South Padre Island Beach and Dune Assessment Project

March 2021 Progress Update

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Summary Overview:

Subcontracts

- The work order with BIO-West is in the final stages of approval
- Naismith Marine is tracking weather and actively looking for a survey window

Task 1

- Shorelines and shoreline change results requested from BEG – have still not received these data
- Wave and water level analyses completed
- Dune crest and toe, and beach width extracted from time series of profiles
- Beach volumes calculated for all profiles
- Conducted lidar surface subtraction for entire island
- Completed digitizing vegetation lines; initial analysis of
- Initial data analysis and interpretation begun

Progress Narrative: Beach Profile Analysis

An assessment of the overall morphology of the beach profiles at SPI reveals a relatively "typical" barrier island morphology - dunes and beaches exposed sub-aerially and a well-formed and persistent offshore bar present in the underwater portion of the beach profile. All beach profiles exhibit a double-bar system with the exception of CBI-1 and many have three offshore bars (Figure 1), the outermost of which is in water depths of 10 ft or greater, and varies considerably alongshore in its distance from the shoreline. The presence of multiple offshore bars is generally indicative of an ample sediment supply, much of which is likely derived at SPI from the almost yearly beach nourishment projects.

Initial analysis of the long-term (Feb 1995- May 2020; 25 yr) beach profile change identifies that there is not a consistent erosional or accretional trend in the beach profiles. In some locations, the entire profile has eroded landward (CBI-1 and 2), but the majority of the profiles have shifted seaward (prograded) over the 25 years covered by the study.

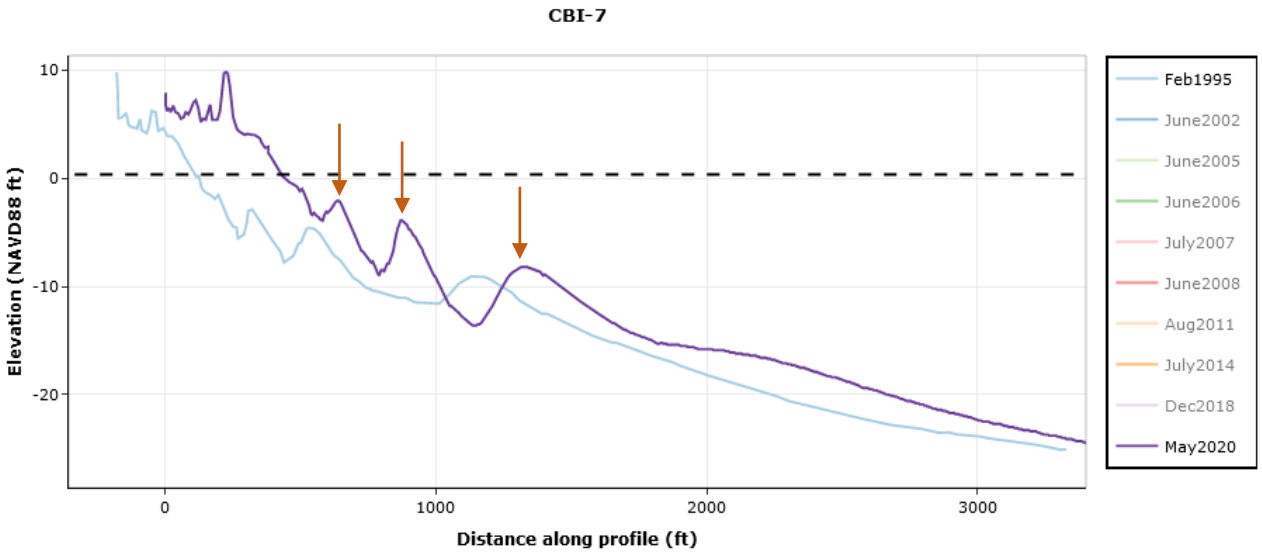

Figure 1. Beach profile CBI-7 shown for 1995 and 2020 (25 years). The dashed horizontal line is the operational mean high water elevation. The profile is substantially seaward (prograded) in 2020, as compared to 1995, and overall appears to have an increased volume. Also note the triple bar system that is prevalent along much of SPI, shown by the arrows.

Progress Narrative: Beach and Dune Analysis

A variety of metrics that can describe changes to the beach and dunes through both time and space were identified and extracted from the time series from the 25 CBI profiles. Metrics include dune crest and dune toe elevations, beach width, profile volumes. The initial analysis, similar to the profile analysis, first focused on how the metrics changed over a longer period. In this case, 2002-2020 was chosen, as there are unresolved QA/QC issues with the 1995 metrics as of the time of this report. Figure 2 shows the alongshore variation in the dune crest and toe elevations over 18 years. The dune crests were more similar between the two time periods in the southern portion of the area but show significant diversion to the north. Overall the mean crest elevation for 2020 was 1.8 ft higher than 2002. The dune toe elevations were highly variable, especially in 2002. The extremely high dune toe values in profiles 6, 12, and 15 may be the result of some artificial dune building or artifacts in the data that still need to be resolved. In 2020, the dune toe was more stable alongshore than in 2002, and the means for both years were very similar.

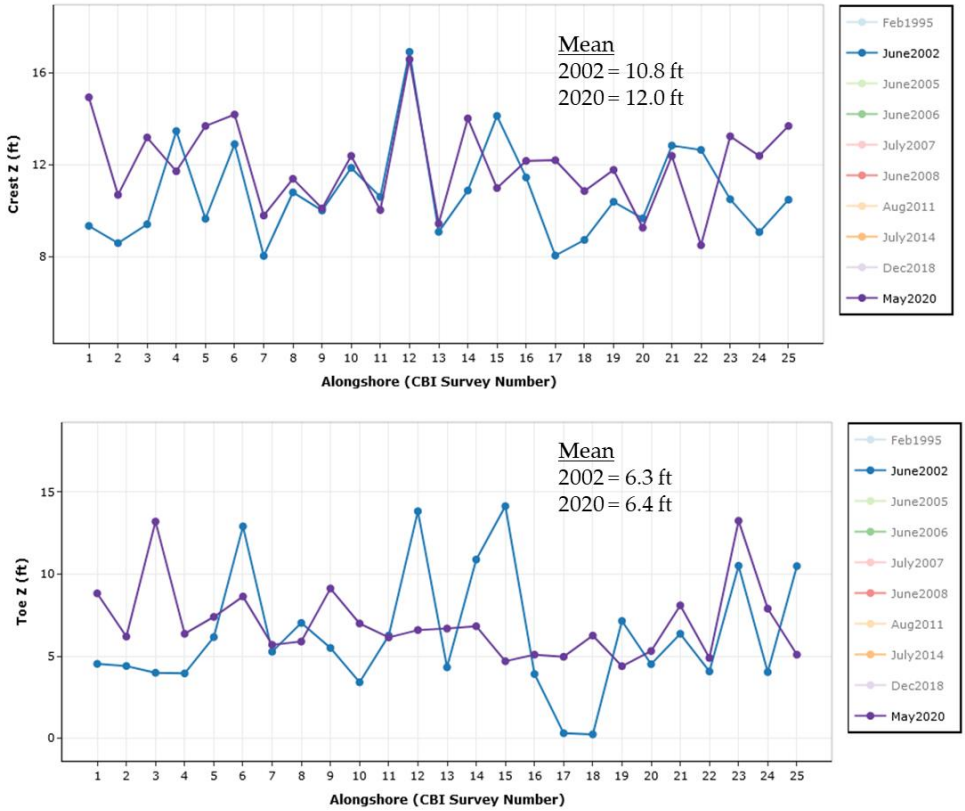

Figure 2. Dune crest (upper plot) and dune toe (lower plot) elevations as they vary along shore on the CBI profiles 1-25.

For the beach with measurements, the alongshore variation and the variation between individual profiles was substantial. In some cases, there is a reverse correlation wherein profiles with wide beaches in 2002 had narrow beaches in 2020, for examples CBI-7, 8, and 12 in Figure 3. In other locations, the widths are similar for the two time periods. Variations like these can be attributed to natural processes, sometimes in the formation of beach cusps in which the beach forms regularly spaced embayments and promontories in the alongshore directions. The results indicate that the mean beach with in 2002 was greater than 2020.

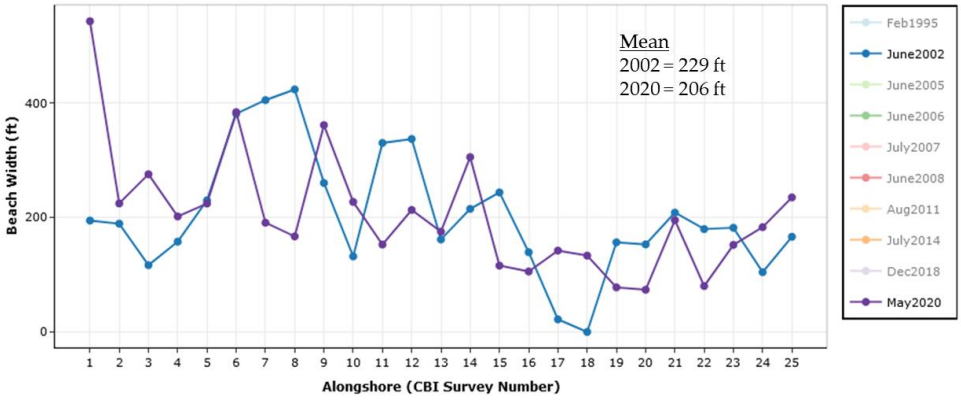

Figure 3. Beach width variations alongshore and over time.

The final metrics examined to date are the volumes of the profiles. Again, focusing on the changes from 2002-2020 (Figure 4). The comparisons are striking, both between the two regions of the profile, onshore (above 0.34 ft) and offshore (below 0.34 ft). In 2020, the onshore beach has significantly greater volume than in 2022. This is most likely the impact of the ongoing beach nourishment program and demonstrates why examining a variety of metrics is important to understand system dynamics and health. Other interesting, although not unexpected, findings are the lack of significant changes in the offshore portion of the profile, which tends to be less dynamic and often only active during larger storm events with the exception of the nearshore bar systems. Note also that the offshore volumes as compared to the onshore volumes are substantially higher. This is primarily because the largest portion of an entire beach profile is below the water, extending out to 30-40 foot water depths, and the onshore portion is much narrower.

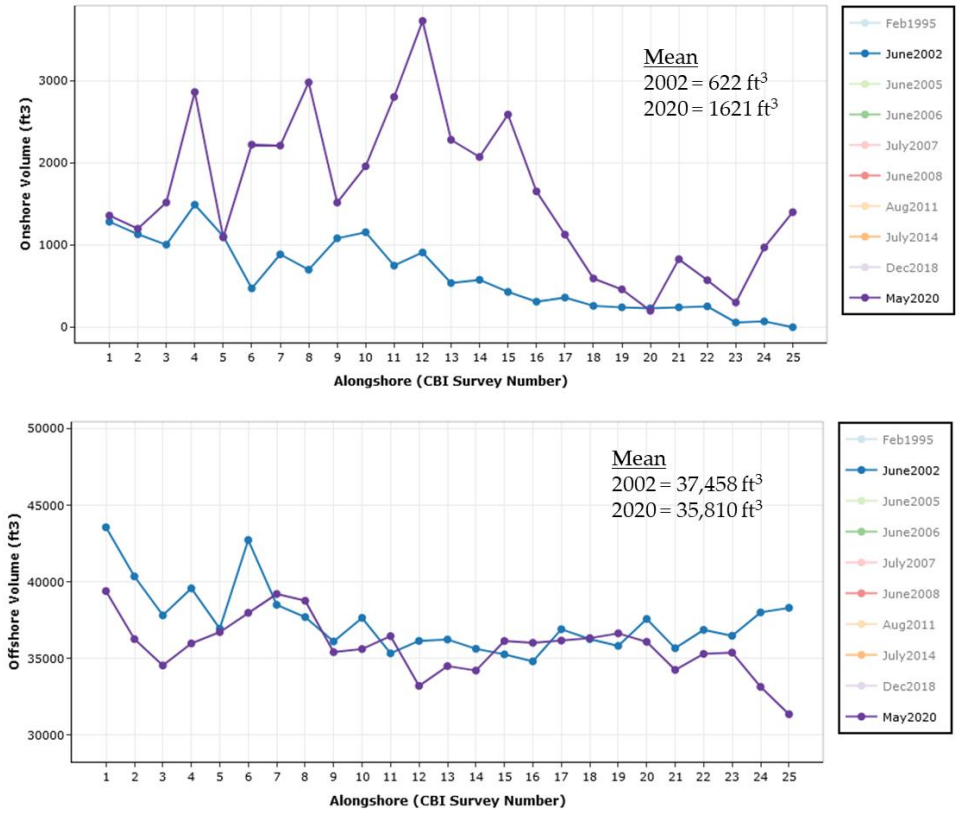

Figure 4. Alongshore volumes of the beach at each profile for 2002 and 2020. The onshore portion of the profile is shown in the upper plot and the offshore in the lower. Note that the vertival scales are different on the plots.

Progress Narrative: Vegetation Analysis

Vegetation lines were digitized from 2002, 2007, 2016, 2020 from available aerial photography (Figure 5). The 2020 line only extends for approximately the southern half of the study area from Brazos Santiago Pass to E. Aries Dr. due to the limited extent of the aerial imagery from 2020. The remaining three dates cover the entirety of SPI, for a time series of 14 years. In 2002, the vegetation line is consistently landward as compared to the later years, thus the vegetated dune area is much narrower and closer to the building line than in future years. In some locations, for example the section of coast from the Seabreeze Beach Resort (E. Carolyn Drive) to the Inverness Condos (Coranado Dr,), the vegetation line is right up against the buildings or nonexistent (Figure 6). Between 2002 and 2007, the vegetation line propagated significantly seaward, resulting in a more robust, wider vegetated dune system. The typical widening of the vegetated dunes from 2002-2007 was approximately 35 feet.

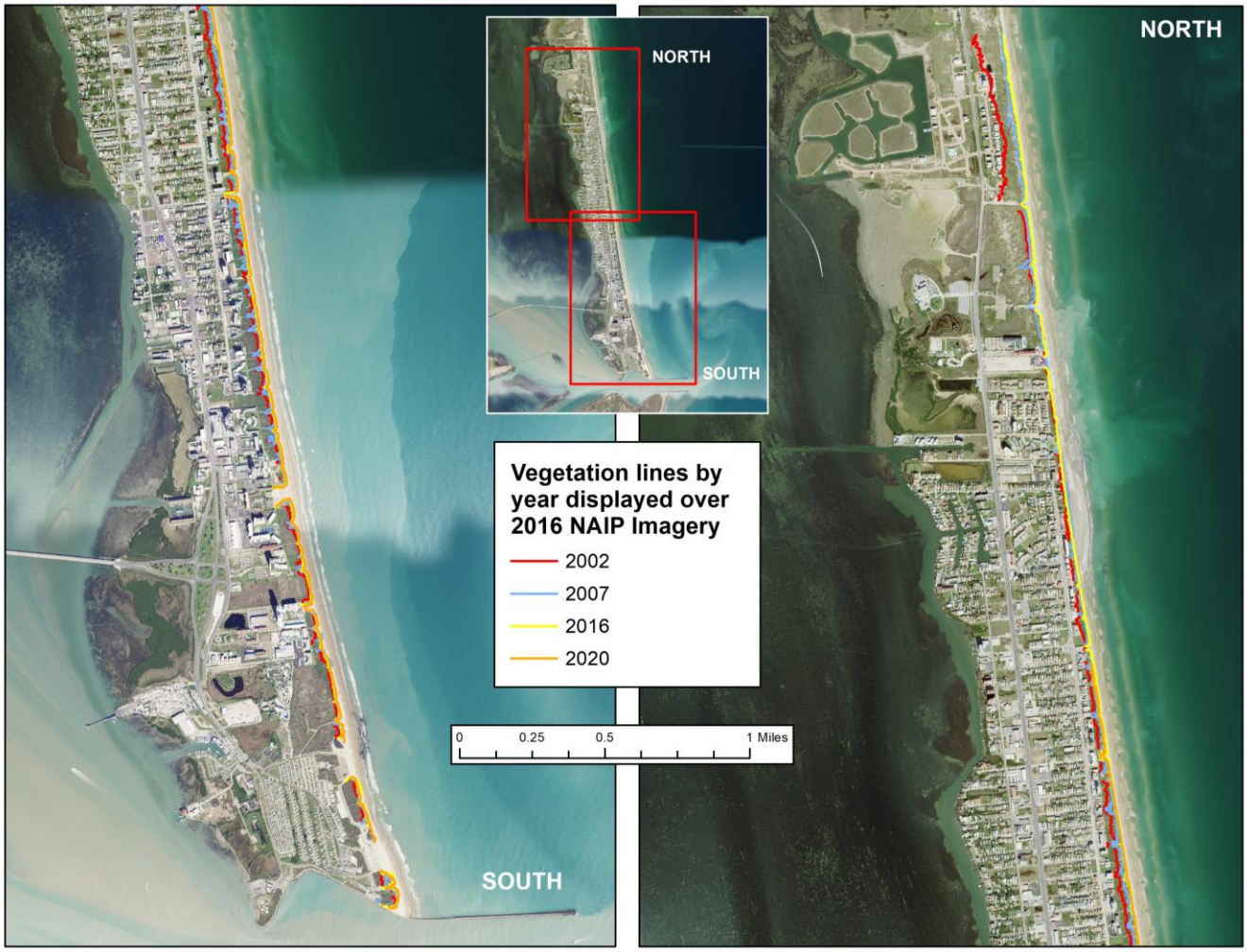

Figure 5. SPI study area showing the vegetation lines from 2002 – 2020. Note the 2020 line only covers the southern half of the study area due to limited coverage of the 2020 aerial imagery.

Although the beaches and dunes at SPI were heavily impacted in 2008 by Hurricanes Dolly and Ike, the location of the vegetation line, dictated by the width of the vegetated dune field, in 2016 and 2020 (where it is

available) is relatively stable and consistently seaward of it's 2007 position (Figure 7). After the 2008 hurricanes, the City ramped up an effort to not only built and protect the beach and dunes but to develop a rigorous planting effort, adding thousands of specialty native dune plants to help stabilize the dune field and between 2012 and 2014 planted over 180,00 plants. These efforts have clearly had a major impact in holding the dune line and providing the City and oceanfront property added protection in the form of a healthy, wide dune field (Figure 8).

Figure 6. Changes to the vegetation line from 2013 to 2016 in the area of SPI adjacent to the Brazos Santiago Pass show substantial loss of vegetation due to human activities.

Figure 7. Portion of SPI that is representative of much of the study area in that the vegetated dune field has continued to prograde, becoming wider, over the time period of the analysis.

Figure 8. Photo from Google earth (credit: Wester Van) showing wide, well-vegetated dune field that presently exists at SPI.