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Pathogen transport via soils from land-applied animal wastes

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Soil works for civilisation in many ways. As well as being the 'place of our nativity' and source of our sustenance, it also recycles much of our wastes and filters our water.

The global intensification of the land application of wastes, from both humans and livestock agriculture, and the accompanying increased incidence of microbiological contamination of water, are causing pathogen fate and transport to emerge as a growing 'buzz' area in soil science. In fact, microbial transport in soil is the most complex of contaminant transport processes.

New Zealand is commonly viewed as having a relatively secure environment. However, it is experiencing rapid growth in the profitability and hence production of livestock products, especially from the expansion of dairying. Its desire to protect public health, its ecosystems and its image (and hence its second major industry – tourism) have lead to increased research into safe methods of livestock waste treatment, and its application to land.

This paper summarises two aspects of research at Lincoln University in NZ's South Island.

1) At the fundamental level, we report on the experimental study of microbial retention in, versus passage through, columns containing either re-packed sands, or natural, undisturbed soils in lysimeters (50 cm diameter x 70 cm depth), with special emphasis on the influence of macroporosity.

2) At farm level, we describe the measurement at Lincoln University's commercially-operated Dairy Farm of the effectiveness of field soils as filtration media for bacteria

(E. coli and campylobacter) entering soil from either deposited manure or irrigated dairy-shed effluent.

We argue that, provided there is careful ‘matching’ of soils, local hydrology, and land application practices, then the soil and its subsurface can indeed act as an efficient barrier for ground and surface water protection, even under intensive farming. However the main threat to the effectiveness of the soil barrier has historically arisen, and will continue to arise, from excess water (via rainfall, flooding or irrigation), causing either runoff, or rapid deep percolation through soil macropores.