Hondsbossche Dunes

The Hondsbossche and Pettemer sea dike no longer met the required safety standards and thus required reinforcement. In 2015, the original dike was reinforced with a natural barrier of about 35 million cubic meters of sand on the seaside of the dike. The flood protection was renamed 'Hondsbossche Dunes'. The reinforcement design consisted of a soft shallow foreshore and beach, and a varied dune landscape that has the potential to develop valuable ecological habitats, such as a dune valley. Together, the connected foreshore and dune systems make up the flood defence. The former Hondsbossche and Pettemer sea dike is still present in the landscape but has no longer a function as flood defence. Besides providing flood safety, the Hondsbossche Dunes were also intended to enhance the spatial quality of the area. For each of these objectives criteria were set in the initiation phase by the client.

Impression of the Hondsbossche Dunes, 2,5 years after construction (Photo:Jakolien Leenders)

The Hondsbossche Dunes are an example where robustness of design and maintenance and monitoring are applied to handle uncertainties. This is illustrated in the sections below with examples from natural, technical and social uncertainties.

Natural uncertainties

For the Hondsbossche Dunes, uncertainties from the natural system were unpredictability of morphological dynamics and uncertainty around vegetation and habitat development, as well as the interaction between these. Vegetation plays a key role in the development of coastal dunes: it traps sediment and as such helps to build up a dune system. It was thus important that the planted vegetation on the foredune would settle and be vital, but it was unpredictable to what extent that would be the case. At the construction of the Hondsbossche Dunes, planting of marram grass was therefore done rather densely and with several seedlings per pocket as a robustness of design.

Stabilization of the dune system is not desirable as the dynamics of the transport of sand in the system are necessary to create the right conditions for several biodiverse dune habitats to develop and sustain. Without the influx of sand, dominant fast-growing species such as shrubs will colonize the dunes and reduce the diversity in habitats and species. It is not possible to give detailed prospects of ecological development over a 20-year period after construction. This is firstly because many processes that influence habitat development are unpredictable (the weather, developments of source populations in other areas, distribution mechanisms), and second, because management interventions can have major influence on habitat development, but cannot always be predicted. Because of this lack of predictability, a monitoring programme

was set up to monitor the development of the dune system. This monitoring programme not only focusses on the ecological development, but also different aspects of morphological development are monitored. Monitoring results are reviewed annually to identify necessary interventions. For example, when the monitoring showed a significant reduction of beach width in the southern part of the project location in 2018, an additional sand nourishment was done to reverse this decrease. Additionally, the monitoring plan itself is reviewed for needed adjustments.

Technical uncertainties

The technical uncertainties in the project comprised mainly the function of the Hondsbossche Dunes as a coastal defence system up to 25 years after construction. How can safety standards be guaranteed, with a solution that is subjected to natural dynamics that are partly unforeseen in such a period? A robust design of the Hondsbossche Dunes was made to ensure that safety levels would still be met with future rises in sea level. Robustness was realized by over-dimensioning: applying an additional volume of sand at construction that resulted in initially higher flood safety levels than mandated. In hindsight, this compensation volume of sand at construction of the Hondsbossche Dunes was not necessary. Monitoring of the morphological development of the Hondsbossche Dunes in the first three years after construction learned that the natural dune growth rate is now expected to keep pace with the rising sea level and subsidence up to 2050 (assuming the foreshore, intertidal area and beach are maintained according to current standards). This example illustrates that lessons are learned through monitoring, which can be used in optimization of future designs of BwN solutions. In addition, maintenance plays a role in guaranteeing safety standards up to 25 years after construction. The main objective of the maintenance was set to keeping the coastal protection system up to the initial (safety) requirements of the project. To ensure that this is also financially feasible, the budget for the project was made available for the construction of the Hondsbossche Dunes plus 20 years of maintenance.

Social uncertainties

An uncertainty with its source in the social system was how the 'sandy solution' was perceived by the local community, stakeholders and visitors. The local community and stakeholders valued the existing landscape and were concerned that the solution and construction thereof would negatively affect these values. There were concerns about the loss of cultural heritage, survival and existence of spatial quality, changes in recreational and natural values, and nuisance from drifting sand. At the start of the project there were objections, up to legal procedures, as people were concerned about the construction activities and the effects on existing natural values. To reduce this value-based uncertainty it was therefore decided to consult stakeholders in the design phase with 'round table conversations'. Based on these 'round table conversations' a design was made in which an optimum was sought to meet peoples desires on nature, landscape and recreation. This resulted for example in a cycle path, viewing points and dune valley in the design. Also, measures were taken to prevent nuisance from drifting sand during construction, such as placing willow screens and cleaning cycle paths. In addition, a monitoring programme was set up to measure nuisance from drifting sand. Interviews were held with visitors and the local community to assess their perception on the construction and result. Before the Hondsbossche Dunes were constructed, 18 inhabitants and other stakeholders had expressed their concerns about sand deposition behind the dike. Three years after construction, monitoring results indicated that almost no sand is blown over the original dike, and that the amount of deposited sand behind the dike decreased exponentially with inland distance. Also, the interviewed stakeholders confirmed that the highest sand transport occurs near the beach and the first dune row. Here, blown sand can give nuisance for the beach restaurants. Within the dune area, sand sometimes accumulated on the cycle paths. The municipalities both north and south of the Hondsbossche Dunes have received no or almost no complaints about blown sand.

Sources

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