Using innovative geotextile constructions to control fine sediment transport and to improve water quality

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Introduction:
The Wormer- en Jisperwater area is the largest uninterrupted peaty grassland in Western Europe and one of the most important areas for wetland birds in the Netherlands. It is under European Natura 2000 protection and under the EU Water Framework Directive (WFD) classified as surface water body. Due to water movement sediment particles keep in suspension en impede sunlight penetration to the bottom. Hereby growth of higher order aquatic plants and natural water quality improvement are inhibited. Commissioned by Dutch water board HHNK, innovative and sustainable measures were taken to reduce hydrodynamics, sediment resuspension and turbidity in order to allow higher order vegetation to develop, enhance biodiversity and improve water quality.

Methods:
A good ecological and morphological method of steering the fines is the creation of lee areas, where fines can settle and vegetation can develop. This vegetation will capture more fines and new areas of high ecological values will be created.
In order to get insight in the wave attack and present transport patterns of fines, a numerical hydrodynamic model was set up first by Witteveen+Bos to examine the best way to create lee areas (programs Delft3D en SWAN).
Second, Tauw and TenCate Geosynthetics B.V. developed a light-weight geotextile structure to control sediment transport: the Flow Attenuator. Both design and implementation of this structure is innovative. A modified prefabricated TenCate Geotube® unit is linked to a geotextile screen and a floater. The geotextile container is filled with sand to keep the structure in place and the floater is used for tensioning the screen. The floater is designed to hold soil and sediment providing substrate for vegetation development (see figure 1).

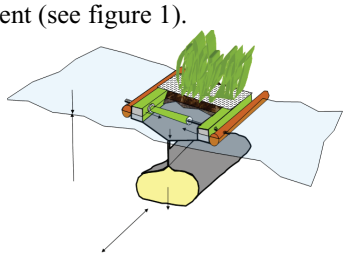

Fig. 1: Schematisation of Flow Attenuator

The Flow Attenuator is designed and tested to reduce the intensity of wave action (like a groyne) and thereby preventing sediment resuspension and transport and inducing sedimentation in lee areas. Moreover it is easy to install, very cost effective and save for water users
Finally, line objects were implemented in the model to define promising locations to install Flow Attenuators.

Results:
Water currents and transportation of fines was well explained by the model. Surprisingly, transportation was mostly determined by lake morphology (especially near the channel mouths) and connecting channels. Implementing line objects in the model resulted in promising locations to effectively reduce sediment transport.
The Flow attenuator was built and installed January 2014, 100 meters in total (4 elements, 25 meters each). Since then the fines transports decreased by 20-40% and on top of the construction vegetation which was missing for the last 30 years returned! Furthermore, a few decimeters thick sediment layer has already been formed at the lee side over a surface area of one hectare.

Fig. 2: Photo of vegetation development (August 2014)

Discussion:
This pilot study has shown that it is possible to control sediment settling and transport and improving recreational and ecological quality of this wetland area. At nautical bottlenecks draft depths are kept and in lee areas vegetation develops.
It is expected that this geotextile construction can also be used for shoreline protection or to prevent harmful algal blooms reaching shores.