Minnesota Pollution Control Agency

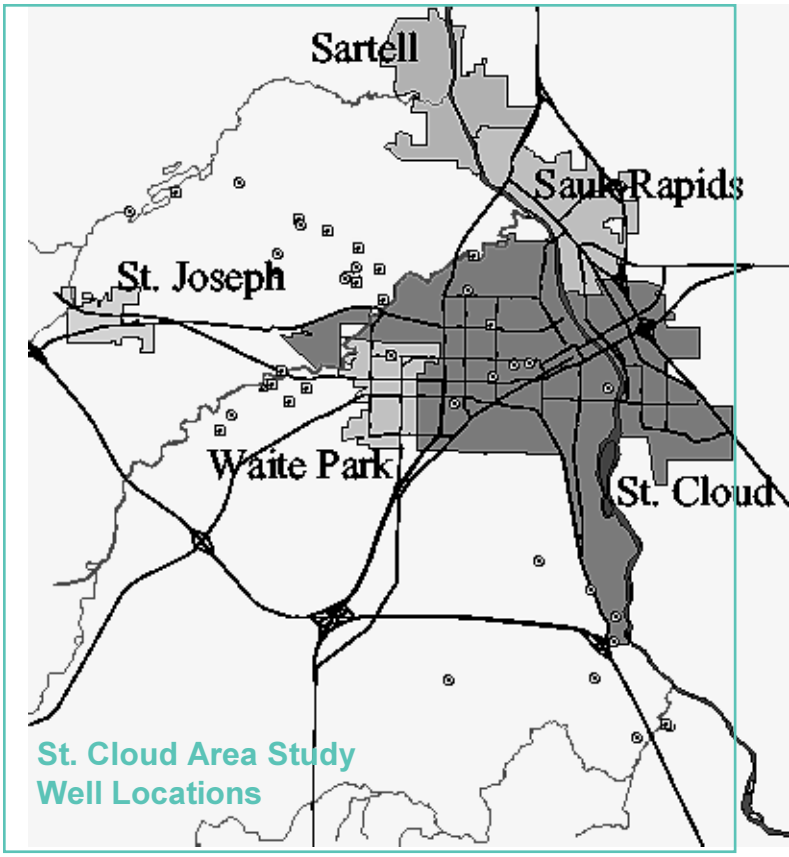
Understanding Land-Use Effects on Ground Water, St. Cloud Area Study First Year Summary

Ground Water/June 1998

G W M A P

Ground Water Monitoring and Assessment Program

The Ground Water Monitoring and Assessment Program (GWMAP) is a non-regulatory program at the Pollution Control Agency that assesses the quality of ground water in Minnesota. The information generated provides water resource managers around the state with information to make good decisions in their communities about protecting and using their ground water resources. This fact sheet summarizes the first year's results from a GWMAP study of the affects of land-use on ground water quality.



St. Cloud Area Study Well Locations

What is the purpose of the study?

This study began in fall of 1996 to assess impacts of land use on water quality. The study area, located in and around St. Cloud, Minnesota, is experiencing rapid urbanization and is underlain by a shallow sand and gravel aquifer. The aquifer is likely to be sensitive to changes in land use. Six different land-use types are being evaluated for their impacts on area ground water. The land uses being studied are: undeveloped, agricultural, irrigated agricultural, unsewered residential, sewered residential, and commercial/industrial.

How is the study being conducted?

A sampling network was established across approximately thirty square miles in and around St. Cloud. The network consists of 23 monitoring wells screened at the water table, 23 domestic wells screened at various depths in the aquifer, two surface sampling locations in the Sauk River, four continuous recorders of water levels in monitoring wells, one surface water gaging station on the Mississippi River, and a weather station. Soil information has been documented where wells were drilled. Four times per year samples are collected and analyzed for a complete list of metals and other parameters of interest, such as nitrates, phosphorus, volatile organic compounds or VOCs (chemicals often used in manufacturing processes), pesticides, and field parameters (temperature and pH of the water).

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What do we know so far?

The results from the first year of the study show that land use has had significant impacts on the water quality of the shallow surficial aquifer. Concentrations of barium, boron, calcium, chloride, nitrate, phosphorus, potassium, silica, strontium, sulfate, sulfur, and total dissolved solids were lower in **undeveloped** land use areas compared to other areas. **Commercial** areas showed the greatest median concentrations of alkalinity, barium, boron, calcium, magnesium, manganese, strontium, and total dissolved solids, while concentrations of these parameters were lowest in the **agricultural** and undeveloped areas, where recharge was greatest. Concentrations of ammonia, chloride, potassium, sulfate, sulfur, and zinc were greatest in the commercial and **sewered residential** areas. The presence of these chemicals at elevated concentrations may reflect long-term inputs from road deicing, sewer pipes, and industrial processes in these older sections of St. Cloud.

Concentrations of nitrate were greatest in **irrigated agricultural** areas. Concentrations of nitrate and boron were greater in **unsewered residential** areas compared to sewered areas, but concentrations of most other parameters were greater in sewered areas compared to unsewered areas. Concentrations of most parameters were greater in irrigated agricultural areas than in nonirrigated areas.

Boron, chloride, potassium, manganese, molybdenum, and silica concentrations were greater in urban areas than in agricultural areas.

The primary chemical of concern from a health perspective was nitrate. Nitrate concentrations were greater in agricultural areas than in urban areas. The differences in water quality between agricultural and urban land uses may be partly related to the amount of water that is reentering the aquifer, which appears to be less in the urban areas. *Although the upper portion of the surficial aquifer has been affected by land use, the level of risk to ground water users is low in the upper portion of the aquifer and nearly unaffected by land use in the deeper portions of the surficial aquifer.* This is because most ground water used for drinking water and other purposes is pulled from wells deeper into the aquifer, where the impacts from the land surface are less noticable. The drinking standard for nitrate was exceeded in six of the monitoring wells and two domestic wells.

Water quality in the upper portion of the surficial aquifer differs from deeper portions of the aquifer. Concentrations of dissolved oxygen and nitrate decrease with depth, while concentrations of manganese and iron increase with depth in the aquifer. Sulfates, fluoride, phosphorus, and arsenic increase in concentration with depth. VOCs were detected in only a few wells, primarily in urban areas. Chloroform and chlorinated solvents were the primary chemicals detected, none of which was detected at a concentration exceeding a drinking water standard.

The pesticide atrazine and its break-down products were detected in two irrigated agricultural wells at concentrations below the drinking water standard. Dicamba and 2,4-D were detected in monitoring wells from urban areas during the August sampling event, reflecting use of these chemicals on lawns and road right-of-ways. None of the concentrations exceeded a drinking water standard.

Who can use this information?

The results from this study can provide water planners and other local decision makers with good tools to make informed decisions on how best to protect their ground water resources. Knowing the connections between activities at the land surface and drinking water supplies also helps planners and others know what to expect when locating new drinking-water wells. This information is applicable to many communtities that are similar to St. Cloud in their growth patterns and underlying geology.

What is next?

Goals for 1998 include continued quarterly sampling, expanded pesticide sampling, additional tests to evaluate the sources of nitrogen, and analysis of results of extensive geoprobing conducted in March and April to quantify vertical variability of water quality in the upper 15 feet of the aquifer. Soil boring information and chemistry data will be used to develop a ground water flow model for the area. This model will be used to assess potential changes in water quality resulting from different patterns of land use.

Where can I get more information?

For more information about the St. Cloud Area Study, contact Jennifer Maloney, hydrogeologist, GWMAP, at (612) 296-8544 or toll-free/TDD (800) 657-3864. Additional information on this study and other ground water projects is available on the MPCA's web page at <www.pca.state.mn.us>.

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