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Modelling aggregated catchment-scale phosphorus transport over 200 years in the Peel Harvey catchment, Western Australia

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Intensification of agricultural activity has resulted in increased eutrophication of waterways throughout the world. In Australia, naturally oligotrophic systems have been severely impacted by changing land use from natural ecosystems to commercial agriculture. Development of amelioration strategies to minimise the water quality impacts of intensive agriculture requires an understanding of nutrient uptake and nutrient flow pathways through catchments.

To address this issue, a simulation model was developed using the STELLA dynamic modelling software package to model the transport of phosphorus (P) through major source, sink and flow sectors of the Peel-Harvey Catchment in South Western Australia. Phosphorus is the most important nutrient in this catchment for promotion of nuisance and toxic algal blooms. The model simulates changes in stores and flows of P over a 200 year time horizon to match catchment development and associated nutrient inputs and outputs to the present day (100 years of development) and a further 100 years into the future. The present catchment scenario produces model outputs which agree well with monitored water quality data, survey data of farm inputs and outputs, and soil P content data.

The model allows for nutrient storage, assimilation and release from the various components of the catchment environment (soil, runoff, groundwater, stream sediment and estuarine water and sediment) and indicates that over the course of a 200 year simulation, releases of P from the soil store reach their maxima approximately 70 years from present and do not reduce from this point. That is, the soil P "storage" components of the catchment are already "leaking" P, and their ability to buffer any more P will be almost exhausted in 70 years if current agricultural practices continue. From this point onwards, P release into the regional waterways will equal annual application (currently 2610 tonnes). The P load target for the estuary is 70 tPpa, with current loads around 140 tPpa and expected to increase exponentially over the next 50 years.

Concomitant with the reduction in soil P storage capacity, is a maximization of the capacity of the catchment streams to store P in around 20 years time. This combined reduction in buffering capacity of the soils and streams has major environmental and management implications for waterways that are already under severe stress.