SHORELINES – February 2010

As presented to the *Island Review* magazine

What is sea level?

The shoreline of course is that rare place in the world where three of the four "spheres" of the Earth meet – the atmo*sphere* (air), the hydro*sphere* (sea), and the litho*sphere* (land). P.S. – the biosphere is the fourth sphere. One could also argue that in most places, the boundary of the sea is the least static of all the spheres, i.e., sea level is constantly moving up or down – everywhere.

Also, considering we live on the Earth's surface and 71% of this surface is water (~95% of which is sea water) and roughly 40% of the world's population lives within ~60 miles of the sea; we tend to care about the current, past, and future positions of sea level for a host of reasons. These reasons cover a vast spectrum of socio-economic needs including agricultural production, sustainable water supply, petroleum hydrocarbon (oil & gas) formation and burial, marine mineral and rock extraction, tourism, coastal heritage, and of course shore protection to name a few.

And finally, the topic of global warming and its affect on sea level is dominating everyday media and blogs all over the internet. It's an important phenomenon impacting barrier islands like Bogue Banks and others along the gentle sloping southeast Atlantic coastal plain because increasing temperature causes a rise of sea level due primarily to the melting of continental ice packs (or glaciers) and thermal expansion of seawater. That's as far as we'll dive into that subject for now.

So transitioning smartly into our next segment – if sea level is so important, then how do we define it? The following is a delicate attempt to answer this question.

Glacio-Eustatic Sea Level - is the portion of sea-level movement (rise or fall) only attributable to the melting or uptake of water in the world's glaciers.

Relative Sea Level – the measurement of the sea surface incorporating glacial melt/uptake and other dynamics such as land movements and sediment supply. So for instance, in areas where mountain building is occurring, the land may be rising at a rate close to that of glacio-eustatic sea level. Thus the relative sea-level surface is balanced and the rate of movement is close to zero. Conversely, in areas where land is subsiding (sinking), sea level may be considered "rising" at an enhanced rate because glacio-eustatic sea level is rising ***and*** the land is sinking.

These first two definitions are obviously more "earth-process" driven. The next series of terms are more datum focused, meaning a base elevation is used as a reference to reckon heights or depths. When discussing sea level, a series of tidal datums (not the word "data") are used as standard elevations, which are defined by a certain phase of the tide. The following are just a few definitions. Importantly, these tidal datums are normalized to the **National Tidal Datum Epoch (NTDE)**, which is a specific 19-year period adopted as the official time segment over which tide observations are taken and reduced to obtain mean values. For instance, "mean high water" along Bogue Banks is +1.1 feet above sea level using the NAVD 88 coordinate system. The present NTDE is 1983 through 2001. So without further *adieu*…

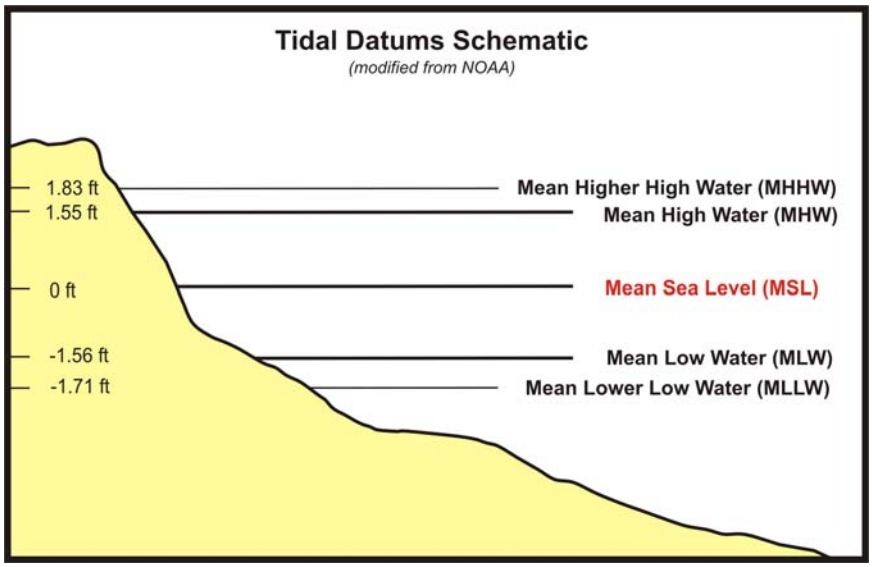
Mean High Water (MHW) – is the average of all the high water heights observed over the NTDM.

Mean Higher High Water (MHHW) – is the average of the higher high water height of each tidal day observed over the NTDM. Remember all tides are not created equal.

Mean Low Water (MLW) – is the average of all the low water heights observed over the NTDM.

Mean Lower Low Water (MLLW) – is the average of the lower low water height of each tidal day observed over the NTDM.

Mean Sea level (MSL) – is the arithmetic mean of hourly heights observed over the NTDM.



Another realm of sea-level height measurement, and an important one for communities along the Atlantic Coast, is related specifically to water levels produced by low pressure systems (e.g., tropical cyclones) out at sea – storm surge and storm tide.

Storm Surge - is the increased height of water attributable to a low pressure system pushing water onshore, e.g. 8 feet of storm surge.

Storm Tide - is the storm surge *plus* the height of the predicted "normal" tidal cycle above mean sea level. E.g., the storm surge was 8 feet but with the high tide that afternoon, the storm tide height was 10 feet above mean sea level.

From a policy perspective, this little summary of sea level purposely coincides with a forum the N.C. Department of Environment and Natural Resources (NCDENR) is hosting on Jan. 14th and 15th regarding Sea-Level Rise in North Carolina. Importantly, the forum includes a release of a preliminary report detailing current and projected rates of sea-level rise in the State. The report will project sea-level rise ranges in 25-year time slices through 2100 (i.e., 2025, 2050, 2075, & 2100). NCDENR will likely use these metrics as the foundation for future policy development and adaptation planning.