Deterministic model of microbial sources, fate and transport: a quantitative tool for pathogen catchment budgeting

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Abstract The most important priority for the management of Australian drinking water catchments is the control of pathogen loads delivered to raw water reservoirs and treatment plant intakes. A process-based mathematical model was developed to estimate pathogen catchment budgets (PCB) for Cryptosporidium, Giardia and E. coli loads generated within and exported from catchments. The model quantified key processes affecting the generation and transport of microorganisms from humans and animal excreta using land use and hydrologic data, and catchment specific information including point sources such as sewage treatment plants and on-site systems. The PCB model was applied in the Wingecarribee catchment, Sydney and used to predict and rank pathogen and indicator loads in dry weather, intermediate (<30 mm in 24 h) and large wet weather events (100mm in 24 h). Sensitivity analysis identified that pathogen excretion rates from animals and humans, and manure mobilisation rates were the most significant factors determining the output of the model. Comparison with water quality data indicated that predicted dry weather loads were generally within 1-2 log10 of the measured loads for Cryptosporidium and E. coli and within 1 log10 for Giardia. The model was subsequently used to predict and rank pathogen and indicator loads for the entire (16 000 km2) Sydney drinking water catchment.