

To Whom it May Concern,

My name is Steve Johnson and I am a resident of the East End of Ocean Isle Beach. I spoke at the November CRC meeting regarding shortcomings around the Inlet Hazard Area Method (IHAM).

I am writing to express my objection to both the adoption of the new Inlet Hazard Area maps, setback factor determination methodologies and rules 15A NCAC 09H.0304, 15A NCAC 09H.0306, 15A NCAC 09H.0309 and 15A NCAC 09H.0310.

I am extremely grateful that the board decided to delay implementation as well as the willingness to both hear out public comment and adapt rules recommendations accordingly. It is critical that the rules are written in a way that is reflective of both the board's intent and the will of the public.

The foundation of my objection is numerous issues within IHAM. The Rules Commission § 150B-19.1(5) calls for rules to be based on **sound**, reasonably available **scientific**, technical, economic, and other relevant **information**. Page 17 of the 2019 Inlet Hazard Area details the use of and touts the benefits of using Linear Regression to determine the linear regression rate (LRR) of shoreline change.

Linear regression is a statistical tool that uses a *single* continuous factor to predict another *single* continuous factor (<https://online.stat.psu.edu/stat462/node/79/>). 1.0 Introduction of the IHA (page 8) states "Inlet shorelines are constantly moving under the combined and powerful influences of nature (tide, wind, current and waves) and engineering practices (dredging, beach nourishment, inlet closure/relocation, erosion control structures)." In this introductory statement 9 unique contributing variables are identified. This statement alone nullifies the scientific use of Linear Regression.

The IHAM utilizes time as predictive factor to shoreline position. The resulting slope of the best fit line established the linear regression rate LRR of shoreline change (page 17). While this is an accurate model of shoreline change within the time period of the model, using that same model to forecast outside of the time range of the model is called extrapolation. Regression models should not be used to extrapolate beyond the range of the data. The model is valid only for predictor values for which the data has sufficient values. Below are three links detailing why extrapolation is not scientifically sound.

- <https://online.stat.psu.edu/stat501/lesson/12/12.8>
- <https://jamanetwork.com/journals/jama/fullarticle/194959>
- <https://www.oreilly.com/library/view/practical-statistics-for/9781491952955/ch04.html>

In addition, 2.6 Modifications to the Computer Inlet Hazard Area admits that "some inlets required additional modification based on how well the computed IHA fit the unique character of each inlet." Going on to state that "the Panel used their professional knowledge of each inlet to aid in the delineation of the IHA boundaries." This is an admission that the IHAM is flawed and where a pre-determined conclusion is not reached, the panel will override the model with opinion. In the case of Shallotte Inlet at Ocean Isle, the opinion of the IHA was determined in 2019- prior to the completion of the Terminal Groin. This lack of relevant information to establish the Shallotte Inlet IHA again breaks 150B-19.1(5).

In conclusion, the IHAM inappropriately utilizes simple single factor linear regression in a multi-factorial situation and relies on unsound extrapolation to predict future model outcomes. When the model provided unreliable/unrealistic results, the Panel overrode these results with opinion. This opinion is now three years old and is outdated. The IHAM does not meet 150B-19.1(5) and therefore rules 15A NCAC 09H.0304, 15A NCAC 09H.0306, 15A NCAC 09H.0309 and 15A NCAC 09H.0310 must not be adopted prior to establishing a sound IHAM and amending said rules per public input.



Steve Johnson

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