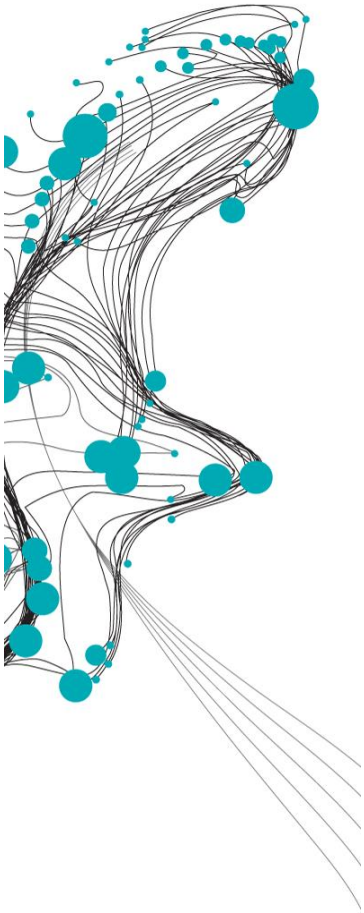
THE POTENTIAL OF SIDE CHANNELS TO MITIGATE LARGE-SCALE BED DEGRADATION IN THE DUTCH RHINE DISTRIBUTARIES: A 1D-MODELLING STUDY



Over the last 60 years, the bed of the Dutch Rhine River and its major distributaries has been degrading. Along the Waal River this degradation has been more than 1.5 m, with some locations exhibiting degradation rates of 2 to 4 cm/year. Degradation is observed also in parts of the IJssel, Nederrijn and Lek Rivers. Spatially varying bed degradation has negative consequences for a multitude of river functions. One way to counter bed degradation is to make use of river interventions, such as side channels. Recent quick scans have looked at the implementation of side channels along large parts of the Dutch Rhine River distributaries. However, no quantification of the long-term effects of side channel implementation on the main channel bed has been done on a system-wide scale. In this research a newly developed 1D model of the Dutch Rhine and its distributaries is used to conduct a scenario-based analysis of the long-term effects of side channels on the main channel bed.

A reference scenario is set up to determine the autonomous bed degradation of the main channel of the Rhine River distributaries over a 100 year period. Results show that the current bed degradation rates will continue throughout the coming century, leading to a slope decrease of the Waal River and degradation of as much as 1.5 – 4.0 m compared to the current bed level. Other distributaries of the Rhine River show less degradation (1.0 – 2.6 m), which leads to a shift in discharge partitioning. After 100 years, the distributaries of the Rhine River have not reached their equilibrium position.

Three cases have been investigated with side channels implemented along the Waal River, Pannerdensch Kanaal or IJssel River, respectively. Each case had 7 scenarios with a fixed set of side channels with different bed levels becoming active at different discharges. One additional case has been investigated with 4 scenarios where side channels are implemented along both the Waal River and Pannerdensch Kanaal. Side channel width has been set at 25% of the adjacent main channel width.

In general, the implemented side channels are able to reduce bed degradation by 10 – 15% in the Waal River (see Fig. 1) and by 20 – 25% in the Pannerdensch Kanaal. A combination of side channels in both the Waal River and Pannerdensch Kanaal is able to increase the effectiveness up to 30 – 35% in the Pannerdensch Kanaal, but has limited effect on the Waal River compared to the single-distributary side channels. The highest reduction is achieved by side channels that are active most of the time. Side channels that flow less than 20% of the time contribute very little to the reduction of bed degradation. After 100 years, the river system including side channels has not reached an equilibrium configuration, which needs to be taken into account in the design of future interventions. Additional measures are necessary to completely stop bed degradation.

Figure 1: Bed level change after 100 years w.r.t. year 0 (top) and w.r.t. autonomous bed level change (bottom).

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