Project Title: Transport and Fate of Nitrate and Pathogens at a Dairy Lagoon Water Application Site: an Assessment of CNMP Performance (GWERD IAG with USDA-ARS, DW1292189901)

Project Officer: S. Hutchins

Project Period: 04/01/2005 - 03/31/2009

Long-Term Goal/APM: WQ MYP LTG2/ APG 94/APM 334, WQ MYP LTG3/APG 58/APM 334 - Report on subsurface transport of nutrients and pathogens to ground water from CAFO land application sites which are operated under comprehensive nutrient management plans developed following NRCS guidelines, due 2009.

Abstract: EPA currently requires that application of Concentrated Animal Feeding Operation (CAFO) wastes to agricultural fields follows a Comprehensive Nutrient Management Plan (CNMP). The tacit assumption is that a well designed and executed CNMP 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 CNMPs are protective of ground water, and to address potential weaknesses in the land application design and operation processes. A well designed and managed CNMP will be implemented on 5x10 m plots at a dairy farm in San Jacinto, California for 4 years using different forage and application patterns. The selected site will be intensively characterized and instrumented for the experimental studies. Lagoon water application rates will be determined by following CNMP protocols established in consultation with the National Resources Conservation Service (NRCS). Spatial and temporal variations in water, nutrient, and indicator microbe levels at the site will be 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. Laboratory experiments will also be conducted, in conjunction with the field experiments, using microbes, lagoon water, well water, and soils from the CNMP field site. Microcosm and batch studies will be initiated to quantify microbial growth, death, and inactivation, as well as equilibrium partitioning of microbes at the solid-water and air-water interfaces.

Transport experiments will be 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 will be estimated by fitting numerical simulations to experimental data. Nitrate and indicator microbe transport and fate at the field site will be modeled using an unsaturated zone water flow and solute transport model capable of simulating preferential flow paths (HYDRUS 1D and 2D). New conceptual processes will be developed and implemented into HYDRUS as needed to improve simulations of nitrate and pathogen transport and fate at the field site.

Status: This is a new research project which was proposed based on observations with previous field sites and on discussions within the newly-formed Land Application Water Quality Task Team (LAWQTT), consisting of EPA ORD, EPA Region 6, USDA-NRCS, and USDA-ARS personnel. Funding has been secured for the first year of the project, and a start date of 04/01/2005 is expected.

Products: (1) An EPA report will be produced at the end of the project period describing all aspects (laboratory and field) of the funded project, (2) It is expected that 2-4 peer-reviewed manuscripts will be produced during and immediately subsequent to the project period.