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NATIONAL RISK MANAGEMENT RESEARCH LABORATORY
GROUND WATER AND ECOSYSTEMS RESTORATION RESEARCH

Transport and Fate of Nitrate and Pathogens at a Dairy Lagoon Water Application Site: An Assessment of CNMP Performance

Research Type and Organization

The research type is an Interagency Agreement (DW1292189901) with the U.S. Salinity Laboratory and the U.S. Department of Agriculture's Agriculture Research Service.

Project Period

April 1, 2005 through September 30, 2009

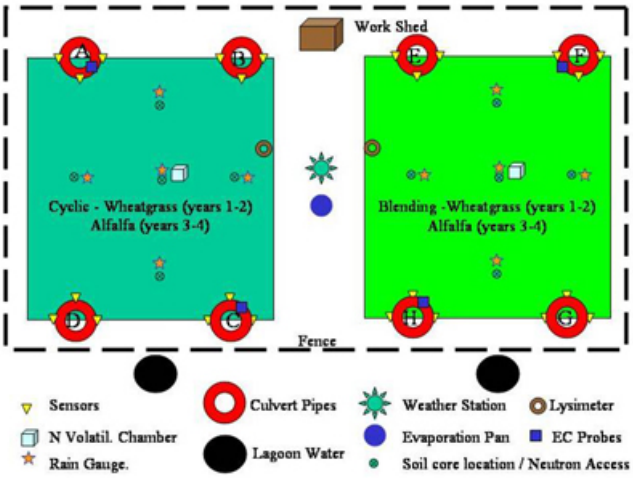
Project Summary

EPA currently requires that application of concentrated animal feeding operation wastes to agricultural fields follows a Nutrient Management Plan (NMP). The tacit assumption is that a well-designed and executed NMP ensures that all lagoon water contaminants (nutrients and pathogens) are retained or taken up in the root zone so that ground water is inherently protected. The proposed research is designed to test the assumption that appropriate NMPs are protective of ground water and to address potential weaknesses in the land-application design and operation processes. A well-designed and managed CNMP was implemented on 5-by-10-meter plots at a dairy farm in San Jacinto, California, for four years using different forage and application patterns. The selected site was intensively characterized and instrumented for the experimental studies. Lagoon water application rates were determined by following NMP protocols established in consultation with the National Resource Conservation Service (NRCS).

Spatial and temporal variations in water, nutrient, and indicator microbe levels at the site were determined using a system of nested tensiometers/soil solution samplers, neutron probe readings, drain gauges, and monitoring wells, as well as periodic soil coring, plant tissue analysis, and apparent soil electrical conductivity measurements. Along with the field experiments, laboratory experiments were also conducted, using microbes, lagoon water, well water, and soils from the NMP field site. Microcosm and batch studies were conducted to quantify microbial growth, death, and inactivation, as well as equilibrium partitioning of microbes at the solid-water and air-water interfaces. Transport experiments were conducted to quantify the influence of water content, microorganism size, grain-size distribution, and lagoon water composition on the movement and retention of microbes.

Kinetic transport parameters were estimated by fitting numerical simulations to experimental data. Nitrate and indicator microbe transport and fate at the field site were modeled using an unsaturated zone water flow and solute transport model (HYDRUS 1D and 2D) capable of simulating preferential flow paths.

This project is completed and has resulted in multiple journal articles that provide detailed information on the various aspects of the project. A final EPA report is in progress to summarize these results.



Products

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