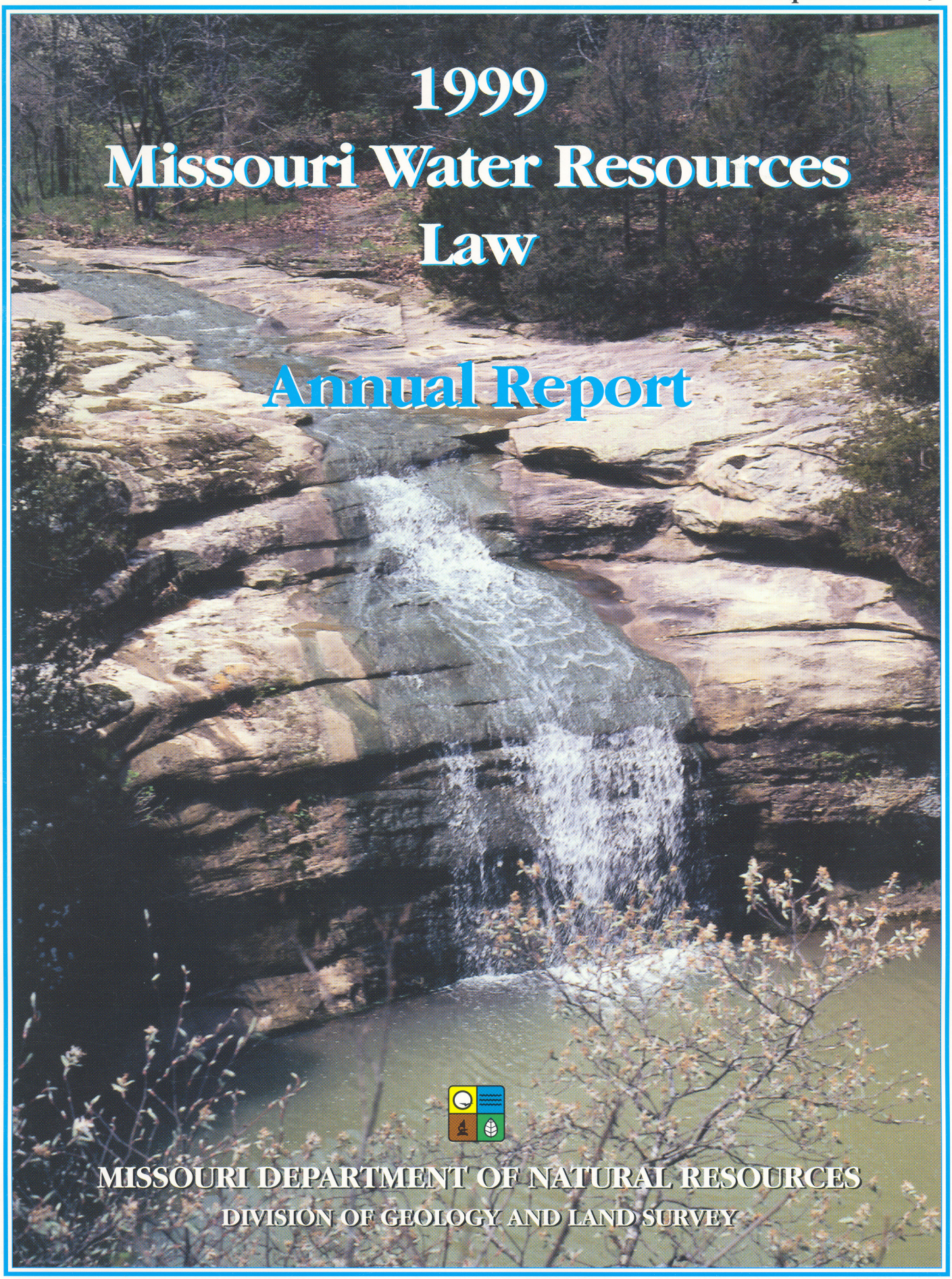
Water Resources Report Number 65



1999 Missouri Water Resources Law

Annual Report

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

Water Resources Report Number 65

Missouri Water Resources Law

1999

Annual Report

Missouri Department of Natural Resources
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MISSOURI WATER RESOURCE LAW

Sections 640.400 to 640.435 shall be known and may be cited as the "Missouri Water Resources Law," in recognition of the significance of the conservation, development and appropriate use of water resources of Missouri.

1999 MISSOURI WATER LAW ANNUAL REPORT

CONTENTS

INTRODUCTION 1
WATER QUALITY AND QUANTITY 3
- Public Drinking Water Systems 3
- Wastewater Treatment Systems 4
- Water Quality Coordinating Committee 5
- Nonpoint Source Pollution 5
- Impaired Waters 7
- Water Pollution Control Tools 7
- Soil and Water Conservation 8
- Pilot Agricultural Nonpoint Source (AgNPS) Special Area Land Treatment (SALT) Projects 9
- Hazardous Wastes 10
- Storage Tanks 12
- Tank Facts as of December 31, 1998 13
- Solid Wastes 13
- Wells For Water, Heat Pumps, Monitoring and Mineral Testing 14
- Wells For Oil, Gas and Underground Injection 14
- Reclamation of Mined Lands 15
- Emergency Response 19

INTERSTATE USE OF WATER 19
- Upper Mississippi River Basin Association 19
- Missouri River Basin Association 19
- Arkansas-White-Red Basins Inter-Agency Committee 21
- Lower Mississippi River conservation Committee 21
- Interstate Council on Water Policy 22
- Mississippi River Parkway Commission 22
- Mississippi River Basin Alliance 22

MONITOR WATER QUALITY 23
- Surface Water Quality Monitoring 27
- Monitoring Program Evaluation 28

INVENTORY WATER USE AND AVAILABILITY 29
- Water Use 29

1997 Missouri River Use as a Percentage of Total Registered Major Water Use 29
Drinking Water provided to Missouri Citizens by Public Water Systems and Private Sources 30
Groundwater Availability 30
1998 Groundwater Level Observation Well Network 31
Surface Water Availability 32
Surface Water Gaging Stations in Missouri 32
Survace Water-Quality Stations in Missouri 33
DAM SAFETY 34
Dam and Reservoir Safety Program Regulated Dams 34
STATE WATER PLAN 35
Background 35
State Water Plan Volumes 35
Groundwater Resources of Missouri 36
Missouri Water Quality Assessment 37
Water Resource Sharing—The Realities of Interstate Rivers 38
A SUMMARY OF MISSOURI WATER LAWS 38
Regional Reports, Phase 2 39
TOPICS IN WATER USE: NORTHEASTERN MISSOURI 39
Overview of "Topics in Water Use: Northeastern Missouri" 39
Water Use Problems Identified in Northeastern Missouri 40
Lack of Regional Water Planning and System Consolidation 40
Lack of Model Contracts for Public Water Supply Systems 40
Outdated Public Water Supply District Laws 40
High Costs Associated With Developing, Expanding, and Replacing Public Water Supplies 40
Aging Infrastructure of Public Water Supply Systems 41
Changing Water Requirements Stemming from Reversal of Long-Term Regional Population Trends 41
Water Quality Threats in Watersheds 41
Water Requirements Associated with Industrial Growth 41
Industrial Water Use Rights 41
Abandoned Pre-law Coal Mines 41
Wastewater Assimilation by Streams 41
Impacts of Concentrated Animal Feeding Operations on Northeastern Missouri's Water Resources 41
Livestock Watering in Drought Conditions 41
Aquifer Depletions in Audrain County 42
Lack of Hydrologic Data 42
Impacts of Stream Channelization 42
Sedimentation in Streams 42
Aquatic Ecosystem Health Concerns 42
Loss of Riparian Corridors/ 42
Streambank Vegetation 42
Loss of Aquatic Species 42

Environmental Water Interests Versus Landowner Water Rights 42
Interstate Water Issues- 42
Iowa and Missouri 42
Lack of Emergency Service Access Points on Lakes and Rivers 42
Water Use "Success Stories" and Opportunities in Northeastern Missouri 42
Management-intensive Grazing 43
Clarence Cannon Dam- Mark Twain Lake 43
Water Quality Improvements in Public Water Supplies 44
Conservation Reserve Program 44
Reductions in Soil Erosion 44
Mark Twain Lake 44
Major Rivers 45
Wetland Mitigation Banking 45
Value-Added Processing of Agricultural and Industrial Products 45
SPECIAL WATER QUALITY PROTECTION AREAS 47
INTERAGENCY TASK FORCE 49
Central Missouri 49
RECOMMENDATIONS 51

1999 MISSOURI WATER LAW ANNUAL REPORT

INTRODUCTION

This is the *1999 Annual Report for the Missouri Water Resources Law*, as required in Section 640.426, RSMo. It provides an overview of the activities that the Missouri Department of Natural Resources (DNR) performs to meet the objectives of the law.

The report focuses upon the accomplishments of individual programs and relates program activities to those sections of the law that are addressed. The report follows the same organizational structure as the law, beginning with Water Quality and Quantity. Each section starts with text from the law, followed by a brief discussion of how the department satisfies the requirements of the law. Through an accumulation of information from different programs throughout the department, each section emphasizes the progress that has been made in implementing the Water Resources Law.

Types of Water Systems

Public Water System *– Provides water to at least 25 people at least 60 days a year or has at least 15 service connections. Public water systems can be publicly owned or privately owned. There are two types of public water systems, community and non-community.*

Community Water System *– Has at least 15 service connections used by year-around residents or regularly serves at least 25 residents year-around.*

Non-Community Water System *– Serves an average of at least 25 persons at least 60 days a year.*

Private Water System *– Serves less than 25 people or has less than 15 service connections; for example, a private well serving a family.*

WATER QUALITY AND QUANTITY

RSMo 640.400.2 – The department shall ensure that the quality and quantity of the water resources of the state are maintained at the highest level practicable to support present and future beneficial uses. The department shall inventory, monitor and protect the available water resources in order to maintain water quality, protect the public health, safety and general economic welfare.

PUBLIC DRINKING WATER SYSTEMS

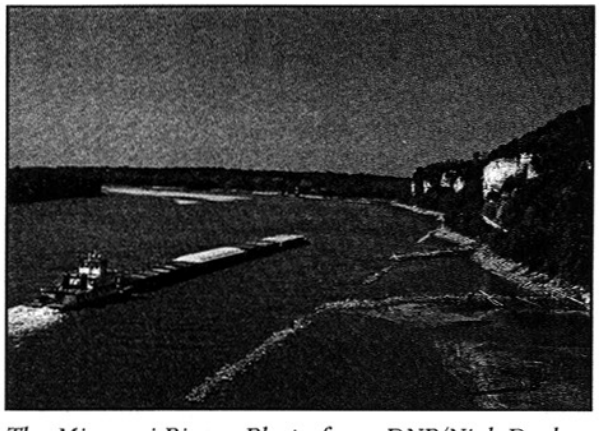
A public water system is defined as a system that provides water through pipes or other constructed conveyances, for human consumption, to at least 15 service connections or serves an average of at least 25 people for at least 60 days each year. There are three types of public water systems: Community (such as towns, subdivisions, or mobile home parks), nontransient noncommunity (such as schools or factories), and transient noncommunity systems (such as rest stops or parks). The requirements for construction, operation, and water quality monitoring vary among systems, based on their type, size, and source of water.

The Department of Natural Resources (DNR) regulates approximately 2,700 public water systems in Missouri that serve most of the state's population. Since drinking water can be a principal agent in the transmission of communicable diseases, these systems must be routinely inspected and samples from each system must be frequently analyzed. Regulation is carried out under the authority of the Missouri Safe Drinking Water Law. The DNR state environmental laboratory analyzes 25,000 to 30,000 drinking water samples annually to help ensure that public water systems throughout the state are in compliance with safe drinking water regulations. Without this protection, the incidence of waterborne illnesses in the state could increase.

The department, in cooperation with the Department of Health routinely monitors drinking water quality. The results provide early detection of potential health problems. Sampling plans are developed that match the degree of contamination threat from a source or system to the type of contaminant and frequency of testing needed. Quality-assurance and quality-control plans for sample collection and analysis are developed for each contaminant group. To avert public health crises related to drinking water, the data are reported to the public water systems and regional office staff within a short period of time.

There is generally plenty of good quality water in Missouri. By far the largest source of water for Missourians is the Missouri and Mississippi river systems. The abundant supply of water in these rivers, and their proximity to the state's major population centers, makes them popular as a water source.

Groundwater is the next most used source for drinking water for Missouri's community supplies. This is especially true in southern Missouri where good quality groundwater is easy to obtain and requires very little treatment to be used as a drinking water source.



The Missouri River. Photo from DNR/Nick Decker.

Raw water sources vary in quality and quantity from one area of the state to another. To produce finished water of satisfactory quality and quantity on a consistent basis, treatment plants must be designed specifically for the raw water sources. Department staff review engineering plans and reports for the construction or renovation of public drinking water systems to ensure that essential sanitary standards are met. Construction permits are issued as appropriate. Department staff members assure that all public water systems are properly operated and maintained and that they operate under a state permit to dispense water. The public water systems must be operated in compliance with the law and regulations.

With the 1998 enactment of House Bill 1161, a drinking water loan program was authorized in DNR for low-interest loans to eligible public water systems. Most of the funding for the loan program comes from the U.S. EPA, with a 20 percent match from state funds required. The loan program provides a mechanism for DNR to assist public water systems in meeting water quality needs. During the first year of the loan program, loan applications totaling about $273 billion were received from 65 water systems for the $61 million available.

WASTEWATER TREATMENT SYSTEMS

Many agencies and organizations are closely associated with water quality issues, however, DNR is the agency responsible for maintaining and improving water quality in Missouri's streams, lakes and groundwater. It is also the agency responsible for enforcing the Missouri Clean Water Law.

Missouri water quality standards are rules made by the Missouri Clean Water Commission. The standards list the classified waters of the state, their beneficial uses, and the allowable concentrations of various pollutants.

The department requires all point source discharges of contaminants (other than from single family residences and stormwater discharges) to obtain a water pollution control permit and comply with its terms.

Permits cover point-source discharges such as treated sewage from towns, subdivisions or businesses, industrial wastewater discharges, and runoff from large concentrated animal feeding operations

(CAFOs), mines, quarries and chemical storage areas. The permits limit the amount of pollutants that can be discharged so that water quality standards set for streams, lakes, and groundwater are not violated.

The State of Missouri issues permits that are recognized by the federal government as equivalent to federal permits (commonly referred to as National Pollutant Discharge Elimination system or NPDES permits under the federal Clean Water Act). This delegation of authority means that the state has the primary responsibility for permitting, inspection and enforcement activities on regulated facilities.

Water Quality Coordinating Committee

There is an *ad hoc* assembly of roughly 30 organizations meeting under the aegis of the Water Pollution Control Program, called the Water Quality Coordinating Committee. This group is an informal interagency-and-public committee dealing with water quality issues. It meets on the third Tuesday of each month at 10:00 A.M. in Jefferson City or Columbia (if there is an agenda for the month's meeting). Nonprofit organizations, business representatives, agency employees and citizens attend to discuss water quality issues. This is a partnering effort that has been going on for several years, designed to keep everyone informed so that those with an interest can interact with each other efficiently.

NONPOINT SOURCE POLLUTION

Nonpoint source pollution (NPS) is defined as contamination caused by diffuse sources that are not regulated as point sources. This type of pollution is normally associated with agricultural, silvicultural and urban runoff, and runoff from construction activities. It results in human-made or human-induced alteration of the chemical, physical, biological or radiological integrity of the water. In practical terms, nonpoint source pollution does not result from a discharge at a specific single location (such as a pipe), but generally results from land runoff, precipitation, atmospheric deposition or percolation. In simpler terms, it is pollution that enters waterways by overland flow or infiltration, as opposed to through conveyances such as pipes or channels.

By the early 1970s, many streams and lakes across the land had become open conduits for the nation's sewage and industrial wastes. With passage of the federal Water Pollution Control Act of 1972 (P.L. 92-500), Congress set in motion a massive clean up. Throughout the following decades, hundreds of waste treatment facilities were constructed. Previously polluted streams and lakes became cleaner and aquatic life began to reappear. However, 24 years and billions of dollars later, we have not completely achieved the goal of having water that is clean enough for swimming, recreational uses, and protection of aquatic life. Only about half of today's pollutants come from pipes or point sources. The remainder are from nonpoint sources.

The State of Missouri operates a nonpoint source management plan designed to address these nonpoint sources. The goals and objectives of the Missouri nonpoint source efforts are to prevent further nonpoint source pollution in the waters of the state of Missouri, and to restore those segments presently not meeting or only partially attaining their designated beneficial uses.

Specific goals are:

- Enhance public awareness of solutions to nonpoint source pollution, and prevention of NPS pollution through education and outreach efforts such as Lakes of Missouri Volunteers, Stream Team Volunteer Monitors, and teacher training in water quality education.
- Support training and certification programs for those in the agricultural chemical industry who provide direct assistance and advice to agricultural producers and other sectors. For example, the National Agronomy Society recognizes Certified Crop Advisors who give advice to farmers in regard to farm chemical use. Efforts should help ensure the advisors' professionalism, environmental awareness, and that they provide accurate, informed assistance.
- Maintain leadership and support for the Missouri Water Quality Coordinating Committee to continue to provide a forum for enhancing understanding, promoting implemention, and sharing nonpoint source information by local, state, and federal agencies and nongovernmental entities involved in water quality issues. Use this and other forums to generate greater participation and build new alliances with the private sector.
- Support adoption of conservation practices that protect environmental quality without removing land from production, except in special cases (such as in small drinking-water reservoir watersheds or for wellhead protection).
- Work with federal and state agencies such as the NRCS and the FSA (USDA) to maximize the targeting of federal and state resources toward watersheds of high nonpoint source priority, and to promote selection of management practices effective in reducing or preventing nonpoint source pollution and in improving stream and riparian habitat.
- Work with forestry and agricultural industry organizations to involve their memberships in nonpoint source pollution abatement activities and promote awareness through information and education efforts; for example, agricultural chemical dealers and sales representatives who take extension courses for continuing education units (CEUs).
- Promote innovative and cost-effective technologies that offer more effective or less expensive control measures, such as through "field days" and demonstrations.
- Provide technical assistance, cost-share assistance for innovative practices, promotional assistance and monitoring support for agricultural nonpoint source Special Area Land Treatment watershed projects implemented by staff of the Soil and Water Districts Commission.
- Support, technically and financially, implementation of nonpoint source watershed projects and demonstrations, particularly for those water bodies supplying water for drinking.
- Financially support demonstrations and technical assistance on a regional or watershed basis; that is, of practices such as whole farm planning, integrated crop management, reduced nitrogen applications, pest scouting, riparian corridor reestablishment, appropriate animal waste management, and other practices and systems, which may be expected to contribute to environmentally sound farm management.
- Expand capabilities in geographic information systems for use in watershed assessments and prioritization.
- Actively seek new partnerships in the private sector; for example, the Mis-

souri Corn Growers Association is actively involved in water quality monitoring, and other commodity groups are becoming involved as partners.

The department has been revising the Nonpoint Source Management Plan, which focuses the state and federal activities that are directed toward nonpoint source pollution and directs federal funds toward eligible management practices. The Nonpoint Source Management Plan will be released for public review and formal revision in calendar year 1999. Public participation is encouraged.

IMPAIRED WATERS

There is, in 1999, heightened interest at the national level in sections of the federal Clean Water Act pertaining to the identification and treatment of impaired waters. It is believed that this interest will translate into additional funding for Missouri and other states to accelerate ongoing programs that address both point and nonpoint pollution sources.

The federal Clean Water Act requires states to assemble a list of waters that do not meet water quality standards. This list must be completed and submitted every two years. DNR completed the 1998 list and submitted it to the U.S. EPA in October, 1998. The list contains the names of 165 streams, lakes, and rivers. EPA must review the list and either accept or modify it. Once the list is made final, the state is obligated to complete studies to determine actions needed to return the waters to compliance with standards. These studies are used to determine what are called "Total Maximum Daily Loads (TMDLs)." Finally, the state is responsible to ensure the needed actions are taken, and the waters are returned to compliance.

WATER POLLUTION CONTROL TOOLS

There are many methods the state uses to protect its waters or repair damaged waters. These include monitoring water quality and the status of pollution control facilities, permitting, financial and technical assistance and enforcement.

Monitoring water quality is fully described in a separate chapter (see page 23). Monitoring information is compiled into several reports, the most notable being the "305(b) report," which is required by the federal Clean Water Act, Section 305(b). This report documents how water in the wells of each state meet that state's water quality standards. For example, it identifies the mileage of waters that provide for safe swimming, and those that are expected to be safe, but are not. These reports also provide the basis for establishing impaired waters lists and other management activities. The 305(b) reports are prepared every two years and the data are reported to Congress.

In addition to monitoring water quality throughout the state, the department compiles lists of water pollution control needs, which support the state's requests for federal grant and loan assistance. The Needs Survey, as it is known, documents the work that must be done to bring water quality related facilities into compliance with design standards or other conditions where they will not damage water quality. Federal grant and loan funds are apportioned to the states in relation to their needs.

In addition to permits described under Wastewater Treatment Systems, permits are required for concentrated animal feeding operations (CAFOs). The permits ensure that properly designed facilities are constucted for holding animal wastes. Letters of Approval (LOA) are offered for

animal feeding operations smaller than 1,000 animal units. An animal unit is the equivalent of one beef steer. This voluntary program was developed two decades ago, and has been operated by the department as a free service to agricultural producers.

The Department of Natural Resources administers a program that distributes grants or low-interest loans for the construction of wastewater treatment and drinking water treatment facilities. The funds for this program come from the state and the U.S. Environmental Protection Agency. In 1998, this loan program dispensed loans valued at $68 million.

The loan program has been in effect since 1990 and requires that most of the burden of funding falls on cities. From 1972 to 1992, a state-federal grant program funded up to 90 percent of the construction costs of wastewater treatment facilities, which helped meet the needs of both expanding populations and replacement of aging facilities. Today, there is concern about the ability of the present funding system to continue to meet construction needs.

In 1995, DNR entered into an agreement with the Department of Agriculture to operate an agricultural loan program. Under this program, DNR will loan funds to the Agricultural and Small Business Development Authority (ASBDA). The ASBDA will use the funds to finance, at subsidized interest rates, animal waste facilities for producers. The loans are limited to animal feeding operations of less than 1,000 animal units. Producers' repayments are used by ASBDA to repay the loan from DNR. The department has committed $10,000,000 to these loans. Another $10,000,000 is available if the program is successful.

Enforcement actions related to water pollution are sometimes necessary. During 1998, there were about 258 active cases involving violations of the Clean Water Law or regulations. Of these, 83 cases were resolved, and the facilities returned to compliance during the year. These settlements included collection by DNR and the attorney general's office of more than $1,200,000 for environmental damages and penalties.

SOIL AND WATER CONSERVATION

Soil is a fragile natural resource capable of sustaining human life. All living things depend on the soil for food. Everything we eat, and most of what we wear comes from the soil.

Today, farmers work soils intensively to produce food for a growing population. In Missouri, agriculture is one of the largest industries. Of the 44 million acres in the state, more than half (27 million) are devoted to agricultural production. Sometimes, however, agricultural production can contribute to erosion.

Erosion is a process where wind and water move crop-producing soil off the land. This topsoil often collects in ditches, along roadsides or ends up in our lakes, rivers and streams. To prevent this, many landowners employ various soil conservation practices on their farms. Controlling and preventing erosion on Missouri's farms helps ensure production and keeps food plentiful and prices reasonable for future generations.

Missouri is now a leader in soil conservation, but in the past the state had the second highest rate of soil erosion in the nation. In 1984, 1988, and again in 1996, Missourians voted for a one-tenth-of-one-percent sales tax to support soil and water conservation efforts and state parks. The tax money added a unique twist to an al-

ready strong mix of federal, state and local players working to save our soil.

Each county has a soil and water conservation district formed by a vote of eligible landowners in the county. These landowners also elect the board of supervisors to oversee the operations of the district. The supervisors work with the landowners and encourage them to participate in the district's voluntary programs. They work together to make decisions on the best treatments for the land.

The local districts work with the Missouri Soil and Water Districts Commission and the federal Natural Resources Conservation Service (NRCS) to administer the state soil and water conservation programs. The Commission sets the policy for use of the tax money and administers it through DNR's Soil and Water Conservation Program. More than 75 percent of expenditures have gone back on the land. NRCS offers technical expertise to landowners on the best treatment or preventive measures for their land. Other partners include the University of Missouri—Outreach & Extension, and the Missouri departments of Agriculture and Conservation.

Missouri is now first in the nation in the rate of reducing soil erosion. But more than 4 million acres of agricultural land still need treatment. The Commission's work and goal for the coming years is outlined in its "Plan for the Future."

The goal is to treat 95 percent of all agricultural land in the state by the year 2006. Through the programs that have been set up to do that, participants also will address agricultural runoff and water quality issues, thus providing the state with a second benefit on its investment.

One way to do that is through the Special Area Land Treatment (SALT) Program. This program brings landowners in watersheds together to help solve soil erosion and water quality problems. Keeping soil and agricultural chemicals out of rivers and streams and on the land contributes to agricultural productivity and good water quality.

Pilot Agricultural Nonpoint Source (AgNPS) Special Area Land Treatment (SALT) Projects

Currently, the SALT program is being expanded to address nonpoint source pollution issues associated with runoff from production agriculture. The SALT program is a voluntary approach to natural resource management and conservation. A project grant is made available to local Soil and Water Conservation Districts to provide general support for the project, technical assistance, and information and education activities in the watershed. Financial assistance is available to landowners to encourage the adoption and implementation of best management practices. SALT projects are coordinated with the Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture (USDA), and their Environmental Quality Incentive Program (EQIP), so that the same acreage does not have two projects at the same time.

The intent of the pilot AgNPS SALT projects is to provide a basic level of resources to make significant contributions to the control and reduction of nonpoint source water pollution from agricultural runoff. The concept is based on numerous partners contributing to the project and various tools utilized to accomplish project goals. Through joint efforts, limited resources and funding can be used in a cost-effective manner.

There are currently twelve pilot AgNPS SALT projects, portions of which are located in 20 counties throughout the state. Because

boundaries of AgNPS SALT projects are based on hydrologic (or watershed) units, five of the twelve projects overlap into more than one county. The twelve pilot projects are located in the following counties: Harrison, Grundy, Daviess, DeKalb, Clinton, Ray, Carroll, Caldwell, Chariton, Randolph, Howard, Saline, Boone, Osage, Bates, Laclede, Greene, Newton, Barry, and Stoddard.

Some of the water quality issues being addressed in the pilot projects include: Sedimentation, nutrification (by nitrogen and phosphorus), chemical contamination from pesticides and herbicides, loss of aquatic habitat, stream-bank erosion, fecal coliform bacteria from animal wastes, and karst groundwater contamination. Often, AgNPS SALT projects provide a springboard for landowners to address additional natural resource problems. Landowners working together in this way can address additional resource goals, such as improved water quality and improved pasture management, along with erosion treatment and control.

Two programs administered by the Soil and Water Conservation Program that help landowners carry out these objectives are the cost-share and loan interest-share programs. The cost-share program funds up to 75 percent of the cost of installing conservation practices on agricultural land. Through this program, the state has installed some 107,000 conservation practices, saving about 140 million tons of topsoil on about 1.7 million acres of cropland and pastureland. The loan interest-share program refunds a portion of the interest on loans for purchasing conservation equipment.

The Soil and Water Districts Commission considers local soil and water conservation districts to be the delivery system for its conservation programs. As such, a major point of the Plan for the Future is to strengthen the role of the local districts. Districts receive grants to provide technical assistance for landowners and other operational costs.

Finally, the Commission plans to assist in the completion of the initial inventory of Missouri's soil resources by the end of state fiscal year 2002.

Missouri is a leader in soil conservation as a result of soil and water conservation districts' work and the voluntary commitment of Missouri farmers. These soil successes will pay off for the state's water quality as well.

HAZARDOUS WASTES

The department regulates hazardous waste to protect human health and the environment and to ensure that any contamination is remediated as quickly as possible. The department oversees groundwater and surface water monitoring at hazardous waste sites within the state. As part of the oversight, hazardous waste facilities are required to determine the impact of past and present waste management practices on water quality. This includes determining the extent of contamination, the distribution of contamination and the potential impact on other waters or water users. If contamination is found to pose a threat, the department will ensure remedial actions are taken.

Groundwater and surface water monitoring activities, and any subsequent remediation, can occur at four different types of sites:

1) Resource Conservation and Recovery Act (RCRA) treatment, storage and disposal facilities (TSDs),
2) Superfund cleanup sites,
3) Voluntary cleanup sites, and
4) Leaking underground storage tank facilities.

DNR field investigatiors use drilling equipment to collect subsurface soil samples at a hazardous waste site. Photo from DEQ/ESP.

As of May 24, 1999, 4,021 of Missouri's hazardous waste generators were considered "small quantity generators" and 700 were considered "large quantity generators." There presently are 66 RCRA TSDs in Missouri.

The department may require RCRA TSD facilities whose practices might affect large bodies of surface water in Missouri to have a surface water-monitoring program. Currently, nine RCRA TSD facilities in Missouri are monitoring surface water for various contaminants. These facilities are required to report to the department at least once per year. The results of the monitoring are examined and tracked by the department.

In accordance with state regulation, a TSD facility that is subject to federal groundwater monitoring requirements must conduct groundwater monitoring on a regular basis until released from such obligation by the department. Currently, 47 TSD sites are conducting groundwater monitoring in Missouri. Of these 47 sites, 21 are actively remediating groundwater contamination to improve the quality of water that may ultimately migrate to surface water bodies or drinking water sources.

Each TSD facility must submit an annual groundwater monitoring report to the department for an official evaluation. The evaluation includes determination of contamination data trends and the extent of contamination resulting from TSD facility operation. All groundwater monitoring data from RCRA TSDs in Missouri are entered into a database where it can be tracked and evaluated. The DNR periodically conducts groundwater monitoring field audits at TSD facilities to help ensure that their samples are collected and analyzed in accordance with accepted standard operating procedures and that the sampling data generated by TSDs are reliable.

There are additional RCRA facilities and Superfund sites in Missouri where the federal government is the lead agency. These sites, which are being remediated, by the U. S. Department of Defense or the Department of Energy, are also required to monitor groundwater for contamination. The Missouri Department of Natural Resources evaluates and tracks contamination data provided by these facilities. There are 45 currently or formerly used federal facilities. Two facilities are actively remediating contaminated groundwater, and three additional facilities are in the final design phase of remedial actions to be taken.

Additional hazardous waste sites fall under the "Superfund" law and its amendments. Superfund includes the authority to initiate surface and groundwater investigations and subsequent remedial actions. The Department of Natural Resources performs site assessments on potential Superfund sites and from these assessments, determines the degree of surface and groundwater investigations that will be required.

Currently, 68 Superfund sites are undergoing some type of groundwater investigation. An additional 42 sites are performing regular groundwater and surface water monitoring. Of the 68 sites, 19 are performing groundwater remediation. The department requires periodic reporting from these sites. Contamination concentrations and trends are tracked in order to recommend future actions.

In 1994, the department began allowing hazardous substance sites to implement their own voluntary cleanup, thus creating Missouri's Voluntary Cleanup Program. These sites must quality first by virtue of not fitting into the RCRA TSD category or the Superfund National Priority List (NPL), and then must express the willingness to remediate their site by entering into a formal agreement with the department. Currently, 113 sites are undergoing voluntary cleanup, and 51 other sites have completed cleanup and received certificates of completion. Of the 113 sites undergoing cleanup, 60 sites involve groundwater monitoring or remediation, either in place now or expected to become part of the site cleanup.

Storage Tanks

The department also regulates the operation and maintenance of underground storage tanks, as leaking tanks can pose a significant threat to Missouri's water resources. Tanks containing petroleum products and some hazardous substances comprise the regulated tanks in Missouri.

Most releases from underground storage tanks are gasoline releases. Gasoline poses a threat to groundwater because it contains benzene, a known carcinogen, and other chemical constitutents, such as methyl tertiary butyl ether (MTBE). MTBE is an additive to fuel to help the gasoline burn more completely.

Requirements are in place to reduce the potential of a release from an underground storage tank (UST). Upgrade standards that took effect December 22, 1998, required UST's to be equipped with spill overfill and corrosion protection. As of the deadline, 62 percent of the UST's in the state were known to meet the upgrade standards. Because a number of these tanks are in temporary closure, the actual percentage of in-use tanks in compliance was 71.6 percent. Another requirement for UST owners is to have leak detection installed on their systems. Leak detection methods are designed to alert the owner of a release occurring on their tank system.

Despite these requirements, releases from tanks will continue to occur. Owners and operators are required to report a release from a tank to the department. Project managers are assigned to specific release sites to oversee the cleanup and remediation of tank releases and work with the owners and operators to devise a plan to clean up the contamination. Over the past ten years, more than 4,900 releases from underground storage have occurred with almost 3,600 of those being remediated to department standards.

Tank Facts as of Dec. 31, 1998

Underground Storage Tank Releases	4,902
UST Clean-ups Completed	3,591
UST On-going Clean-ups	1,311
Aboveground Storage Tank Releases in Remedial Oversight	203
AST Clean-ups Completed	15
AST On-going Clean-ups	188
Total USTs (active and closed)	35,810
Total Closed USTs	23,015
Total Active and Temporarily Closed USTs	12,795
Active USTs Known to Meet Upgrade Requirements	8,036 (62.8%)
Active USTs Known to Meet Leak Detection Requirements	10,550 (82.5%)
In-Use USTs Known to Meet Upgrade Requirements	71.6%

SOLID WASTES

Historically, some landfills have been a source of surface and groundwater contamination. As of April, 1994, stricter federal subtitle D design and operational requirements affected all operating landfills in Missouri. Some of the new requirements are related to establishing, developing and maintaining surface and groundwater monitoring. These include: detailed hydro-geologic investigations; installation of groundwater monitoring wells capable of detecting any contaminants that could leave the site; and installation of a composite liner and leachate collection system on areas that were not covered by waste as of April, 1994.

Another change that should help protect water quality in Missouri relates to the final "cover cap" requirements. Areas already landfilled but not properly closed will require a final cover cap of at least two feet of compacted clay and one foot of soil. All areas with a geomembrane liner (an impermeable material that does not allow liquids to pass through it) require cap designs that include a geomembrane, even if the areas were previously permitted for another final cover cap design.

There are more than 150 closed or abandoned landfills scattered throughout Missouri. These older landfills were not constructed or operated like the modern subtitle D sanitary landfills we have today. The presence of these older landfills poses an unknown impact to the water resources of Missouri. No statewide assessment has been conducted; however, it is very possible that they are contributing leachate contamination to both surface and subsurface waters.

DNR field investigatior measures the static water level in a landfill groundwater monitoring well. Photo from DEQ/ESP.

WELLS FOR WATER, HEAT PUMPS, MONITORING AND MINERAL TESTING

If wells are not constructed properly, they may allow surface water, with its contaminant load, to bypass the earth's natural filtering system and enter directly into drinking water aquifers. The "Water Well Drillers Act" was passed in 1985. By the fall of 1987, rules were in place governing the construction of domestic water wells, pump installations, and the plugging of abandoned wells. The drilling contractors and pump installation contractors were required to be permitted, and their rigs were required to be registered.

This law was passed to ensure that the quality of Missouri's groundwater is maintained at the highest level practical to support present and future use. The importance of this law and its enforcement plays a pivotal role in the protection of our groundwater.

An important amendment to this law was passed in 1991. The amendment brought the heat pump, monitoring well, and mineral test hole drilling industries under regulation. It also created the Well Installation Board. The department's Division of Geology and Land Survey, with the approval of the Well Installation Board, is responsible for implementation of the Water Well Drillers Act.

A total of 8,271 wells were reported drilled in 1998. This includes 6,877 water wells, 1,151 monitoring wells and 243 heat pump wells. Also, 1,400 wells were reported plugged and 334 wells were reconstructed. Some 2,483 water pumps were installed. A total of 1,611 contractors are currently permitted in the following areas: 513 water well; 987 pump installation; 642 monitoring well; 327 heat pumps; and 68 test holes. A total of 1,353 rigs were permitted for 1997.

As a tool to aid in proper well construction, the Division of Geology and Land Survey has been accumulating geologic information on wells since the early 1900s. Data on over 25,000 wells drilled within Missouri has been assembled into a database system to allow easy access and retrieval of the information. As new wells are drilled, additional data are added to the system to improve our understanding of subsurface geology in Missouri. In early 1997, a project to edit the data for consistency with current terminology was completed by division staff. Anyone who desires access to the well log data must request permission and receive a password by contacting the DGLS Administration Program at Rolla, Missouri.

WELLS FOR OIL, GAS AND UNDERGROUND INJECTION

The Oil and Gas Law was passed in 1965. This law requires wells used for oil and gas production, water disposal, enhanced oil recovery, gas storage and geologic information to be constructed in a manner that does not contaminate surface and groundwater resources. Approximately 4,700 wells have been permitted since 1966. In 1998, 111 wells were permitted.

In addition to ensuring proper well construction, the oil and gas law requires a plugging bond to be placed on all permitted wells. This bond is required to be maintained until the wells are properly plugged. In the event an operator improperly abandons a well, the plugging bond is forfeited and the state, working through the Missouri Oil and Gas Council, has the authority to plug the well.

The Underground Injection Control Program is an EPA-delegated program for

which Missouri has primacy. Injection wells have been divided into five classes by EPA, based upon the type of fluid injected and where it is injected in relation to underground sources of drinking water. Missouri has wells that fit into two of these classes – Class II and Class V.

Class II wells are oil- and gas-related injection wells. These wells may be used for the disposal of other fluids produced during oil extractions (mostly water) back into the producing horizon, or for enhanced recovery methods to increase production. These wells are subject to regulation under the Missouri Oil and Gas Law.

Class V wells (also called shallow injection wells) include a variety of well types that inject fluid into or above an underground source of drinking water. In Missouri, this well category includes mine backfill wells, septic systems (tank and lateral field), sinkholes improved for drainage purposes, heat pump systems, and injection wells used in groundwater cleanup projects. Septic systems are regulated by the Department of Health. Most other types of Class V injection wells are regulated through the Clean Water Law. The department administers the program and maintains an inventory of Class II and Class V wells.

RECLAMATION OF MINED LANDS

The mission of the Land Reclamation Commission and the Land Reclamation Program is to assure the beneficial restoration of mined lands and to protect public health, safety and the environment from the adverse effects of mining within Missouri. Active mining regulation includes permitting, inspection and enforcement activities. The minerals regulated include coal, industrial minerals (clay, barite, limestone, sand and gravel, oil shale, and tar sands) and metallic minerals (lead, iron, zinc, copper, gold and silver). While the Land Reclamation Commission is responsible for overseeing coal and industrial mineral laws, the responsibility for carrying out the duties associated with metallic minerals regulations rests solely upon the Land Reclamation Program and the director of the Department of Natural Resources.

At active coal mines, surface water quality is protected through National Pollutant Discharge Elimination System (NPDES) permitting. NPDES monitoring ensures that acid-forming spoils are being properly managed and adequate soil erosion control measures are being taken to prevent sedimentation or acid mine drainage from entering downstream tributaries. As for the protection of groundwater, coal mining companies are required, under land reclamation permits, to conduct hydrogeologic assessment prior to, during, and after mining. They evaluate any impacts to groundwater quantity or quality in the vicinity of mine sites. Mine operators are further required to mitigate adverse effects stemming from mining activities.

For industrial minerals sites, the hydrogeologic evaluations are not required. Measures to control erosion and sediment movement off-site are required. Under the Metallic Minerals Law, the two lead mining companies and the one iron ore mining company in Missouri are required to provide plans and financial assurance for the continued maintenance of the mine waste sites after mining ceases. The objective is to ensure that the sites are stable and not subject to wind or water erosion of the waste materials (tailings). This primarily involves a coordination role to ensure that dam safety, water pollution control, air pollution control, and hazardous waste management regulatory requirements are met.

An estimated 14,200 acres at approximately 700 industrial minerals mine sites in Missouri are permitted for mining. Nearly 19,000 acres at 17 coal mine sites are permitted and are either actively being mined or are in various stages of reclamation. In addition, there are 14 coal mine bond forfeiture sites with approximately 5,100 acres that the department now has responsibility to reclaim. Six of these projects have been completed and eight are in various stages of reclamation design or construction. The 10 lead mine sites and one iron ore mine site permitted under the Metallic Minerals Law comprise approximately 4,600 acres.

Serious health, safety, and environmental problems are often associated with coal mine lands that were left abandoned or inadequately reclaimed prior to passage of state and federal coal mining statutes in 1972 and 1977, respectively. The problems are being eliminated over time as funding becomes available through the Federal Abandoned Mine Land Program.

More than 72,000 acres of coal mine lands have been disturbed in Missouri's history. Since 1989, several projects have been completed that have improved water quality on 3,700 of those acres. These areas include: Huntsville Gob II in Randolph County; Keoto Gob in Macon County; Sweet Spring Creek in Randolph County; Crutchfield in Randolph County; Tebo Creek in Henry and Johnson counties; three separate Cedar Creek projects in Boone and Callaway counties; Middle River in Callaway County; and Upper Cedar Creek Watershed Reclamation in Boone and Callaway counties. Other projects include the closure of abandoned mine shafts and the stabilization of several mining subsidence sites.

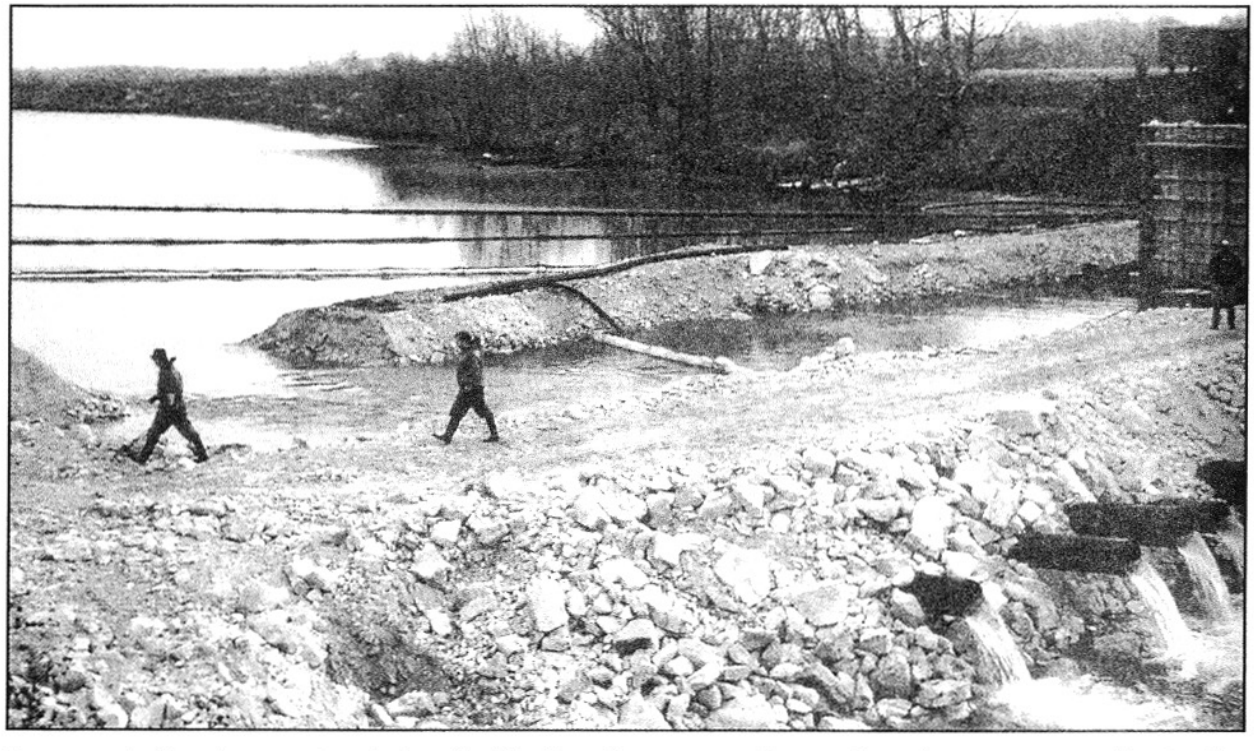
EMERGENCY RESPONSE

The department staffs a 24-hour telephone line for reporting environmental emergencies, and maintains a unit that responds to the scene of environmental emergencies when situations warrant. Response personnel are trained to provide technical assistance concerning response, containment and cleanup of hazardous materials. This assistance includes responding to emergencies on the Missouri River and the Mississippi River, for which the department uses a 24-foot vessel equipped with specialized response gear.

In FY '97, nearly 1,750 incidents were reported, for which DNR staff provided assistance. Staff have been assigned to five of the regional offices to improve response capability. Each region has a primary emergency response vehicle, supplied with specialized equipment, to assist in mitigation of emergencies.

In FY '98, 1,736 incidents were reported, for which DNR staff provided assistance that consisted of either technical advice over the telephone or actual on-scene emergency response. Staff have been assigned to five of the DNR regions to improve response capability. In FY '96, prior to staffing the regions with trained emergency response personnel, DNR responded on-scene to 17 percent of the incidents that were reported to the department. In FY '98, after the regions became fully staffed with response personnel, DNR responded on-scene to 34 percent of the reported incidents. Each region has a primary emergency response vehicle, supplied with specialized equipment, to assist in mitigation of emergencies.

DNR Environmental emergency response boat equipped for responding to petroleum and other chemical spills on major waterways.



Large underflow dam constructed on the Chariton River to contain petroleum from a catastrophic pipeline release. Photos from DEQ/ESP.

INTERSTATE USE OF WATER

RSMo 640.405 – The department shall represent and protect the interests of the state of Missouri in all matters pertaining to interstate use of water, including the negotiation of interstate compacts and agreements, subject to the approval of the general assembly. Any department of state government affected by any compact or agreement shall be consulted prior to any final agreement.

Missouri shares the waters of its major rivers with 19 other states. Upstream states and Indian tribes can use water from these rivers before they reach Missouri. Federal agencies also manage much of this water. To make sure that Missouri's interests are considered, the department represents the state of Missouri in the following river basin associations:

UPPER MISSISSIPPI RIVER BASIN ASSOCIATION

The Upper Mississippi River Basin Association (UMRBA) is made up of representatives of Missouri, Wisconsin, Minnesota, Iowa and Illinois. Governor Carnahan appointed Steve Mahfood, director of DNR, as Missouri's UMRBA representative.

The Association developed a master plan to balance economic development with environmental improvement on the upper Mississippi River. UMRBA works through Congress and the states to carry out provisions in the master plan, and pursues a legislative agenda as agreed upon by the board members. The Association also serves in an oversight or review capacity for the ongoing Mississippi River Navigation Study, scheduled for completion in 1999, to improve river transportation with attention given to environmental concerns. The Association has been very successful at bringing in federal funding to enhance the Mississippi River.

MISSOURI RIVER BASIN ASSOCIATION

Membership of the Missouri River Basin Association (MRBA) includes Missouri, Kansas, Iowa, Nebraska, North Dakota, South Dakota, Montana, and Wyoming, plus one member representing Indian tribes. Governor Carnahan appointed Steve Mahfood, director of DNR, as Missouri's MRBA representative. The Association is currently working with the U.S. Army Corps of Engineers on revising the Master Water Control Manual for the Missouri River. It also pursues a legislative agenda as agreed upon by its Board of Directors, and provides a forum for the

discussion of contemporary water resource issues in the basin, such as tribal water rights, flow management, agricultural issues, and endangered species.

For the past 10 years, the states of the Missouri River basin have been embroiled in controversy over how the river should be managed. The disagreement, brought on by severe and persistent drought that began about 1988 and ended with the Great Flood of '93, focuses on the requirements embodied in the Missouri River Master Water Control Manual. This document, familiarly called the "Master Manual," guides the Corps' Reservoir Control Center in Omaha. The Control Center operates the system of dams and reservoirs that enable management of the river's flow.

The Master Manual was written to direct the Corps' administration of the Water Development Act of 1944, which authorized construction of the dams and directed the Corps to provide benefits as specified in the legislation. As long as rainfall in the basin was normal or above, there was little disagreement between the states of the upper basin and those of the lower river. However, the system was not severely tested by drought until reservoirs began to be drawn down in response to the six-year drought that began in the late 1980s.

The crux of the disagreement is fundamental. Upper basin states contend that reservoir levels ought to be held at high levels – even in drought – to protect the recreational industry that has developed around the six large lakes on the upper river. The downstream states view this position with considerable alarm, because it would deny them the use of a significant share of the water stored in the reservoirs.

In effect, if the upstream states were to be successful in changing the management strategy to meet their demands, it would completely compromise the purposes for which the system was designed and built. The design objectives for the system were to store water in wet seasons, and release it in dry seasons, to provide flood control, navigation, water supply, power generation, irrigation water, and fish and wildlife benefits throughout even the most severe droughts.

During the past two years, the MRBA has been developing recommendations for improving the river.

The Department of Natural Resources, as lead agency for the state, has become involved in the potential revision of the Master Water Control Manual for the operation of the Missouri River dams by the U.S. Army Corps of Engineers. Department staff members have been attending 1998-1999 workshops on the Master Manual, held by the Corps, from Montana to Louisiana.

Political winds continue to push the Corps to change the way the river is operated in ways that would harm Lower Missouri River water uses, especially in Missouri. The department initiated a review of 13 technical volumes produced by the Corps, as well as many subsets and technical appendices of the volumes published in 1993 and updated in 1998.

Controversial proposals include providing what is called a "spring rise" in river stage, altering permanent pool levels in the main stem reservoirs, and changing navigation guide curves. All of the proposed changes alter the flow regimes of the river. Still, extremely important environmental benefits can be achieved by collaborative efforts among resource management agencies in the states along the Missouri River.

ARKANSAS-WHITE-RED BASINS INTER-AGENCY COMMITTEE

The Arkansas-White-Red Basins Inter-Agency Committee (AWRBIAC) includes representatives from the states of Missouri, Arkansas, Louisiana, Texas, Oklahoma, Kansas and New Mexico. Governor Carnahan appointed Steve Mahfood, director of DNR, as Missouri's AWRBIAC representative. Federal agencies in AWRBIAC include the Dept. of the Interior, U.S. Geological Survey, Bureau of Reclamation, National Oceanic and Atmospheric Agency, Federal Emergency Management Agency, U.S. Army Corps of Engineers, and the Natural Resources Conservation Service.

The committee exists primarily for coordination and communication purposes. Administration and hosting of meetings are rotated among both state and federal members. The primary activity of interest to Missouri is the development of a revised operating plan for the White River, which includes Table Rock Dam, Clearwater Dam, and part of Lake Norfork in Missouri. Also of interest is the development of abatement measures and methodology to improve dissolved oxygen content of the tailwaters of White River dams. A new operating plan for the White River has been developed that improves economic return while addressing issues related to low dissolved oxygen in the tailwaters that flow from hydropower dams.

LOWER MISSISSIPPI RIVER CONSERVATION COMMITTEE

The Lower Mississippi River Conservation Committee (LMRCC) has membership that includes the states of Missouri, Tennessee, Kentucky, Arkansas and Louisiana. Federal agencies represented include the U.S. Army Corps of Engineers, Environmental Protection Agency, U. S. Geological Survey, Natural Resources Conservation Service and U.S. Fish & Wildlife Service.

The LMRCC differs from other basin associations by including fish and wildlife agencies as well as environmental regulatory agencies. The LMRCC has several operating committees that deal with specific subsets of lower Mississippi interests, such as fish and wildlife and water quality.

The LMRCC is addressing several water quality issues, including Gulf hypoxia. Hypoxia is thought to be caused by excessive nutrients in Mississippi River water flowing into the Gulf of Mexico. High nutrient levels ultimately result in oxygen depletion and the development of a widespread "dead zone" in the Gulf that has been characterized as the marine equivalent of the "ozone hole" over Antarctica. This is an issue for Missouri because the source of nutrients has been identified as nitrates and phosphates coming from grain-producing states in the Midwest, both point sources and nonpoint sources.

The 1986 Water Resources Development Act authorized the Corps of Engineers to purchase land and develop fish and wildlife habitat on existing public lands to partially compensate losses incurred as a result of the Missouri River Bank Stabilization and Navigation Project.

In Missouri, the plan output on nonpublic land is acquisition of 14,450 acres, and on public lands is the development of 14,350 acres of habitat. Following approval of the federal FY '99 budget and completion of pending purchases, the Corps of Engineers will have acquired 11,902 acres. Sites are: Hamburg Bend in NW Missouri, the mouth of the

Nishnabotna River, lands adjacent to Thurnau Conservation Area, Overton Bottom, Morrison Bend and Berger Bend.

Developments on Department of Conservation lands are being planned for Grand Pass, Worthwine Island, Howell Island and Columbia Bottom.

While these acreage limitations are a given, there is also a limited amount of dollars. The full appropriation in 1997 dollars is about $72 million for the project in Missouri, Iowa, Kansas and Nebraska. Missouri's share of that is approximately 50 percent, with one-half of it expended to date. Depending on annual appropriations, the project could go for another three to five years.

INTERSTATE COUNCIL ON WATER POLICY

The Interstate Council on Water Policy (ICWP) is a national organization, with members representing state water resource agencies, that strives to promote the interests of states in dealing with the federal government on issues related to water. ICWP has a Washington office and a board of directors elected from among state members. The organization sponsors annual forums addressing water resource issues of interest to states, and an annual conference in Washington to bring together federal agency officials and Congressional staff with state representatives to discuss water resource concerns of states.

MISSISSIPPI RIVER PARKWAY COMMISSION

The membership of the Mississippi River Parkway Commission (MRPC) includes all states of the Mississippi River main stem, plus various other agencies and interest groups. The MRPC's major thrust is toward improving opportunities for tourism growth along the Mississippi River corridor from New Orleans to St. Paul.

In 1997, Governor Carnahan appointed four commissioners and the Missouri legislature appointed four members, to form a revitalized Missouri commission. The department participates in a technical advisory capacity, with the Missouri departments of Transportation and Conservation, and the Division of Tourism.

Missouri's participation in the MRPC has focused on improving the environmental quality of the river corridor as a way to increase the region's attractiveness to tourism and economic development.

MISSISSIPPI RIVER BASIN ALLIANCE

The Mississippi River Basin Alliance (MRBA) includes both individual and agency/corporate memberships. It is a relatively new organization that focuses on environmental issues throughout the Mississippi River basin. Various committees focus their energies on issues of current importance, such as environmental justice, nonpoint source pollution, legislative agenda, and monitoring federal initiatives.

The MRBA meets annually, usually in St. Louis, for technical sessions and training activities.

MONITORING WATER QUALITY

RSMo 640.409 calls for the department to establish, develop and maintain an ongoing statewide surface and groundwater monitoring program, the purposes of which are the following: 1) determination of ambient surface and groundwater quality for use as background or baseline water quality data; 2) detection of trends in the character and concentration of contaminants in surface and groundwater resources; and 3) identification of areas highly vulnerable to contamination.

The Department of Natural Resources conducts an extensive monitoring program for chemicals and microbial contaminants in public drinking water systems. In FY 97, approximately 2,700 public water supplies were tested, with over 46,000 samples analyzed. This effort covers both surface and groundwater sources.

Most of the tests are performed on tap water, the "finished" water that people drink or use for cooking; this is water after treatment. Some "raw" water monitoring also is done to provide operational data to water system operators, and to help them in their treatment processes. For example, well water is tested to help the water companies know what is entering their water works.

The department has also been providing testing since January 1996, for disinfection by-products (DBPs) in water such as trihalomethanes (THMs), to help water suppliers prepare in advance to comply with regulations that the U.S. Environmental Protection Agency (EPA) has recently made final. THMs are potentially cancer causing agents and have been regulated in drinking water in Missouri since 1981. The new EPA regulation is more stringent and may be difficult for Missouri's small surface water suppliers to meet.

The vast majority of water quality violations are for failure to meet the requirements of the Total Coliform Rule. Total coliform bacteria serve as an indicator that disease-causing organisms may be present, and all public water systems in the state must test for this type of bacteria every month they dispense water to the public. The number of major monitoring violations decreased from 1,328 in 1996 to 1,202 in 1997. A number of systems missed collecting samples for one or two months; relatively few systems missed sampling for three or more months.

Public water systems with serious water quality violations potentially affecting public health or multiple monitoring violations are placed on a Significant Non-

Complier (SNC) list. The DNR works closely with violators to return them to compliance in a timely manner. During 1997, only 87 of the 2,692 public water systems were on the SNC list.

For all violations, public water systems are required to notify the customers they serve. The method of notification varies by the violation and system type. Some water quality violations, such as the confirmed detection of fecal coliform bacteria or *E. coli*, warrant more immediate action due to the threat to public health. For such acute violations, DNR requires systems to immediately notify their customers to boil their water before consumption. Boil water orders remain in effect until the problem has been corrected, and the water is safe to consume.

A part of the monitoring plan is a vulnerability assessment performed to support the "waiver of monitoring" requirements. This indicates various threats to specific public water supplies and allows that information to be considered in establishing monitoring requirements.

The Public Drinking Water Program uses a vulnerability assessment to determine which sources of drinking water need to be tested for certain chemicals. If certain chemicals are located in a geographic area that may potentially affect a drinking water source, that source is monitored for the presence of that chemical in the water. This allows the cost of analysis to be focused on the vulnerable sources. Without these assessments, the department would have to test every source for every chemical listed by EPA. Vulnerability assessments save Missouri approximately $4.5 million per year.

With the 1998 enactment of House Bill 1161, DNR was authorized to conduct drinking water source water assessments

Chemists go through many steps to analyze a sample of drinking water. Photo from DEQ/ESP.

and delineation. A voluntary, local-initiative source water quality protection opportunity for local agencies and water systems also was authorized. DNR's source water assessment plan includes: Delineating source water areas; identifying potential contaminants in those areas; assessing the susceptibility of drinking water sources to contamination, and providing this information to the public. Source water areas will be identified on maps that will be available to the public upon completion of the source water assessments in 2003. These maps also will show the potential contaminant sources identified during the assessment.

Source water assessments will not impose any new regulations on source water areas or potential contaminant sources located therein. DNR strongly encourages voluntary source water protection efforts and hopes that communities will take advantage of the assessment results as a starting point for local source water protection efforts.

The department studies the recharge areas of springs, and delineates losing streams and sinkholes to determine areas where groundwater is particularly prone to contamination. Harmless fluorescent dyes are used to trace the movement of groundwater from its recharge area to its discharge point.

Since 1989, the department has performed numerous water traces in karst areas where groundwater resources can easily become contaminated by surface activities. In karst areas, much surface water is channeled underground in losing streams and sinkholes. The water lost to the subsurface typically resurfaces, sometimes as far as 40 miles away, at a spring or springs. Water wells between the recharge point and the receiving spring can be affected by contaminants entering losing streams and sinkholes.

The results of individual dye traces are stored in the department's Dye Trace Data Base. Since 1989, several reports have been published that describe in-depth studies of several major spring systems (*Hydrogeology of the Bennett Spring Area, Laclede, Dallas, Webster, and Wright Counties, Missouri*, Water Resources Report No. 38; and *Hydrogeology of the Maramec Spring Area*, Water Resources Report No. 55).

The Water Well Drillers law requires that all persons engaged in water tracing register with the department and renew the registration annually. All proposed injections must be reported to the department's Division of Geology and Land Survey prior to injection of dye, and written and graphical documentation of traces is provided to the department within 30 days after completion of each trace. The information will be provided to interested parties upon request at cost of reproduction. For the trace to be included in the department's dye trace database, the data must be examined by a three-member Dye Trace Committee. If the data quality and documentation is satisfactory, then the results are entered into the department dye trace database.

Compliance monitoring is performed to test wastewater from facilities with National Pollutant Discharge Elimination System (NPDES) state operating permits.

The department performs a variety of water- and sediment-quality investigations each year in the form of complaint investigations, wasteload allocations, ecological risk assessments, and fish tissue contaminant monitoring. Department biologists are currently developing aquatic macroinvertbrate-based "biocriteria" for assessing stream quality in each eco-region of the state. These criteria will eventually be incorporated into the state water quality standards.

Staff collect fish for analyses of pollutants that may accumulate in fish tissues. Photo from DEQ/ESP.

Due to the Flood of 1993, a federally funded sanitary landfill monitoring project for flood-damaged sanitary landfills was implemented. Effects of the flood included periods of surface ponding, soil saturation, and elevated groundwater table and increased velocity in the subsurface movement of water. The department received equipment and training to monitor landfills that operated before and after the flood to determine if any surface or groundwater contamination occurred.

The results of the study indicated that landfills contributed no measurable contamination of surface water off-site. Also, no impact to groundwater could be determined to have taken place. However, many of the landfills studied did experience a significant increase in the migration of landfill gas (methane) through the soil away from their facilities.

Some of these migrations present a potential public safety problem due to the dangers associated with explosion or asphyxiation should the gas accumulate in nearby structures. For example, in the spring of 1998, a fire started in the basement of a private home situated next to a closed landfill. A field investigation conducted by the DNR confirmed that the fire was caused by methane gas migrating from the landfill into cracks in the floor, and igniting from the water heater. No one was injured; however, within weeks of the investigation, the landfill owner purchased the home and property from the citizen, and bought another home that was threatened. Both homes were vacated due to the ongoing threat of explosion. Through an extension of the original project, further study is underway to gain a better understanding of what can be done to evalu-

ate and address these methane gas migrations that may occur at landfills throughout the state.

SURFACE WATER QUALITY MONITORING

The major purposes of the water quality monitoring program are to: (1) characterize "background" or "reference" water quality conditions; (2) better understand flow events, and diurnal and seasonal water quality variation and its underlying processes; (3) characterize aquatic biological communities and habitats, and distinguish between the impacts of water and habitat quality; (4) assess time trends in water quality; (5) characterize specific and regional impacts of point and nonpoint source discharges on water quality and; (6) to check for compliance with water quality standards or wastewater permit limits.

All of these objectives are statewide in scope. Reference conditions of water chemistry and of aquatic macroinvertebrates have been or are being used to develop water quality standards. Due to the cost of environmental monitoring, the department routinely coordinates its monitoring activities with other state and federal agencies.

The strategy for monitoring varies by the waters being sampled. Many water quality monitoring strategies exist including monitoring effluent discharges, monitoring the impacts of discharges upon localized surface waters, monitoring extended impacts from effluent sources, and conducting surveys of "background" conditions. The monitoring activities through which these strategies are implemented take several forms:

1) Fixed station chemical monitoring networks. DNR maintains 42 fixed stations through cooperative agreements with the U.S. Geological Survey, and routinely tracks data from 63 other sites.
2) Intensive surveys
3) Special topic monitoring (fish kill investigations, bacterial monitoring, contaminant transport studies, etc.)
4) Toxics monitoring
5) Biological monitoring (of aquatic macroinvertebrates). DNR presently is monitoring 26 streams annually.
6) Fish tissue, sediment, and shellfish monitoring. The Missouri Department of Conservation monitors about 30 sites and DNR/USEPA monitors about seven sites annually for toxicants, primarily pesticides and metals, in fish tissue.
7) Monitoring by volunteers – A cooperative program between DNR, the Dept. of Conservation, and the Conservation Federation of Missouri has trained and equipped over 700 people around the state to conduct both chemical and biological water quality monitoring. Much of these data are reported back to state agencies.

Staff measure stream flow as part of a comprehensive stream survey. Photo from DEQ/ESP.

MONITORING PROGRAM EVALUATION

The water quality monitoring program within the department evolved as a program to characterize and cope with point source wastewater discharges. This program, which has stressed chemical monitoring, appears to have been successful.

In 1998, the department shifted emphasis of monitoring programs in the following ways: (1) maintain the size of the fixed station flow and chemistry network, and include chemical analysis of sediments in some streams; (2) increase the amount of intensive chemical and biological water quality studies; and (3) increase the amount of aquatic invertebrate sampling statewide toward the development of biological criteria within the water quality standards.

The major reasons for these changes are the perception that: (1) more large municipal or industrial wastewater discharges need substantial water quality study to fully understand their impacts on receiving waters than the department is presently able to conduct; (2) biological criteria may be better than conventional chemical monitoring for characterizing many nonpoint pollution sources; (3) many problems in streams are not due to water chemistry problems, but to physical problems in the stream channel, in the riparian zone, or farther up in the watershed.

The biggest challenge will be to find a way to assess the water quality impact of thousands of confined animal feeding operations across the state. To date, the Department of Natural Resources and the Department of Conservation have been able to investigate and document at least a portion of all discharges that have caused fish kills, but no monitoring program has ever tried to assess the day-to-day subacute impacts of these pollution sources, which may be significant.

INVENTORY OF WATER USE AND AVAILABILITY

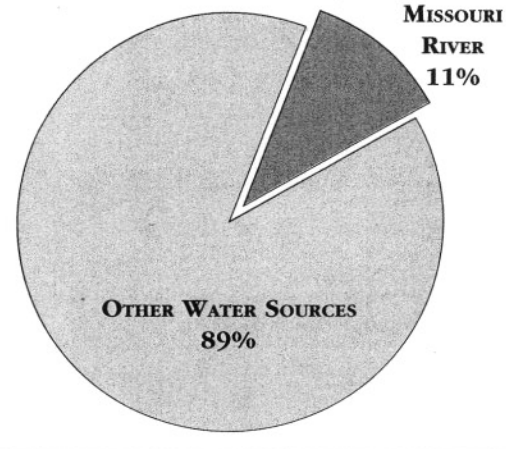
RSMo 640.412– The department shall maintain an inventory on ground and surface water uses, quantity and users. - The department shall inventory the following: 1) existing surface and groundwater uses; 2) quantity of surface and groundwater available for uses in the future; 3) and water extraction and use patterns.

WATER USE

As part of the Major Water Users Law (RSMo 256.400), the department compiles water use information. Major water users are defined as those users that are capable of pumping greater than 100,000 gallons per day from either groundwater or surface water. There are 1,887 users registered. There is no penalty for failing to report. Most likely, there are many major water users that do not report. The Major Water User Database includes information about location, amount of water used and type of use (domestic, municipal, irrigation, recreation, industrial, electrical generation, fish and wildlife, and drainage.)

The department is updating the water user registration forms for Internet compatibility. Currently, the water user registration forms are mailed via the U.S. Postal Service to the major water users in the state. Users type in or print in the information and then mail the completed form back to the department. The first stage of the programming will allow Internet access to the registration forms. Adobe Public Document Format (PDF) computer files of the registration forms will be available in 1999. These PDF files can be linked to the Water Resources Program—Major Water Users Unit Internet web page (http://www.dnr.state.mo.us/dgls/wrp/wateruse.html).

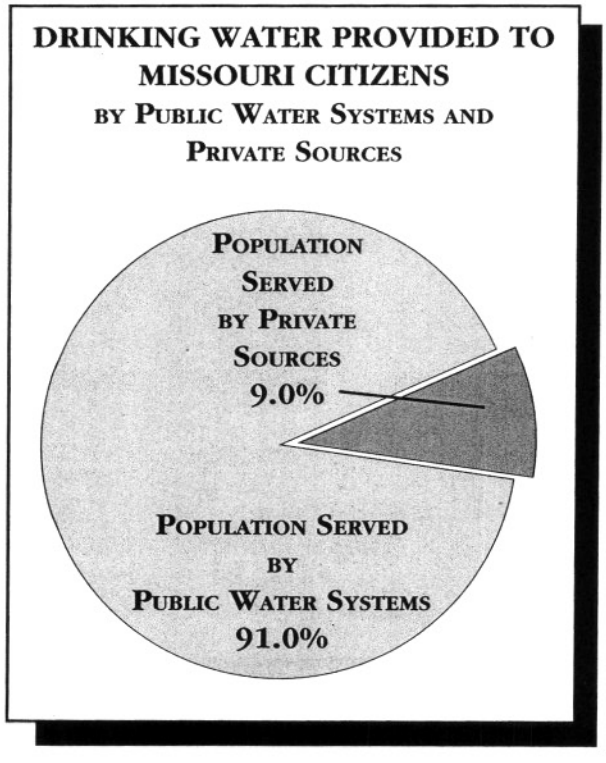
1997 MISSOURI RIVER USE AS A PERCENTAGE OF TOTAL REGISTERED MAJOR WATER USE



The second stage will allow users to complete their annual reporting obligation by filling out the forms on their home computers, and sending them to the department for registration. The registration forms will be able to be filled out on the computer screen and then submitted via e-mail (mowaters@mail.dnr.state.mo.us) to the department.

The final stage, some time away, will allow interactive communication between the users' computers and the department's computers, so that the public can view their own water usage and anyone can view and study water use trends by area and source. The department's Internet firewall and other safeguards must be in place before public sharing of the Major Water Users database will be allowed. The data may be copied or "downloaded" to individual computers to that people can study them. The original, master database will be write-protected and in read-only mode so that the data are not altered. During the last several years, the data have been geographically referenced so data users can develop data layers on geographic based data platforms. Water withdrawal information now is in both the latitude-longitude format and the township-range format.

Public drinking water systems are significant users of both surface and groundwater. The Census of Missouri Public Water Systems, published by the department, provides many details about water use by public water systems. It includes the water source, the production capacity and average daily consumption, the location of surface water intakes, and the number of customers served. Today, there are 2,714 public water systems serving cities, water districts, subdivisions, trailer parks, and institutions. Almost 5 million citizens of Missouri use public water systems as their source of water. The total production capacity of our community water systems is 2,579.5 million gallons daily (MGD), with an average consumption of 1,146 MGD.



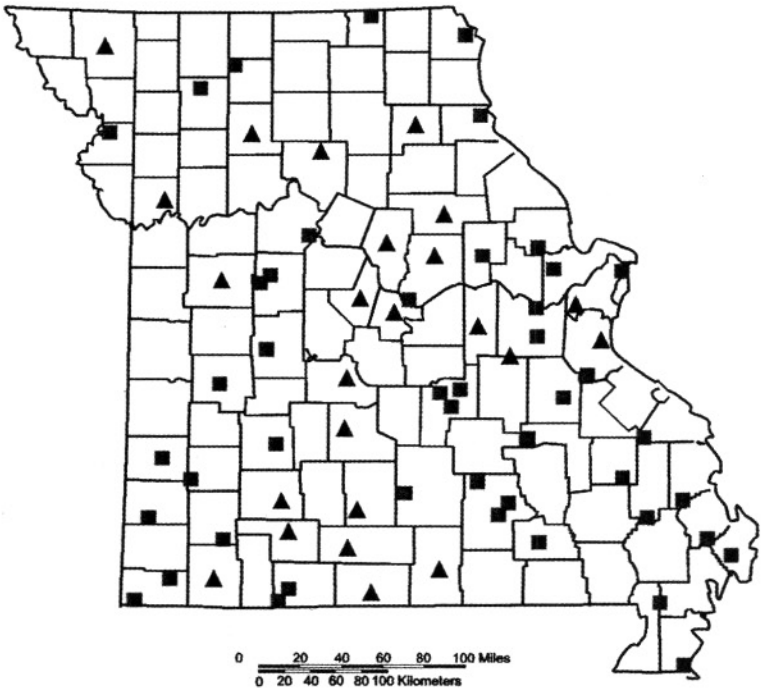
GROUNDWATER AVAILABILITY

Most cities in southern Missouri rely on groundwater for all of their water-supply needs. The department is sometimes called upon to determine if the amount of water being used is causing long-term water level changes in aquifers, or causing water quality changes. The results of some of these studies have been published (i.e. *A Hydrologic Analysis of the Ozark Aquifer in the Rolla Area*, Water Resources Report No. 41; *Hydrogeologic Investigation of the Fulbright Area, Greene County, Missouri*, Water Resources Report No. 43).

The department operates and maintains a network of approximately 50 groundwater-level observation wells throughout the state that are equipped

with automatic recorders. The recorders measure and record the distance from land surface to the water level in the well. Water levels in the wells change in response to changes in natural conditions. Precipitation will generally cause a decrease in the depth-to-water in shallow wells. During extended periods of dry weather, depth-to-water in most wells increases as water drains from the aquifer through springs and streams. Water levels also change in response to pumping. The observation well network is used to monitor the quantity of water available from particular aquifers across the state.

1999 GROUNDWATER LEVEL OBSERVATION WELL NETWORK



LEGEND

■ Existing installations (46 stations)

▲ Proposed additional installations (24 stations)

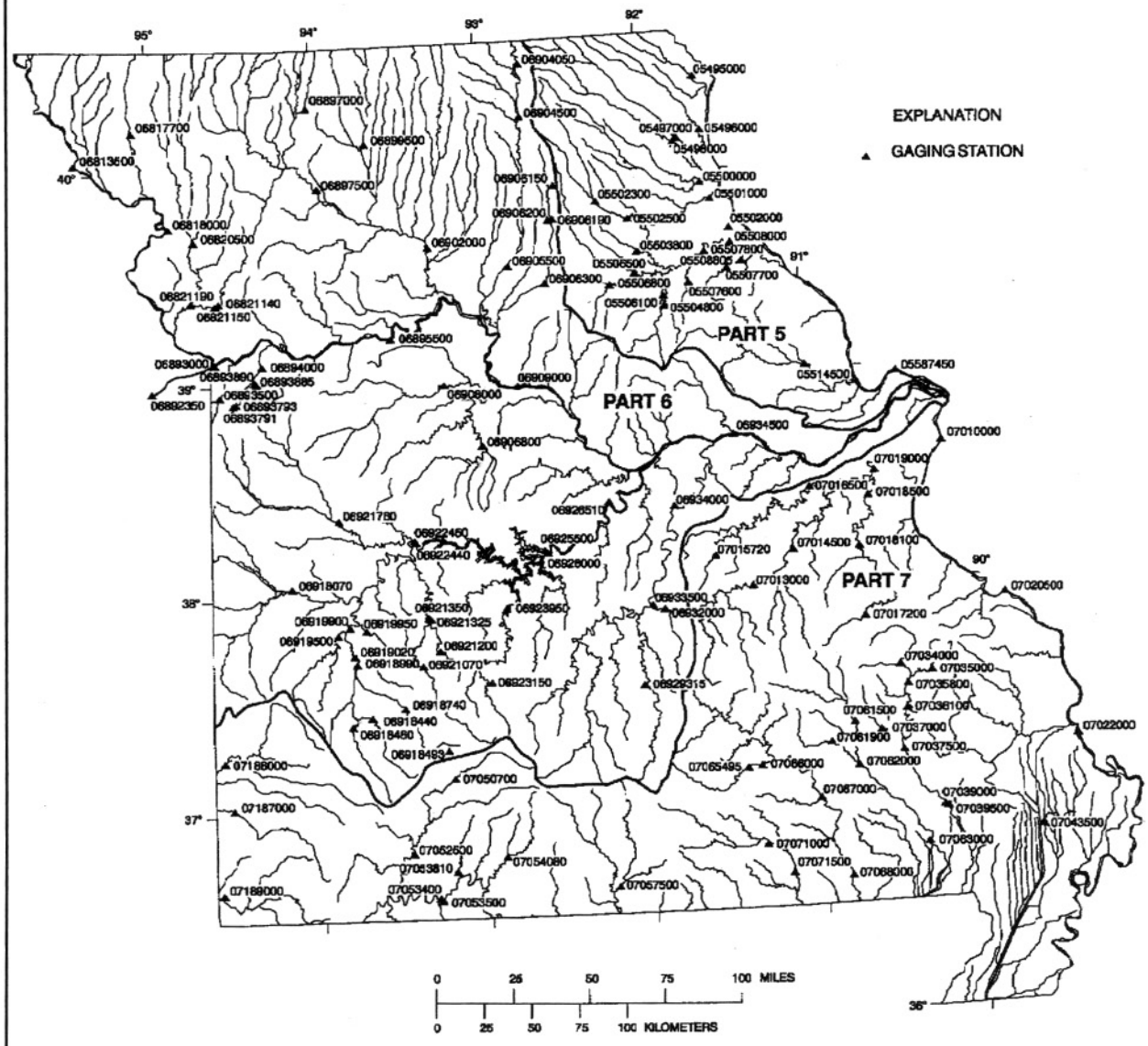
The data from the observation well network is processed and published in an annual report (currently available through Water Year 1993). The data reports contain the average daily water level for each station, a graphic representation of the data, and daily precipitation from the nearest National Weather Service recording station.

Recently published is the *Hydrology of Maramec Spring*, Water Resources Report No. 55. This report contains information on the history, geology, and hydrology of Maramec Spring's recharge area, and its water quality. Among other things, the 98-page book describes the exposed bedrock, the caves, the sinkholes, the springs, and the losing streams in the area of Maramec Spring, Missouri's fifth largest spring.

This publication was paid for in part by a grant from the Water Pollution Control Program, DEQ. It and other Water Resources reports can be obtained from the division's Maps and Publications Service, DGLS, Rolla.

The department is developing a statewide pesticide groundwater monitoring plan under the authority of the U.S. Environmental Protection Agency. The purpose of the plan will be to ensure that pesticides are not reaching the aquifers used for public and private water supplies. Groundwater hydrologists will be looking at areas where contamination is likely and will build upon several separate monitoring projects that have occurred over the last decade.

SURFACE WATER GAGING STATIONS IN MISSOURI

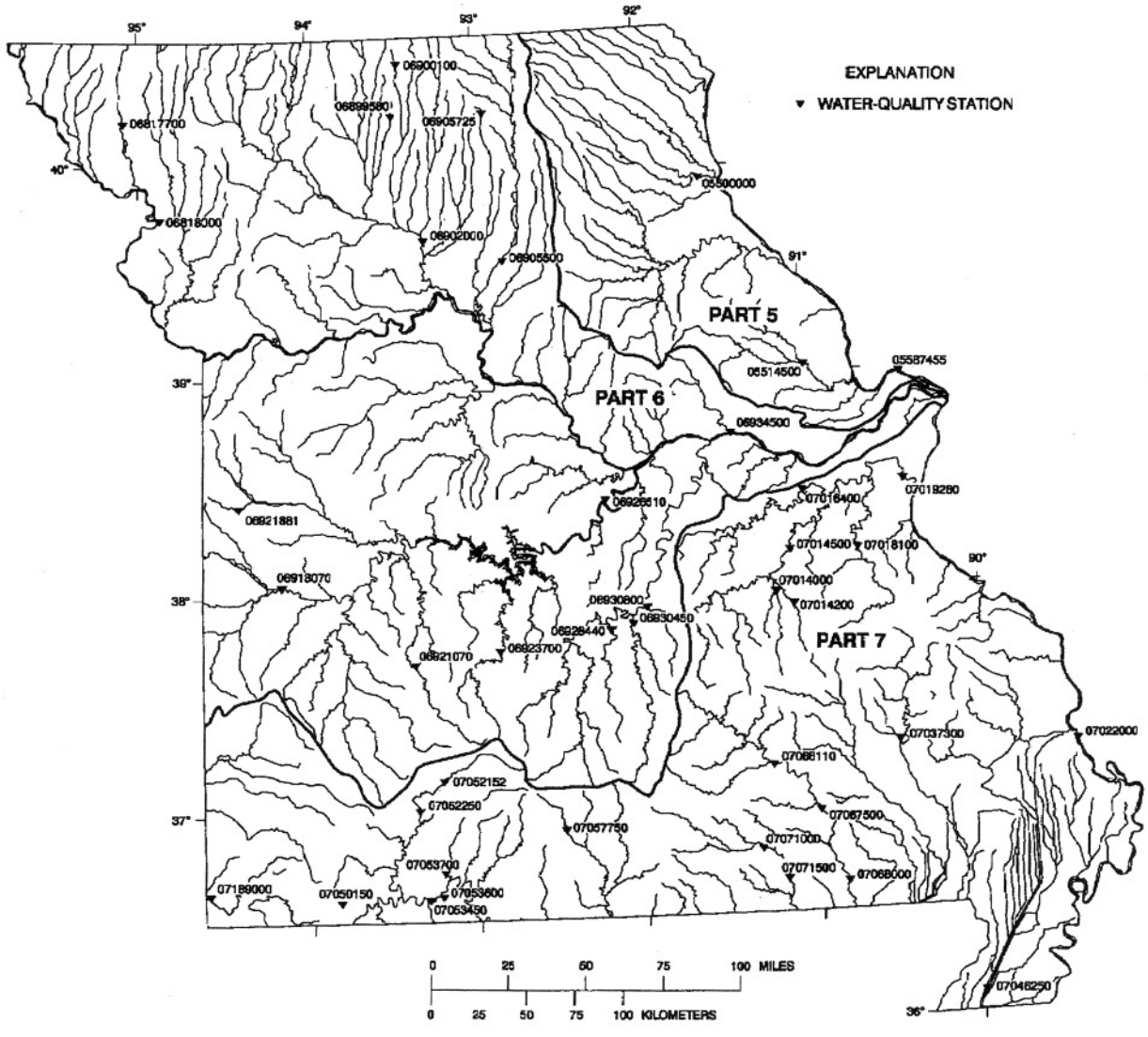


Source: USGS

SURFACE WATER AVAILABILITY

The department is a cooperator in the U.S. Geological Survey program that collects and publishes water data for Missouri's surface and groundwater resources. Substantial amounts of surface and groundwater information have been collected through this effort, and published annually in a report series titled *Water Resources Data—Missouri*. Records have been collected in this manner for nearly

SURFACE WATER-QUALITY STATIONS IN MISSOURI



Source: USGS

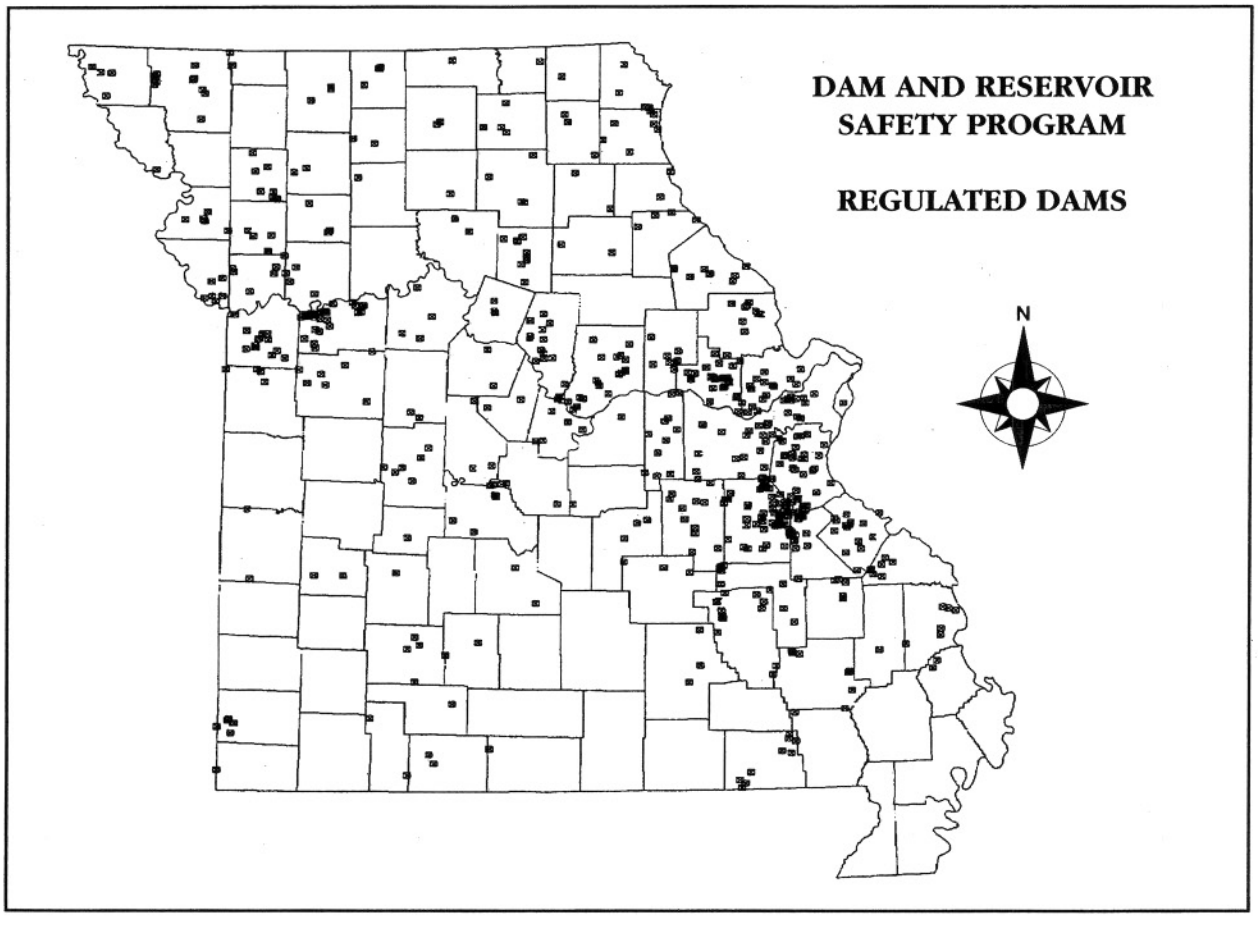
75 years. The scope of data collection efforts has widened to include surface and groundwater quality information. Presently, the stream-gaging network monitors flow and stage at 109 stations, the stage at 12 lakes and reservoirs, and surface water quality at 58 sites statewide (including 2 lakes and reservoirs). Water quality stations include physical, chemical, and biological parameters such as water temperatures, specific conductance, dissolved oxygen, pH, carbonate, bicarbonate, alkalin-

ity, inorganic constituents, nutrients, trace elements, indicator bacteria, sediment, and pesticides.

DAM SAFETY

The department maintains two databases on dams in the state. The STATUS database contains only those dams that are regulated in accordance with Chapter 236 of the Revised Statutes of Missouri. This includes dams that are 35 feet or more in height as measured from the crest to the downstream toe of the dam. The number of dams currently included in this database is 617. The database includes spatial and physical data, downstream hazard classifications, ownership information, water use, and the current regulatory status of each dam.

The NATDAM database is maintained through a continuing contract with the Federal Emergency Management Agency (FEMA) and the Association of State Dam Safety Officials. This database includes dams that meet the height and storage criteria established by FEMA and are identical to the criteria established by the U.S. Army Corps of Engineers for the original national inventory compiled in the 1970s. Dams which are 25 feet or more in height with a storage volume of at least 15 acre-feet, or which are 6 feet or more in height with a storage volume of at least 50 acre-feet, are included in this inventory. The number of dams currently inventoried in this database is 4,037. The database includes spatial and physical data, downstream hazard rating, water use, ownership information and purpose of the dam.



STATE WATER PLAN

640.415—1. The department shall develop maintain and periodically update a state water plan for a long-range, comprehensive statewide program for the use of surface water and groundwater resources of the state, including existing and future need for drinking water supplies, agriculture, industry, recreation, environmental protection and related needs. This plan shall be known as the "State Water Resources Plan."

2. The department shall establish procedures to ensure public participation in the development and revision of the state water plan.

3.3. The department shall submit a report to the general assembly at least one year prior to the submission of the state water resources plan, and may recommend any statutory revision which may be necessary to implement the requirements of this section. The plan shall be submitted to the general assembly for approval or disapproval by concurrent resolution.

BACKGROUND

Since 1989, when the Water Resources Law was passed by the Legislature, DNR has undertaken activities to address and fulfill the requirements set forth in RSMo 640.415. Specifically, these activities include public participation, issue identification, needs assessment, resource inventory, and multi-level planning and coordination.

DNR has sought public input through the use of various forums that have included statewide public meetings and conferences, regional meetings and stakeholder meetings. This effort has included the Missouri Rural Opportunities Council (which is composed of various private groups as well as state and federal agencies), Regional Planning commissions, the Water Quality Coordinating Committee, the Missouri Irrigators Association, Missouri Association of Counties, the Clean Water Commission, Distributive Educational Clubs of America, DNR sponsored "Open Houses," the Small Watershed Program Conference, Ozark Scenic Riverways Association, and the Missouri Municipal League. These public input forums serve to support, enrich, and further define the water resource issues first defined in 1990, identify new issues, and inform and educate the public on the broader, and often interrelated, water resource planning issues.

STATE WATER PLAN VOLUMES

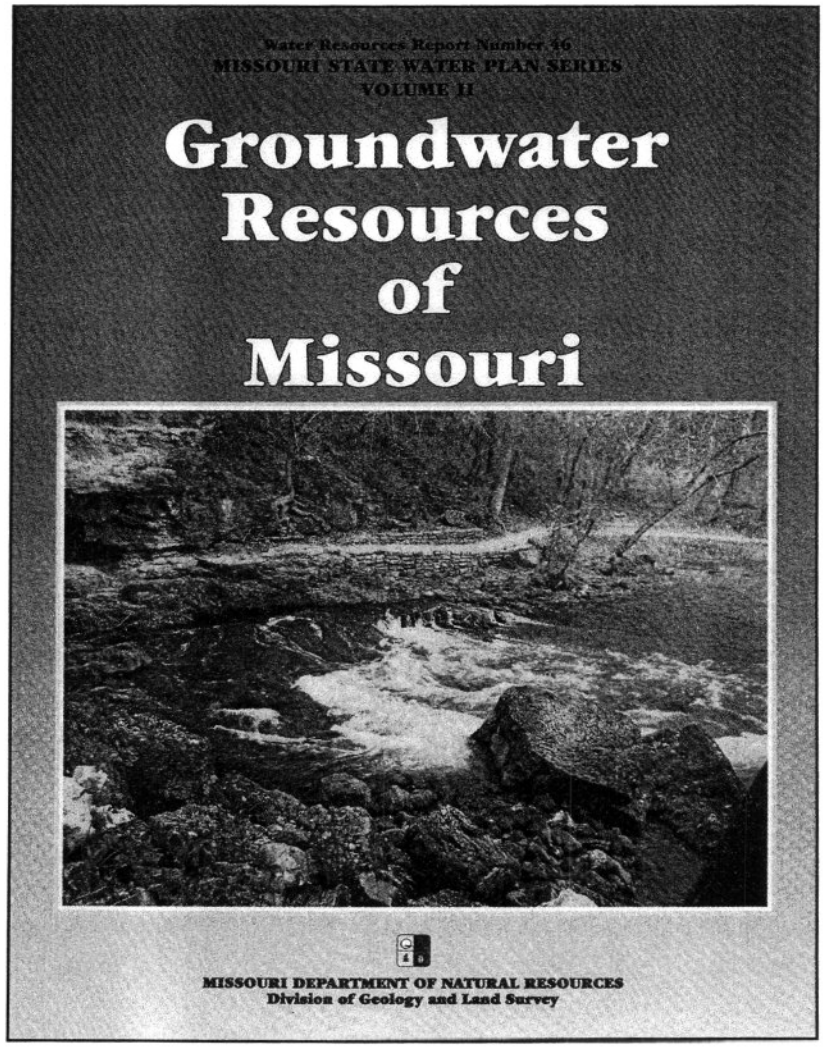
The department is completing a series of technical documents to provide basic information about Missouri's surface water, groundwater, water use, water quality, in-

terstate issues, hydrologic extremes and water law. These volumes will assist in focusing the development of the Missouri State Water Plan. They will serve to support and complement public participation, issue identification, needs assessment, and multi-level planning coordination. When these volumes are completed, the department will work with groups and individuals across the state to gather input on a regional and watershed basis for the development of the State Water Plan. The Interagency Task Force will also have input into the State Water Plan before it is finalized and submitted to the governor and General Assembly.

The seven basic information volumes are being published serially. Completed volumes include Volume I — *Surface Water Resources of Missouri*, Water Resources Report No. 45, by James E. Vandike; Volume II — *Groundwater Resources of Missouri*, Water Resources Report No. 46, by Don E. Miller and James E. Vandike; Volume III — *Missouri Water Quality Assessment*, Water Resources Report No 47, by Cynthia N. Brookshire; Volume IV — *Water Use of Missouri*, Water Resources Report No. 48, by Charles B. DuCharme and Todd M. Miller; Volume V — *Hydrologic Extremes in Missouri: Flood and Drought*, Water Resources Report No. 49, by John D. Drew and Sherry Chen, and Volume VI — *Water Resource Sharing: The Realities of Interstate Rivers*, Water Resources Report No. 50, by Jerry D. Vineyard.

The last in the series, Volume VII — *A Summary of Missouri Water Laws*, Water Resources Report No. 51, by Richard M. Gaffney and Charles R. Hays, is currently in review and not yet published.

The purpose and contents of the three volumes published in the last year are summarized in the following paragraphs.

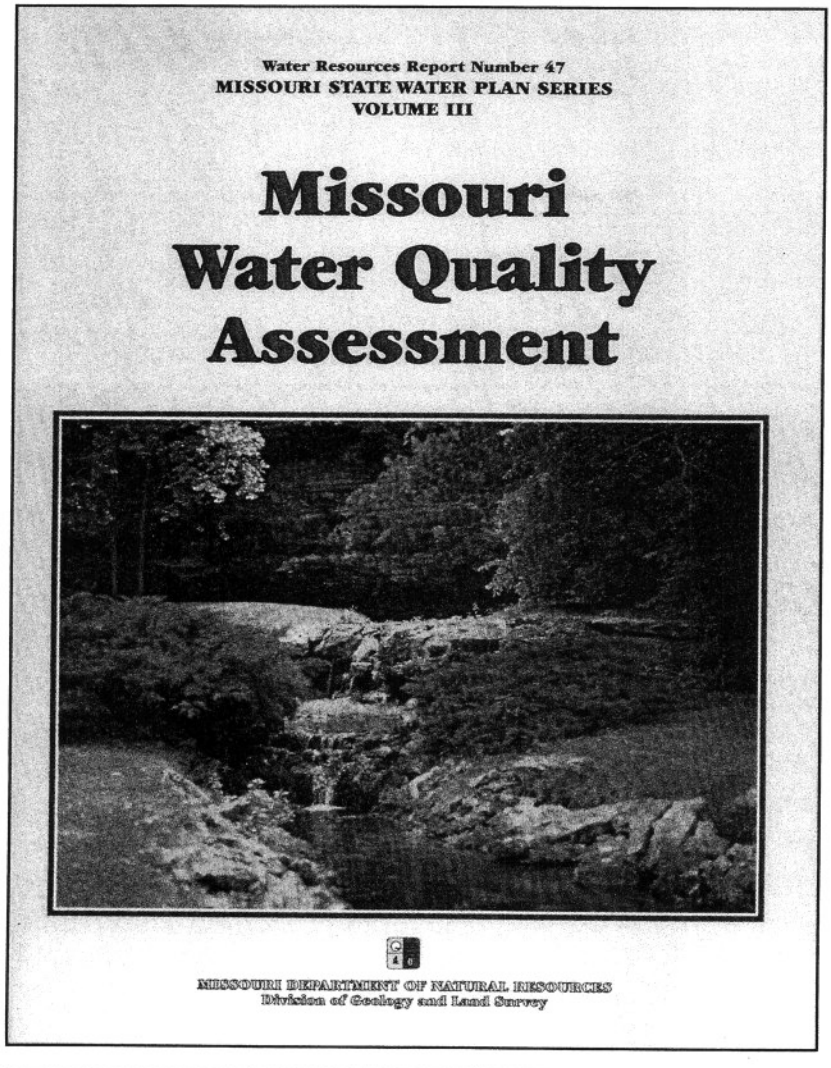


GROUNDWATER RESOURCES OF MISSOURI

This volume, printed in 1998, presents a detailed statewide assessment of the groundwater resources of Missouri. It provides information concerning the availabil-

ity and natural quality of groundwater throughout the state. With this report, users will be able to determine if groundwater in a particular province will supply the quantity and quality of water necessary to meet a particular purpose. Additionally, the report will be useful in helping to protect groundwater resources from degradation.

Unlike surface water, it is inappropriate to discuss groundwater resources based on surface watersheds. For this report, Missouri has been subdivided into seven groundwater provinces whose boundaries were established using geologic and groundwater-quality criteria. The provinces are: (A) the Ozarks (Salem Plateau); (B) Springfield Plateau; (C) Southeastern Missouri (Bootheel), Mississippi River alluvium, Missouri River alluvium; (D) St. Francois Mountains; (E) northwestern Missouri; (F) northeastern Missouri, and (G) the Osage Plains of west-central Missouri. The geology, aquifer characteristics, groundwater availability, and general quality of groundwater in the seven groundwater provinces are presented in this report. The report also includes information on groundwater development, well construction criteria, groundwater contamination potential, fluctuations and trends of groundwater levels, aquifer volumes, and groundwater recharge and storage.

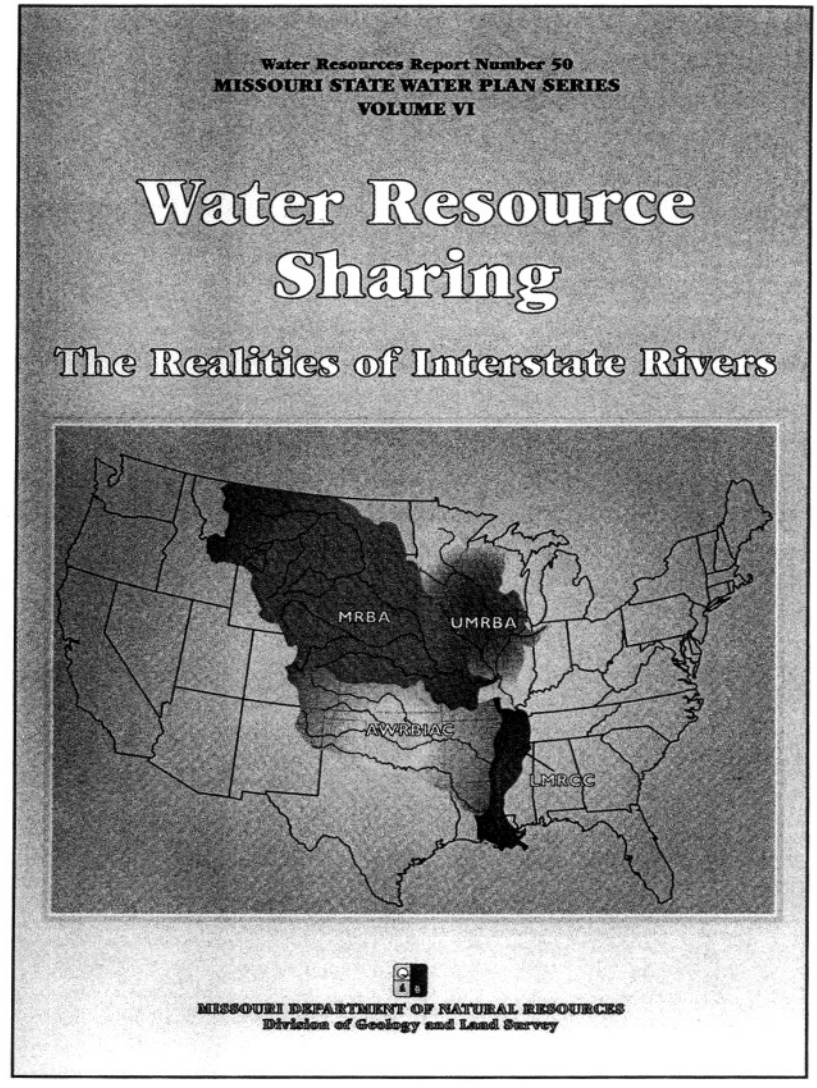


MISSOURI WATER QUALITY ASSESSMENT

This volume, printed in 1998, focuses on the current quality of Missouri's surface water and groundwater. The volume looks at chemical, bacteriological, and radiological quality of water, natural and man-induced water-quality changes, and the effects of waste disposal on water. It will serve as a valuable reference for anyone seeking water quality information whether for resource development or resource protection.

Data collected by various programs in DNR, the Department of Health, the Department of Conservation, and the U.S. Geological Survey are used to depict the current state of Missouri water quality, and delineate areas of water-quality problems.

WATER RESOURCE SHARING — THE REALITIES OF INTERSTATE RIVERS



Missouri is the farthest state downstream on the Missouri River. It is the middle section of the Mississippi River, and an upstream state on the Arkansas and White rivers. Because of its location, Missouri can be greatly affected by activities and water policy in the upper basin states of the Missouri and Mississippi river basins. Missouri policy can also affect downstream states on the Mississippi, Arkansas and White rivers. Many serious issues affecting these rivers have less to do with their physical characteristics than with political, economic, and social trends. The issues affecting the Missouri, Mississippi, White and Arkansas rivers are very complex, and their potential impact on Missouri is so great that a detailed presentation of Missouri's views and policy concerning these great rivers is necessary and are presented in this volume, printed in 1998.

A SUMMARY OF MISSOURI WATER LAWS

This volume will provide an overview of Missouri Water Law. Previous publications on Missouri Water Law were completed by T.E. Lauer in 1964 and 1969, and updated by Peter Davis and James Cunningham in 1977. Sufficient changes have occurred in the field of environmental law and regulation since 1977 to warrant the drafting of a new publication covering the topic.

Legal restrictions and requirements on how we manage, use, and protect our water resources serve to balance individual rights with the needs of society. Water law is an integral part of the larger realm of water resources management. Public health, public safety, and the economic well being of the state and its people depend on adequate availability of quality water.

Chapters in this volume include a History and Overview (from the Attorney General's Office), Water Rights, Protection from Water, Water Quality, Water Supply, Water Use, Boundaries and Interstate Water-

ways, and a chapter on "other water law topics." Useful appendices, a glossary of selected legal terms and acronyms, and an extensive bibliography also are included. This volume deals with statutory law, case law (court decisions), and legal doctrines relative to water in Missouri.

REGIONAL REPORTS, PHASE 2

The seven technical volumes have been prepared in Phase 1 of the State Water Planning effort. Editing and publication of the final volume will conclude the first phase. Meanwhile, Phase 2 of the effort has commenced, and the first of several regional reports is to be published in 1999.

Beginning with Northeast Missouri, the department is preparing a series of six regional reports, identifying water use problems and opportunities. The six regions are congruent with the six regional office territories of the Division of Environmental Quality. The staff of the Water Resources Program is preparing the reports, with the help of DEQ Regional Office personnel and other agency staffs.

The Interagency Task Force (see Section 640.430, RSMo, below) met in 1998 to review the Phase 2 planning process and the Northeast Missouri Report and the department is following the Task Force's recommendations in continuing the planning process.

TOPICS IN WATER USE: NORTHEASTERN MISSOURI

Now in the form of a review draft, the department is seeking public comments on the first of the Phase 2 reports. The following "executive summary" of the report provides highlights of the draft report, which is available, upon request. The summary provided here is being added to the DNR/DGLS home pages on the World Wide Web (Internet) to solicit public comments.

Overview of "Topics in Water Use: Northeastern Missouri"

According to the Missouri Water Resources Law (RSMo 640.400), the state water resources plan is to address water needs for the following uses: drinking, agriculture, industry, recreation and environmental protection. Addressing water "needs" requires us to establish why these needs exist in the first place. In some cases, an existing water need is tied to one or more unresolved water problems. For example, communities "need" clean water. To meet this need, communities may have to address problems with water supply infrastructure and source water quality. This report will explore the current issues facing the water resources of the northeastern Missouri region. Also included will be a section addressing recent successes various water-related programs have enjoyed, and how they have affected the water resources of the region.

To ensure equal consideration for all uses, emphasis is initially placed on identifying water use problems in each topical area identified in the Water Resources Law. Recognizing that individual problems are usually associated with more than one topical area, however, references to usage categories will be excluded in the final report. This will enable us to acknowledge the true complexity of these problems and help us remove barriers to solving them, rather than create and perpetuate them.

Although considered individually in this report, water use problems are not truly independent of each other. When reading through the water use problems identified in northeastern Missouri, it will quickly become apparent that many of them are, in fact, very

closely related. In addition, because of the diverse perspectives the various contributors bring to this effort, what from one standpoint may appear to be a "serious problem" may not seem so from another. For these reasons, the following problems underscore the importance of working cooperatively in addressing the water use problems facing northeastern Missouri.

Water resource professionals commonly subdivide the state into physiographic units, such as watersheds or aquifers. While this approach is important for resource-based discussions, it may not sufficiently address water use problems or solutions. This series of reports addresses the subject using the broad geographic similarities of the six field service areas of the department's Division of Environmental Quality (DEQ) (figure 1). Each of these regions has distinctive physiographic features and socio-economic characteristics, and therefore was chosen for the ease of referencing water use problems. This approach allows us to recognize Missouri's diversity, and lends itself well to this phase of the State Water Plan.

The area served by the Division of Environmental Quality's Northeast Regional Office is the focus of this report. To this point, staff from this office and other state agencies dealing with water resources have served as the primary sources of input. This has enabled us to draw upon the insight and experience of field staff who, by virtue of their work, deal with many water use issues facing northeastern Missouri on a daily basis.

WATER USE PROBLEMS IDENTIFIED IN NORTHEASTERN MISSOURI

A number of discrete water use problems have been identified by contributors from a number of state agencies, each providing a unique perspective on the water use problems faced in northeastern Missouri. In each, a brief problem statement is followed by a short discussion in which background information is provided and the nature of the problem is established. It is important to note that the problem descriptions appearing below are not arranged according to priority or degree of severity.

Lack of Regional Water Planning and System Consolidation

There is no overall, coordinated plan to link independent public water systems together. The current approach to water system consolidation is based on opportunity rather than advance planning.

Lack of Model Contracts for Public Water Supply Systems

Public water suppliers frequently enter into contractual agreements with other public water suppliers for a variety of reasons. Standard contracts have not been devised to help streamline this process, and often, poorly written contracts between water suppliers contain language that is disadvantageous to one or both parties.

Outdated Public Water Supply District Laws

Legislation enacted several decades ago to allow formation of public water supply districts does not allow for the greater flexibility necessary to meet today's economic conditions.

High Costs Associated With Developing, Expanding, and Replacing Public Water Supplies

Many public water supplies serving small northeastern Missouri municipalities need expensive modifications or expansions that may be unaffordable to smaller, financially weak systems.

Aging Infrastructure of Public Water Supply Systems

The basic equipment, structures and installations public water suppliers use to provide services can become less efficient with age and undersized with increasing demands. Since much of the population of northeastern Missouri is served by public water supplies, problems associated with aging water supply infrastructure may need to be addressed in the future.

Changing Water Requirements Stemming From Reversal of Long-Term Regional Population Trends

The populations of several northeastern Missouri counties have increased since 1990, reversing a decades-long decline. Public water suppliers in the region may be unprepared to meet growing domestic and industrial water requirements.

Water Quality Threats in Watersheds

Land use practices in a watershed can degrade water quality, impacting downstream users.

Water Requirements Associated with Industrial Growth

On a regional basis, there are no mechanisms that are readily available to match industrial growth with areas that can best accommodate their water needs.

Industrial Water Use Rights

Some industries need large quantities of water to operate. Under Missouri's current water law, there is no guarantee that the necessary quantities of water will be available for use. Conflict resolution among competing water users is decided by the courts on a case-by-case basis, so outcomes are uncertain. This can have impacts on the long-range planning ability of industries and water availability for other users.

Abandoned Pre-Law Coal Mines

Acid water discharges are associated with abandoned coal mining land. These discharges degrade streams and lakes, making them unsuitable for uses such as aquatic habitat, agriculture, and drinking. The estimated cost for reclaiming abandoned mine lands greatly exceeds the amount of money that is currently available for that purpose.

Wastewater Assimilation by Streams

Streams in northeastern Missouri often have very low base flows, which limit the capacity of streams to assimilate wastewater discharges. Low wastewater assimilation capacities increase the likelihood that a stream will be impacted by wastewater discharges. They also increase the level of treatment necessary to maintain streamflow at acceptable water quality standards.

Impacts of Concentrated Animal Feeding Operations on Northeastern Missouri's Water Resources

Large-scale concentrated animal feeding operations (CAFOs) have developed in many areas of the state, including northeastern Missouri. With their growth, water quality problems associated with manure management have arisen. Manure management deficiencies associated with these operations have led to water quality problems. As the number and size of CAFOs grow, the potential for further water quality problems may increase.

Livestock Watering in Drought Conditions

During extended dry periods, shortfalls in water availability occur which can impact livestock watering.

Aquifer Depletions in Audrain County

Agricultural irrigation in Audrain County may be contributing to groundwater-level decline in the Cambrian-Ordovician aquifer. Lowering of groundwater levels could induce the poor quality of groundwater in extreme northern and northeastern Audrain County to move to the south into areas where the aquifer currently contains freshwater.

Lack of Hydrologic Data

Critical water resources data are inadequate and unavailable, affecting our ability to effectively and efficiently utilize water to meet our needs.

Impacts of Stream Channelization

Stream channelization can have an adverse impact on some water uses and riparian/floodplain activities.

Sedimentation in Streams

Sedimentation, stemming from soil erosion, deposits vast amounts of silt, sand and even gravel into ponds and streams each year. Sediment deposition results in reduced water storage space and a decrease in water quality.

Aquatic Ecosystem Health Concerns

Aquatic habitats in and along streams are being degraded as a result of land use activities and chemicals, which are toxic to stream life.

Loss of Riparian Corridors/Streambank Vegetation

Many stream reaches in northeastern Missouri have lost much of the vegetation along their banks. Loss of riparian corridors results in accelerated bank erosion, channel widening and shallowing of water depth, diminished water quality, and loss of aquatic and riparian habitat.

Loss of Aquatic Species

Stream habitat degradation in northeastern Missouri has resulted in declining mussel populations, and has caused the ranges of sensitive fish species to be significantly reduced.

Environmental Water Interests Versus Landowner Water Rights

The extent of permissible reasonable use of water by a riparian landowner and its relationship to natural environmental water needs has never been fully defined in Missouri.

Interstate Water Issues — Iowa and Missouri

Streams flow from Iowa into Missouri across the state boundary, but no agreement exists between Missouri and Iowa to ensure that Missouri receives a fair share of the water.

Lack of Emergency Service Access Points on Lakes and Rivers

A shortage of emergency service access points on lakes and rivers in northeastern Missouri hampers emergency response efforts in times of crisis.

WATER USE "SUCCESS STORIES" AND OPPORTUNITIES IN NORTHEASTERN MISSOURI

This report will primarily document water use problems that have been identified in northeastern Missouri. In addition to water use problems, however, several "success stories" and opportunities in water use will be recognized as well. Although the goal of this series is to identify problems rather than offer solutions, some of these findings are described below. By taking note of successes (and opportunities for success), we recognize approaches that work, and can use them as stepping stones to problem resolution.

In northeastern Missouri, public (and private) partnerships and cooperation emerged as positive forces in addressing regional water "needs." Some examples are briefly described in the following paragraphs:

Management-intensive Grazing

Management-intensive Grazing (MiG) and rotational grazing may provide an increased opportunity for clean streams and lakes. MiG calls for a rotational grazing program instead of the more traditional continuous grazing. Rotational grazing, in practice, requires animals to be rotated to another pasture before they can cause damage to plants or soil. Frequent rotations allow unused pastures to "rest," restoring trampled high-use areas adjacent to streams and lakes and allowing grasses to regrow.

Agricultural benefits include improved livestock gains, higher stocking rates per acre, and more efficiently used pastures. Environmental benefits include reduced fertilizer usage through a more even manure distribution, reduced riparian damage, less top-soil erosion, and more stable streambanks, and diminished risk from contaminants in runoff.

Currently, the United States Department of Agriculture, through its Environmental Quality Incentives Program (EQIP); the Missouri Department of Natural Resources, through its rotational grazing incentives; and the Missouri Department of Conservation, through its streambank and watering systems cost-share programs, have all invested public funds to benefit the usage of Missouri's natural resources for animal production.

Clarence Cannon Dam — Mark Twain Lake

Mark Twain Lake was constructed as a result of federal, state and local partnerships. The people and agencies involved represented many interests, but were able to work towards a common goal and create a multipurpose reservoir. The Clarence Cannon Wholesale Water Commission (CCWWC), which withdraws water from the reservoir, is an example of long-term coordinated water planning. It provides treated water on a wholesale basis to member municipalities and rural water districts. Through the efforts of the Clarence Cannon Wholesale Water commission, a reliable supply of water is readily available to a large area of northeastern Missouri.

The predicted rate of sediment deposition, used by the Corps of Engineers to compute the operational life of the Mark Twain Lake project, was 11,500 acre-feet per year; the measured rate is 4,183 acre-feet per year, which is substantially lower.

This means that soil erosion (and therefore sedimentation) was greater when the reservoir was planned than what is actually occurring, now. This tremendous reduction is directly tied in part to the soil and water conservation efforts in the basin through the department's various soil conservation incentive programs and the technical assistance provided by the local soil and water conservation districts in the basin. This portion of the assistance, totaling almost $14.5 million has extended the life of the project by almost three times. This has had a dramatic effect on the success of this project.

Partnership-building efforts did not end after the completion of Mark Twain Lake. The Natural Resources Conservation Service (NRCS) is currently directing the Mark Twain Water Quality Initiative, a cooperative effort between NRCS, DNR, the University of Missouri, the Missouri Department of Conservation and landowners to demonstrate and evaluate the effectiveness of "total resource management plans" to address water quality problems in the Mark Twain Lake watershed.

Water Quality Improvements in Public Water Supplies

Although water supply problems persist in northeastern Missouri, regional water supply efforts have led to improvements in drinking water quality. According to the Missouri Department of Health, the statewide expansion of public water districts has substantially reduced the number of Missourians drinking contaminated water. For example, the number of people in the Department of Health (DOH) Northeast District drinking nitrate-contaminated water has fallen 50 percent in recent years. In 1990, 24 percent of the samples from the Northeast District analyzed by the state Public Health laboratory exceeded the drinking water standard for nitrates; by 1995, excedences had dropped to 12 percent. Water quality in northeastern Missouri has also improved through an increased awareness of water resources issues by agricultural producers, due to the availability of quality assurance plans offered by various agricultural associations and commercial enterprises.

Conservation Reserve Program

The Conservation Reserve Program is the largest land conservation program in the nation. Congress established it in the 1985 Farm Act as a voluntary, long-term cropland-banking program. The USDA provides participants with annual payments and cost-share assistance in exchange for retiring highly erodible or environmentally sensitive cropland for a period of 10 to 15 years. Since its inception, landowners in Missouri have returned more than 1.7 million acres of land under the CRP. Most of the CRP contract acreage in Missouri is distributed north of the Missouri River, much of it in northeastern Missouri. In northeastern Missouri, about 15,000 tons of soil is saved every year, approximately 50 percent of the amount saved statewide.

Reductions in Soil Erosion

Partnership building has contributed to reduced soil erosion in northeastern Missouri and throughout the rest of the state. Through the combined efforts of state and federal agencies, local officials and private landowners, soil erosion statewide was reduced by nearly 76 million tons between 1982 and 1992 (DNR/DGLS, 1996). Between 1982 and 1992, 27 million tons of soil were saved in northeastern Missouri. Local landowners, county soil and water conservation districts, the USDA Natural Resources Conservation Service, the Missouri departments of Natural Resources, Conservation and Agriculture, the University of Missouri Extension and others all play important roles in reducing soil erosion through various programs.

Several water use "opportunities' have also been suggested by some contributors to this report. These border on recommendations, and for this reason, were not fully developed in this phase. Water use opportunities are presented in this section to stimulate further thought and discussion, without endorsement of feasibility or merit.

Mark Twain Lake

The development of Mark Twain Lake, as mentioned above, is an example of successful partnership building. As a regional water source, it has considerable untapped potential as well. Water supply is one of the designated purposes of Mark Twain Lake. Currently, only a fraction of the 16 million gallons of water available daily is used for water supply. Although domestic water use is the most common water supply application in northeastern Missouri, commercial and industrial water supply allocations are substantial as well. The unused portion of

Mark Twain Lake's water supply allocation may provide additional benefits in terms of increased domestic water availability, and increased water availability for industrial applications, with associated economic gains.

During drought, opportunities may exist to supplement agricultural water requirements using water from Mark Twain Lake and other lakes within the region. In dry conditions, the water supply of farm ponds and small reservoirs is quickly exhausted, causing hardships for livestock producers. It may be possible to resupply dry ponds and reservoirs from these lakes, and provide water for pumping stations.

Major Rivers

The Missouri and Mississippi rivers are resources that may not be fully developed for many uses. Both rivers serve as transportation corridors, providing a means to move large volumes of commodities at reasonable costs to shippers. Opportunities may exist to enhance navigation through the development of intermodal terminals, developing more efficient loading/unloading capabilities, improving navigation infrastructure, and providing ready access to ports by both rail and truck transport.

Increasing demands on the waters of the Missouri River for various uses threaten to deplete water supplies in Missouri. The resolution of completing demands for water use among the states and Indian tribes of the Missouri Basin will require knowledge and diplomacy. The U.S. Army, Corps of Engineers, operates the many dams on the Missouri and its tributaries according to a Master Water Control Manual. Political efforts to revise the manual are on going.

Wetland Mitigation Banking

Missouri's wetlands perform many functions, such as providing fish and wildlife habitat, reducing flood damages, and improving water quality. Missouri's Wetland Conservation Plan recommends an increase in the quantity and quality of the state's wetland resource base, and wetland mitigation banking may provide a means to achieve that goal.

Value-Added Processing of Agricultural and Industrial Products

Opportunities may also exist to make use of northeastern Missouri's water resources in value-added processing of agricultural and industrial products. Value-added processing is a manufacturing activity, which improves a raw or less processed article or product into a more finished item or food product. Northeastern Missouri has a number of food processing plants. However, most agricultural products of this region are shipped to market raw, in bulk, by truck, train or barge. Value-added processing often reduces the bulk of a product, making shipping and storage easier. However, value-added production opportunities require more water in processing. In addition, food processing and specialty industries employ local residents, strengthening the regional economy. The added value then accrues to the region upon the marketing of the product.

SPECIAL WATER QUALITY PROTECTION AREAS

640.418—Special water protection area, procedure to establish. —1. The department may establish special water quality protection areas where it finds a contaminant in a public water system in concentration which exceeds a maximum contaminant level established by the environmental protection agency pursuant to the Safe Drinking Water Act, as amended, or a maximum contaminant level established by the department pursuant to this chapter or sections 640.400 to 640.435 or a contaminant in surface or groundwater which exceeds water quality standards established pursuant to chapter 644, RSMo, which presents a threat to public health or the environment. In making such a determination, the department shall consider the probable effect of the contaminant or contaminants on human health and the environment, the probable duration of the elevated levels of the contaminant, the quality, quantity and probable uses of surface or groundwater within the area, and whether protective measures are likely to prevent, mitigate or minimize the level of the contaminant in the surface of groundwater.

2. If the department determines that a special water quality protection area should be established, it shall consult with the interagency task force and with the public water system or systems affected and determine the boundaries of such area. When the boundaries of any such areas have been determined, the department shall, after a public hearing, issue an order designating the area as a special water quality protection area. Such an order shall include a geographic, hydrologic and stratigraphic definition of the area.

4. The department shall hold a public hearing or a public meeting within the area under consideration for designation as a special water quality protection area. The department shall notify every city and county within the proposed area and shall notify the public by press release and by publication of a notice in a newspaper of general circulation in the region.

640.420—Special water protection area, information program to be established, purpose, duties. —When a special water quality protection area has been established, the department shall implement an area informational program to help prevent, eliminate, mitigate or minimize the continued introduction of the contaminant or contaminants into the surface or groundwater.

640.423—Designation as protection area removed, when. —The department shall determine when the level of a contaminant or contaminants in a special wa-

ter quality protection area does not exceed, and are not likely to exceed, the water quality standards established pursuant to sections 640.400 to 640.435 and this chapter, and chapter 644, RSMo. Upon such determination, the designation of an area as a special water quality protection area pursuant to section 192.300, RSMo, sections 640.100, 640.120, and 640.400 to 640.435 shall be removed.

No special water quality protection areas have been formed under this statute.

INTERAGENCY TASK FORCE

640.430—Interagency task force established, members, meetings.—1. The department shall establish an interagency task force consisting of the departments of health, conservation, agriculture, the University of Missouri College of Agriculture, and other such departments and agencies as may be necessary to effectuate the purposes and provisions of sections 640.400 to 640.435.

2. The interagency task force shall meet at least semi-annually. The department shall be the lead agency in matters related to surface and groundwater protection.

On September 4, 1998, Department Director Stephen Mahfood distributed the first draft of the state water plan phase II northeast regional report (NERO) to the interagency task force. On October 7, 1998, the department hosted a working meeting to review the NERO document and update the task force members on state water planning activities. Task Force agencies in attendance included several department staff members and the following agencies and their representatives.

Agriculture ..... Marla Young
Conservation..... James Czarnezki
Economic Development.... Kevin Highfill
Health ..... Randy Maley
Public Safety ..... Sgt. Hans Huenik
Transportation ..... John Howland
University of Missouri ..... Chris Barnett

Throughout 1998, Water Resources Program staff, especially Todd Miller, hydrologist II, and Steve McIntosh, Water Resources Program director, worked with the Task Force members to incorporate their agencies' inputs to the draft NERO water plan report. The Interagency Task Force (IATF) provided substantial information for the water use problems, regional observations, and regional water use chapters of the NERO draft report.

Central Missouri

The department and the IATF are concurrently developing the regional water resource problems and opportunities of central Missouri. The geographic area being considered is again fixed upon the Division of Environmental Quality regional office (JCRO) in Jefferson City. Water Resources Program staff members are developing topics contributed by field staff and others in the department. The IATF members will also be developing problem and opportunity statements for program staff to develop.

The next IATF meeting is expected to be held in the spring of 1999 and will center upon the draft JCRO water plan report and emphasize identifying water use problems.

RECOMMENDATIONS

640.426—The department shall prepare and submit to the general assembly and the governor an annual report which details the progress it has made in meeting the objectives of sections 640.400 to 640.435 and which contains recommendations in furtherance of the purpose and provisions of sections 640.000 to 640.435.

This *1999 Annual Report* explains how the staff of the Missouri Department of Natural Resources carries out the legislative mandates of the Missouri Water Resources Law. It demonstrates the breadth of activities that the department conducts and the progress that has been made in meeting the objectives of the Water Resources law. This report is not a comprehensive listing of the department's water related activities.

As the State Water Plan volumes and reports continue to be published, the state's water quantity and quality needs will become more apparent. The goal of the State Water Plan is to produce a set of recommendations for local, regional, and statewide implementation, both short-range and long-range.