USGS

# WATER RESOURCES RESEARCH GRANT PROPOSAL

1. Title: Sources and Control of Geosmin in Midwestern Water Supply Reservoirs

2. Focus Categories: WS, WQL, TRT

3. Keywords: Geosmin, taste and odor, algae, cyanobacteria, actinomycetes, reservoir management, water quality control, water treatment

4. Duration: September 1, 1998 to August 31, 2000

5. Federal Funds Requested: $55,000

6. Non-Federal (Matching) Funds Pledged: $130,292

7. Principal Investigators: Stephen J. Randtke, David W. Graham, and Frank deNoyelles, Jr., University of Kansas, Lawrence, KS

8. Congressional District: Third

9. Critical Regional or State Water Problem:

Although seasonal taste and odor problems are not considered a direct threat to public health, they are perhaps the single greatest public relations issue many water utilities face because consumers generally rely on the taste of their water as the primary indicator of its safety (McGuire, 1995). Also, the cost of controlling taste and odor problems can be quite substantial. For example, the City of Wichita, KS recently devoted $500,000 to control non-point source pollution to address taste and odor problems in Cheney Reservoir, and the City of Emporia, KS recently installed ozonation facilities for taste and odor control at a cost of $830,000. In the winter of 1995-96, the City of Lawrence, KS, unable to adequately treat a severe taste and odor problem (involving geosmin levels of 200 to 300 ng/L) at its Clinton Lake water treatment facility, was forced to shut the plant down for nearly two months and is now in the process of assessing the capital improvements needed to address future episodes. Another severe episode just a few months ago once again caused Lawrence to cease production at its Clinton Lake water treatment plant. Similar problems are occurring throughout the region. In the past two years, the investigators have been contacted by six water utilities (in four different Midwestern states), four consulting firms, and other parties seeking assistance in assessing or controlling taste and odor problems in reservoirs, virtually every one of which was either known or thought to be caused by geosmin. The consensus among those actively involved in water supply and treatment is that the problem is growing worse as the reservoirs age and fill with silt. At the same time, a growing number of people are relying on reservoirs as sources of water supply.

Because blue-green algae (cyanobacteria) and actinomycete bacteria are known to be important sources of geosmin, it is commonly assumed that geosmin levels in a water supply should correlate with counts of blue-green algae or actinomycete spores. In reality, the situation is far more complex; and such correlations, if found at all, may lead to erroneous conclusions. Not only are there a number of potentially significant sources of geosmin other than algae in Midwestern reservoirs (e.g., weeds, standing timber, soil, sediments, etc.); but geosmin is produced intracellularly and most of its release into the water occurs only when the microbes that produce it die and decompose. The relative importance of various sources of geosmin in Midwestern reservoirs is not known; and the factors influencing its production, release, and decomposition are also not well understood. Therefore, it is not clear which in-lake management techniques will most effectively control the problem. Control of non-point source pollution is expected to be beneficial to some extent, but will clearly not be an adequate solution for many reservoirs. Geosmin is not removed by conventional water treatment processes; and, although it can be partially removed by adsorption on powdered activated carbon (PAC), this process is often not adequate to treat the severe problems that have been occurring in water supplies throughout this region. There is much need for greater understanding of the production, release, and decay of geosmin in Midwestern water supply reservoirs and for practical solutions to address severe taste and odor episodes associated with geosmin.

10. Expected Results and Benefits:

Successful completion of the proposed research project will: 1) significantly improve practical and scientific understanding of the sources of geosmin in Midwestern reservoirs and the factors influencing geosmin production, release, and decay; and 2) contribute to the identification and development of practical in-lake management techniques and in-plant treatment processes that lake and reservoir managers and water treatment plant superintendents will be able to use to control geosmin, especially in severe cases. Ultimately, consumers of drinking water obtained from reservoirs that experience high concentrations of geosmin will benefit by receiving better tasting water, which will also serve to increase their confidence in the safety of their drinking water supply. Furthermore, although preliminary efforts to directly correlate geosmin with toxins released by cyanobacteria have been unsuccessful, complex relationships between these substances may exist. If so, the proposed research may eventual be helpful in efforts to minimize the production of algal toxins.

The primary intended beneficiaries of the proposed research project are lake and reservoir managers, water treatment plant superintendents, and their advisors. The final project report and various journal articles and conference proceedings papers stemming from the proposed research will be prepared with the goal of providing such individuals with sound, practical information that will better equip them to address taste and odor problems associated with geosmin and related compounds. Also, a doctoral student will receive extensive training in the areas of water quality management, lake ecology, and drinking water treatment; and other students, both graduate and undergraduate, will have an opportunity to participate in the project.