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Fate of trace organics and their metabolites in an urban stream in South Australia

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The presence of trace organic compounds (TrOCs) in streams that receive wastewater treatment plant (WWTP) effluent impairs ecosystem functioning and poses challenges for drinking water production downstream. Despite recent research efforts, quantitative information on the in-situ fate of many TrOCs and their transformation products in receiving rivers is widely unavailable. We studied the in-stream attenuation of 18 parent compounds (PCs) and 12 transformation products (TPs) in a first-order stream in a forested, mountainous catchment in South Australia that, during the study period, received 100% of its discharge from a regional WWTP. A salt tracer test was combined with a Lagrangian sampling approach to calculate relative removal rates and first-order removal rate constants for TrOCs along a 4.3 km stream reach. Out of the 25 TrOCs that were detected in the stream, 14 compounds including three sartans as well as carbamazepine and two of its TPs did not show significant removal and were effectively conveyed downstream. Eleven compounds however, were significantly removed along the investigated stream reach. The degradation of all of these compounds, with the exception of valsartan, could be reasonably well estimated by first-order degradation kinetics (R2 > 0.7) with half-lives varying between 3.1 $\pm$ 0.7 d for methylbenzotriazole and 0.4 $\pm$ 0.06 d for guanylurea, the main transformation product of the anti-diabetic drug metformin (t1/2 = 2.1 $\pm$ 0.7 d). All investigated TPs were already present in the WWTP effluent and no stream specific TP could be identified. Although the mean transit time in the stream reach was high (33 h), relative removal of the majority of TrOCs was < 50%. Compared to other studies, the overall in-stream removal rate constants in the present study were relatively low. We mainly attribute this finding to the absence of a significant transient storage compartment in the stream reach (i.e. hyporheic zone) and the presence of a dense cover of riparian vegetation which is likely to limit photo-degradation potential.