

# The Coastal Drain: What Can It Do or Not Do?

Per Bruun

34 Baynard Cove Road  
Hilton Head Island, SC 29928, USA

## WHAT IS THE COASTAL DRAIN?

The *Journal of Coastal Research* (Vol. 4, No. 3, 1988) contains an article by BRUUN and ADAMS that features the use of hydraulic pressure to improve channel and bypassing stability at tidal inlets. A perforated pipe buried in the bottom is provided with a pressure potential causing an upward pressure gradient increasing buoyancy forces, thereby bed load transport.

The coastal drain system does exactly the opposite. It has long been observed that drainage improves the stability of soil, and many different methods of draining exist (see *e.g.*, BRUUN, 1989, Chapter 4). That pumping and draining of water out of a beach or river bank improves its stability is known from wells found in eroding areas, as well as from mining operations on the beach. The system described by VESTERBY (1988) was tested in Denmark through government funding and was found to have a certain limiting ability in stabilizing a section of about 20 m width (70 ft) widening the high tide beach and increasing its average elevation compared to adjoining beaches. This *only refers to milder weather conditions*.

The theory is just "upside down" on the lift theory (BRUUN and ADAMS, 1988). Using the bed-load function:

$$\phi(t) = 40(\psi(t))^3$$

where  $\psi(t)$  is the so-called Shield's Parameter  
 $\psi(t) = T_o(t)/(S - 1)\rho_w D$   
 $T_o =$  the bottom shear stress (force/m<sup>2</sup>),  $S - 1 = \rho_s - \rho_w/\rho_w$   
 $\rho_s =$  density of materials,  $\rho_w$  is water density,  
 $D =$  characteristic grain diameter.

Consider the  $\Psi(t)$  factor =  $T_o(t)/(S - 1)\rho_w D$  it will be noted that a decrease in 1 (one) in the denominator making it "one minus downward pressure gradient at the surface of the beach" will be able to decrease bed load transport. The pressure gradient we speak of, however, is very small compared to the lift forces exerted upon the beach sand by up- and downrushing water making the sand move continuously. The relative importance of the downward pressure gradient decreases with the "violence" of the moving water masses. The drain, therefore, only functions under mild wave conditions when it may raise the beach width by about 20 meters (one pipe-string), plus or minus 0.5 meter depending upon weather conditions. The elevated beach, however, erodes quickly with more severe wave conditions, *i.e.* when lift forces on the beach face may be 100 times higher than the downward pressure gradient.

Advocates of the drain system claim that it raises the beach rapidly after storms. So does every beach, but by natural means. An example is given by KRIEBEL *et al.* (1986) who say that more than 50% of the eroded cross section of a beach on Long Beach Island above MSL returned within two days of fair weather following a storm. This experience is confirmed by innumerable similar observations (*e.g.* BRUUN, 1954). Proponents thus tend to overestimate the return taking too much credit for nature's own healing process. Furthermore, dune erosion which takes place regardless of the drain seems to be omitted in the materials balance calculations which only refer to the beach. If it is included the positive materials balance becomes much less and may even turn negative. Figure 1 gives an impression of the drain's actual function. On the Danish North Sea coast the total width of the eroding profile is of the order of 1,000 meters. The drain

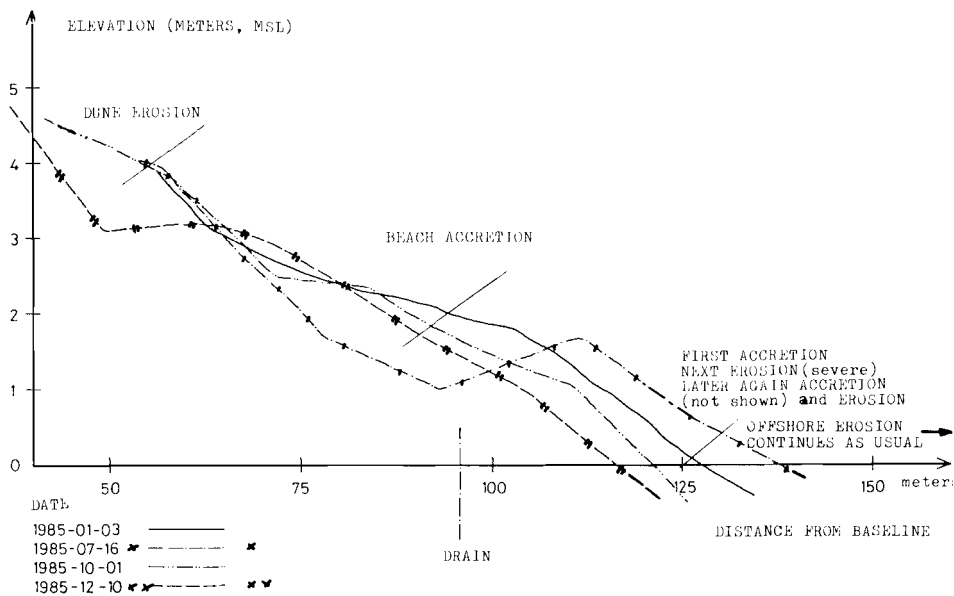


Figure 1. Profile development on test section, Danish North Sea coast example showing extreme movements. (Danish Geotechnical Institute Report, 1986, project 170 83322).

improves 20 meters of the visible section which is only 2% of the total width. On the East Coast of Florida the figure will be almost the same, while on the Gulf of Mexico it will rather be about 5%. These figures speak for themselves. The drain has a stabilizing influence on part of the beach, but it neither stops dune erosion nor general profile erosion extending offshore. And, of course, it is not a replacement for artificial profile nourishment. With a price of approximately \$250 per foot and a running cost of approximately \$10 per foot per year it becomes a rather expensive device. \$250/ft may provide 60 to 80 cubic yards of artificial fill widening the beach by 30 meters (100 ft), when the fill erodes it benefits neighboring beaches. The drain has no positive effect on adjacent beaches. It widens and raise the beach, but not permanently, and may be suitable where hotels, recreational areas, public beaches, clubs *et cetera* want a wider high tide beach and, at the same time, use drain waters for flushing canals, swimming pools, fountains, and so on. It would be unfortunate if the coastal drain was considered a suitable substitute for nourishment! Its counterpart (BRUUN and ADAMS, 1988) may be used as shown in the schematics of Figure 2.

Fluidization pumps material in slurries back to shore from offshore deposits, as they *e.g.* occur at many tidal inlets in Florida and South Carolina. As an example at Port Royal Sound (South Carolina) the system, if designed correctly, will become very cost-effective. It will also be cost-effective at many Florida coastal inlets.

Implementation of the coastal drain system requires thorough investigation of general erosion, seasonal and extreme profile fluctuations, and migrating sand waves. An optimization of its function will then be possible. A comprehensive test is in progress at Sailfish Point (Stuart), Florida.

## CONCLUSION

- (1) Under mild wave conditions the coastal drain system stabilizes beach profiles and provides a wider, higher high tide beach. The coastal drain system is useful under certain specific conditions as described.
- (2) The coastal drain does not stop beach or dune erosion during storms. It in no way is a substitute for artificial nourishment. Its effec-

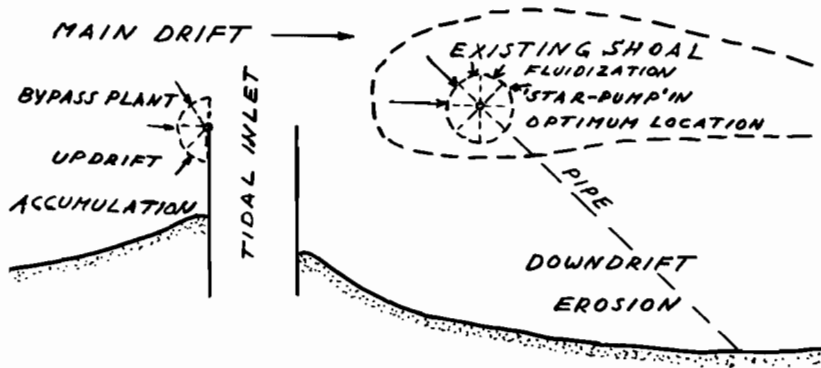


Figure 2. Backpassing from Inlet Shoals by fluidization system, schematics.

tiveness on an eroding shore will decrease with time.

#### ACKNOWLEDGEMENT

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