DIVISION OF COASTAL MANAGEMENT TO STUDY CURRENT LONG-TERM EROSION RATES ADJACENT TO TERMINAL GROINS

North Carolina Department of Environmental Quality
Division of Coastal Management

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Introduction

Session Law 2017-10 (S131) Section 3.16 directs "the N.C. Division of Coastal Management (DCM) of the Department of Environmental Quality (DEQ), in consultation with the Coastal Resources Commission (CRC), shall study the change in erosion rates directly adjacent to existing and newly constructed terminal groins to determine whether the long-term erosion rates, currently in effect in accordance with 15A NCAC 07H .0304 (AECs within Ocean Hazard Areas), should be adjusted to reflect any mitigation of shoreline erosion resulting from the installation of the terminal groins." Long-term beach erosion rates established under 07H.0304 are updated by the DCM about every five years, and are used to determine construction setbacks for oceanfront development.

Terminal Groins

Terminal groins are hardened structures used to mitigate shoreline erosion at inlets. North Carolina currently has three; 1) Pea Island at Oregon inlet, constructed in 1991; 2) Fort Macon State Park at Beaufort Inlet, lengthened to its current size in 1970; and 3) Bald Head Island at Cape Fear Inlet, constructed in 2015.

These structures are often constructed using large granite boulders which are placed at the terminus of a barrier island, generally parallel to the inlet shoreline and perpendicular to the ocean shoreline. By design, they are typically anchored landward of the shoreline and extend into the nearshore to act as a barrier to hold or trap sediment on the updrift side of the groin. They are designed to reduce beach erosion, reduce the frequency of beach nourishment projects, or slow inlet migration (NC DCM, 2016). The success of a terminal groin in mitigating erosion while minimizing adverse downdrift effects is dependent on a variety of factors, such as (NC CRC, 2010):

- Size and scale of terminal groin structure
- Wave energy distribution and wave approach along the coast
- Rates and direction of sediment transport
- Tide ranges
- Wind regime and effects of vegetation

- Effects of major storms
    - Frequency and track
    - Storm surge elevations
    - Wave energy
    - Erosion and depositional trends
- Historical morphological changes of the shoreline and inlet system
- Bathymetric changes of the inlet and nearshore
- Sand circulation patterns at tidal inlet
- Process of inlet sediment bypassing
    - Geological framework controls on inlet stability and nearshore sediment supplies
- Dredging history to include disposal sites
- Sea level trends

Terminal groins are constructed in a very dynamic and high-energy coastal environment, and when properly designed and sited, these structures can serve as an effective mitigative strategy when combined with regular beach nourishment (NC CRC, 2010). However, the potential negative consequence of increased erosion on the downdrift shoreline still remains, as these structures have been shown to interrupt the natural movement of sediment (Riggs and Ames 2009). For this reason, when the N.C. General Assembly revised the Coastal Area Management Act (CAMA) in 2011 and 2013 to allow for the permitting of up to six terminal groins, conditions were included that require those communities constructing terminal groins to have an inlet management plan that includes a beach fill maintenance strategy, and mitigation measures in the event of any adverse impacts as measured during post-construction monitoring of adjacent shoreline positions (see § 113A-115.1 Limitations of Erosion Control Structures).

Long-Term Erosion Rates:

For nearly 40 years, North Carolina has been measuring rates of oceanfront shoreline change for the purpose establishing “setback factors,” used in the siting of oceanfront development. Although site-specific studies occurred prior to 1979 (Wahles, 1973), it wasn’t until 1979 that DCM

completed its first erosion rate study (Tafun, Rogers, and Langfelder, 1979). DCM has subsequently provided update studies approximately every five years (NC DCM, 2004, 2011).

DCM defines "long-term erosion rates" to be the amount of change in the shoreline's position over a period of at least fifty years. The rates are calculated by digitizing the shoreline position from orthorectified aerial photography, measuring the distance between an early and most recent digitized shoreline, then dividing distance by time to calculate average rates of change. DCM uses the most advanced mapping and computation software available; however, the fundamental techniques for measuring beach erosion using data derived from aerial photographs were first developed and applied to the North Carolina coast in 1968 (Stafford, 1968).

It should be noted that the calculations used by DCM to document long-term shoreline change are influenced by human alterations, including beach nourishment projects and terminal groins, since stabilized shoreline positions may be similar to the historic shoreline position. This can mask the underlying rate of erosion and any changes in beach profiles. For example, calculations for barrier island communities such as Atlantic Beach, Pine Knoll Shores, Indian Beach/Salter Path, Emerald Isle, Wrightsville Beach, Kure and Carolina Beaches, Caswell Beach, and Ocean Isle all demonstrate lower than average long-term erosion rates when compared to beaches that have not previously received sand placement projects.

Both the Oregon Inlet and Beaufort Inlet terminal groins have demonstrated the ability to reduce inlet migration and erosion rates when accompanied by regular beach nourishment (NC CRC, 2010). However, given the age of the Bald Head Island terminal groin, it is still too early to accurately determine whether long-term erosion rates adjacent to that terminal groin have changed (Bald Head Island, 2017). Short-term changes in shoreline positions are currently being monitored through the associated "inlet management plan" and in accordance with permit requirements.

Conclusion

Terminal groins have an impact on natural ocean and inlet shoreline positions; they may be successful in slowing erosion, or may cause adverse impacts on downdrift shorelines due to interruption of the natural sediment transport system. Due to the many dynamic factors that

influence success or failure of these structures, only long-term monitoring can reveal an individual structure's influence on the natural system. Therefore, it is recommended that DCM continue to monitor shoreline change and update long-term erosion rates adjacent to terminal groins every five years for use in calculating beachfront construction setbacks.

DCM is currently in the process of calculating inlet and oceanfront shoreline change rates coast-wide. This analysis will include the areas adjacent to any newly-constructed terminal groins, and any change in long-term erosion rates will be detected and applied to construction setback factors in accordance with 15A NCAC 07H .0304. DCM anticipates presenting the results of this analysis to the CRC in 2018.

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