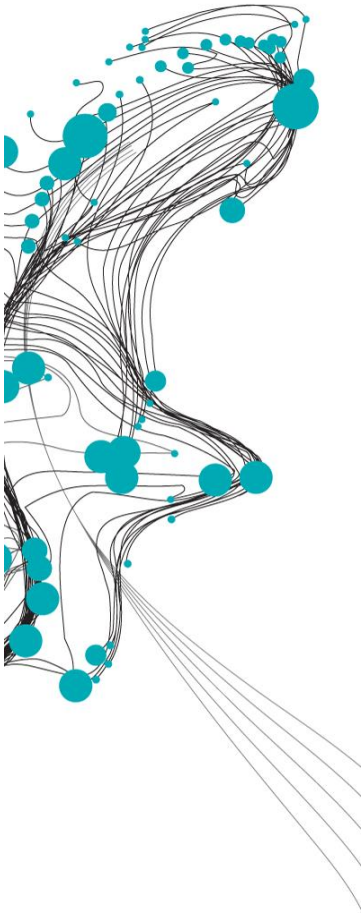
THE EFFECT OF RIVER INTERVENTIONS ON RIVER DUNES



Rivers have several important functions in society, such as transport, recreation, and ecological functions. River dunes are located on the riverbed and have a wave-like shape, they affect the roughness and navigation depth of a river. River dunes respond to changes in discharge. Thus, the construction of river interventions, which change the way discharge is conveyed by the river, can change the dimensions of river dunes. The aim of this research is to assess the effects of river interventions on the characteristics of river dunes.

Three study areas were chosen in the river Waal, a section in the Middle Waal (rkm 894 – 911), Lower Waal (rkm 934 – 944), and a section with longitudinal training dams (LTD) (rkm 914 – 921.5), the locations can be seen in figure 1. These three sections allow for the analysis of the effect of groin lowering, LTD construction, and side channel construction on river dune characteristics. In the river Waal the bed level is measured on average once per two weeks with multi-beam echo sounding. Bed level data from 2005 to 2020 is used, this includes sufficient data before and after the construction of river interventions.

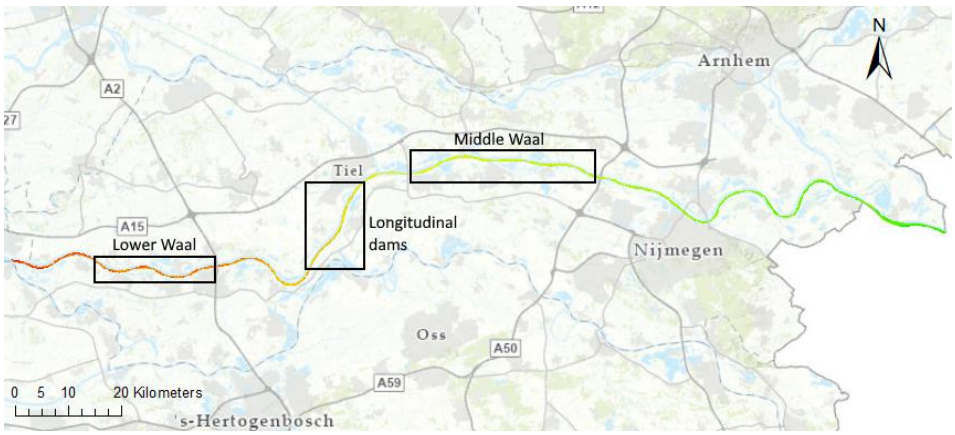


Figure 1. Indication of the locations of the study areas.

From each bed level measurement river dunes have been identified, using the method of Lokin et al. (in prep.). Dune height, dune length, the aspect ratio, lee slope angle and dune celerity are calculated. To identify differences in dune characteristics before and after the construction of an intervention, the average dune characteristics in the study areas per measurement were plotted against the five-daily average discharge at Tiel. Isotonic regression was used to aid the analysis (De Leeuw et al., 2009).

The results show that the characteristics of river dunes have changed after groin lowering and LTD construction, but no conclusions could be drawn about the effects of side channel construction on river dunes. LTD construction leads to slightly milder dunes for discharges below bankfull and steeper dunes for discharges larger than bankfull. Whereas groin lowering leads to steeper dunes for discharges larger than 1900 m^3/s and 1200 m^3/s in the Middle Waal and Lower Waal, respectively. Moreover, groin lowering in the Middle Waal and LTD construction lead to reduced dune celerity for discharges larger than 1200 m^3/s and 1100 m^3/s, respectively. This indicates reduced amounts of sediment transport in these areas, which is beneficial for the river Waal, as it mitigates the long term erosion observed in the river Waal.

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10 March 2022

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De Leeuw, J., Hornik, K., & Mair, P. (2009). Isotone Optimization in R: Pool-Adjacent-Violators Algorithm (PAVA) and Active Set Methods. Journal of Statistical Software, 32(5). https://doi.org/10.18637/jss.v032.i05
Lokin, L.R., Warmink, J.J., Bomers, A., Hulscher, S.J.M.H. (in preparation). River dune dynamics during low flows.

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