



WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: Student Support for Assessment of Groundwater Contamination from Subdivisions

Focus Categories: NU, GW, SW

Key Words: Nutrients, Microbiology, Septic Systems, Ground Water, Surface Water

Duration: 01 March 1999-28 February 2000

Federal Funds Requested: \$ 6,600

Non-Federal Match: \$13,743 Total Proposal \$20,343

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Congressional District: Montana At Large

Statement of Critical Regional or State Water Problems

Nutrients and pathogens have been identified as parameters that limit water quality for some streams in the Gallatin Valley. Residential rural subdivision development has been identified as a potential source of contamination but the nutrient and microbial load delivered to water-quality impaired streams by shallow ground water which flows beneath subdivisions has not been directly measured. To date, the traditional approach used to assess contamination from septic systems has been to examine county-wide trends in ground-water quality, but trends have been elusive. The U.S. Environmental Protection Agency, Montana Department of Environmental Quality, Conservation Districts, Local Water Quality Districts and the public are all interested in the quality of shallow ground water, ground water from aquifers used by residents, and surface water which may receive ground water contaminated by waste disposal below mature developed areas.

Statement of Results or Benefits: The project will address several questions of high interest to Montana and the developing west.

A. Is microbiological contamination of ground water dominantly from poor well seals, septic contamination or other sources?

B. Are fecal coliform contaminated or nutrient contaminated wells on a flow line that contains one or more septic systems?

C. Are wells that are contaminated with nutrients also contaminated microbiologically?

D. Is the contamination level and type (nutrient/pathogen) dependent on the texture of the sediments below the subdivision?

E. What nutrient and coliform loads enter and leave a subdivision area via the ground water, and what are the likely loads being delivered to water-quality impaired streams in the Local Water Quality District?

F. Do the Bauman-Schafer and phosphorus breakthrough models correctly predict observed concentrations of nutrients below mature subdivisions?

Nature, Scope and Objectives of the Research

Introduction. This proposal supplements another project funded through the EPA 319 program. The nature, scope, objectives, methods, and procedures are all taken from that project. Insufficient funds were available from that program to support the salary of a graduate student. This proposal under the Water Resources Research Act (PL 101-397) targets salary support for a graduate student. The Local Water Quality District has reached its budgetary limit for matching because of commitments to other projects funded before this one and cannot commit further matching funds. The Department of Environmental Quality has committed funds to the 319 project for analytic costs and has no further funds for match. The reviewer must understand that this proposal is for student support only and that other aspects of the project are supported by the related 319 proposal which has no funds for student salary support. The material below has been taken directly from the 319 proposal and reorganized to fit the Water Center Proposal format unless a new section is requested.

Problem. Septic systems have been shown to contaminate ground water at a variety of locations (for example, Yates, 1985, Yates and Yates, 1988, Cogger, 1988, Reneau et al., 1989, Robertson and others, 1991; Ingram 1993; Hantzsche, and Finnemore, 1993). Nutrients and pathogens have been identified as parameters that limit water quality for some streams in the Gallatin Valley, and residential rural subdivision development has been identified as a potential source of contamination but the nutrient and microbial load delivered to water-quality impaired streams by shallow ground water which flows beneath subdivisions has not been directly measured. To date, the traditional approach used to assess contamination from septic systems has been to examine county-wide trends in ground-water quality (Slagle, 1995; Bauder et al., 1993; Dunne, 1978; Hackett et al., 1960). Trends have been elusive. The Department of Environmental Quality has suggested reexamination of subdivisions studied by Peavy et al. in 1980 to determine if ground-water quality has been degraded below and down flow of subdivisions and to determine whether the Bauman-Schafer and phosphorus breakthrough methods currently used for subdivision review and non-degradation assessment reasonably predict impacts of development on ground-water quality. While the DEQ's proposed reexamination is interesting, the original research wells are gone, home owner cooperation is not assured, and the study areas would require significant travel. An alternative is to examine ground water below 1970's-vintage subdivisions in the LWQD in Gallatin County which are thought to contribute nutrients and/or coliform to streams. Such a study could be used to

answer several important questions of interest both to the State of Montana and the Local Water Quality District.

1. Is microbiological contamination dominantly from poor well seals, septic contamination or other sources?
2. Are fecal coliform contaminated or nutrient contaminated wells on a flow line that contains one or more septic systems?
3. Are wells that are contaminated with nutrients also contaminated microbiologically?
4. Is the contamination level and type (nutrient/pathogen) dependent on the texture of the sediments below the subdivision?
5. What nutrient and coliform loads enter and leave a subdivision area via the ground water, and what are the likely loads being delivered to water-quality impaired streams in the Local Water Quality District?
6. Do the Bauman-Schafer and phosphorus breakthrough models correctly predict observed concentrations of nutrients below mature subdivisions?

Goals and Objectives. The goal of this project is to assess the source, distribution, and amount of nutrient and microbiological contamination in two mature subdivisions on substrates of different texture in the Local Water Quality District (LWQD), Gallatin County Montana. The data will be used to assess nutrient and pathogen loads delivered to the streams by ground water.

Objective 1. Select Subdivisions.

Task 1: Identify candidate subdivisions and rank-order them in a work shop with LWQD, DEQ, USGS and EPA personnel. Choose subdivision based on rank-order list and permission from subdivision home owners and home owners association.

Product: Reconnaissance maps, meeting summary, list of two subdivisions who agree to study.

Objective 2. Characterize the subdivisions.

Task 2: Map well locations, septic system locations, characterize the hydrogeology, soils, septic system type, septic installation quality, percolation tests, stratigraphy, hydrogeologic characteristics, land use and land-use history. Install well points for monitoring. Measure water levels in wells in the subdivision. Prepare a summary characterization for each subdivision.

Product: Report characterizing subdivision.

Task 3. Sample wells and streams for coliform, nitrate plus nitrite, phosphorous, pH, and specific electrical conductance once during a high ground-water level period and once during a low ground-water level period. Select wells for C-14 and Tritium sampling and have the water analyzed to assess the effect of the age of ground water on the nutrient and pathogen loads. Analyze data.

Product: Data Table

Objective 3. Analyze and interpret the data. Answer the questions posed above.

Task 4. Interpret data in terms of spatial and temporal relationships between well and septic location, hydrogeologic setting, and contamination type and source. Assess the potential effect of travel time on patterns of contamination. Calculate expected nutrient loading based on available data using the Bauman-Schafer model and a phosphorus breakthrough analysis. Evaluate nutrient and microbial loads delivered from subdivisions to water quality impaired streams via the ground-water flow system. Report the results to the home owners, LWQD, and DEQ

Product: Assessment reports on each of the six questions identified above.