Point effluent discharges have unclear direct impacts on local biogeochemical P cycling against high background complexity in catchment pollution processes and ecosystem responses

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Point discharges of pollution such as effluents, enriched in bioavailable nutrients, organic matter and multiple contaminants, are often considered as having both strong local and cumulative downstream effects on aquatic ecosystem quality. Since potential impacts of effluents involve many multiple stressor interactions it requires an integrated suite of in-situ and ex-situ techniques to evaluate the biotic and abiotic interplay of the ecosystem effects. This study aimed to evaluate impacts using sampling transects around discharges from wastewater treatment works (WWTW) to a range of watercourses. The hypothesis was that major effluent discharges would lead to local downstream enrichment in nutrient and microbial contaminants, altered microbial communities and impairment in P processing rates with downstream recovery distances related to cumulative upstream pollution.

Five river transects were evaluated on two dates comprising points 100m above then 100, 200, 500 m below stream-side WWTW. Stream water samples were collected (effluents where possible) and analysed for C, N, P forms, coliforms, pesticides and pharmaceuticals. Biofilms (grown on tiles between sampling dates) and recovered for analysis alongside bed sediments for stoichiometry, P enzyme activity, substrate induced respiration assays and chlorophyll (biofilms). Catchments were characterised using spatial data on landcover, stream network and cumulative pollution sources.

Patterns of pollution presence in the waters and cycling indicators in the bed and periphyton did not show clear patterns of high local and declining downstream impacts. Instead a surprising complexity of weak transect effects amongst a high background heterogeneity was seen. This likely results from a heterogeneous biophysical environment of the channel as well as the complexity of the catchment 'diffuse' pollution inputs. Hence, WWTW impacts on aquatic pollution presence and processing factors were unclear and masked by catchment system heterogeneity and complexity.