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The water quality of the River Enborne, UK: insights from high-frequency monitoring

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The River Enborne is a rural lowland catchment, impacted by agricultural runoff, and septic tank and sewage treatment works (STWs) discharges. Between November 2009 and February 2012, the river was instrumented with in situ analytical equipment to take hourly measurements of total reactive phosphorus (TRP), using a Systea Micromac C; nitrate, using a Hach Lange Nitratax; and pH, chlorophyll, dissolved oxygen, conductivity, turbidity and water temperature, using a YSI 6600 Multi-parameter sonde. In addition, weekly 'grab samples' were also collected and analysed for a wide range of chemical determinands including major ions, nutrients, and trace elements.

The catchment land use is largely agricultural, with wheat the dominant crop, and the average population density is 123 persons per sq. km. The river water is largely derived from calcareous groundwater, with a mean calcium concentration of 68.5 mg/l, and high nitrogen and phosphorus concentrations, with mean nitrate and TRP concentrations of 3.96 mg/l-N and 0.17 mg/l-P respectively. A mass-balance for the catchment demonstrated that agricultural fertiliser is the dominant source of annual loads of both nitrogen and phosphorus, accounting for 77 % and 84 % respectively. However, the concentration data show that sewage effluent discharges have a disproportionate effect on the river nitrogen and phosphorus dynamics, with the diurnal STW discharge signal discernable in the high-frequency nutrient dynamics. The nutrient dynamics and correlation structure of the data indicate a substantial contribution of groundwater and agricultural runoff to stream nitrate concentrations, whereas discharges from septic tank systems and sewage treatment works are a more important source of phosphorus. The high-frequency turbidity and conductivity dynamics reveal key information about the seasonal changes controlling the system dynamics, with marked differences in diurnal conductivity dynamics at the onset of riparian shading linked to the decreased importance of the photosynthetically-driven cycle of bicarbonate concentration. Only 4 % of the phosphorus input and 9 % of the nitrogen input is exported from the catchment by the river, highlighting the importance of catchment process understanding in predicting nutrient concentrations. High-frequency monitoring will be a key to developing this vital process understanding.