

MORPHODYNAMIC MODELLING SUPPORTS THE DEVELOPMENT OF TIDAL MARSHES IN THE WATERDUNEN AREA

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The Waterdunen project, a coherent development of coastal design, recreation and nature development aims to achieve a solid estuarine nature area with controlled reduced tides in the coastal hinterland along the Western Scheldt, west of Breskens.

This paper reports on a detailed study by means of hydrodynamic modelling (1D-2D) focusing on a further development/refinement of the final design restoration plan. The study aims to optimize the operation of the inlet configuration and the evaluation of the development of silt and salt marshes in the intertidal areas.

The project Waterdunen is located on the coast of Zeeuws-Vlaanderen, close to Breskens in the Western Scheldt area of the Netherlands. Several years ago, two private parties, The Landscape and Molecaten Zeeland BV, took the initiative for the project "Waterdunen", as response of both the "weak links" project for coastal protection and the development plan for the region, called "Natural Vitality". Besides the two private parties, 3 government bodies are involved in the project: the province of Zeeland (leading the project), the municipality of Sluis and the Water Board of Zeeuws-Vlaanderen. The area will be developed as a silt nature area with reduced tidal influence. Antea Group was contracted to carry out a hydrodynamic and morphological study within this project.

The main part of the actual study consisted of a check of the calculated hydro- and morphodynamic parameters in the respective development stages of the marsh hinterland. For this purpose a specific evaluation framework for morphology and ecology was developed in function of the objectively identified (expert) indicators. These defined indicators were directly deduced from the numerical simulations (1D/2D), leading to a direct validation, visualisation and synthesis of the model results. By using an iterative process (through a set of computer simulations), an optimized situation (with respect to the design of the intertidal area and the control of the inlet) was obtained.

The main conclusion of the modelling confirms that the finally proposed design of the Waterdunen intertidal area can be sustainably designed and maintained. With the combination of an inlet, an open connecting canal and the restoration of the hinterland as silt and salt marsh area, as described, the 2D model shows in a detailed way that the area fills in an effective and optimal dynamic way at rising tide and empties at falling tide within the defined natural and operational boundary conditions. In this way, the detailed hydro- and morphodynamic model contributes to the further optimization of design and operation of the integrated sustainable intertidal area Waterdunen.

From the modelled hydrodynamic processes one finds that a clear asymmetry exists between the rapid filling of the intertidal zone at high tide flow and the slower emptying of the system at reduced ebb tide. This hydrodynamic asymmetry is followed by morphodynamics: the potential sediment load in suspension during flood will - given both the low absolute velocities and also the asymmetric lower ebb-load - largely be deposited in the intertidal area. From the morphological point of view, in order to maintain and preserve the ecological potentials one can therefore say that:

- the supply of sediments from the Scheldt should be minimized;
- a maximum retention of the incoming sediment on the Western side should be pursued.
- a minimum flow of sludge material is strictly necessary for the conservation of the natural development of this marsh area, as a compromise with the minimal maintenance efforts (dredging) to preserve the initial state.

For the practical realisation of the project, the following suggestions are made:

- Given the expected sedimentation (as also shown in the sediment sampling campaign), a construction of the intertidal zone with a small overdepth (ten cm) is possible.
- Close monitoring of the intertidal zone allows not only the ecological development but shall at the same time picture (unwanted) morphological evolutions, allowing appropriate (maintenance or management) measures.
- Considering the existing (critical) connection to the Westerschelde (via “Killetje”) on the one hand and the need to limit sediment supply from the Western side on the other hand, a thorough re-design of the access configuration between the Western Scheldt and the tidal diver is a good opportunity.

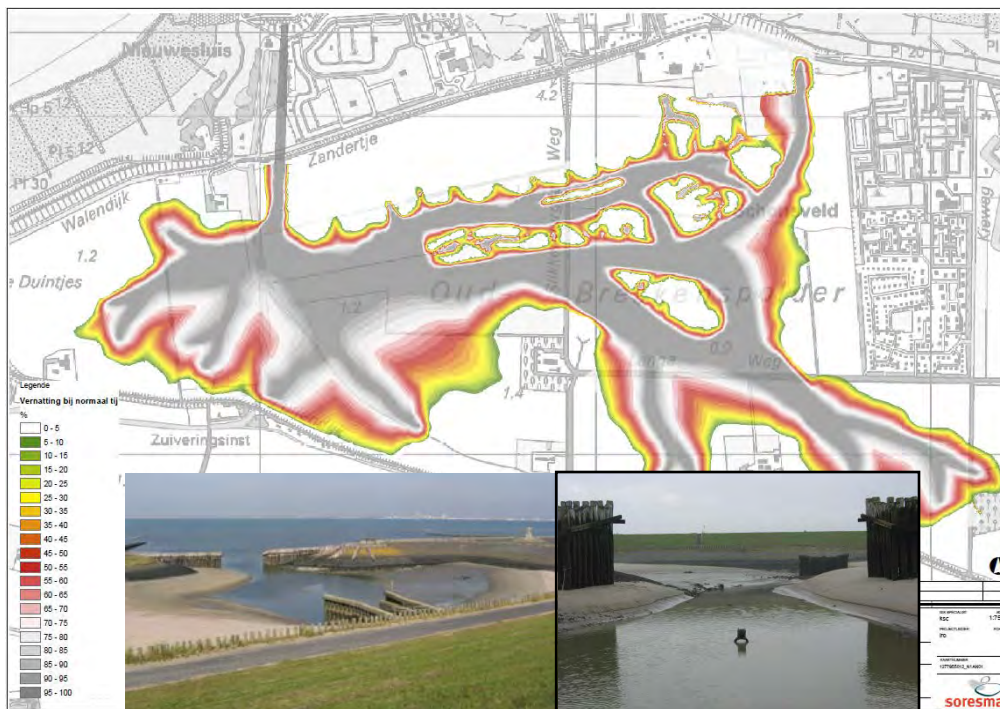


Figure 1 Lay-out of the modelled area

When a choice must be made between different alternatives and variants it can be stated that the variant N1R3 is the best guarantee on:

- a large salt marsh area;
- a significant foraging area for birds;
- sufficient potential as breeding ground for fish species;
- a low dynamic ebb-tide regime that leans pretty towards the natural situation;
- a natural appearance;
- a reduced need for intervention during the construction phase;
- a (presumably) limited need for intervention during the management phase;
- a limited-avifauna disruption during the management phase.

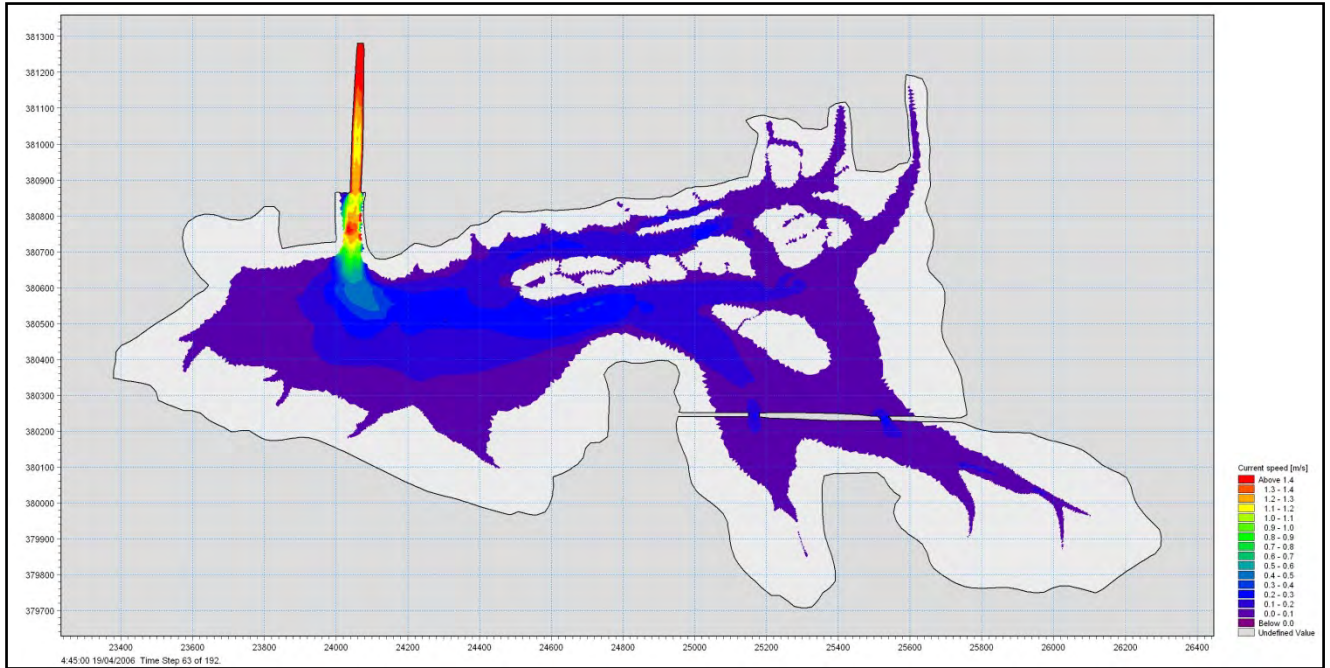


Figure 2 Modelling results: velocity field for scenario N1R3, at maximal inlet velocity, during normal tidal conditions