

The addition of large scale WSUD alternatives and their effect on kerbside stormwater systems

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Abstract: This study evaluates the effectiveness of various Water Sensitive Urban Design (WSUD) solutions in reducing stormwater runoff and pollutant loads within urban catchments. While WSUD practices such as bioretention basins, swales, green roofs, wetlands, and permeable pavements are widely documented, limited research has examined their combined performance when applied as integrated treatment trains. This study addresses this gap by conducting a comparative analysis of individual and combined WSUD systems using MUSICX software by eWater, applied to a real urban catchment dataset from Blacktown City Council.

The methodology combined a literature review, SWOT analysis, and simulation modelling to quantify reductions in Total Suspended Solids (TSS), Total Phosphorus (TP), Total Nitrogen (TN), and Gross Pollutants (GP). Modelled scenarios compared standalone WSUD measures with integrated treatment trains to assess both pollutant removal and runoff volume reduction.

The modelling results show clear differences in the pollutant reduction performance of individual WSUD measures. Constructed wetlands provided the most consistent reductions across all pollutants, achieving approximately 98% reduction in Total Suspended Solids (TSS), 95% in Total Phosphorus (TP), and over 80% in Total Nitrogen (TN). Green roofs also demonstrated strong performance, with 85–90% reductions for TP and TN, and over 90% for Gross Pollutants (GP). Bioretention basins and grassed swales achieved moderate pollutant removal, reducing TSS by 30–35% and TP by 15–20%, while offering only limited nitrogen reduction (<15%). Permeable pavements were the least effective for nutrient removal, with <15% reduction for TSS, TP, and TN, but showed high effectiveness for GP (≈100%). Overall, these results confirm that while individual WSUD solutions can target specific pollutants effectively, their performance varies substantially, reinforcing the need for integrated treatment trains to maximise reductions across all pollutant types.

By demonstrating the comparative advantages of integrated WSUD systems and quantifying pollutant load reductions using real catchment data, this study contributes evidence-based insights to guide future stormwater management policy and sustainable urban development.

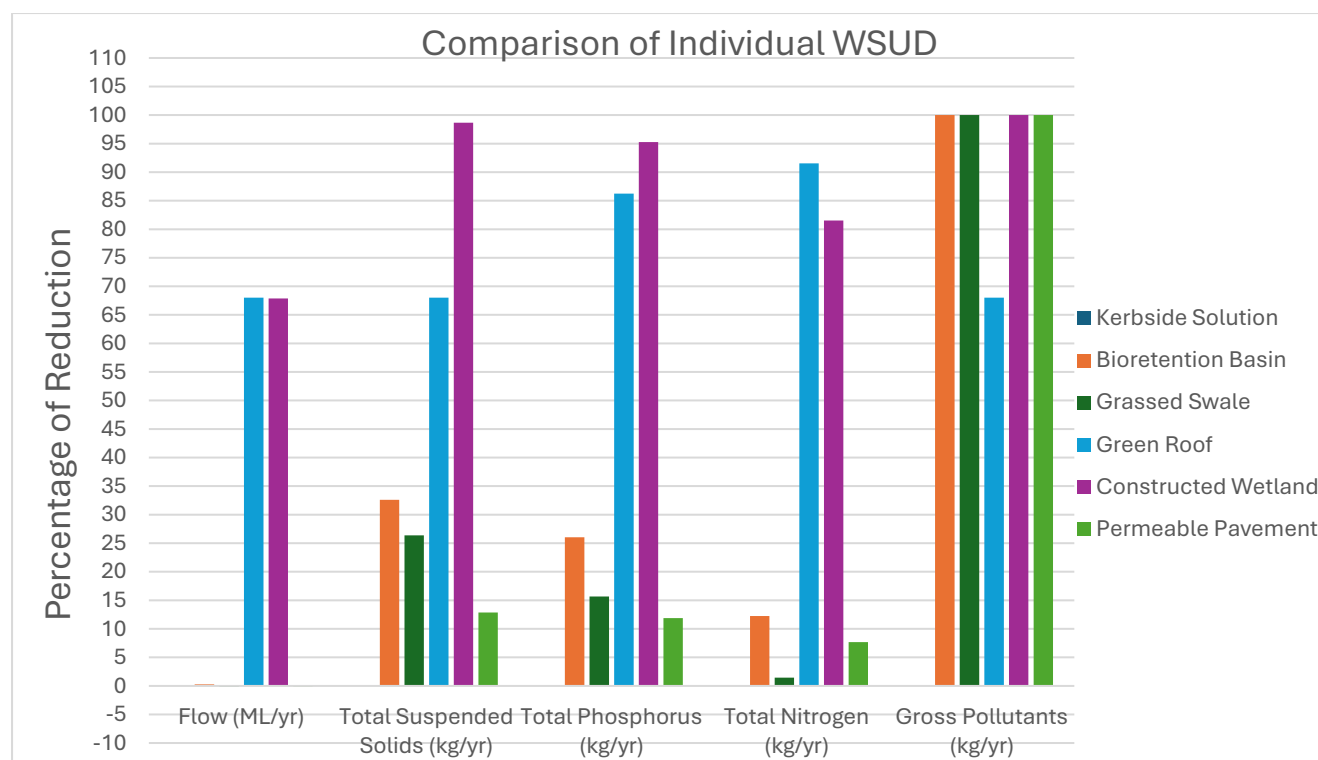


Figure 1 Individual treatments pollutant load reduction

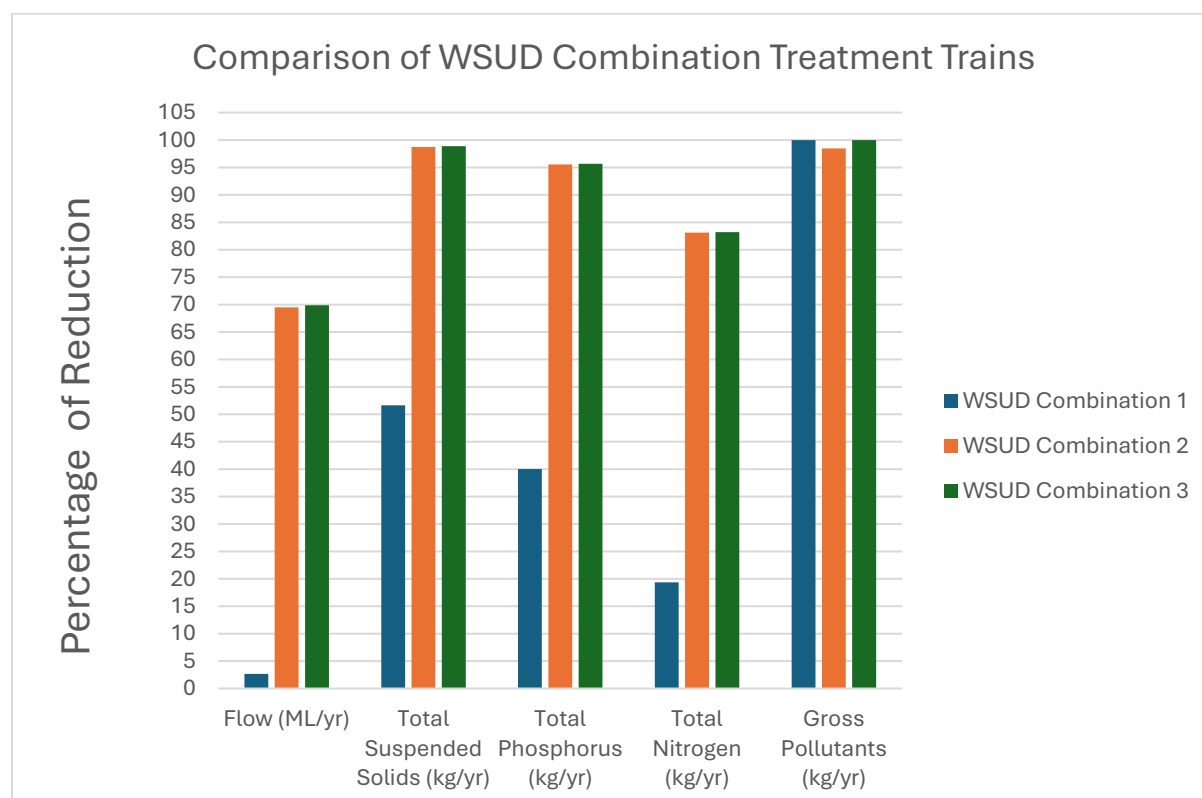


Figure 2 Treatment train pollutant load reduction

Keywords: *Water Sensitive Urban Design, Stormwater Management, MUSICX, Urban Hydrology, Sustainable Design*