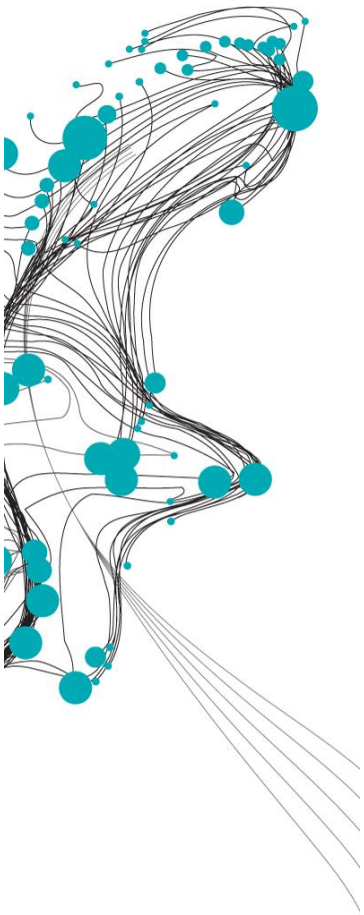
FLOOD PROTECTION USING THE ‘HOLWERD WEST’ SALT MARSH



Coastal risks are likely to increase the coming decades because of increasing storm intensity and sea-level rise as a result of climate change. This has resulted in the rejection of many dike trajectories along the Wadden Sea dike, such as at Holwerd West. The use of salt marshes in combination with a dike, is an ecologically sound alternative for further raising dikes. These vegetated forelands are namely capable of reducing waves so that the hydraulic load on the adjacent dike is lowered.

Since 1950, the growth of the salt marsh of Holwerd West has been stimulated by human interventions as the salt marsh works, composed by brushwood dams and ditches. Flooding and wave action subsequently assured that sand, sludge and organic matter were supplied to the platform. As a consequence, vegetation could develop; creating an intertidal landscape of high biodiversity, which is maintained by the grazing of different animals. Since 1979, higher elevated salt marsh zones have solely been exposed to storms rather than tides, which caused that the platform has reached a maximum height of 2 m+NAP. Meanwhile, the lower salt marsh zone is extending with 20 m/year due to tidal influences.

Wave reduction over a salt marsh is achieved as a consequence of three bio-physical processes: (1) depth-induced wave breaking, (2) wave energy dissipation by bottom friction and (3) wave attenuation by vegetation. The significant wave height reduction of Holwerd West was determined by a SWAN wave model and appears 0.61-0.77 m (45-53%) during a T=100-year storm event while accounting for spatial variety along transects (see Figure 1 and Figure 2). Wave damping due to vegetation obstruction contributes most to this. In case of a rarer T=1000-year event, when vegetation is assumed to be damaged by the flow, this effect is 0.31-0.63 m (18-36%), mainly due to depth-induced wave breaking, in which summer dikes play a big role. During a T=10,000-year event the reduction is 0.31-0.73 m (15-35%) and during a T=37,500-year event 0.28-0.71 m (13-31%). In case of the latter return period, representing the norm for an overtopping failure mechanism (GEKB), the normative dike height is 23-41 cm lower than the original.

In order to increase the wave reducing effect of Holwerd West, it is recommended to stimulate salt marsh growth so that a high (elevation) varying bottom profile is created. This can be achieved by preserving the high vegetation diversity so that sediment particles are captured in a scattered way. In addition, a sludge nourishment could account for a sufficient (clay-containing) sediment supply, which will decrease the erodibility of the bed.

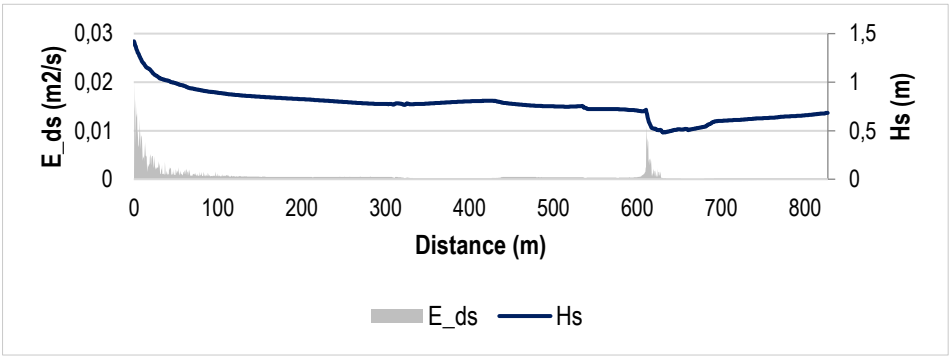


Figure 1 - Wave energy dissipation (E_ds) and corresponding wave height (Hs) along the high wave reducing transect for T=100 years

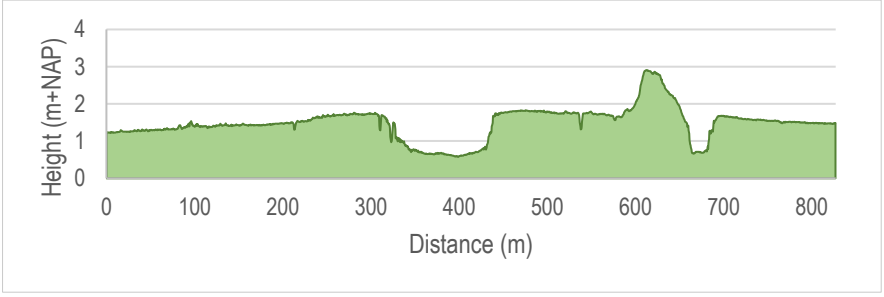


Figure 2 - Elevation profile of the high wave reducing transect

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