RIVER INTERVENTIONS TO RESTORE THE LOW DISCHARGE DISTRIBUTION AND REDUCE BED DEGRADATION IN THE BOVEN WAAL

A 2D MODELLING STUDY OF RIVER INTERVENTIONS IN THE BOVEN WAAL AND PANNERDENSCH KANAAL

Over the past century, the Waal's riverbed has degraded by 1-2 meters, with particularly high bed degradation rates in the Boven Waal. This degradation negatively impacts various river functions. Specifically, the discharge partitioning to the Pannerdensch Kanaal has decreased. This is problematic during low flows, as the required discharge partitioning to the Pannerdensch Kanaal is then not met, while this branch is essential for freshwater supply to the North(-West) and East of the Netherlands. This study investigates how interventions in the Boven Waal and Pannerdensch Kanaal can be used to increase low discharge partitioning to the Pannerdensch Kanaal and reduce bed degradation in the Boven Waal.

Using the updated 2D DVR model (released in April 2024), this study focuses on implementing Longitudinal Training Dams (LTDs) in the Boven Waal. It is found that LTDs are effective in increasing the low discharge partitioning to the Pannerdensch Kanaal (+24–42 m³/s) by narrowing the Boven Waal's main channel by approximately 65 meters. LTDs are also effective in reducing bed degradation in the Boven Waal, particularly due to their impact during high flows, throughout which they even cause significant reach-averaged sedimentation. However, the main channel narrowing during low flows leads to significant erosion during these flows, thereby counteracting the goal of reducing bed degradation in the Boven Waal.

To mitigate the effects of the additional discharge drawn to the Waal by the LTDs during high flows, summerdike removal and floodplain lowering in the Pannerdensch Kanaal are also investigated. Findings indicate that summer dike removal and a 0.5-meter floodplain lowering can restore the required discharge distribution at a design discharge of 16,000 m³/s. With more extreme floodplain lowering (2-3 meters), the interventions in the Pannerdensch Kanaal show little effect in further reducing bed degradation in the Boven Waal.

In conclusion, LTDs should be included in the strategy to increase low discharge partitioning to the Pannerdensch Kanaal and to reduce bed degradation in the Boven Waal, as they demonstrate strong potential in addressing both objectives. Further recommendations are made to improve the LTD design and combine it with other interventions. In this way, further research can build upon the results of this study to ultimately identify an approach that can restore the low discharge distribution and stop bed degradation in the Boven Waal.

Table 1. Low discharge partitioning to the Pannerdensch Kanaal for the Reference Scenario and Scenario LTD-S.

Lobith discharge [m³/s]	Discharge to Pannerdensch Kanaal [m³/s]					
	Required	Start (t = 0)		After 20 years (t = 20)		
		Reference	LTD-S	Reference	LTD-S	
1020	254	193	227	174	215	
1294	314	251	293	232	281	
1544	315	301	325	281	316	

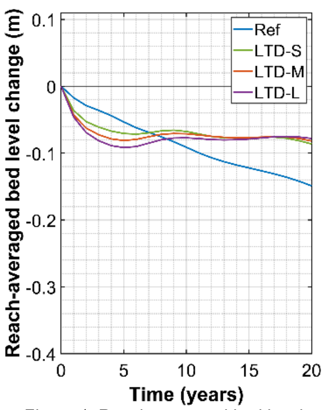

Figure 1: Reach-averaged bed level change in the main channel of the Boven Waal over time relative to t = 0 (LTD scenarios).

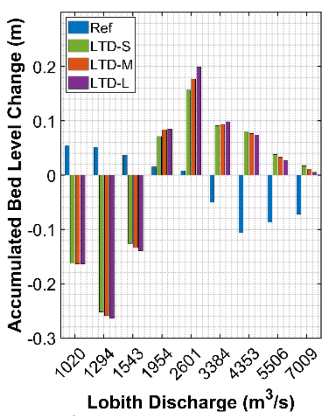

Figure 2: Accumulated reach-averaged bed level change per Lobith discharge during 20 years of bed level development in the Boven Waal.

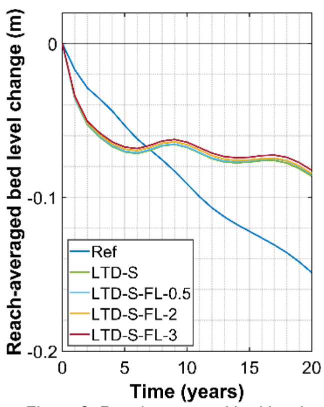

Figure 3: Reach-averaged bed level change in the main channel of the Boven Waal over time relative to t = 0 (including floodplain lowering (FL)).

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