

The Diverse Dike in the Port of Rotterdam

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Introduction: The aim of the Water Framework Directive (WFD) is to establish a good ecological and chemical status for all European surface waters. For the aquatic environment, the goals and objectives partly overlap with the Birds and Habitats Directives.

The Port of Rotterdam Authority, in cooperation with Deltares and the Dutch ministry of Transport, Public Works and Water Management, implemented the Diverse Dike concept as a pilot project in 2010. Goal of this project was to learn if nature friendly port infrastructure can lead to an increase in biomass and biodiversity in the Port of Rotterdam waters, while not hampering port activity in any way.

Methods: The Diverse Dike concept basically consists of nature friendly dikes, quaywalls and other vertical port structures by improving shape and choice of material during construction of dikes, groynes, piers and jetties. Application of the Diverse Dike can result in an increase in biomass and biodiversity, such as mussels, oysters and other filter feeders in the Port of Rotterdam waters. An increase of filter feeders can lead to an improvement in water quality and a cleaner sedimentation on the waterbed.

Results: The Diverse Dike is beneficial to sustainable development of the port. It integrates the social and economic benefits of an ecosystem with managing land, water and living resources (including ecosystem services). It could apply to all areas, including coastal seas, connected water systems and infrastructural water works. The measures should be designed in close cooperation with authorities, other users and stakeholders.

Working and building with nature not only contributes to a sustainable port area and goals and objectives of the WFD. It also underpins and accelerates the green reputation for the port authority. Application of the Diverse Dike leads to an increase in biomass and biodiversity in the Port of Rotterdam waters. Water will be filtered by diverse 'filter feeders' e.g. mussels, so turbidity will be lessened. This will attract more fish, birds and plants. This will lead to an improvement of water quality and thus eventually to cleaner sedimentation in the port. It may also result in quicker recolonisation of

waterbeds, after disturbance by e.g. ship's screw action or dredging.

Discussion: To actively create additional biomass and biodiversity and right conditions for species within a port area, can be seen as letting the Trojan horse in. When a designated port industrial area is colonised by strict protected species, the provisions of the Habitats Directive will apply. A strict conservation scheme in port areas can potentially hamper port development and/or maintenance work. There are some examples on land of conflicts between port interests and the natterjack toad *Bufo calamita*, creating a lot of uncertainty for port development projects. This conflict is solved by creating artificial breeding grounds for the toad. In the watersystem it is foreseen that the same conflicts could arise between port operation and protected fish species that migrate through waterways and navigation channels along highly industrialised areas. Conflicts between economy and ecology can arise and lead to a negative reputation. Also from a practical point of view: The Port of Rotterdam Authority has focused on not hampering shipping with the nature friendly structures on quay walls and vertical structures. The Diverse Dike will not be implemented in e.g. 'oil-regime harbours', because of the risk of oil-spills damaging the nature friendly structures. The Port Authority furthermore wants to ensure that the nature friendly structures don't complicate the cleaning of or the maintenance work on the jetties, piers and groynes.

On suitable locations the diverse dikes can attract fish species protected by the Habitats Directive. In order to balance the economic development with the protection and conservation of species and habitats it is proposed to work in line with the instruments of the Water Framework Directive (WFD) and with principles such as the ecosystem approach and adaptive management.

Port of Rotterdam Authority is currently developing a strategy on whether it's beneficial to upscale the pilot project in the port area.