

DESIGN CONSIDERATIONS FOR CONSTRUCTED TREATMENT WETLANDS TO MITIGATE NUTRIENT AND SEDIMENT RUNOFF FROM LOWLAND INTENSIVE AGRICULTURAL CATCHMENTS

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Constructed treatment wetlands (CTWs) have been implemented as mitigation tools to manage diffuse pollution from intensive agricultural catchments to shallow peat lakes in the Waikato region. This research investigated CTW efficacy, evaluating different predictors of performance, and exploring morphological and environmental variables influencing treatment efficiency.

The CTWs were comprised of a sedimentation pond 'module', with around half including shallow wetland-modules planted with native species, and three CTWs with additional sedimentation pond-modules. The inflows were surface-flow watercourses diverted from modified or artificial drainage networks, and the outflows were either surface-flow (through drainage channels or culverts), or filtration (through vegetated riparian margins). Morphological predictors of CTW performance included area (range 7 – 1950 m²), depth (0.2 – 2.1 m), volume (12 – 2030 m³), Wetland to Catchment Area Ratio (0.01 – 1.18), hydraulic retention time (0.2 – 37.2 h), and hydraulic loading rate (0.4 – 130 m³ d⁻¹).

The presence/absence of macrophytes as well as outlet type and the number of CTW modules were included as categorical variables in analyses. Reductions in nitrogen (N), phosphorus (P) and suspended solids (SS) differed considerably across CTWs, driven by varying influent concentrations and dominant forms of N, P, and SS, as well as CTW morphologies. Generally, CTWs with larger areas and volumes improved removal performance of nitrate, total N and coarse sediments, while deeper CTWs more effectively reduced particulate N and volatile SS. Macrophytes improved removal of nitrate and P, whereas CTWs with filtration outlets frequently increased ammonium. Greater accumulated sediment depths significantly reduced P removal efficiency, signifying the importance of CTW maintenance, and increasing the number of CTW modules generally improved performance.

A simple, nonetheless comprehensive wetland treatment-train concept is presented, designed to accommodate anticipated variability in agricultural pollutant loads and internal nutrient cycling, whilst fitting practically within the productive farming landscape.

Editor's Note: An extended manuscript has not been submitted for this presentation.