



PA and the control of nitrogen pollution in dairy systems

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The risk of N loss and pollution

Movement of nitrogen (N) from dairy farms (nitrogen loss) into the environment can cause pollution. Two important nitrogenous pollutants are nitrate, a toxin to humans in drinking water and catalyst of toxic algal growth in surface waters, and nitrous oxide, a very serious greenhouse gas.

The amount of nitrogen available for loss varies across the landscape as nitrate leaching and nitrous oxide emissions depend upon environmental and management factors. The environmental factors include rainfall, deep drainage, slope, slope shape, depth to watertable, waterlogging and proximity to nearest water course. The management factors include ground cover, plant perenniality/ rooting depth, N fertiliser use – form, rate and timing, effluent disposal rate and method, nutrient

hotspots and stocking rate. Just as these factors vary spatially across a paddock, nitrogen losses also vary across the paddock.

applying specific management strategies to zones with a uniform risk of nitrogen loss

The risk of nitrogen pollution occurring is a function of both the probability of nitrogen loss and the severity of the pollution consequences. The probability of nitrogen loss at any point in the paddock depends upon the environmental and management factors prevailing at that point. Once measured, these 'risk' factors can be used to calculate the relative risk of nitrogen loss. This information can

be mapped to help farmers adapt management to minimise nitrogen pollution across an entire farm.

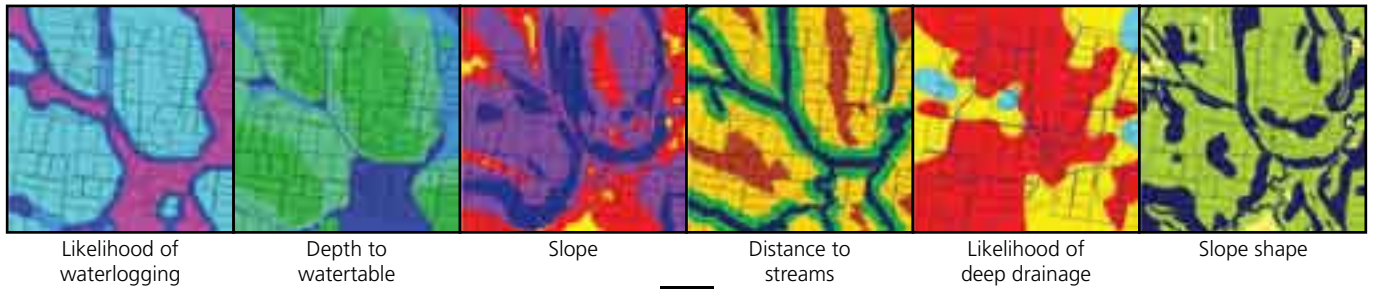
Management zones

In precision agriculture (PA), management zones are identified using a statistical clustering technique that groups data in such a way that the variation within a zone is minimised and the variation between zones is maximised. While there will still be some variation within zones, for any individual zone this will be less than the total amount of variation within the paddock as a whole, and so for all practical management purposes, individual zones can be regarded as uniform.

Rather than identifying zones of uniform yield potential, this research is assessing the practicality of applying specific management strategies to zones with a uniform

Figure 1. Data layers used to produce a nitrate leaching risk map

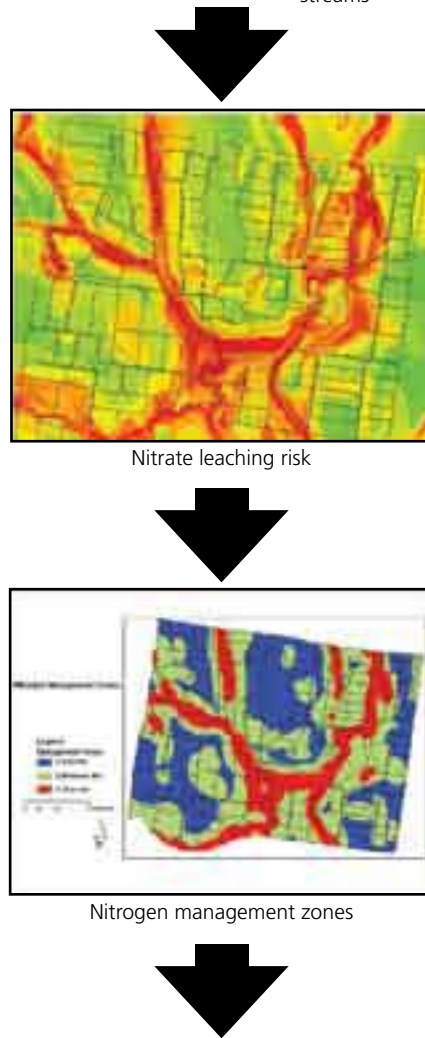
Pasture



risk of nitrogen loss, with the aim of minimising nitrogen pollution from dairy farms. While there are 'Best Management Guidelines' that aim to minimise environmental impact and concurrently optimise the economic response to nitrogen fertiliser for the dairy industry (www.nitrogen.unimelb.edu.au/BMPs.htm), there are currently no tools to spatially identify areas with a high N loss risk or for spatially targeted management to reduce nitrogen loss.

The practicality of the zone approach will be assessed in various ways, including:

- Can zones of a suitable size and uniformity be determined, which match dairy management logistics?
- Can the risk of nitrogen loss across the landscape be predicted accurately enough and in a timely fashion?
- Can the method be readily applied to other dairy properties or to other catchments?
- Will management zones assist to minimise the risk of nitrogen loss at the farm and catchment scale?
- Will modified management provide economic, production and environmental benefits and costs compared to current management?



This research is being undertaken in West Gippsland, Victoria at the DPI Ellinbank Research Institute's

commercial dairy. Datasets for each of the environmental factors that contribute to nitrogen loss have been collected across the entire property. Collected datasets include soil data (eg soil chemistry, soil hydraulic characteristics), management data (eg effluent management, fertiliser regimes), and topographic data (eg digital elevation models, stream networks). This data is being used to produce a mosaic of nitrogen management zones across the landscape (Figure 1). The final step is to identify appropriate management strategies for each zone, depending on the relative nitrogen loss risk in that zone. Table 1 contains examples of the type of nitrogen management strategies that could be applied to each zone.

Nitrogen management zones will remain static through the year but management will be changed to match the environmental conditions.

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Table 1. Development of management zones for nitrogen, based on nitrogen pollution risk.

Zone	Characteristic	Example management strategy
Zone 1	Low nitrate leaching risk	<ul style="list-style-type: none"> • Soil test to determine current n status • Calculate likely pasture response to N and cost of pasture produced
Zone 2	Moderate nitrate leaching risk	As above and: <ul style="list-style-type: none"> • Reduce stocking rates when soils are at, or above, field capacity • Only apply N when pasture is actively growing
Zone 3	High nitrate leaching risk	As above: <ul style="list-style-type: none"> • Consider permanently reducing stocking rates • Introduce a proactive soil testing and liming strategy