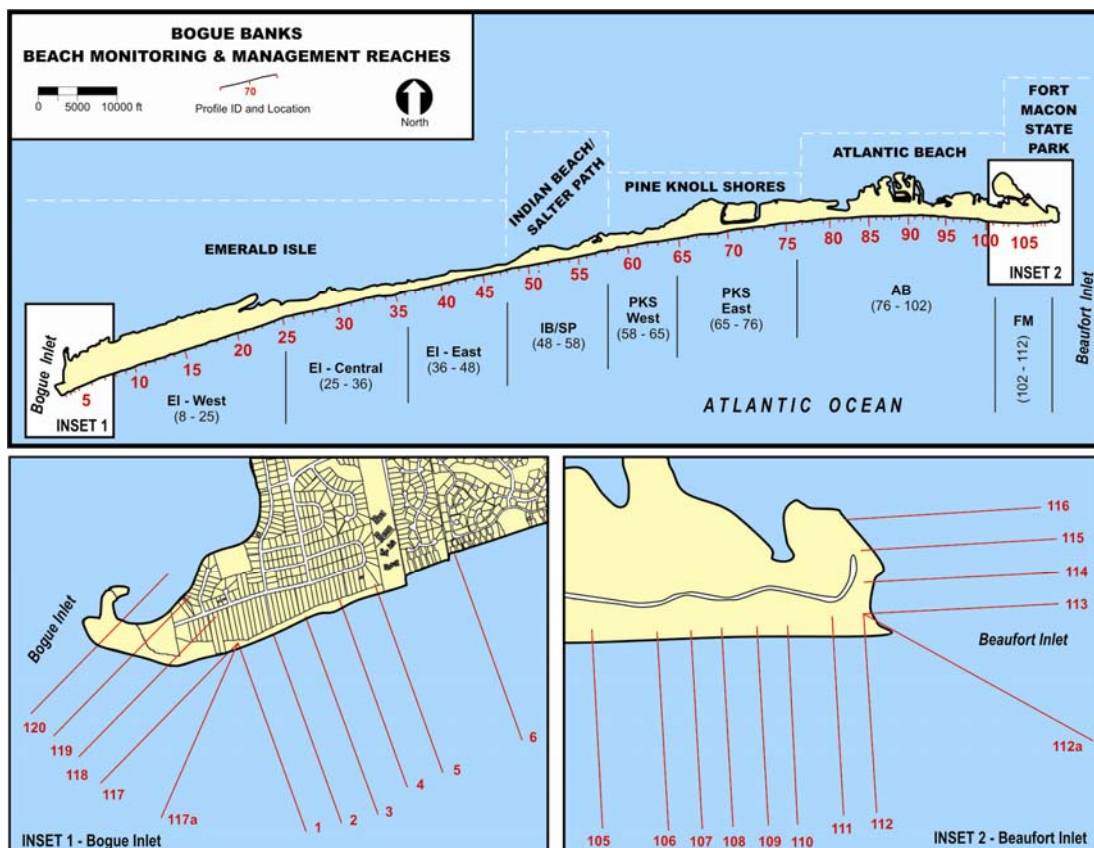


## SHORELINES – December 2009

### State of the Beach – 2009

As presented to the *Island Review* magazine

This past October the engineering firm of Moffatt & Nichol provided the Carteret County Beach Commission a presentation highlighting the most significant results and conclusions regarding our beach monitoring program. In 1999, 111 shore-perpendicular profiles were established along Bogue Banks to gain baseline information and begin assessing the overall health of the beach in the wake of the hurricanes that impacted the region in the decade of the 1990s – most notably *Bertha* (1996), *Fran* (1996), *Bonnie* (1998), *Dennis 1 & 2* (1999), and *Floyd* (1999). Elevations of the dry and underwater (nearshore) portion of the beach have been obtained along these same profiles on a routine basis since 1999 and these measurements have been utilized to monitor two important beach parameters that are discussed in more detail below – (1) the volume of sand residing in the beach system, and (2) shoreline movement.



**Fig. 1 – Site map depicting the location and identification scheme of the 122 profiles positioned along Bogue Banks utilized for beach/nearshore monitoring purposes.**

The monitoring program has grown since its formative years and now includes 122 profiles along Bogue Banks (Fig. 1), in addition to 24 profiles along Shackleford Banks, and 18 along Bear Island, located east and west of Bogue Banks, respectively. The beaches are ideally surveyed in May, June, or July every year. As implied above, the monitoring

program has continued to serve several very important functions, including; (1) providing a statistical metric to determine volume change/deficiencies for past and future beach nourishment needs, (2) help assess the volume of sand lost during Hurricanes *Floyd* (1999), *Isabel* (2003), and *Ophelia* (2005) and where applicable, obtain FEMA reimbursement to replace the sand lost during many of these aforementioned events, (3) provide spatial (survey) control during beach construction events, (4) assess the fate of various beachfills constructed along Bogue Banks since 2001, and (5) provide a method to determine the overall condition (health) and changing geomorphology of Bogue Banks and adjacent islands. Accordingly, our annual beach monitoring presentation is often considered as a “State of the Beach” address.

Interestingly, our most recent beach nourishment activity took place in 2007 and the past two years of non-nourishment activity constitutes the longest interval of this type we have experienced along Bogue Banks since 2001-02. Our 2009 survey thus provides a new opportunity to better understand our ambient (natural) shoreline behavior and beach volume change.

### Beach Volume

One of the means to quantify beach health is to compare the volume of sand lost or gained over time along Bogue Banks and the adjacent islands. Engineers and scientists most often use the measuring unit of a **cubic yard** to describe volume change, which can be envisioned as a 3 ft. by 3 ft. by 3 ft. block of sand, or 27 ft<sup>3</sup>. A standard dump truck holds roughly 15 cubic yards as a convenient mental image. By utilizing a volumetric approach, we can review the past year or any other time slice in a “sand debit – sand credit” mindset. Generally, storms and other high-energy events serve as large “debits” and beach nourishment is envisioned as a “credit”.

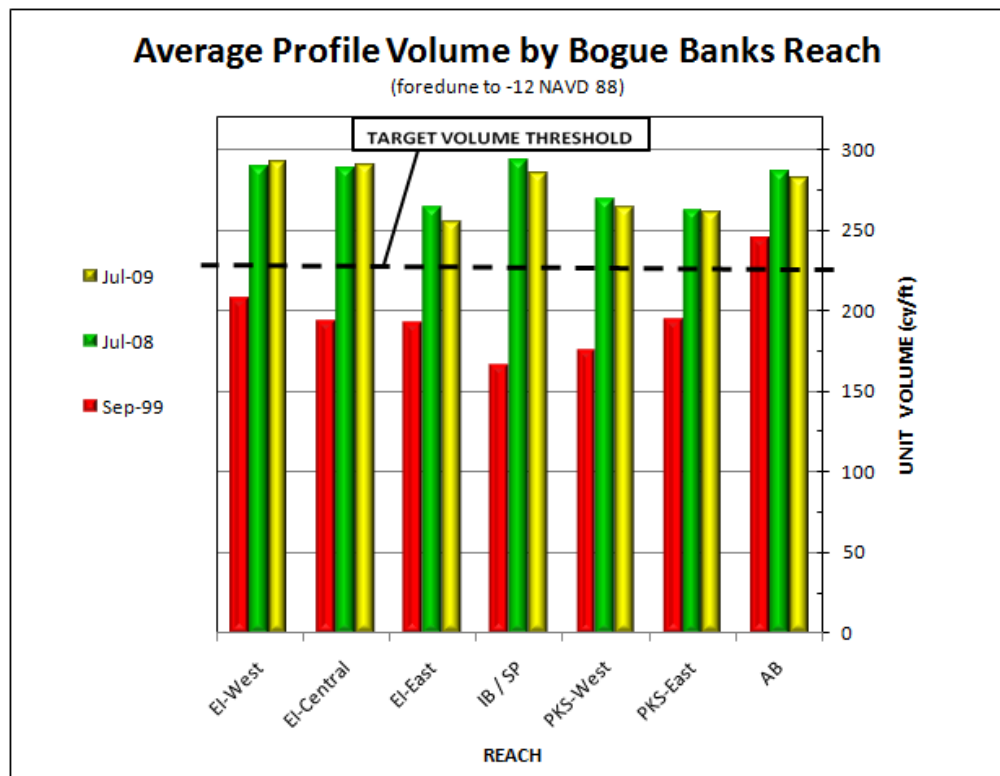


Fig. 2 – Average profile volumes for September 1999, July 2008, and July 2009 for seven oceanfront reaches along Bogue Banks. A target volume threshold of 225 cubic yards per linear foot (cy/ft) was established in 1999 as a benchmark for beach health.

2009 also marks the ten-year anniversary of hurricane *Floyd* and as Figure 2 indicates, the volume of sand residing along the entire island is significantly higher than a decade ago, and is attributable to the many beach nourishment projects that have been constructed since 2001. The entire island also substantially meets our “target minimum volumetric threshold” established for Bogue Banks. The target minimum volumetric threshold is simply an average volume of sand per linear foot that is considered as a management benchmark – beaches with more sand than the target volume is advantageous. Beaches with less sand residing in any of the management reaches is obviously a cause for concern (225 cubic yard/linear foot is the benchmark).

The target volume was modeled after Atlantic Beach that has been a traditional recipient of beach nourishment associated with the dredging of the Morehead City Harbor well before *Floyd*. Quite simply, immediately after *Floyd* we noticed Atlantic Beach was relatively unscathed while the remaining island communities sustained significant dune erosion and property damage. As the red bar (1999) in Figure 2 demonstrates, the average volume of sand in Atlantic Beach was significantly higher than the adjacent beaches and was consequently selected as a beach health benchmark.

Since 1999 Bogue Banks has *gained* roughly 6.46 million cubic yards of sand, which again is mostly attributed to the many beach nourishment projects that have been constructed along the island beginning in 2001. A total of approximately 10.3 million cubic yards of sand have been placed on Bogue Banks as a result of beach nourishment, meaning that 3.8 million cubic yards have since eroded off the beach (10.3 million placed on the beach *minus* 6.46 million cubic yards remaining). If we average the volume loss (3.8 million cubic yards) across the entire 120,961 feet of Bogue Banks oceanfront, the island has lost sand at a rate of almost 3 cubic yards per linear foot per year (-3 cy/ft/yr) since 1999 (a 10-year window). This number is essentially our “background erosion rate”. The background erosion rate averaged across the entire island and reported for the 2009 – 2008 timeframe was -4 cy/ft, again close to our background rate of 3 cy/ft/yr.

### **Shoreline Change**

Another and more common/familiar measurement of beach health is shoreline change. To quantify and consistently compare shoreline positions over time, the “shoreline” is determined as the mean high water elevation established at +1.1 feet above sea level. This measurement parameter is sometimes referred to as a “datum-derived shoreline” as we can numerically determine where along a profile the +1.1 feet elevation resides rather than depending upon more subjective determinations that are required by other methods, such as aerial photography.

Utilizing a datum-derived shoreline, the average net shoreline change from July 2008 and July 2009 for Bogue Banks was 24 feet landward (Fig. 3). Shoreline positions have reacted to an influx of nourishment sand over the past several years and movement of that sand in the alongshore and cross shore directions. Sand may be moving east or west along the beachfront or in some places, could be migrating in the offshore direction or conversely even welding itself to the visible dry beach. Emerald Isle – East experienced the largest average shoreline retreat in 2009 (-43 feet) and Atlantic Beach had the smallest shoreline recession value (-12 feet). Importantly and as evidenced this year, shoreline losses or gains don't always equate proportionally to volume changes as sand moves above and below the +1.1 mean high water elevation. The 2009 average shoreline recession value may be 24 feet towards land as measured at the +1.1 feet elevation, but some of the sand may have shifted just below the +1.1 feet mean high water mark, and therefore the volume change across the entire dry sand *and* underwater profile could be very little. Indeed that

appears to be the case for 2009 – as mentioned above, the average volume loss over the past 10 years is 3 cy/ft/yr and the 2009 - 2008 value was 4 cy/ft/yr.

Reach	Profiles	Linear Feet	Average Shoreline Change (July 2008 - July 2009)	Average Volume Change (July 2008 - July 2009)
Emerald Isle - West	8 - 25	22,344	19 feet landward (-)	3 cubic yards / linear foot
Emerald Isle - Central	25 - 36	15,802	22 feet landward (-)	2 cubic yards / linear foot
Emerald Isle - East	36 - 48	13,220	43 feet landward (-)	-10 cubic yards / linear foot
Indian Beach/Salter Path	48 - 58	12,850	42 feet landward (-)	-8 cubic yards / linear foot
Pine Knoll Shores - West	58 - 65	9,063	20 feet landward (-)	-5 cubic yards / linear foot
Pine Knoll Shores - East	65 - 76	14,815	17 feet landward (-)	-1 cubic yards / linear foot
Atlantic Beach	76 - 102	26,176	12 feet landward (-)	-4 cubic yards / linear foot
Ft. Macon State Park	102 - 112	6,691	37 feet landward (-)	-21 cubic yards / linear foot
<b>Totals or Average =</b>	<b>105</b>	<b>120,961</b>	<b>24 feet landward (-)</b>	<b>- 4 cubic yards / linear foot</b>

Fig. 3 – Average shoreline and volume change from July 2008 to July 2009 for eight oceanfront reaches positioned along Bogue Banks.

This is obviously a very brief review of the monitoring report, but don't hesitate to visit <http://www.protectthebeach.com/Monitoring/monitoring.htm> if you would like more information - the entire report by sections is available on-line approximately half-way down the webpage.