

Location, location, location – where in agricultural catchments will wetlands provide the greatest nitrogen attenuation?

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One of the key ecosystem services wetlands can provide in agricultural landscapes is attenuation of flows and diffuse pollutant loads. The question of where in agricultural catchments wetlands should optimally be located for water quality enhancement has been posed a number of times, but has proven difficult to clearly resolve. This is possibly because the answer changes depending on the landscape of interest and the particular contaminants being targeted. Recognising that hydrology is the most fundamental factor influencing pollutant removal performance, this study uses a simple dynamic model for wetland pollutant removal to explore potential wetland nitrate removal performance from surface waters at various locations within an agricultural catchment. The model operates on an hourly time-scale, dividing water flow through the wetland into 3 equal sized complete-mix reactors in series. Average first-order areal removal rates derived from a range of comparable wetland studies (Kadlec, 2005) are applied at each stage to calculate wetland removal performance. Annual nitrate removal performance over two annual periods (2008 and 2009) is compared at 4 locations within the Toenepi catchment in the North Island of New Zealand (Fig. 1) where contemporaneous hourly flow records were available. The predominant catchment land-use is intensive year-round pastoral grazing of dairy cows, with an estimated diffuse nutrient yield of $15 \text{ kg ha}^{-1} \text{ yr}^{-1}$ of total nitrogen and $12 \text{ kg ha}^{-1} \text{ yr}^{-1}$ of total phosphorus over the 2004-2006 period (Wilcock *et al.*, 2007). The four locations for which wetland performance is assessed are:

1. a subsurface tile-drain (2.6 ha catchment; Tanner *et al.*, 2005; Tanner and Sukias, 2011)
2. a headwater wetland (8.7 ha; Mueller *et al.*, 2010)
3. a channelised second order stream (164 ha, Roland Stenger, unpublished data), and
4. Outlet of catchment (1512 ha; Wilcock *et al.*, 1999; Wilcock *et al.*, 2007)

Measured hourly flows at each location are normalised on the basis of their contributing catchment area to enable direct comparison of theoretical wetland performance under the different hydrological regimes. It is recognised that this attempt to evaluate the role of hydrological flow characteristics at different locations in agricultural landscape on wetland treatment performance, considers only one of the aspects important for determining the optimal location to retain, restore or create wetlands. A much wider range of hydrogeomorphical, ecological, and ultimately, social, economic, and political issues need to be evaluated if we are to realise the full spectrum of ecological services provided by wetlands.

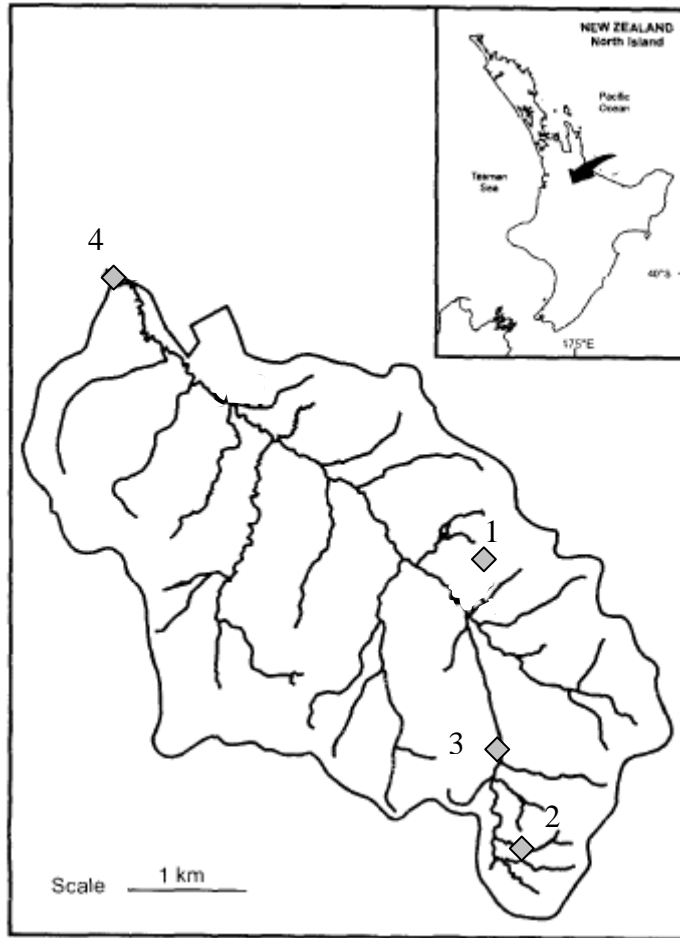


Figure 1 . Map showing the 4 locations in the Toenepe catchment, New Zealand, where hypothetical wetland performance was assessed. Note that some of these sites may not be conducive to wetland creation. (Adapted from Wilcock *et al.*, 1999)

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