Fact Sheet

United States Geological Survey
Programs in Minnesota

The USGS provides maps, reports, and information to help others meet their needs to manage, develop, and protect America's water, energy, mineral, and land resources. We help find natural resources needed to build tomorrow, and supply scientific understanding needed to help minimize or mitigate the effects of natural hazards and environmental damage caused by human activities. The results of our efforts touch the daily lives of almost every American.

For more than 100 years, the U.S. Geological Survey (USGS) has been mapping, describing, and seeking to understand Minnesota's resources. The USGS is known for impartial data collection and data interpretation that enables resource planners and others to make informed decisions. Today's issues are more pressing than ever—understanding natural hazards to minimize effects on life and property, the continuing need for mineral- and water-resource development, and understanding the effects of human activities on water resources. As the Nation's lead earth science agency, the USGS works with State, local, and other Federal agencies in addressing these issues. Watershed districts; soil- and water-conservation districts; Tribal governments; mining industries; educators; city, county, regional, State, and Federal planning agencies; consulting firms; crop consultants; farmers; and other private citizens use USGS maps, interpretive reports, and data to manage Minnesota's resources better.

Mineral Resources

Economic growth and development in Minnesota depends, in part, on the availability of local sources of minerals for use in industry and manufacturing and for maintaining and upgrading transportation networks. Raw materials, such as sand and gravel, for example, are needed by State agencies and private industrial and construction firms to construct roads and buildings. To ensure continued growth and development of industry, new sources of construction materials and other mineral resources must be identified because existing supplies are limited and land-use constraints rule out exploitation of some geologic resources. Minnesota not only contains identified resources of iron, copper, and nickel, but also has potential for developing gold, zinc, platinum, and other minerals of local, national, and global importance. Extraction and processing of these mineral resources could form the basis for enhanced local and regional economies.

The USGS, in cooperation with the Minnesota Geological Survey, the Minnesota Department of Natural Resources, the U.S. Bureau of Mines, and other agencies, is preparing an inventory of known mineral resources in Minnesota. These agencies also are assessing the potential for developing undiscovered mineral deposits in the State. Maps and reports in digital and paper form assist Federal, State, and local land-management agencies to ensure adequate supplies of minerals at low cost and to promote sound management of the region's substantial mineral resources. The USGS, in cooperation with the Minnesota Geological Survey, is mapping the distribution, thickness, and chemical, physical, and engineering characteristics of surficial deposits in the State. Working directly with the Bureau of Indian Affairs and the Red Lake Tribe, the USGS helped identify areas on Reservation lands that may yield gold reserves and provide a new economic base for the region. The USGS cosponsored an industrial minerals workshop in Minneapolis that included discussions on the current status of raw materials, their projected needs, associated mining problems, and development of a strategy for assuring mineral availability now and in the future. In 1994, the Governor of Minnesota presented the USGS with a certificate of commendation for its partnership efforts with State agencies to evaluate the mineral resources of Minnesota.

Water Availability

Water is one of the most prevalent resources in Minnesota. During 1990, about 79 percent of all Minnesotans obtained their domestic supplies from ground water, and nearly 800 million gallons of ground water were withdrawn every day. During the past 20 years, withdrawals of ground water from glacial and bedrock aquifers in Minnesota have increased, particularly for irrigation purposes in areas of sandy soils. Irrigated acreage in many sand-plain areas increased by a factor of 10 during the 1970's according to the soil and water conservation districts. Anticipated future changes in land use, population, and economic development also will increase ground-water withdrawals. Because of these increased demands, State and local agencies are concerned about the effects of drought on water supplies, long-term sustainable yields of wells, effects of pumping on ground- and surface-water levels, and interferences among nearby wells pumping from the same aquifer.

The USGS is the leading Federal agency in Minnesota that collects and interprets water-resource data and information used by resource managers, planners, and the general public. To define the availability of water for public, irrigation, and industrial supplies, the USGS monitors streamflow, lake levels, and groundwater levels at many locations and has studied numerous aquifers in Minnesota (fig. 1). These studies have mapped and quantified water supplies for Minneapolis, St. Paul, Rochester, Moorhead, and

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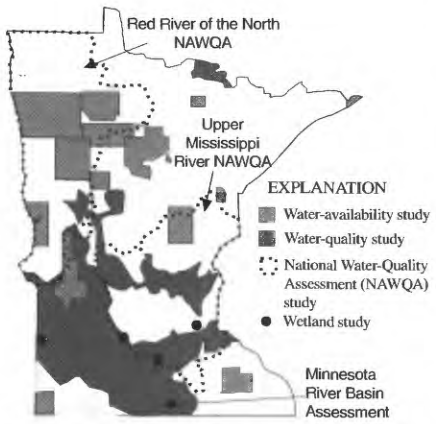

Figure 1. Selected water-resources investigation study areas in Minnesota, 1980–94.

other cities. Typically, the studies describe the effects of present and future ground-water withdrawals on the levels and quality of ground water and streams.

Some specific uses of the USGS studies by cities, counties, and regional groups include development of ground-water protection plans, enhancement of water-supply systems, and evaluation of the possible effects of urban development. Some study results were instrumental for water-resource managers to evaluate the vulnerability of local ground-water resources to contamination. Tribal officials of the Grand Portage Indian Reservation used results of a USGS study to develop alternative community water supplies from Lake Superior.

Water Quality

Expansion of urban and industrialized areas and development of agricultural resources during the past 50 years have adversely affected some water resources. State and local water managers and the citizens of Minnesota are concerned about the effects of human activity on the quality of Minnesota's streams and ground water. Consequently, many of the most recent requests for USGS assistance have been related to water-quality issues. Of particular interest to water managers are the water-quality effects of applying nutrients and pesticides to agricultural crops.

To determine the quality of water in Minnesota's streams and lakes, the USGS maintains 5 surface-water-quality stations, 2 sediment stations, 13 lake stations, and 1 precipitation station. The USGS also has completed numerous studies of ground-water quality. The USGS studies water quality at scales that range from a farm field (fig. 2) to regional drainage basins in the 12-State Midwest Corn Belt. Ongoing regional studies of water quality cover most of the major drainage basins in Minnesota. A study of the Minnesota River Basin determined how suspended sediment, agricultural chemicals, and bacteria impair use of the river water. The effects of conventional and improved farming practices on water quality are being examined in several farm-field studies. Results of one study have shown that as much as one-third of the nitrogen applied to a typical corn crop in sandy soils reaches the ground water. The USGS also is studying the environmental effects of an oil spill near Bemidji that is similar to numerous other sites of contamination across the Nation. Results of this study may help reduce the costs of cleaning oil-contaminated ground water.

Results of USGS water-quality studies provide water managers with essential information needed to make ground-water management decisions throughout Minnesota. State regulatory agencies are

Figure 2. Irrigating a corn field.

using results of USGS studies to develop new agricultural best management practices (BMP's) for farmers to reduce stream and ground-water contamination. The USGS works closely with State and local agencies to monitor whether the BMP's reduce this nonpoint-source contamination. Tribal officials used study results to develop plans to close existing landfills, to site new landfills, to assess the health of a large lake, to evaluate mercury contamination of a major river, to assess nitrate contamination of ground- and surface-water resources from a large feedlot operation, and to develop a pesticide-control ordinance. Networks of USGS observation wells in many of the aquifers in Minnesota are now used by State and local groups to monitor water quality.

National Water-Quality Assessment Program

A critical factor in understanding water quality is the ability to make comparisons among different locations through time. Nationally consistent and comparable information is needed to make valid statements about regional and national water-quality conditions now and in the future. Assessments are needed that identify the natural and human factors that affect the quality of the Nation's surface- and ground-water resources. The USGS National Water-Quality Assessment (NAWQA) Program was established to address these needs.

NAWQA studies in the Red River of the North and the Upper Mississippi River Basins investigate nonpoint- and point-source water-quality issues in Minnesota and adjacent States. Such factors as natural ground-water chemistry and climate are used to assess contamination of water by runoff from population centers and from agricultural activities. These studies are using intense monitoring of stream- and ground-water quality and stream biology. They are producing water-quality information that is used by policy makers and water managers at the local, State, and national levels. For example, information on land use and land cover is being compiled to determine their effects on water quality. Results of the NAWQA study along the St. Croix National Scenic Waterway (fig. 3) will benefit the National Park Service in managing this scenic recreational area. The NAWQA studies are prompting cooperation among State agencies in Minnesota, North Dakota, and Wisconsin and various Provincial and Federal agencies in Canada to consider consistent, basinwide approaches to monitor water quality in the Red River of the North and the Upper Mississippi River Basins.

Interaction of Ground Water and Streams

The quantity and quality of streamflows in most of Minnesota are controlled by ground water during periods of low rainfall. State and local agencies are concerned about the effects of ground-water withdrawals on streamflow and stream-

Figure 3. St. Croix National Scenic Waterway.

water quality. There also is concern that contamination within the aquifers or the streams could adversely affect public water supplies. Water managers need to obtain more information about how streams are affected by ground-water withdrawals from adjacent aquifers and about how poor water quality in these aquifers affects streams.

The USGS has studied the interaction of ground water and streamflow at several sites in Minnesota. One study found that, during the 1988–89 drought, the Mississippi River did not lose water to the adjacent ground-water system. The city of Minneapolis and the U.S. Army Corps of Engineers used results of this study to plan for future droughts. Study of the Straight River in north-central Minnesota found that return flow from increased irrigation in the adjacent glacial aquifer could change the stream's trout habitat. The Minnesota Department of Natural Resources is using results of this study to manage the local trout population better. The USGS is currently (1995) studying interaction of the Rock River with the surrounding alluvial aquifer, in part, because sources of contamination to the river are present upstream from ground-water-supply wells in Luverne. State and local water managers are concerned about how ground-water quality will be affected as a result of inducing flow from the Rock River into the aquifer, which is one of the largest and most productive alluvial aquifers in southwestern Minnesota.

Wetlands

Wetlands are an ecologically important but disappearing component of the natural landscape. Wetlands provide habitat for many species of plants and animals that would not exist otherwise. Minnesota has lost about 50 percent (8 million acres) of its wetlands since the mid-1800's, primarily from draining for agricultural purposes. The loss of wetlands can cause flooding, soil erosion, and water-quality problems.

The USGS is studying how existing and restored wetlands in agricultural and other landscapes can store flood water, settle suspended soil particles, and alter or remove fertilizer and pesticides by plant uptake and microbial action. USGS studies provide water managers in State and Federal agencies with a better understanding of how efficiently restored wetlands can reduce flooding and improve water quality. Such information will help water managers identify locations where wetland preservation and restoration can strike the best balance between ecological and economic imperatives.

Hydrologic Data Collection

Hydrologic data are needed for hazard warning, hydroelectric power, irrigation, management, operation, planning, pollution abatement, water-resource development, water supply, and wildlife management. To address the needs of water managers and the citizens of Minnesota, the USGS operated 167 daily- or partial-record streamflow-gaging stations in 1994 (fig. 4). Data from these stations are added to a national data base each year for easy access.

Planning for Future Floods and Droughts

Floods threaten lives and property, annually cause tens of millions of dollars in property damage and remediation costs, and disrupt commerce. The damage to bridges and other structures caused by channel scour or migration during a flood can cost millions of dollars. Because many of Minnesota's cities are adjacent to rivers, knowledge of probable flood discharges and river elevations is needed for designing new bridges or near-stream housing developments.

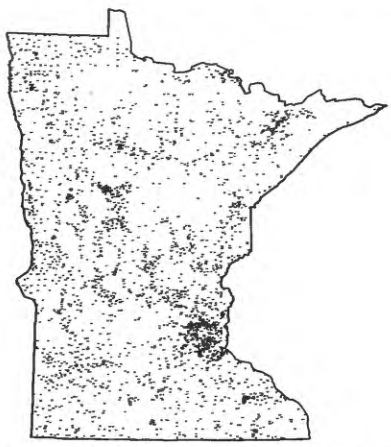

Figure 4. Surface-water data-collection sites.

The 1988–89 drought and the 1993 flood (fig. 5) are two recent natural disasters that illustrate the need for the long-term, consistent hydrologic information obtained by USGS. During the 1988–89 drought, Minnesota Department of Natural Resources personnel required continuous streamflow information throughout the State to protect fish and guard against excessive water use. In addition, USGS data were used by the U.S. Army Corps of Engineers to manage and operate their locks, dams, and reservoirs and were used by many cities to manage their water supplies and sewage-treatment plants. During the 1993 flood, the U.S. Weather Service depended on the USGS for accurate and continuous water-flow data to forecast flooding and prevent or minimize damage to public and private property.

Figure 5. Flooding of the Minnesota River in 1993.

National Mapping Program

Among the most popular and versatile products of the USGS are its topographic maps at the scale of 1:24,000 (one inch on the map represents 2,000 feet on the ground). This scale is useful for civil engineering, land-use planning, natural resource monitoring, and other technical applications. Minnesota is covered by 1,725 of these maps, which have long been favorites with the general public for outdoor uses, including hiking, camping, exploring, and back-country fishing expeditions. These maps depict natural and

cultural features of the landscape, such as lakes and streams, highways and railroads, boundaries, and geographic names. Contour lines are used to depict the elevation and shape of terrain. The USGS periodically updates map features in most of the larger towns across the State, including changes in suburban development around metropolitan areas. The updated map information is used by State agencies such as the Minnesota Department of Transportation and the Minnesota Department of Natural Resources for project planning and geographic information systems applications.

The USGS cooperates with Minnesota in several programs to produce cartographic data to meet State needs. The Land Management Information Center and the USGS have agreed to update topographic maps, to produce computerized (digital) elevation models, and to convert mapping and other aerial photographs into computer-readable formats (fig. 6). Since 1993, Minnesota and the USGS have been producing computerized aerial mapping photographs for the whole State. These digital images will provide a "snapshot" of the State's surface that will be fundamental to statewide application of geographic information systems techniques. The Alexandria Technical College was awarded a grant administered by the USGS to develop training programs that address standardization issues in the production of geospatial data. The project will promote better management of geospatial data and more efficient collection, maintenance, access, and transfer of new data among multiple users.

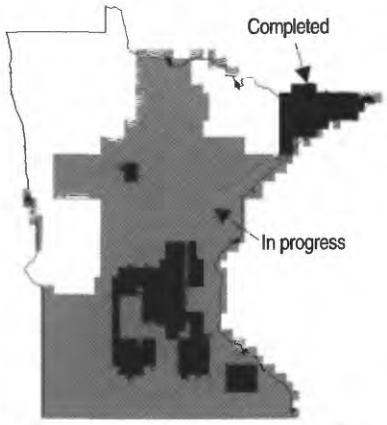

Figure 6. Digital aerial photographs.

Earth Observation Data

Through its Earth Resources Observation Systems Data Center near Sioux Falls, South Dakota, the USGS distributes a variety of aerial photographs and satellite image data products that cover all of Minnesota. Aerial photographic records in Minnesota date back about 40 years. Satellite imagery dating from 1972 are used to investigate regional changes in landscapes.

Submergence of Lake Superior Shorelines

The Lake Superior shoreline in Minnesota and other areas is slowly submerging as a result of residual uplift following glacier retreat 9,800 years ago. The lake level is controlled by the outlet at Sault Ste. Marie, Michigan. The outlet to the lake is rising more rapidly than most other points along the shore. Consequently, the lake level is rising about one inch per decade near Duluth where as much as 18 feet of submergence has taken place. Submerged wetlands and forests are evident below the present lake level. Rising lake levels attributable to uplift at the outlet will continue to inundate low-lying areas and river mouths, expand wetlands, and contribute to erosion of exposed and erodible shores. Engineers and water managers in Duluth, and elsewhere along the Lake Superior shoreline, will benefit from results of this study in making management decisions.

Cooperative Programs

The USGS cooperates with more than 50 local, State, and Federal agencies in Minnesota. Cooperators include regional, county, and municipal public works departments; State Departments of Natural Resources, Public Health, Pollution Control, Agriculture, and Transportation; the University of Minnesota; Indian Tribal governments; soil- and water-conservation districts; the U.S. Department of Agriculture; and the U.S. Army Corps of Engineers, to name only a few. Cooperative activities include water-resources data collection, interpretive water-availability and water-quality studies, mineral-resource assessments, and mapping. When local and State agencies are involved, activities typically are funded on a matching-funds basis.

The USGS provides support to the Water Resources Research Center, which conducts a program of research, education, and information and technology transfer.

For more information contact any of the following:

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For geologic information
Assistant Chief Geologist
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(703) 648-6660

Additional earth science information can be found by accessing the USGS "Home Page" on the World Wide Web at "http://www.usgs.gov".

For more information on all USGS reports and products (including maps, images, and computerized data), call 1-800-USA-MAPS.

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