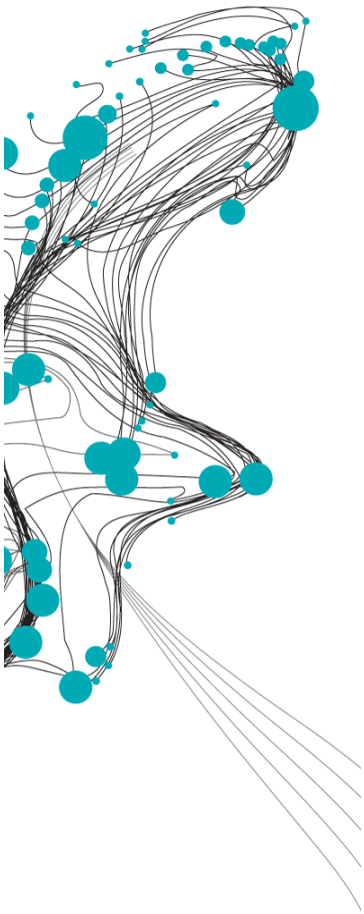
The impact of vegetation configurations on the hydraulic roughness

USING DELFT3D TO GAIN KNOWLEDGE FOR THE MAINTENANCE OF LOWLAND STREAMS IN THE NETHERLANDS



Waterboards maintain their lowlands streams by mowing to ensure the conveyance capacity for the normative event of a return period of 10 years. The setup of the corresponding maintenance plan is based on empirical knowledge and available equipment. The Waterboards boards aim to make their maintenance more cost-coefficient and aim to consider the impact of different approaches of maintenance on the ecological value. Therefore, they aim to expand their knowledge on the relation between conveyance capacity and different vegetation patterns in the stream. This research is done as part of the Lumbricus project and the objective was to investigate the relation between vegetation characteristics and configurations and the hydraulic parameters: water levels, velocities and roughness with Delft3D and the Dotter model to expand the knowledge which can be used to set up mowing strategies for Waterboards.

Because the vegetation species Callitriche Platcarpa (Dutch: gewoon sterrenkroos) was found in the literature to be the most common species in Dutch streams with significant flow blockage, the characteristics of this species were used for modelling in Delft3D. The configurations of interest which are based on a literature study and expert opinion are shown in Figure 1. These configurations are simulated with Delft3D with multiple vegetation widths over the cross-section and multiple vegetation heights. To model a lowland stream the stream the 'Lage Raam' in the district of Waterboard Aa & Maas was used as case study. The profile of this stream with a bottom slope of 0.5 m/km was implemented in Delft3D and stationary boundary conditions were used. These were an upstream discharge of 0.45 m^3/s and a downstream water level of 0.6 m.

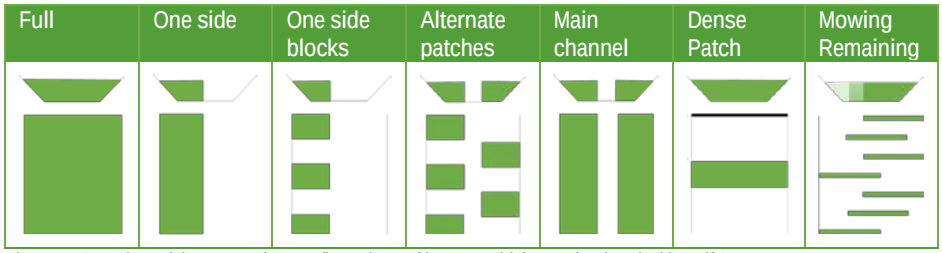


Figure 1: Overview of the vegetation configurations of interest which are simulated with Delft3D

Based on the results of the Delft3D simulations, it can be concluded that the water level set-up was mainly influenced by the amount of blockage by vegetation over the cross-section. Comparing the configurations with similar vegetation width and height, the coverage of vegetation at the deepest part of the stream influences the differences in water level set-up the most. Considering the velocities, the configurations show only small variations in magnitude. As expected the velocities were larger outside the vegetation than inside the vegetation. The water level set-ups calculated by Delft3D were translated with the Dotter model to the Manning roughness coefficient. This resulted in a small range of values for the Manning coefficient, which are relatively high for vegetated streams. These values did not give more insights into the differences caused by the configurations.

In conclusion, to obtain the largest conveyance capacity the vegetation in the deepest parts of the stream must be removed. From an ecological perspective, it is advised to mow in blocks or leave some patches to create the most variation in the velocities over the stream. Because the model is a significant simplification of the field situation the results should not be interpreted as true values, but the relative differences between the different vegetation characteristic and configurations are expected to be a realistic representation of what can be expected in the field.

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