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DISCUSSION

Rejoinder to: Pilkey, O.H.; Young, R. S.; Thieler, E. R.; Jacobs, B.S.; Katuna, M.P.; Lennon, G., and Moeller, M.E., 1996. Reply to Houston, J.R. A Discussion of the Generalized Model for Simulating Shoreline Change (GENESIS). *Journal of Coastal Research*, 12(4), 1044–1050.

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INTRODUCTION

YOUNG *et al.* (1995) presented a lengthy criticism of the GENESIS shoreline-change numerical model, but HOUSTON (1996) noted the criticism was devoid of concrete supportive evidence. Despite lack of evidence, YOUNG *et al.* (1995) reached the strong conclusion that "Future use of GENESIS for design of coastal engineering projects should not be allowed." The Folly Beach Project, South Carolina, was the only specific example they cited of what they claimed was a failure of GENESIS in a practical application.

HOUSTON (1996) provided quantitative beach-width and sand-volume monitoring data and 16 photographs covering the length of the Folly Beach fill to demonstrate that claims by YOUNG *et al.* (1995), that little beach-nourishment sand remained at Folly Beach were simply not true. HOUSTON (1996) also showed that GENESIS predictions of fill fate up to that time were reasonable.

PILKEY *et al.* (1996) continue the YOUNG *et al.* (1996) criticism of GENESIS, but unlike YOUNG *et al.* (1996) provide evidence they believe support their criticism.

UPDATE ON FOLLY BEACH PROJECT PERFORMANCE

PILKEY *et al.* (1996) unlike YOUNG *et al.* (1995) present some quantitative data on fill performance at Folly Beach, and these data largely agree with data that HOUSTON (1996) presents and are at odds with the assessment of fill performance by PILKEY *et al.* (1996) and Dr. Pilkey in other publications. PILKEY *et al.* (1996) present an average subaerial beach width of 35 m and note, "These numbers are closely in line with what Houston says the project should be if the design predictions were correct and if GENESIS correctly predicted beach behavior." They qualify this, however, by saying HOUSTON (1996) used a definition of beach width that gives an average beach width of 43 m, but their definition would give an average beach width of 32 m (PILKEY *et al.* (1996) sometimes say the average beach width is 32 m and sometimes 35 m). GENESIS predictions were made with the beach-width definition presented by HOUSTON (1996) therefore, the comparisons are consistent. In any case, we can argue one definition versus the other and 43 m versus 32 m, but the fact remains that even a beach width of 32 m (the design beach width is only 23 m) is hardly the beach described in multiple publications by Dr. Pilkey. For example, Dr. Pilkey was quoted one month after project completion as saying, "It's disappearing. They're pumping as we speak, and when they're finished, there will be no beach. This is the worst case I've ever seen." (CLEELAND, 1993). PILKEY and DIXON (1995) write, "At the time of writing, two years post-replenishment, the Folly beach steadily disappears. Looking to the north and south from the eight floor of the Holiday Inn, the view is much as it was pre-replenishment." They also say, "In 1995, however, with little dry beach remaining and the storm berm largely gone . . ." However, HOUSTON (1996), presented monitoring data and 16 pre- and post-project photographs taken in August, 1995 (2 ½ years after the project was completed and six months after the statement by PILKEY and DIXON, 1995) that prove their statements were wrong. The beach-width data in PILKEY *et al.* (1996) support HOUSTON (1996). PILKEY *et al.* (1996) hedge their earlier statements by saying, "Of course sand remains from the project; the community will continue to benefit from it for a few more years, barring any major storm events."

The most recent 3-year monitoring data presented by EBERSOLE and NEILANS (1997) show that "As of January, 1996, the average beach width was 47 m (average added beach width was 32 m). Beach widths actually increased between January 1995 and January 1996 over much of the project reach." Again, observed beach behavior hardly reconciles with the statements by PILKEY and DIXON (1995) that the project had little dry beach remaining, the storm berm was largely gone, and the project looked little different than pre-fill. In fact, these statements by PILKEY and DIXON (1995)

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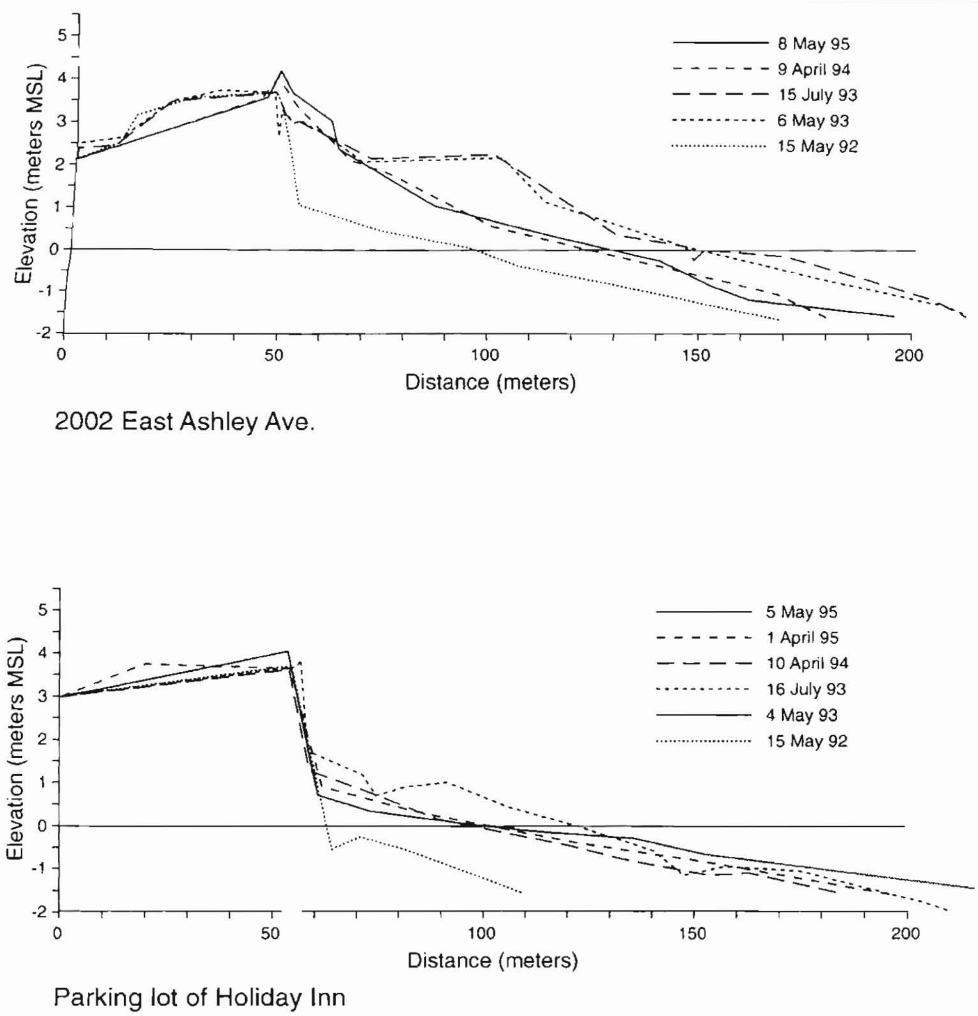

Figure 1.

are contradicted by the average beach width given as 32 m to 35 m by PILKEY *et al.* (1996) and by Figure 1 reproduced from PILKEY *et al.* (1996) that shows most of the project as of February 1996 had beach widths greater than the design width of 23 m (note further that Figure 1 shows winter-profile data when beach widths are at their minimum). Those areas not having beach widths greater than the design width (*e.g.*, Holiday Inn and the "washout") are protected by structures offering greater protection than the fill, and these areas were predicted by GENESIS to have accelerated erosion as discussed by HOUSTON (1996).

PILKEY *et al.* (1996) note, "For reasons that are not clear, our volume measurements differ significantly from those of EBERSOLE *et al.* (1996) . . ." Actually, the reasons are clear since Figure 2 (reproduced from PILKEY *et al.* 1996) shows their calculations based on their own measurements to be erroneous. PILKEY *et al.* (1996) calculate that only 14 percent (or 283,000 cu m) of the original replenishment volume remained above low-tide wading depth. The only evidence they cite is Figure 2 that shows profiles for 2002 East Ashley and the Holiday Inn Parking lot. The profile for 2002 East Ashley Ave has a beach width of about 32 m, about equal to the average beach width cited by PILKEY *et al.* (1996). The reader can readily see in Figure 2 that about half of the sand placed remains above low-tide wading depth (15 May 92 is the pre-fill profile, 6 May 1993 the post-fill, and 8 May 1995 the latest profile used by PILKEY *et al.* (1996) to calculate the volume and percentage of fill remaining versus the 6 May 1993 profile). The Holiday Inn Parking lot profile is not representative since it covers only about 400 m of the 8,600 m and protrudes significantly seaward of the normal shoreline. However, the reader can see that more than half of the sand placed on this profile is still above low-tide wading depth. Therefore, Figure 2 shows that half or more of the sand placed above low-tide wading depth remains, not the 14% incorrectly calculated by PILKEY *et al.* (1996).

The sand volume above low-tide wading depth shown in Figure 2 is consistent with project design. HOUSTON (1991) notes that normally over half the sand placed in a fill must nourish the subaqueous beach, and the design assumes this

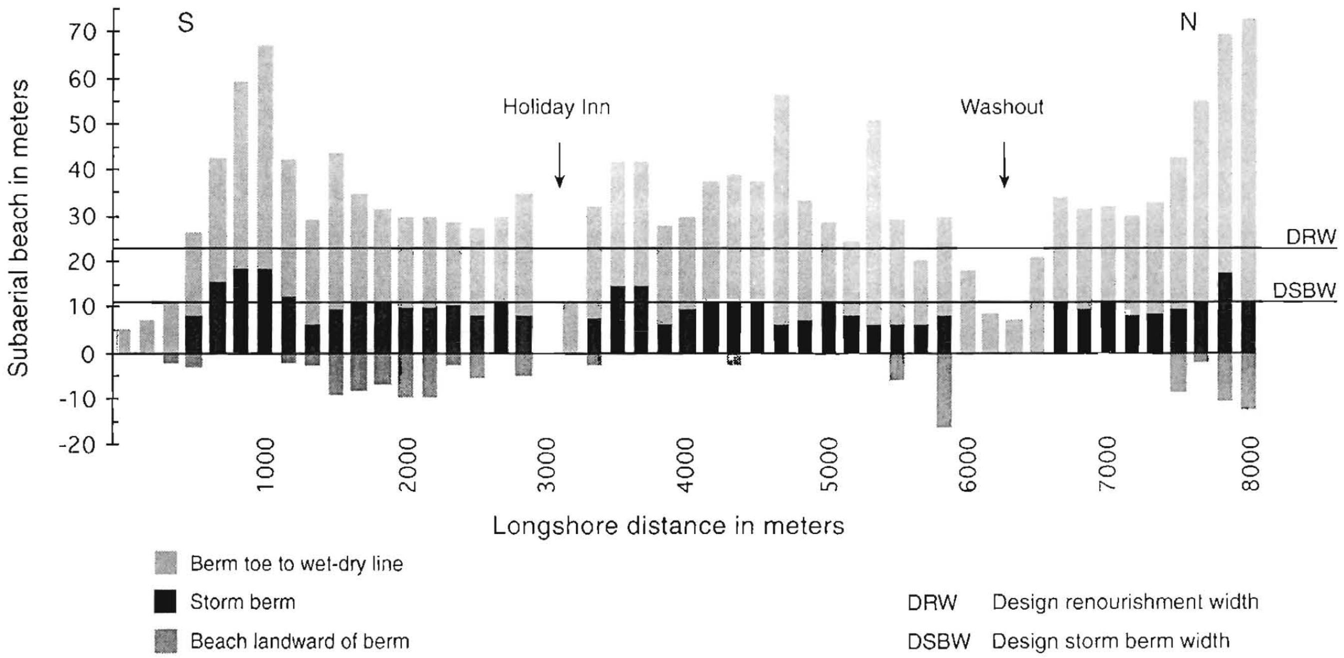

Figure 2.

sand volume will move to nourish the subaqueous beach after the first winter season. Sand is typically "stacked" on the subaerial beach during beach-fill construction (*e.g.*, see the profile for East Ashley Ave) because this is the cheapest way to place the sand. The design then expects nature to rework the sand the first year to distribute it along the entire profile down to an approximate closure depth. This natural redistribution is confirmed in Figure 2 where one can easily see that approximately half the sand placed in Figure 2 currently remains above wading depth, not $\frac{1}{7}$th the volume (as the 14% figure given by PILKEY *et al.* (1996) would indicate).

Figure 2 and a simple back-of-the-envelope calculation easily contradict the volume of 283,000 cu m that PILKEY *et al.* (1996) say is based on Figure 2. Figure 2 shows the East Ashley Ave profile length from the dune to low-tide wading depth to be about 130 m and average sand thickness of the 6 May 1995 profile above the original 15 May 1992 profile to be about 1 m. The fill's length is about 8,600 m. Sand volume, therefore, is approximately 1 m × 130 m × 8,600 m = 1.1 million cu m (or 52 percent of the 2.1 million cu m placed). This is about four times the volume that PILKEY *et al.* (1996) say they calculate using Figure 2. Actually, as seen in Figure 2, the volume above low-tide wading depth is even greater than this since some sand was placed landward of the dune and remains and the Holiday Inn profile has a greater percentage of sand remaining on the profile above wading depth.

PILKEY *et al.* (1996) maintain that they ". . . do not believe that Houston has made the case that the groins have impacted the project to a significant degree" and "The opposite is true." However, they do not cite quantitative data supporting their contention. Indeed they avoid referring to their own data that show beach widths exceed design widths for the entire groin area. The groin area is between longshore distance locations 3,300 m and 4,500 m shown in Figure 1 (from PILKEY *et al.*, 1996). Figures 13 and 14 in HOUSTON (1996) show before- and 2 ½-years-after photographs of the groin area (pre-fill photographs were taken in 1990 and post-fill in 1995). HOUSTON (1996) notes that the "after" photographs of the groin area show the "beach (is) too wide for the photograph to capture." EBERSOLE and NEILANS (1997) note that after three years, "The refurbished groins were functioning well; and the beach within the groin compartments was wide and stable."

PILKEY *et al.* (1996) claim that ". . . along 60 percent of its length, the protective storm berm is either missing or has been significantly reduced in size." However, they do not describe how they measured storm-berm size. EBERSOLE and NEILANS (1997) present several of 60 photographs that show the storm berm intact everywhere on the fill except small areas at the inlets on either fill end, in front of the Holiday Inn, and at the "washout" area where seawalls and revetments offer greater protection than a storm berm and where GENESIS predicted accelerated erosion. They note ". . . the project is intact and functioning well at all locations where the storm berm provides the major source of projection to upland structures. No storm-induced damage was experienced in the four winter seasons since construction began." PILKEY *et al.* (1996) lament that ". . . the actual recreational subaerial beach is only about half the design beach," neglecting to mentioned that the project was primarily justified economically by flooding and storm-damage-reduction benefits and not recreational benefits. The storm berm has successfully prevented damages from several storms as it finishes its fourth winter season. In addition to providing these flooding and storm-damage reduction benefits, the fill also has provided substantial secondary recreation benefits as are obvious from the photographs presented by HOUSTON (1996).

A primary issue in PILKEY *et al.* (1996) is that HOUSTON (1996) focused only on the analysis by YOUNG *et al.* (1996) of the GENESIS application to the Folly Beach Project. Actually, the crux of the criticism offered by HOUSTON (1996) is that YOUNG *et al.* (1996) are highly critical of GENESIS but offer almost no concrete evidence that can be addressed. Most of the discussion by YOUNG *et al.* (1995) was merely a description of GENESIS and a list of what GENESIS developers provided as model limitations, uncertainties, and warnings that needed to be taken into account before applying GENESIS. The Folly Beach project is the only concrete example that YOUNG *et al.* (1995) provide of what they claim to be a failure of GENESIS in a practical application. However, HOUSTON (1996) points out that, ". . . they neither provide evidence supporting their contention that the Folly Beach project is performing poorly nor evidence that GENESIS predictions used in project design are incorrect." HOUSTON (1996) focuses on their criticism of the application of GENESIS to the Folly Beach Project because it is the only specific criticism presented by YOUNG *et al.* (1995) of an actual GENESIS application.

CONCLUSION

It would be difficult to debate subtleties of models such as GENESIS when agreement cannot even be reached on simple facts relating to the Folly Beach Project—the only application of GENESIS that YOUNG *et al.* (1996) criticize. Is the view of the Folly Beach Project "much as it was pre-replenishment" with "little dry beach remaining and the beach berm largely gone" as stated by PILKEY and DIXON (1995)? Or is the true picture given by the photographs presented by HOUSTON (1996) 2 ½ years after fill placement, quantitative monitoring data after one year (EBERSOLE *et al.,* 1996) and three years (EBERSOLE and NEILANS, 1997) including photographs the length of the fill, and Figures 1 and 2 taken from PILKEY *et al.* (1996)? Again, I invite the reader to look at the photographs presented by HOUSTON (1996) taken 2 ½ years after fill placement. Trick photography is not involved. The photographs were selected to cover the fill's length with the Holiday Inn almost always in the picture for reference. The 3 ½-year appearance of the beach is much the same. EBERSOLE and NEILANS (1997) provide quantitative monitoring data that show there has been almost no change in shoreline location between the 2 ½ and 3 ½ year interval. Further, they present photographs taken in July 1996 (almost 3 ½ years after fill placement) that are similar to those of HOUSTON (1996) and show nice beaches and healthy dunes. They have 60 post-fill photographs that cover the entire fill and show that most of the beach (except the Holiday Inn, "washout," and fill ends) is in good shape. PILKEY and DIXON (1997) present two photographs of Folly Beach (one near the "washout" and the other at the fill end) and argue that, "Both their photos and ours are useless as evidence of the overall success of the Folly Beach project." There is a big difference between presenting two selected photographs and presenting large numbers of photographs that cover the length of Folly Beach and show the complete fill condition. The extensive post-fill photographs do tell the story of the performance of the Folly Beach Project, it is just not the story that PILKEY and DIXON (1997) want to hear. Finally, the only data (Figures 1 and 2) provided by PILKEY *et al.* (1996) basically agree with data and photographs presented by HOUSTON (1996), EBERSOLE *et al.* (1996), and EBERSOLE and NEILANS (1997), and contradict statements in PILKEY *et al.* (1996). That is, the arguments of PILKEY *et al.* (1996) are not supported by their own data!

If presented with concrete criticism, the GENESIS developers can do a much better job than I debating the efficacy of GENESIS. My criticism of YOUNG *et al.* (1995) is that they provide virtually no concrete criticism that GENESIS developers can address. Further, I am familiar with the Folly Beach project, and its performance to date is completely misrepresented by PILKEY and DIXON (1995), YOUNG *et al.* (1995), PILKEY *et al.* (1996), PILKEY and DIXON (1997), and CLEELAND (1993). Finally, PILKEY *et al.* (1996) provide data for Folly Beach, and the data support the observations of HOUSTON (1996) and contradict their own arguments. Using Figure 2 taken from PILKEY *et al.* (1996) the reader can readily see by eye or perform simple calculations that show the sand volume remaining above low-tide wading depth is at least 4 times greater than PILKEY *et al.* (1996), say they calculated from Figure 2. EBERSOLE and NEILANS (1997) further show that most of the remainder of the sand that is not above low-tide wading depth is on the subaqueous profile above closure depth as was assumed would occur in the fill design.

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