USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: Survival of Escherichia Coli in the Sediments of a Northwest Arkansas Stream and Spring

Focus Categories: WQ, NPP, SED

Descriptors: Bacteria, Surface-Ground Water Relationships, Ground-Water Quality, Surface Water Quality

Duration: March 1, 1999 - February 28, 2000

Federal Funds: $21,555 $21,555 $0 Total Direct Indirect

Non-Federal Funds:$41,832 $24,488 $17,344 Total Direct Indirect

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Congressional District : Third

Statement of Critical State/Regional Water Problem

Animal waste associated with the production of livestock (poultry, cattle and swine) contribute significantly to non-point source contamination of surface water and ground water in northwest Arkansas (Davis et al., 1998; Edwards et al., 1997a and 1997b). Contaminants of concern include nutrients (nitrate-nitrogen and phosphorus) and bacteria. According to the 1996 Water Quality Inventory Report prepared by the Arkansas Department of Pollution Control and Ecology, 909 miles of Arkansas's streams are contaminated by non-point sources of pathogen indicator bacteria. This proposed project focuses on the viability of bacteria, up to several months, and will quantify the viability of Escharichia coli (E. coli), the predominant fecal coliform, in surface water and ground water flow systems typical of those observed throughout northwest Arkansas.

Escharichia coli is used as a pathogen indicator and presence of these organisms in the water indicates the likelihood of other health-threatening pathogens. If the environment within the streams and springs is conducive to survival of E. coli then it may also be conducive to supporting other potentially harmful pathogens.

Statement of Results or Benefits:

We anticipate that pathogen indicator bacteria can survive in these systems over sufficiently long periods to be a source of contamination through seasons when fresh inputs are limited. Demonstrating this provides a means to begin separating sources over the hydrograph. Separating sources over the hydrograph will help when designing monitoring techniques for evaluating management changes used to reduce sources and transport.

This project is important to water resources planners and managers, and will help them to formulate effective animal waste best management practices related to minimizing bacterial loading of surface water and ground water in the karst regions. These data will also be important in terms of design, operation and density of septic systems permitted within the area because these have a potential to introduce pathogens of concern into the water resources.

Nature, scope, and objectives of the research

Water-quality data based on analysis of samples collected over storm hydrographs from several springs and streams throughout northwest Arkansas indicate that concentrations of fecal coliform bacteria rise significantly in the early portion of the storm hydrograph. Peak concentrations frequently occur prior to the peak of the storm hydrograph. Noted, was that concentrations of fecal coliform bacteria often drop dramatically after the hydrograph peaks and do not tend to follow the recessional curve of the storm hydrograph (Davis, et al., 1998; Marshall et al., 1998). Marshall and others (1998) indicate that the occurrence of an exponential increase was not consistent with known flow distances or flow velocities in well characterized karst basins. Available data suggest that microbial transport occurs during flood pulses associated with re-suspension

of sediment due to turbulent flow. This means that the fecal coliform bacteria must be viable within the sediment for periods exceeding several months (Davis, et al., 1998; Marshall et al., 1998).

The hypothesis is that the pathogen indicator (Escheria coli) is transported into aquatic systems, deposited with the sediments, and remains viable for several months until re-suspension by turbulent flow. Bacteria observed during transport events are probably a combination of surface runoff and the re-mobilization of surviving organisms that were deposited by sedimentation from earlier events. This is important because if the pathogen indicator survives, pathogens may also persist.

The objectives of this study are:

a) determine the in-situ survival rate of Escheria coli in the sediments of a spring and stream in northwest Arkansas,
b) identify the region of the hydrograph dominated by re-suspended bacteria, and
c) attempt to separate the hydrograph based on re-suspension and other sources from within the watershed that are contributing bacteria from runoff and recharge.