

## **Integral water management on the Wadden island Vlieland**

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### **Abstract**

As a result of the increasing knowledge of the causes of dehydration (the last 20 years) there had been a growing realisation that tackling only the groundwater recharge on the Wadden islands would not lead to the desired (partial) recovery of the hydrological system and the related nature value. It became clear that other activities and interests were exerting their influence on the hydrological system and, in turn, the groundwater level and quality, and the natural features that are dependent on them. It shows us that an integral approach of this problem has more effect than sectoral solutions. The two realised integral water management projects on Vlieland and Schiermonnikoog have shown this.

Keywords: Integral water management; Wadden islands; Restoration; Hydrological system.

### **Problem**

Vlieland is one of the four Frisian islands. This island amidst the salty waters of the Wadden and the North Sea is a favourite holiday spot. Translated, the island's drinking-water requirement varies strongly in proportion to the number of tourists. For the drinking water groundwater is used from the freshwater lens beneath the island. The yearly recharge is around 200,000m<sup>3</sup>.yr<sup>-1</sup> and this demand is still growing.

### **Realised activities and results**

The natural hydrological system on the Frisian Islands consists of an island with a freshwater lens underneath it that has been formed as a result of surplus precipitation. The freshwater lens is able to expand down to considerable depths under massive dunes. In addition to fresh rainwater infiltration to the subsoil, there is also shallow runoff via the dunes in the direction of the North Sea. Moreover, groundwater also flows through the soil and via the surface water out of the dunes in the direction of the Wadden Sea. Before the water reaches the Wadden Sea, it passes the inner edge of the dunes and the undiked salt marsh. The hydrology and related ecological features of the Frisian islands form a complex whole, within which all sorts of factors exert an influence. This natural hydrological island system has been influenced in many ways in the course of centuries. The tidal salt marshes have been embanked and the water balance in the

resulting polders is highly regulated. The requisite number of changes in the dune areas themselves have been made. In some cases, localised areas of dunes have been drained for the cultivation of dune meadows. In order to fix the dunes, large areas of coniferous forests were planted on most of the islands around 1900. These areas have become dehydrated. Furthermore, the withdrawal of groundwater for drinking water supplies on the islands increased greatly after 1950 as a result of the growth in tourism. All these activities have had a detrimental effect on the natural hydrological island system. They are the logical result of a long-term social process that enabled the residents to survive, live and work on the islands.

As a result of the increasing ecohydrological knowledge of the causes of dehydration, there was a growing realisation that tackling only the groundwater recharge on the island would not lead to the desired (partial) recovery of the hydrological system. It also became clear that other activities and interests were exerting their influence on the hydrological system and, in turn, the groundwater level and quality, and the natural features that are dependent on them. To diminish the resultant dehydration, Vitens set up, with other parties, an integral water management project in 1994. Objective of this project was to restore the island's hydrological conditions as much as possible, on the precondition that an independent and sustainable waterproduction would still be possible on the island. The following solutions/results were found:

- reduce vaporisation in the coniferous forest by cultivating vegetation in the area;
- partial transfer of pumping wells from the centre to the southern coastline of the island;
- partial transfer of pumping wells from the first to the second, deeper aquifer;
- nature-restoration project in the dune slack 'Kooisplek';
- supplementary hydrological and ecological monitoring in different dune slacks;
- the measured hydrological and ecological effects on Vlieland are positive.

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