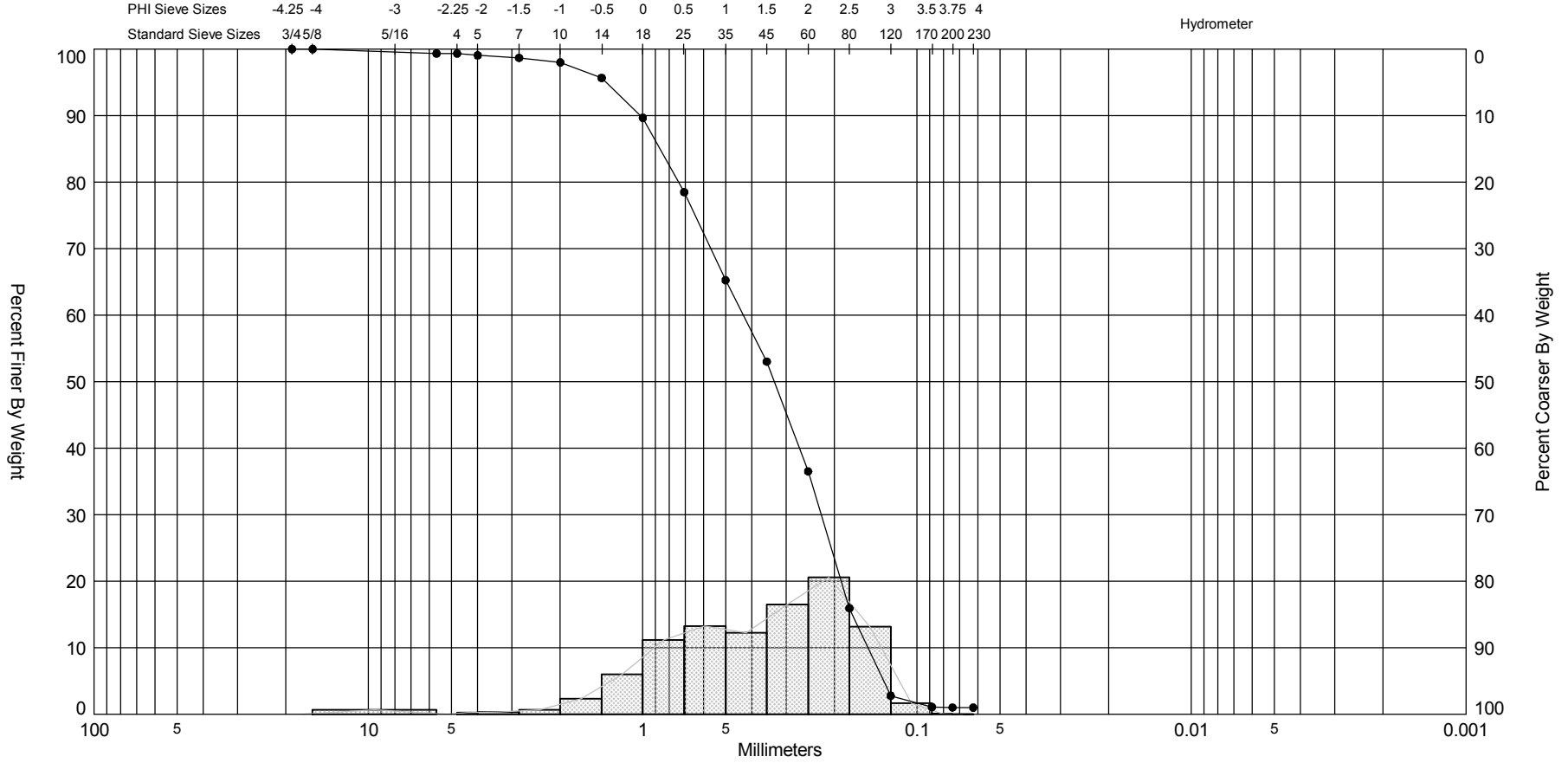
Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4"	-4.25	19.03		0.00	0.00	100.00
5/8"	-4.00	16.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.00	0.00	0.00	100.00
#5	-2.00	4.00	0.00	0.00	0.00	100.00
#7	-1.50	2.83	0.29	0.21	0.29	99.79
#10	-1.00	2.00	0.45	0.33	0.74	99.46
#14	-0.50	1.41	1.84	1.35	2.58	98.11
#18	0.00	1.00	5.55	4.07	8.13	94.04
#25	0.50	0.71	15.69	11.51	23.82	82.53
#35	1.00	0.50	29.23	21.45	53.05	61.08
#45	1.50	0.35	30.10	22.08	83.15	39.00
#60	2.00	0.25	24.89	18.26	108.04	20.74
#80	2.50	0.18	19.66	14.42	127.70	6.32
#120	3.00	0.13	7.15	5.25	134.85	1.07
#170	3.50	0.09	0.52	0.38	135.37	0.69
#200	3.75	0.07	0.03	0.02	135.40	0.67
#230	4.00	0.06	0.01	0.01	135.41	0.66

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Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.63	2.16	1.88	1.25	0.68	0.44	-0.12
Moment Statistics	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis	
	1.25	0.42	0.83	-0.2	2.89	

GRANULARMETRIC REPORT BALD HEAD CREEK, NC, FEB. '14.GPJ FL DEP ROSS.GDT 3/3/14

SIEVE ANALYSIS: BALD HEAD CREEK, NC., FEB. '14, GPJ, FL DEP ROSS.GDT 3/3/14



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort	Sample Information	
BHC-20 #Comp	—●—	-1.4	SP	#200 - 1.02 #230 - 0.99		11.70	1.59	1.39	-0.84	4.12	1.11	Project Name:	Village of Bald Head Island
Comments:												Analysis Date:	02-17-14
Depths and elevations based on measured values												Analyzed By:	CRM Sr.
							Athena Technologies, Inc. 1293 Graham Farm Road McClellanville, SC 29458 ph (843) 887-3800 fax (843) 887-3801					Easting (X, ft):	2,305,532
												Northing (Y, ft):	51,170
												Horizontal System:	NAD 1983
												Vertical System:	NGVD 29

Granulometric Report

Depths and elevations based on measured values



Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
ph (843) 887-3800
fax (843) 887-3801

Project Name: Village of Bald Head Island

Sample Name: BHC-20 #Comp

Analysis Date: 02-17-14

Analyzed By: CRM Sr.

Easting (ft): 2,305,532	Northing (ft): 51,170	Coordinate System: North Carolina State Plane	Elevation (ft): -1.4 NGVD 29
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USCS: SP	Munsell:	Comments:
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Dry Weight (g): 149.48	Wash Weight (g): 148.02	Pan Retained (g):	Sieve Loss (%):	Fines (%): #200 - 1.02 #230 - 0.99	Organics (%):	Carbonates (%): 11.70	Shells (%):
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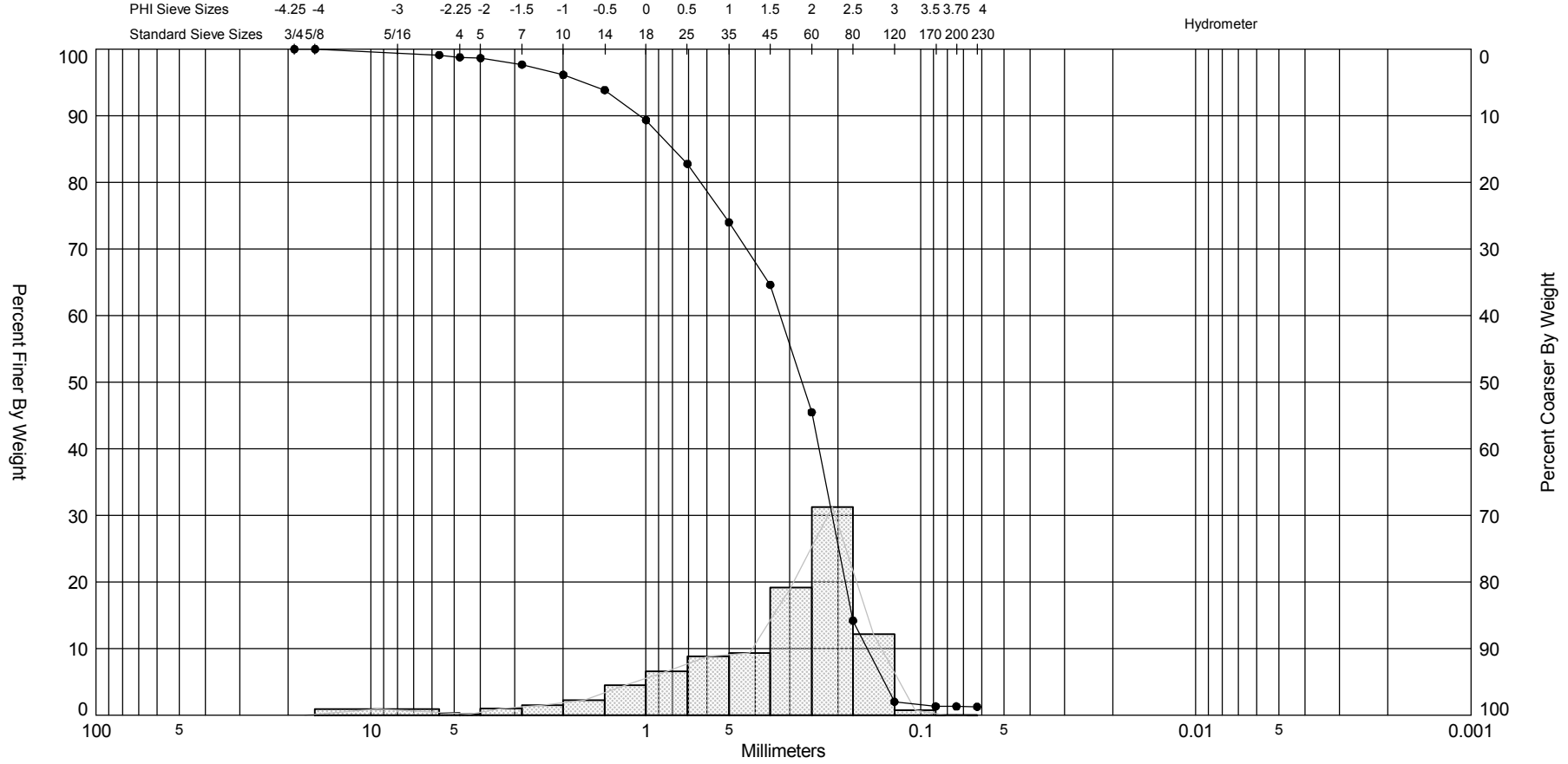
Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4"	-4.25	19.03		0.00	0.00	100.00
5/8"	-4.00	16.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.98	0.66	0.98	99.34
#4	-2.25	4.76	0.00	0.00	0.98	99.34
#5	-2.00	4.00	0.44	0.29	1.42	99.05
#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	1.00	8.97	6.00	15.47	89.66
#25	0.50	0.71	16.70	11.17	32.17	78.49
#35	1.00	0.50	19.77	13.23	51.94	65.26
#45	1.50	0.35	18.29	12.24	70.23	53.02
#60	2.00	0.25	24.66	16.50	94.89	36.52
#80	2.50	0.18	30.78	20.59	125.67	15.93
#120	3.00	0.13	19.66	13.15	145.33	2.78
#170	3.50	0.09	2.53	1.69	147.86	1.09
#200	3.75	0.07	0.11	0.07	147.97	1.02
#230	4.00	0.06	0.05	0.03	148.02	0.99

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.92	2.50	2.28	1.59	0.63	0.25	-0.44


Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.39	0.38	1.11	-0.84	4.12

GRANULARMETRIC REPORT BALD HEAD CREEK, NC, FEB. '14.GPJ FL DEP ROSS.GDT 3/3/14

SIEVE ANALYSIS BALD HEAD CREEK, NC., FEB. '14, GPJ, FL DEP ROSS.GDT 3/3/14



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort	Sample Information	
BHC-20 #2	—●—	-7.6	SP	#200 - 1.30 #230 - 1.27		12.60	1.88	1.51	-1.45	5.39	1.15	Project Name:	Village of Bald Head Island
Comments:												Analysis Date:	02-17-14
Depths and elevations based on measured values												Analyzed By:	CRM Sr.
						Athena Technologies, Inc. 1293 Graham Farm Road McClellanville, SC 29458 ph (843) 887-3800 fax (843) 887-3801						Easting (X, ft):	2,305,532
												Northing (Y, ft):	51,170
												Horizontal System:	NAD 1983
												Vertical System:	NGVD 29

Granulometric Report

Depths and elevations based on measured values



Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
ph (843) 887-3800
fax (843) 887-3801

Project Name: Village of Bald Head Island

Sample Name: BHC-20 #2

Analysis Date: 02-17-14

Analyzed By: CRM Sr.

Easting (ft): 2,305,532	Northing (ft): 51,170	Coordinate System: North Carolina State Plane	Elevation (ft): -7.6 NGVD 29
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USCS: SP	Munsell:	Comments:
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Dry Weight (g): 126.67	Wash Weight (g): 125.07	Pan Retained (g):	Sieve Loss (%):	Fines (%): #200 - 1.30 #230 - 1.27	Organics (%):	Carbonates (%): 12.60	Shells (%):
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Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4"	-4.25	19.03		0.00	0.00	100.00
5/8"	-4.00	16.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	1.11	0.88	1.11	99.12
#4	-2.25	4.76	0.43	0.34	1.54	98.78
#5	-2.00	4.00	0.17	0.13	1.71	98.65
#7	-1.50	2.83	1.23	0.97	2.94	97.68
#10	-1.00	2.00	1.95	1.54	4.89	96.14
#14	-0.50	1.41	2.89	2.28	7.78	93.86
#18	0.00	1.00	5.71	4.51	13.49	89.35
#25	0.50	0.71	8.32	6.57	21.81	82.78
#35	1.00	0.50	11.15	8.80	32.96	73.98
#45	1.50	0.35	11.86	9.36	44.82	64.62
#60	2.00	0.25	24.27	19.16	69.09	45.46
#80	2.50	0.18	39.60	31.26	108.69	14.20
#120	3.00	0.13	15.43	12.18	124.12	2.02
#170	3.50	0.09	0.90	0.71	125.02	1.31
#200	3.75	0.07	0.01	0.01	125.03	1.30
#230	4.00	0.06	0.04	0.03	125.07	1.27

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Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.88	2.47	2.33	1.88	0.94	0.41	-0.75
Moment Statistics	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis	
	1.51	0.35	1.15	-1.45	5.39	

GRANULARMETRIC REPORT BALD HEAD CREEK, NC, FEB. '14.GPJ FL DEP ROSS.GDT 3/3/14

Boring Designation BHC-21

DRILLING LOG		DIVISION Olsen Associates, Inc.	INSTALLATION Jacksonville, Florida	SHEET 1 OF 1 SHEETS
1. PROJECT Village of Bald Head Island Geotechnical Investigation of Bald Head Creek		9. SIZE AND TYPE OF BIT 3.0 In.		
2. BORING DESIGNATION BHC-21		10. COORDINATE SYSTEM/DATUM North Carolina State Plane		
3. DRILLING AGENCY Athena Technologies, Inc.		11. MANUFACTURER'S DESIGNATION OF DRILL <input type="checkbox"/> AUTO HAMMER <input type="checkbox"/> MANUAL HAMMER		
4. NAME OF DRILLER P. McClellan		12. TOTAL SAMPLES DISTURBED 1 UNDISTURBED (UD) 2		
5. DIRECTION OF BORING <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		13. TOTAL NUMBER CORE BOXES		
6. THICKNESS OF OVERBURDEN 0.0 Ft.		14. ELEVATION GROUND WATER 5.2 Ft.		
7. DEPTH DRILLED INTO ROCK 0.0 Ft.		15. DATE BORING STARTED 02-04-14 09:42 COMPLETED 02-04-14 10:27		
8. TOTAL DEPTH OF BORING 10.0 Ft.		16. ELEVATION TOP OF BORING -2.6 Ft.		
		17. TOTAL RECOVERY FOR BORING 8.1 Ft.		
		18. SIGNATURE AND TITLE OF INSPECTOR A. Freeze		

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-2.6	0.0					
			Medium quartz SAND, few fine sand size shell, trace silt, poorly graded, subrounded, bioturbated, color grades to gray (2.5Y 6/1), light brownish gray (2.5Y-6/2), (SP).		1	Sample #1, Depth = 0.0' - 0.4' Mean (mm): 0.31, Phi Sorting: 0.97 Carbonate: 8.9%, Fines (230): 1.16% (SP)
-5.4	2.8		Medium quartz SAND, little medium sand size shell, poorly graded, subrounded, color grades to light gray (2.5Y 7/2), light brownish gray (2.5Y-6/2), (SP).		Comp	Sample #Comp, Depth = 0.0' - 5.4' Mean (mm): 0.41, Phi Sorting: 1.09 Carbonate: 10.7%, Fines (230): 1.11% (SP)
-7.4	4.8		Medium quartz SAND, few medium sand size shell, trace silt, poorly graded, subrounded, gray (2.5Y-6/1), (SP).			
-8.4	5.8		Fine quartz SAND, little medium quartz sand (in layers), trace fine sand size shell, trace silt (in layers), poorly graded, subrounded, gray (2.5Y-6/1), (SP).		2	Sample #2, Depth = 5.0' - 5.4' Mean (mm): 0.49, Phi Sorting: 1.19 Carbonate: 15.3%, Fines (230): 1.06% (SP)
-9.0	6.4		Medium quartz SAND, little coarse sand to gravel size shell, trace silt, poorly graded, subrounded, gray (2.5Y-6/1), (SP).			
-9.7	7.1		Silty medium quartz SAND, some coarse sand to gravel size shell, little silt, subrounded, dark grayish brown (2.5Y-4/2), (SM).			
-10.7	8.1		End of Boring			

FLORIDA DEP ROSS BALD HEAD CREEK, NC, FEB. '14, GPJ FL DEP ROSS.GDT 3/3/14



**Bald Head Island
North Carolina
BHC-21**

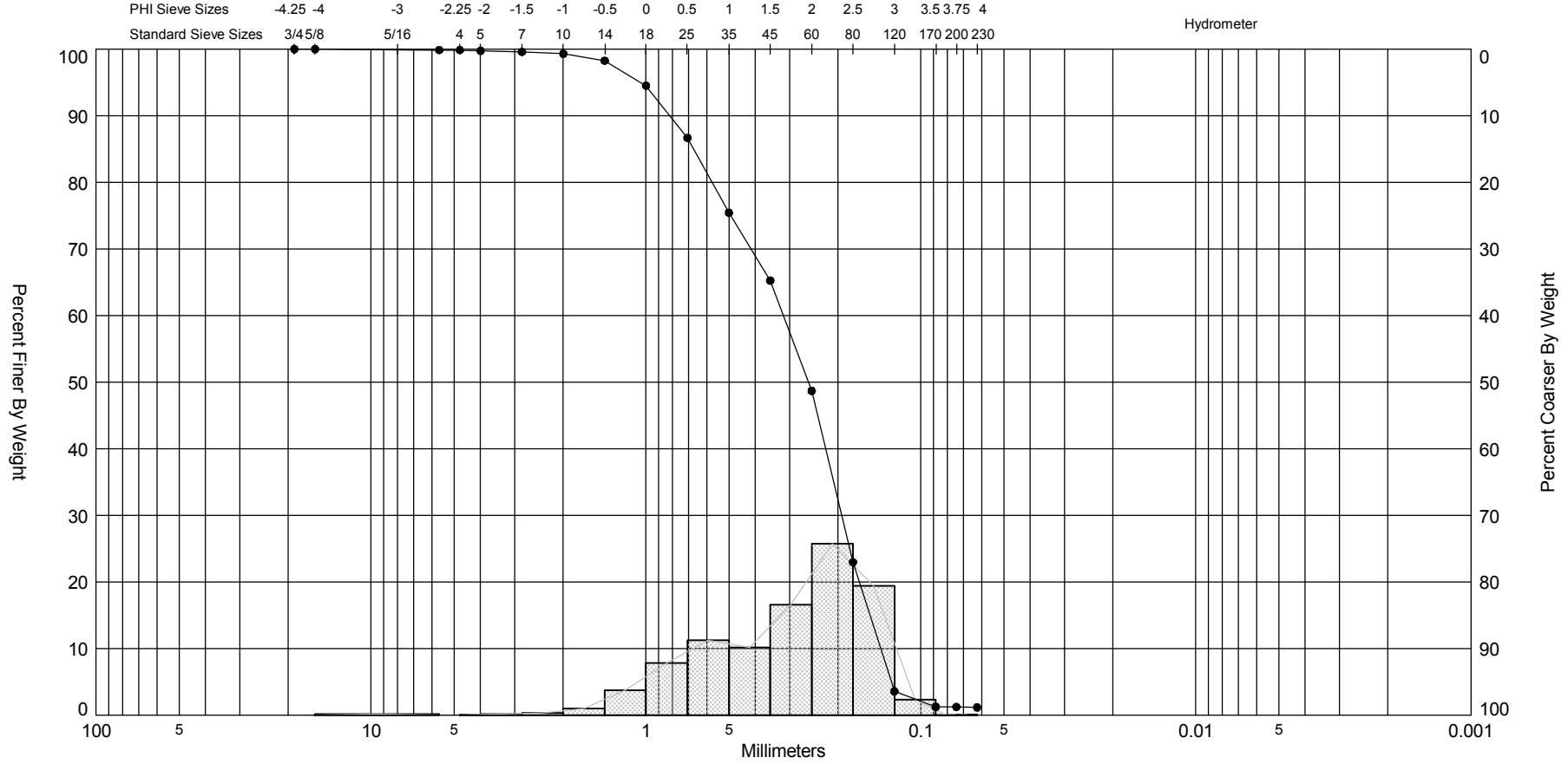
February 2014

**Scale in Feet
Photo Mosaic Image**




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

SIEVE ANALYSIS: BALD HEAD CREEK, NC., FEB. '14, GPJ, FL DEP ROSS.GDT 3/3/14



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort	Sample Information	
BHC-21 #1	—●—	-2.6	SP	#200 - 1.23 #230 - 1.16		8.90	1.96	1.7	-0.85	3.65	0.97	Project Name:	Village of Bald Head Island
Comments:												Analysis Date:	02-17-14
Depths and elevations based on measured values												Analyzed By:	CRM Sr.
						Athena Technologies, Inc. 1293 Graham Farm Road McClellanville, SC 29458 ph (843) 887-3800 fax (843) 887-3801						Easting (X, ft):	2,305,156
												Northing (Y, ft):	51,563
												Horizontal System:	NAD 1983
												Vertical System:	NGVD 29

Granulometric Report

Depths and elevations based on measured values



Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
ph (843) 887-3800
fax (843) 887-3801

Project Name: Village of Bald Head Island

Sample Name: BHC-21 #1

Analysis Date: 02-17-14

Analyzed By: CRM Sr.

Easting (ft): 2,305,156	Northing (ft): 51,563	Coordinate System: North Carolina State Plane	Elevation (ft): -2.6 NGVD 29
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USCS: SP	Munsell:	Comments:
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Dry Weight (g): 141.96	Wash Weight (g): 140.34	Pan Retained (g):	Sieve Loss (%):	Fines (%): #200 - 1.23 #230 - 1.16	Organics (%):	Carbonates (%): 8.90	Shells (%):
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Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4"	-4.25	19.03		0.00	0.00	100.00
5/8"	-4.00	16.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.18	0.13	0.18	99.87
#4	-2.25	4.76	0.00	0.00	0.18	99.87
#5	-2.00	4.00	0.17	0.12	0.35	99.75
#7	-1.50	2.83	0.22	0.15	0.57	99.60
#10	-1.00	2.00	0.43	0.30	1.00	99.30
#14	-0.50	1.41	1.46	1.03	2.46	98.27
#18	0.00	1.00	5.33	3.75	7.79	94.52
#25	0.50	0.71	11.13	7.84	18.92	86.68
#35	1.00	0.50	15.96	11.24	34.88	75.44
#45	1.50	0.35	14.47	10.19	49.35	65.25
#60	2.00	0.25	23.49	16.55	72.84	48.70
#80	2.50	0.18	36.53	25.73	109.37	22.97
#120	3.00	0.13	27.53	19.39	136.90	3.58
#170	3.50	0.09	3.31	2.33	140.21	1.25
#200	3.75	0.07	0.03	0.02	140.24	1.23
#230	4.00	0.06	0.10	0.07	140.34	1.16

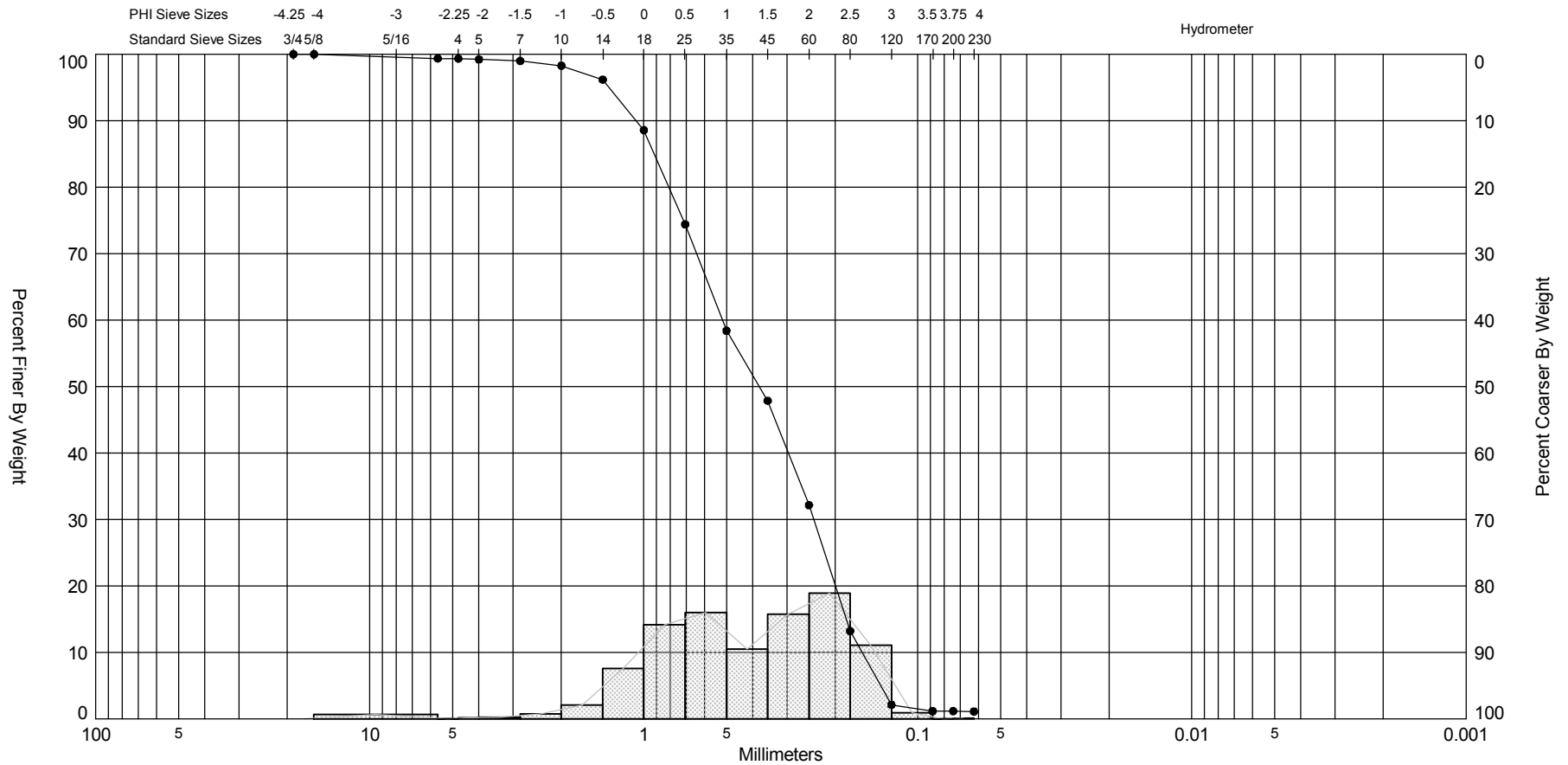
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Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.96	2.68	2.46	1.96	1.02	0.62	-0.06


Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.7	0.31	0.97	-0.85	3.65

GRANULARMETRIC REPORT BALD HEAD CREEK, NC, FEB. '14.GPJ FL DEP ROSS.GDT 3/3/14

SIEVE ANALYSIS: BALD HEAD CREEK, NC., FEB. '14, GPJ, FL DEP ROSS.GDT 3/3/14



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort	Sample Information	
BHC-21 #Comp	—●—	-2.6	SP	#200 - 1.16 #230 - 1.11		10.70	1.4	1.27	-0.62	3.72	1.09	Project Name:	Village of Bald Head Island
Comments:												Analysis Date:	02-17-14
Depths and elevations based on measured values												Analyzed By:	CRM Sr.
						Athena Technologies, Inc. 1293 Graham Farm Road McClellanville, SC 29458 ph (843) 887-3800 fax (843) 887-3801						Easting (X, ft):	2,305,156
												Northing (Y, ft):	51,563
												Horizontal System:	NAD 1983
												Vertical System:	NGVD 29

Granulometric Report

Depths and elevations based on measured values



Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
ph (843) 887-3800
fax (843) 887-3801

Project Name: Village of Bald Head Island

Sample Name: BHC-21 #Comp

Analysis Date: 02-17-14

Analyzed By: CRM Sr.

Easting (ft): 2,305,156	Northing (ft): 51,563	Coordinate System: North Carolina State Plane	Elevation (ft): -2.6 NGVD 29
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USCS: SP	Munsell:	Comments:
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Dry Weight (g): 130.23	Wash Weight (g): 128.78	Pan Retained (g):	Sieve Loss (%):	Fines (%): #200 - 1.16 #230 - 1.11	Organics (%):	Carbonates (%): 10.70	Shells (%):
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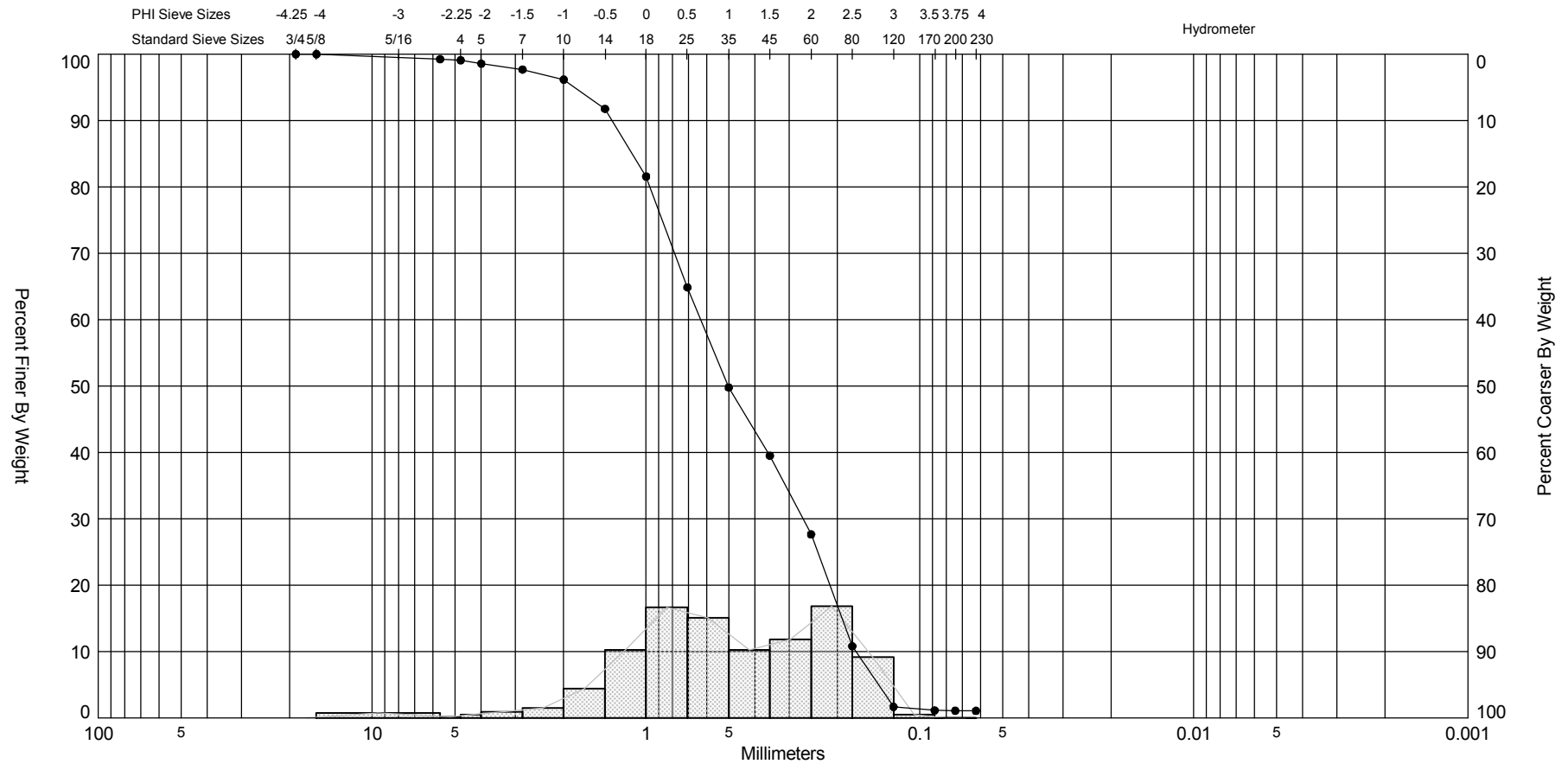
Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4"	-4.25	19.03		0.00	0.00	100.00
5/8"	-4.00	16.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.82	0.63	0.82	99.37
#4	-2.25	4.76	0.03	0.02	0.85	99.35
#5	-2.00	4.00	0.18	0.14	1.03	99.21
#7	-1.50	2.83	0.28	0.22	1.31	98.99
#10	-1.00	2.00	0.93	0.71	2.24	98.28
#14	-0.50	1.41	2.72	2.09	4.96	96.19
#18	0.00	1.00	9.92	7.62	14.88	88.57
#25	0.50	0.71	18.47	14.18	33.35	74.39
#35	1.00	0.50	20.84	16.00	54.19	58.39
#45	1.50	0.35	13.70	10.52	67.89	47.87
#60	2.00	0.25	20.47	15.72	88.36	32.15
#80	2.50	0.18	24.65	18.93	113.01	13.22
#120	3.00	0.13	14.46	11.10	127.47	2.12
#170	3.50	0.09	1.24	0.95	128.71	1.17
#200	3.75	0.07	0.01	0.01	128.72	1.16
#230	4.00	0.06	0.06	0.05	128.78	1.11

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Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.87	2.43	2.19	1.40	0.48	0.16	-0.42

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.27	0.41	1.09	-0.62	3.72

GRANULARMETRIC REPORT BALD HEAD CREEK, NC, FEB. '14.GPJ FL DEP ROSS.GDT 3/3/14



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort	Sample Information	
BHC-21 #2	—●—	-7.6	SP	#200 - 1.09 #230 - 1.06		15.30	0.99	1.02	-0.48	3.21	1.19	Project Name:	Village of Bald Head Island
Comments:												Analysis Date:	02-17-14
Depths and elevations based on measured values												Analyzed By:	CRM Sr.
						Athena Technologies, Inc. 1293 Graham Farm Road McClellanville, SC 29458 ph (843) 887-3800 fax (843) 887-3801						Easting (X, ft):	2,305,156
												Northing (Y, ft):	51,563
												Horizontal System:	NAD 1983
												Vertical System:	NGVD 29

Granulometric Report

Depths and elevations based on measured values



Athena Technologies, Inc.
1293 Graham Farm Road
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ph (843) 887-3800
fax (843) 887-3801

Project Name: Village of Bald Head Island

Sample Name: BHC-21 #2

Analysis Date: 02-17-14

Analyzed By: CRM Sr.

Easting (ft): 2,305,156	Northing (ft): 51,563	Coordinate System: North Carolina State Plane	Elevation (ft): -7.6 NGVD 29
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USCS: SP	Munsell:	Comments:
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Dry Weight (g): 137.43	Wash Weight (g): 135.99	Pan Retained (g):	Sieve Loss (%):	Fines (%): #200 - 1.09 #230 - 1.06	Organics (%):	Carbonates (%): 15.30	Shells (%):
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Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4"	-4.25	19.03		0.00	0.00	100.00
5/8"	-4.00	16.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	1.04	0.76	1.04	99.24
#4	-2.25	4.76	0.21	0.15	1.25	99.09
#5	-2.00	4.00	0.71	0.52	1.96	98.57
#7	-1.50	2.83	1.21	0.88	3.17	97.69
#10	-1.00	2.00	2.10	1.53	5.27	96.16
#14	-0.50	1.41	6.04	4.39	11.31	91.77
#18	0.00	1.00	14.03	10.21	25.34	81.56
#25	0.50	0.71	22.94	16.69	48.28	64.87
#35	1.00	0.50	20.73	15.08	69.01	49.79
#45	1.50	0.35	14.13	10.28	83.14	39.51
#60	2.00	0.25	16.31	11.87	99.45	27.64
#80	2.50	0.18	23.15	16.84	122.60	10.80
#120	3.00	0.13	12.56	9.14	135.16	1.66
#170	3.50	0.09	0.73	0.53	135.89	1.13
#200	3.75	0.07	0.06	0.04	135.95	1.09
#230	4.00	0.06	0.04	0.03	135.99	1.06

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.82	2.35	2.08	0.99	0.20	-0.12	-0.87

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.02	0.49	1.19	-0.48	3.21

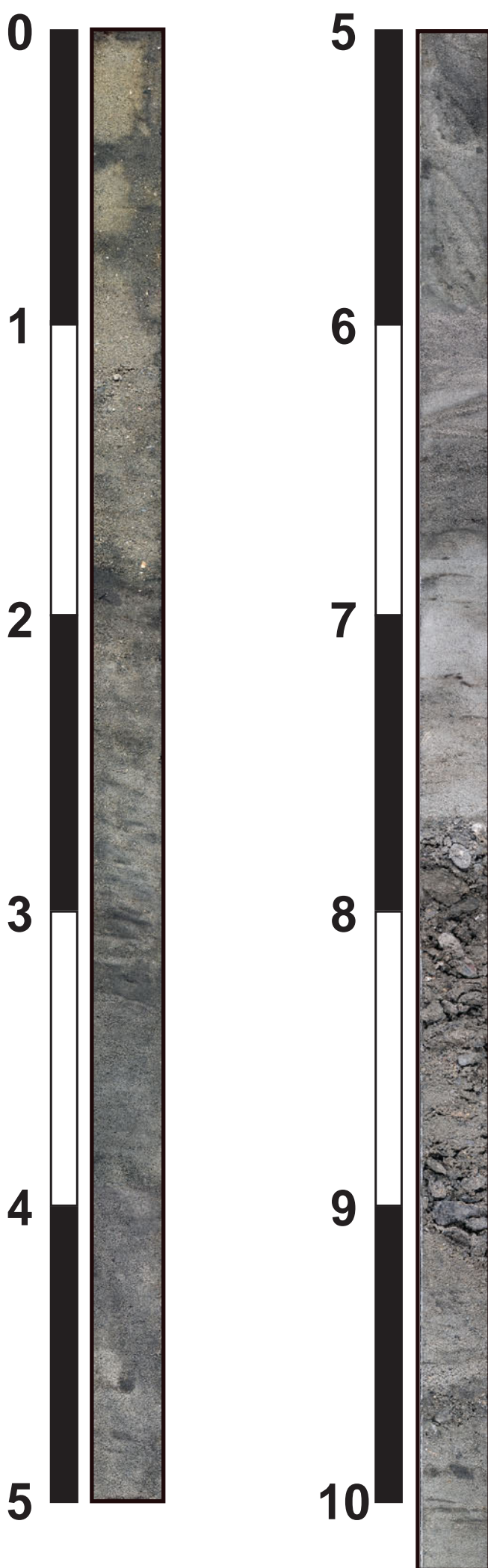
GRANULARMETRIC REPORT BALD HEAD CREEK, NC, FEB. '14.GPJ FL DEP ROSS.GDT 3/3/14

Boring Designation BHC-22

DRILLING LOG		DIVISION Olsen Associates, Inc.	INSTALLATION Jacksonville, Florida	SHEET 1 OF 1 SHEETS
1. PROJECT Village of Bald Head Island Geotechnical Investigation of Bald Head Creek		9. SIZE AND TYPE OF BIT 3.0 In.		10. COORDINATE SYSTEM/DATUM North Carolina State Plane
2. BORING DESIGNATION BHC-22		LOCATION COORDINATES X = 2,305,707 Y = 51,479		HORIZONTAL NAD 1983
3. DRILLING AGENCY Athena Technologies, Inc.		CONTRACTOR FILE NO.		VERTICAL NGVD 29
4. NAME OF DRILLER P. McClellan		11. MANUFACTURER'S DESIGNATION OF DRILL		<input type="checkbox"/> AUTO HAMMER <input type="checkbox"/> MANUAL HAMMER
5. DIRECTION OF BORING <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		DEG. FROM VERTICAL		BEARING
6. THICKNESS OF OVERBURDEN 0.0 Ft.		12. TOTAL SAMPLES		DISTURBED 1 UNDISTURBED (UD) 2
7. DEPTH DRILLED INTO ROCK 0.0 Ft.		13. TOTAL NUMBER CORE BOXES		
8. TOTAL DEPTH OF BORING 12.0 Ft.		14. ELEVATION GROUND WATER 5.8 Ft.		
		15. DATE BORING		STARTED 02-04-14 10:36 COMPLETED 02-04-14 10:51
		16. ELEVATION TOP OF BORING -3.1 Ft.		
		17. TOTAL RECOVERY FOR BORING 10.3 Ft.		
		18. SIGNATURE AND TITLE OF INSPECTOR A. Freeze		

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values	% REC.	BOX OR SAMPLE	REMARKS
-3.1	0.0					
			Medium quartz SAND, few fine to medium sand size shell, trace silt, poorly graded, subrounded, bioturbated, light brownish gray (2.5Y-6/2), (SP).		1	Sample #1, Depth = 0.0' - 0.4' Mean (mm): 0.31, Phi Sorting: 0.99 Carbonate: 8.3%, Fines (230): 1.20% (SP)
-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).		Comp	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).		2	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).			
-9.8	6.7		Fine quartz SAND, trace silt / organic silt, poorly graded, subrounded, bioturbated, gray (2.5Y-6/1), (SP).			
-10.4	7.3		Medium quartz SAND, trace fine sand size shell / silt, poorly graded, subrounded, light gray (2.5Y-7/1), (SP).			
-10.7	7.6		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).			
-12.1	9.0		Medium quartz SAND, few silt, trace fine sand size shell, poorly graded, subrounded, bioturbated, gray (2.5Y-6/1), (SP-SM).			
-12.7	9.6		Fine quartz SAND, few silt, trace fine sand size shell, poorly graded, subrounded, bioturbated, gray (2.5Y-5/1), (SP-SM).			
-13.4	10.3					

FLORIDA DEP ROSS BALD HEAD CREEK, NC, FEB. '14, GPJ FL DEP ROSS.GDT 3/3/14



**Bald Head Island
North Carolina
BHC-22**

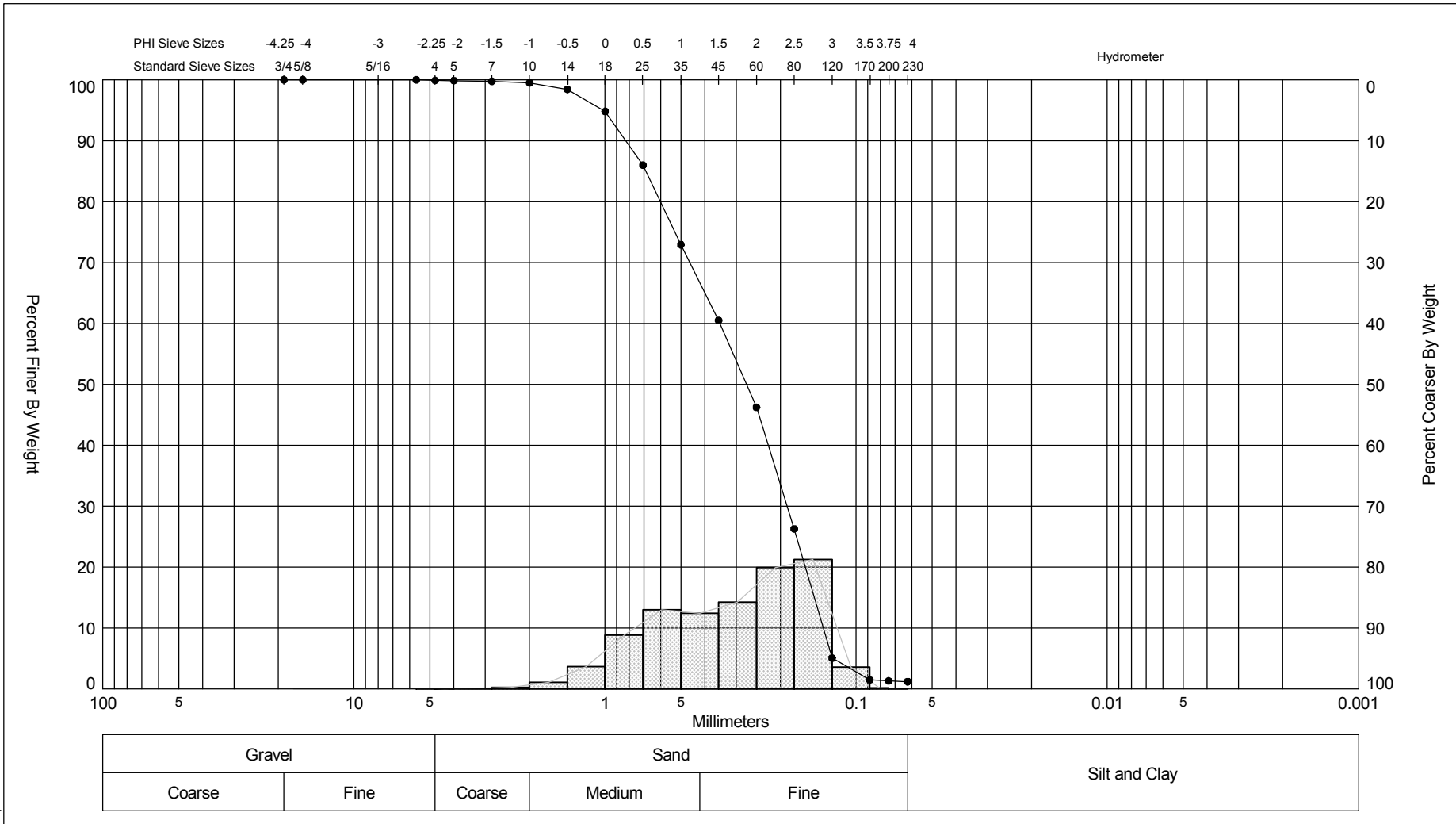
February 2014


**Scale in Feet
Photo Mosaic Image**



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SIEVE ANALYSIS BALD HEAD CREEK, NC., FEB. '14, GPJ, FL DEP ROSS.GDT 3/3/14



Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort	Sample Information	
BHC-22 #1	—●—	-3.1	SP	#200 - 1.31 #230 - 1.20		8.30	1.87	1.68	-0.53	2.66	0.99	Project Name:	Village of Bald Head Island
Comments:												Analysis Date:	02-17-14
Depths and elevations based on measured values												Analyzed By:	CRM Sr.
						Athena Technologies, Inc. 1293 Graham Farm Road McClellanville, SC 29458 ph (843) 887-3800 fax (843) 887-3801						Easting (X, ft):	2,305,707
												Northing (Y, ft):	51,479
												Horizontal System:	NAD 1983
												Vertical System:	NGVD 29

Granulometric Report

Depths and elevations based on measured values



Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
ph (843) 887-3800
fax (843) 887-3801

Project Name: Village of Bald Head Island

Sample Name: BHC-22 #1

Analysis Date: 02-17-14

Analyzed By: CRM Sr.

Easting (ft): 2,305,707	Northing (ft): 51,479	Coordinate System: North Carolina State Plane	Elevation (ft): -3.1 NGVD 29
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USCS: SP	Munsell:	Comments:
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Dry Weight (g): 131.05	Wash Weight (g): 129.50	Pan Retained (g):	Sieve Loss (%):	Fines (%): #200 - 1.31 #230 - 1.20	Organics (%):	Carbonates (%): 8.30	Shells (%):
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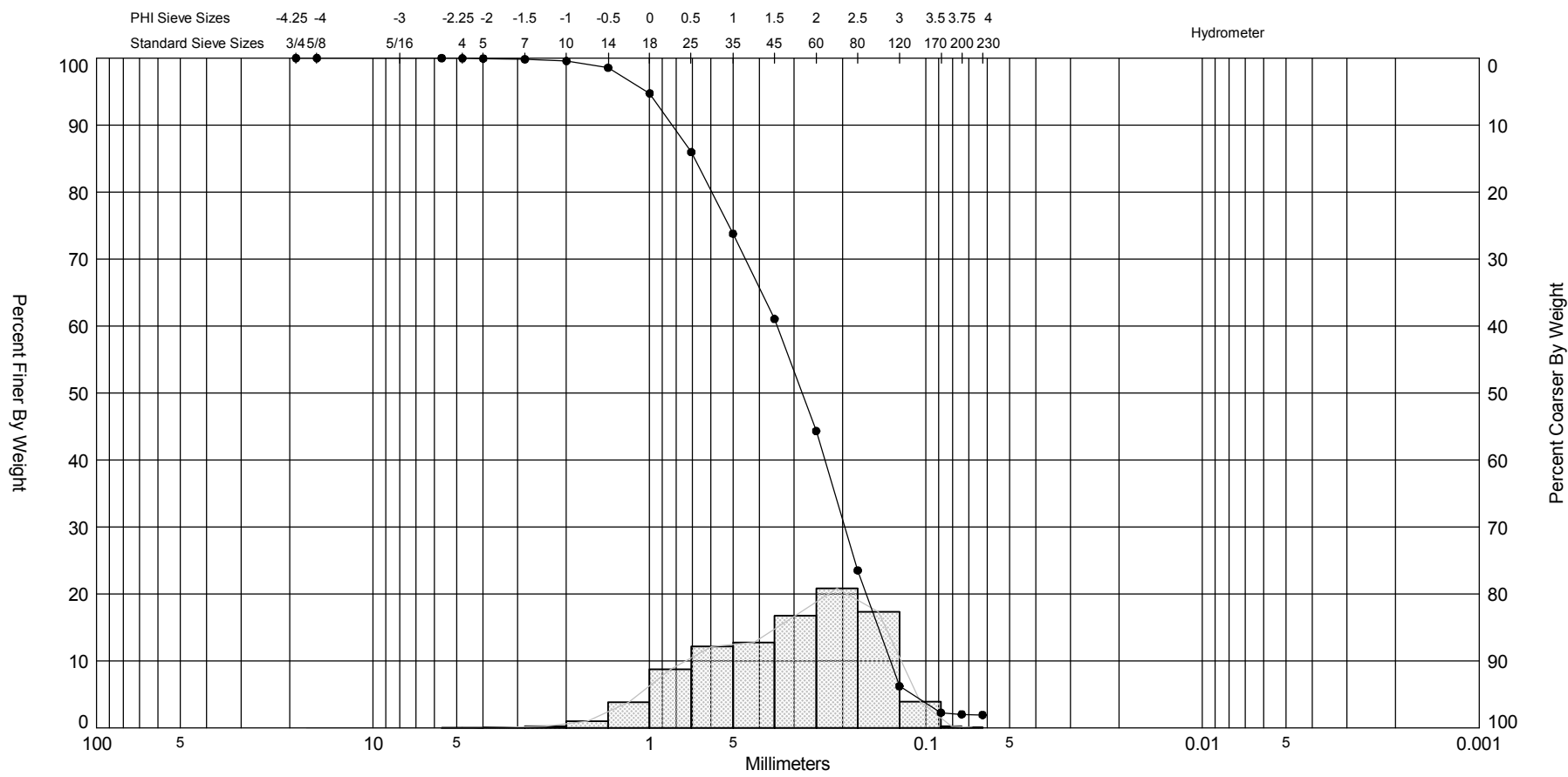
Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4"	-4.25	19.03		0.00	0.00	100.00
5/8"	-4.00	16.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.13	0.10	0.13	99.90
#5	-2.00	4.00	0.04	0.03	0.17	99.87
#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	-0.50	1.41	1.43	1.09	2.05	98.44
#18	0.00	1.00	4.77	3.64	6.82	94.80
#25	0.50	0.71	11.55	8.81	18.37	85.99
#35	1.00	0.50	17.09	13.04	35.46	72.95
#45	1.50	0.35	16.32	12.45	51.78	60.50
#60	2.00	0.25	18.73	14.29	70.51	46.21
#80	2.50	0.18	26.11	19.92	96.62	26.29
#120	3.00	0.13	27.84	21.24	124.46	5.05
#170	3.50	0.09	4.68	3.57	129.14	1.48
#200	3.75	0.07	0.22	0.17	129.36	1.31
#230	4.00	0.06	0.14	0.11	129.50	1.20

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.01	2.74	2.53	1.87	0.92	0.58	-0.03


Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.68	0.31	0.99	-0.53	2.66

GRANULARMETRIC REPORT BALD HEAD CREEK, NC, FEB. '14.GPJ FL DEP ROSS.GDT 3/3/14

SIEVE ANALYSIS: BALD HEAD CREEK, NC, FEB. '14, GPJ, FL DEP ROSS, GDT 3/3/14



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort	Sample Information	
BHC-22 #Comp	●—	-3.1	SP	#200 - 2.03 #230 - 1.94		6.00	1.83	1.66	-0.48	2.63	0.97	Project Name:	Village of Bald Head Island
Comments:												Analysis Date:	02-17-14
Depths and elevations based on measured values												Analyzed By:	CRM Sr.
							Athena Technologies, Inc. 1293 Graham Farm Road McClellanville, SC 29458 ph (843) 887-3800 fax (843) 887-3801					Easting (X, ft):	2,305,707
												Northing (Y, ft):	51,479
												Horizontal System:	NAD 1983
												Vertical System:	NGVD 29

Granulometric Report

Depths and elevations based on measured values



Athena Technologies, Inc.
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fax (843) 887-3801

Project Name: Village of Bald Head Island

Sample Name: BHC-22 #Comp

Analysis Date: 02-17-14

Analyzed By: CRM Sr.

Easting (ft): 2,305,707	Northing (ft): 51,479	Coordinate System: North Carolina State Plane	Elevation (ft): -3.1 NGVD 29
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USCS: SP	Munsell:	Comments:
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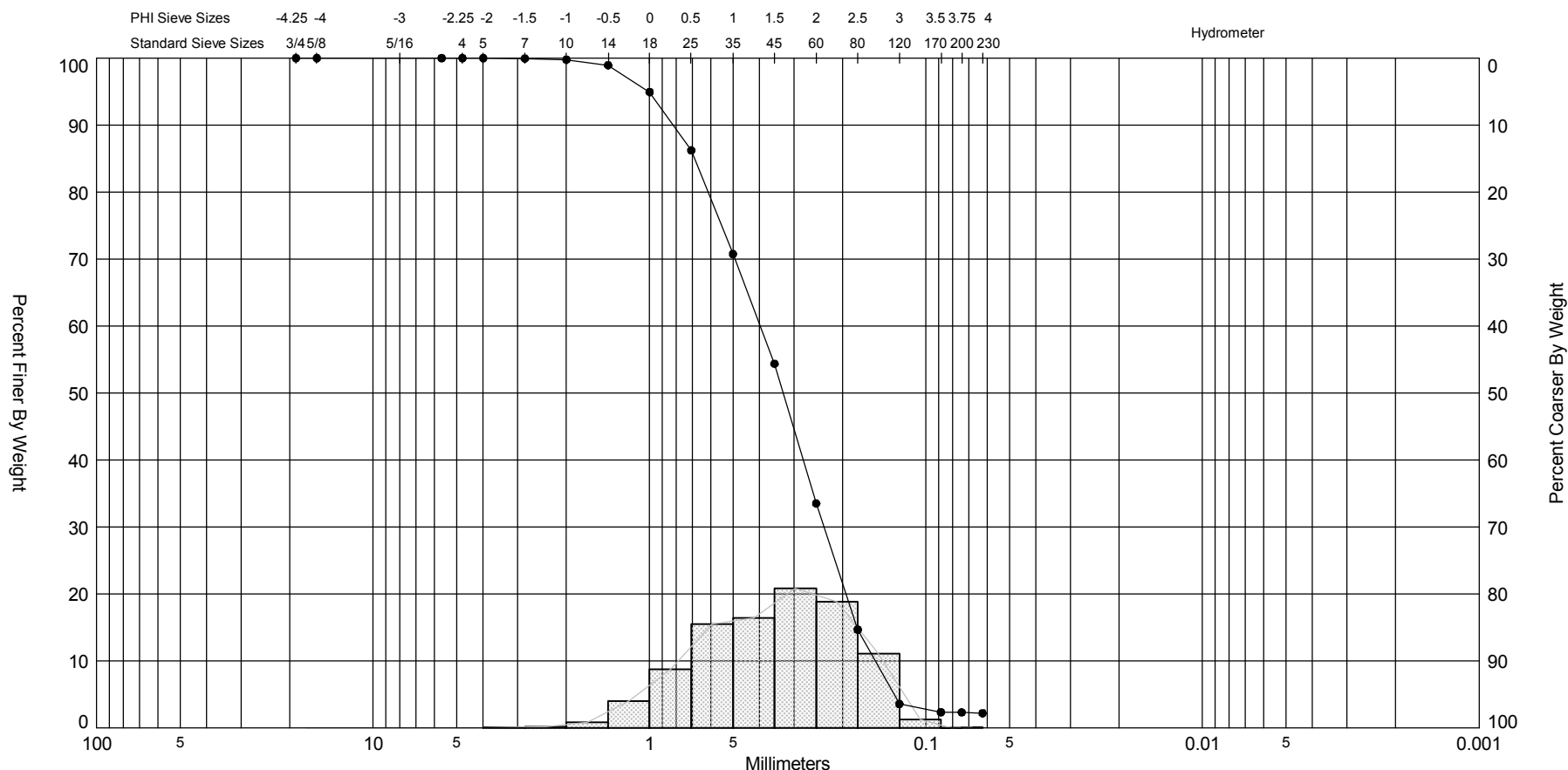
Dry Weight (g): 135.53	Wash Weight (g): 132.87	Pan Retained (g):	Sieve Loss (%):	Fines (%): #200 - 2.03 #230 - 1.94	Organics (%):	Carbonates (%): 6.00	Shells (%):
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Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4"	-4.25	19.03		0.00	0.00	100.00
5/8"	-4.00	16.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.04	0.03	0.04	99.97
#5	-2.00	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	-0.50	1.41	1.35	1.00	1.94	98.57
#18	0.00	1.00	5.20	3.84	7.14	94.73
#25	0.50	0.71	11.88	8.77	19.02	85.96
#35	1.00	0.50	16.49	12.17	35.51	73.79
#45	1.50	0.35	17.26	12.74	52.77	61.05
#60	2.00	0.25	22.68	16.73	75.45	44.32
#80	2.50	0.18	28.19	20.80	103.64	23.52
#120	3.00	0.13	23.44	17.30	127.08	6.22
#170	3.50	0.09	5.35	3.95	132.43	2.27
#200	3.75	0.07	0.32	0.24	132.75	2.03
#230	4.00	0.06	0.12	0.09	132.87	1.94


Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.15	2.72	2.46	1.83	0.95	0.58	-0.04

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.66	0.32	0.97	-0.48	2.63

GRANULARMETRIC REPORT BALD HEAD CREEK, NC, FEB. '14.GPJ FL DEP ROSS.GDT 3/3/14



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort	Sample Information	
BHC-22 #2	—●—	-7.6	SP	#200 - 2.31 #230 - 2.20		2.70	1.6	1.5	-0.32	2.56	0.88	Project Name:	Village of Bald Head Island
Comments:												Analysis Date:	02-17-14
Depths and elevations based on measured values												Analyzed By:	CRM Sr.
						Athena Technologies, Inc. 1293 Graham Farm Road McClellanville, SC 29458 ph (843) 887-3800 fax (843) 887-3801						Easting (X, ft):	2,305,707
												Northing (Y, ft):	51,479
												Horizontal System:	NAD 1983
												Vertical System:	NGVD 29

Granulometric Report

Depths and elevations based on measured values



Athena Technologies, Inc.
1293 Graham Farm Road
McClellanville, SC 29458
ph (843) 887-3800
fax (843) 887-3801

Project Name: Village of Bald Head Island

Sample Name: BHC-22 #2

Analysis Date: 02-17-14

Analyzed By: CRM Sr.

Easting (ft): 2,305,707	Northing (ft): 51,479	Coordinate System: North Carolina State Plane	Elevation (ft): -7.6 NGVD 29
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USCS: SP	Munsell:	Comments:
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Dry Weight (g): 132.10	Wash Weight (g): 129.20	Pan Retained (g):	Sieve Loss (%):	Fines (%): #200 - 2.31 #230 - 2.20	Organics (%):	Carbonates (%): 2.70	Shells (%):
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Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	Grams Retained	% Weight Retained	Cum. Grams Retained	% Passing Sieve
3/4"	-4.25	19.03		0.00	0.00	100.00
5/8"	-4.00	16.00	0.00	0.00	0.00	100.00
#3.5	-2.50	5.66	0.00	0.00	0.00	100.00
#4	-2.25	4.76	0.00	0.00	0.00	100.00
#5	-2.00	4.00	0.00	0.00	0.00	100.00
#7	-1.50	2.83	0.07	0.05	0.07	99.95
#10	-1.00	2.00	0.22	0.17	0.29	99.78
#14	-0.50	1.41	1.10	0.83	1.39	98.95
#18	0.00	1.00	5.30	4.01	6.69	94.94
#25	0.50	0.71	11.52	8.72	18.21	86.22
#35	1.00	0.50	20.44	15.47	38.65	70.75
#45	1.50	0.35	21.64	16.38	60.29	54.37
#60	2.00	0.25	27.54	20.85	87.83	33.52
#80	2.50	0.18	24.92	18.86	112.75	14.66
#120	3.00	0.13	14.66	11.10	127.41	3.56
#170	3.50	0.09	1.63	1.23	129.04	2.33
#200	3.75	0.07	0.02	0.02	129.06	2.31
#230	4.00	0.06	0.14	0.11	129.20	2.20

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.94	2.46	2.23	1.60	0.86	0.57	-0.01

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.5	0.35	0.88	-0.32	2.56

GRANULARMETRIC REPORT BALD HEAD CREEK, NC, FEB. '14.GPJ FL DEP ROSS.GDT 3/3/14