

High spatial variation in a farm groundwater nitrate levels

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Introduction

The threat of nitrate (NO₃-N) contamination in shallow aquifers is of concern globally, with agriculture being a major contributor. The aim of this work was to study the variation in NO₃-N concentrations in 27 piezometers in shallow ground water (perched ground water table < 5 m deep) in the 63 ha dairy farm at Johnstown Castle.

Methods

Water samples were collected monthly after purging the previous day. Piezometers were sampled between July and Dec. 2007. Samples were analysed for ammonium-N (NH₄+N), nitrite (NO₂-N) and total oxidised nitrogen (TON). TON can be taken as NO₃-N for practical purposes since NO₂-N levels are so low. Depth of individual piezometers, elevation AOD, mean water table (WT) levels and mean NO₃-N concentrations are shown in Fig. 1.

- However, the mean NO₃-N concentration for the 27 piezometers on the farm was 5.3 mg/L. This is below the EEC guideline of 5.65 mg/L.

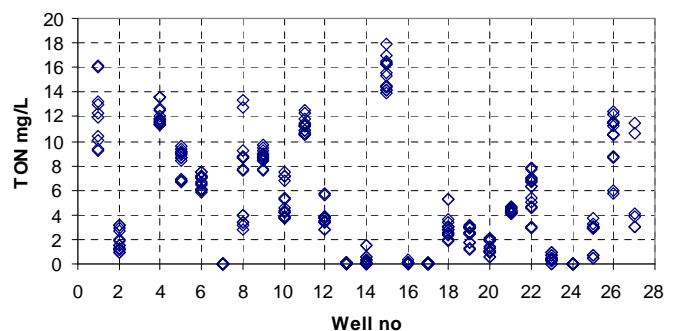


Fig.2. High spatial variation in NO₃-N levels in the 27 individual piezometers between July and December 2007

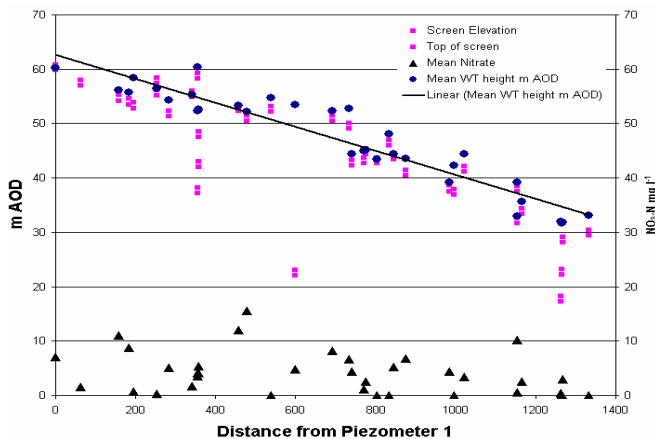


Fig.1. Relating piezometer elevation to mean water table and NO₃-N concentrations

Results

- Data from July to December 2007 indicate high spatial variation in NO₃-N concentrations between piezometers: high in several piezometers and very low in others, ranging from 0 to 18 mg/L (Fig.2).
- Piezometers 1, 4, 11 & 15 had average concentrations above maximum allowable concentrations (MAC) of 11.3 NO₃-N mg/L.

Discussion

- There was a high spatial variation in NO₃-N concentrations in shallow groundwater on this dairy farm. In general, the piezometers with high NO₃-N concentrations remained high and vice versa.
- Historic treatments, including N applications as fertilizer, slurry and dirty water, and possible groundwater nitrate plumes, may be responsible for high concentrations of NO₃-N in some piezometers.
- Varying NO₃-N concentrations in the groundwater may be linked to soil + subsoil or aquifer properties viz. reducing and oxidising conditions, high and low hydraulic conductivity, regulating the extent of nitrate levels as a result of nitrate leaching or denitrification.

Conclusion

The NO₃-N levels in the groundwater on this dairy farm showed large spatial and temporal variations. However, the mean concentration was below the MAC/EEC threshold levels. An attempt is underway to identify the sources of NO₃-N using a natural abundance multi-isotope approach.