MINNESOTA ENVIRONMENT

Minnesota Pollution Control Agency

A Message from the **Governor**

Minnesotans are endowed with a beautiful state, rich in natural resources and covered by scenic landscapes — from the rocky shores of Lake Superior in the northeast, to the rolling prairie grasslands in the southwest. The "environment" is one reason why most of us choose to stay here; it's also why many people decide to move or vacation here.

As governor, I have advanced a blueprint for Minnesota's future called "The Big Plan." One of the four principles of the Plan is "Healthy, Vital Communities." Specific goals include energy efficiency, modern transportation systems and smart growth. All of these elements contribute to maintaining a healthy environment.

Our citizens expect government to ensure that the water is clear and the air is clean. But as you read this report on the status of the environment in the year 2000, you will see that individuals share in the responsibility.

I challenge you to become active stewards of the land, water and air. A healthy environment is a heritage we owe our children.

Jesse Ventura
Governor

A Message from the **Commissioner**

Fishable and swimmable lakes and rivers, clean and clear air, uncontaminated ground water and land, and healthy ecosystems. These Minnesota Pollution Control Agency (MPCA) goals reflect the core values Minnesotans hold for their environment. Are we there yet?

The answer is complex. On one hand, the environment is better today than 30 years ago, when skies were filled with sooty smoke, our waters fouled by human and industrial sewage, and our land and ground water poisoned by garbage and hazardous waste. Credit must go to government, industry and citizens for significant progress in cleaning up our state and adopting pollution prevention practices. On the other hand, we face different, serious health and environmental risks from the many pressures of a growing population.

The safety of the air we breathe is threatened by toxic air pollutants from cars, trucks, industries and other sources. Our rivers, wetlands, lakes and fish face greater risks than ever from polluted runoff and sediment, risks intensified by careless development in their watersheds. Our urban areas are sprawling outward into farmland and wildlife habitat. Malformed frogs suggest something is seriously amiss.

The early pollution problems were not overcome by the MPCA alone. The same holds true for these new threats to our environment and quality of life. It is a responsibility shared with all citizens of Minnesota, and success will depend on the way *all* of us conduct ourselves at work, at home, on the road and in the outdoors. Ultimately, we're all accountable to current and future generations for this important mission.

Minnesota Environment 2000 is not meant to be an all-inclusive report on the state of the environment. Rather, it highlights key conditions and trends, including those specific to the diverse yet interdependent geographic regions that comprise our home state.

A wealth of additional information about the environment, MPCA programs, and opportunities for public involvement may be found on the agency's worldwide web site, at *www.pca.state.mn.us.* More good information is available on the web sites of other agencies and organizations, many of which are listed on page 40.

I hope you will find *Minnesota Environment 2000* informative, and that it inspires you to continue in innovative partnership with us to secure Minnesota's environmental future.

Karen A. Studders
Commissioner

Throughout the "Air, Water and Land" section of this report, the above symbol indicates when additional information is available on the MPCA's *Minnesota Environment 2000* web page. To check out these additional resources, surf to: www.pca.state.mn.us/about/pubs/mnereport/ There you'll find a list of web links that correspond to the web citations found in this printed report.

Contributors: Jim Anderson, Becker County Historical Society and Museum, Todd Biewen, Katherine Carlson, Stacy Casey, Tom Clark, Douglas County Historical Society, Patricia Engelking, Shawna Gibson, Ralph Heussner, Paul Hoff, Louise Hotka, Steve Lee, Shannon Lotthammer, Micheal O'Neill, Kari Palmer, Ralph Pribble, Gaylen Reetz, Andrea Wieland, Chris Zadak

Editor: Paul Hoff

Graphic Artist: Carol Pruchnofski

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IS OUR ENVIRONMENT GETTING BETTER?

Minnesota Historical Society

Governor Karl Rolvaag (left) and local resident George Serbesku examine one of the 10,000 ducks injured or killed in the aftermath of two huge oil spills on the Minnesota and Blue Earth rivers, April 2, 1963.

On December 7, 1962, more than one million gallons of oil spilled onto the Minnesota River ice from a broken pipeline in Savage.

Eight weeks later, on January 23, 1963, a 40-foot high soybean-oil storage tank collapsed in Mankato, releasing a 3 million-gallon tidal wave of soybean oil. It flooded several blocks of the city near the junction of the Blue Earth and Minnesota rivers. The gooey wave also toppled storage tanks and rail cars, releasing an additional half-million gallons of salad oil and other substances into the Blue Earth River.[1]

These weren't the worst environmental catastrophes in our state's history. But they may be the most significant.

Why? Because the public outcry over 10,000 ducks killed or injured during the spring thaw aftermath of the two events awakened Minnesota's environmental consciousness and eventually led to the creation of the state's environmental regulatory agency, the MPCA.

Today, nearly 40 years later, such disasters are rare in Minnesota. Serving the public's desire for clean air, land and water, federal and state lawmakers passed vital legislation designed to protect the environment. Minnesota has been among the most active states, admired nationally for decades of environmental leadership. Government, citizens and industry all deserve credit for our significant progress.

But the question persists: Is the environment getting better? Yes — and no. The answer is not simple. Through the 1970s and 80s, Americans concentrated on eliminating the worst problems — the belching smokestacks, the untreated sewage, the careless dumping of hazardous wastes. These familiar "point" sources of pollution now are largely controlled.

Today, the environment is threatened ... by a growing array of "nonpoint" sources.

Today, the environment is threatened as much or more by a growing array of "nonpoint" sources, such as untreated runoff, motor vehicles and rapidly changing land uses — the outgrowth of a booming economy and population. More than ever, we are all part of the problem.

Minnesotans stand before a new millennium with a critical challenge: *Will each one of us — whether at home, at work, in the community, or in the outdoors — accept our responsibility to protect the environment?*

Photo courtesy Betty Goihl

Willard Munger:

Mr. Environment

In the last year of the 20th century, Minnesota lost an exceptional individual. Representative Willard Munger served in the Minnesota Legislature for 43 years until his death July 11, 1999, at age 88. Munger was involved in virtually every piece of environmental legislation during that span, fighting for tough anti-pollution laws, energy conservation and protection of natural resources for citizens to enjoy.

Munger's legacy of environmental accomplishments is phenomenal and lengthy. Among many highlights, the Duluth motel operator and state representative is best known for helping establish the Environment and Natural Resources Trust Fund, which Minnesota voters overwhelmingly endorsed as constitutional amendments in 1988, 1990 and 1998. The trust fund, administered by the Legislative Commission on Minnesota Resources, provides money for projects involving recreation, fish and wildlife habitat, water resources, environmental education, conservation reserve easements, park acquisition and other environmental conservation efforts.

He successfully fought for laws and funding for clean lakes and rivers. Northeastern Minnesota's St. Louis River, once heavily polluted by human and industrial sewage, now boasts excellent fishing, whitewater rafting, and a national training center for kayaking. Munger led the effort to build a modern wastewater treatment system that protects the river while serving people and industries in the Duluth and Cloquet area.

Munger also championed laws to protect ground water and wetlands, to clean up old hazardous waste sites, to mandate recycling, and to build wastewater treatment plants. He helped establish requirements for pre-construction environmental review and public comment on major development projects. He fought for money in the state budget to make sure environmental projects and laws were carried out.

The environment was more important to Munger than making a name for himself. Despite his many successes, he never held news conferences or sent out news releases about his work.

"It was never about him," says John Helland, long-time research analyst for the state House of Representatives. "He'd want to get back to work on the next environmental problem. For Willard, it was always about future generations — protecting the environment for our children and grandchildren."

Nonetheless, his colleagues in the Legislature couldn't resist honoring his conservation leadership long before he died by establishing the Willard Munger State Trail in 1988. The trail is paved from Duluth to Hinckley, and may eventually link to other trails all the way to St. Paul.

MINNESOTA AND THE GLOBAL ENVIRONMENT

NASA/GSFC/
NOAA/USGS

Minnesota's prosperity and quality of life depend on a healthy environment. But air and water are not constrained by geographic borders. Increasingly, environmental issues must be viewed from regional, national and even global perspectives. Factors outside the state influence our environment, and our actions in Minnesota have consequences beyond our borders.

Minnesota's position near the center of North America, atop three major continental watersheds, gives us an invigorating four-season climate, an abundance of surface and ground water, and a varied landscape of bedrock and glacial features spanning more than 3 billion years of geologic history.

Only in the last century, a blink of an eye in geologic terms, have human impacts on Minnesota's environment become a concern. One reason is our population, which has grown from 1.7 million in 1900 to an estimated 4.5 million in 2000.

Growth brings major changes to the landscape. Suburban areas expand, taking over farmland and wildlife habitat. Sprawling development paves over sensitive areas that feed underground drinking-water supplies, and sends untreated runoff into rivers and lakes.

Climate change

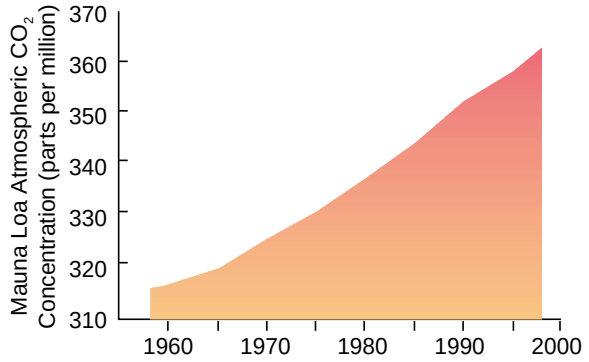
Around the globe, carbon dioxide and other "greenhouse" gases are increasing in the atmosphere (Figure 1). In the past 130 years, the average surface temperature of the earth has risen almost two degrees Fahrenheit. It looks like the planet is warmer now than any time in the past 1,000 years.

So, what does this mean for Minnesota? Forecasting the future is full of uncertainties. However, evidence suggests the state will probably warm four to eight degrees Fahrenheit over the next century, based on projections by the Intergovernmental Panel on Climate Change and computer modeling results. We will probably experience earlier springs and later falls. We may have more intense rainfall. Plants and animals will move to Minnesota from the south and our forests will move north — which means our boreal forest in the Boundary Waters Canoe Area and Voyageurs National Park may disappear.

As a result of these changes, heat-related illnesses and deaths could increase in Minnesota. We may experience more severe summer air pollution due to higher peak temperatures. Agriculture, forestry, fisheries and tourism — important economic sectors in the state — may be significantly affected.

Many of these potential changes are not far off in the future. They could begin soon, certainly during the lifetime of today's children. As a state, we need to determine now what we can do to reduce these potential threats. We need to participate in the

Figure 1 — Rise of carbon dioxide in the atmosphere



According to monitoring conducted since 1958 at the Mauna Loa observatory in Hawaii, the amount of carbon dioxide in the earth's lower atmosphere has increased steadily over the last 40 years.

Source: Adapted from Keeling and Whorf, 1998

national and global debate on when and how to address the factors that contribute to climate change.

More global connections

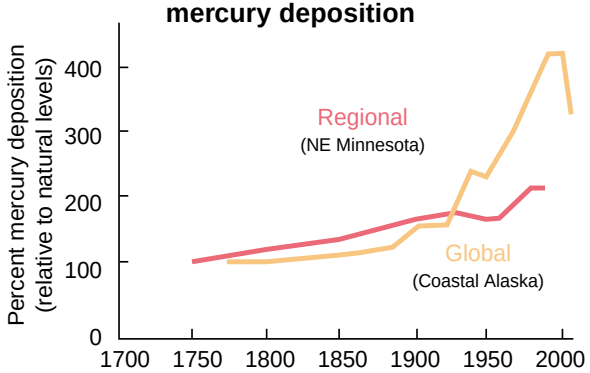
Two other examples point out both the global and local aspects of current environmental problems:

- Mercury — a metal that can make fish unsafe to eat. The amount of airborne mercury falling on Minnesota in rain, snow and dust peaked in the 1960s and 70s and is now declining (Figure 2). However, in Alaska, which receives more airborne mercury from Asia, fallout is increasing. While we're reducing mercury emissions in and around Minnesota, on a global scale they're rising. 3

- Gulf of Mexico Dead Zone. When nitrogen runoff from the Mississippi River basin reaches the Gulf of Mexico, it steals oxygen from the gulf's waters. A large "dead zone" has formed, knocking out commercial fisheries and threatening aquatic life (Figure 3). In a typical year, about a third of the nitrogen reaching the gulf comes from Upper Midwest states, including Minnesota. Efforts are underway to control this runoff, especially in the Minnesota River basin, but repairing the damage will take many years.

The upper and middle Mississippi watersheds, which drain upper Midwest states like Minnesota, contribute more than a third of the nitrogen reaching the Gulf of Mexico each year. This nitrogen steals oxygen from the gulf's waters, creating a large "dead zone" where fish and other aquatic life cannot survive.

Figure 2 — Global and regional mercury deposition



A recent study indicates that less mercury is getting into Minnesota lake sediments than in the past, while studies in Alaska show that mercury from global sources is rising. If this global increase continues without corresponding local and regional decreases, mercury contamination in Minnesota will also rise.

Figure 3 - Gulf of Mexico "Dead Zone"

What about acid rain?

While global pollution issues present additional challenges, it is possible to address them. Take acid rain, for example, which forms when sulfur and nitrogen oxides from air pollution mix with moisture in the atmosphere. In a process called deposition, the acids fall to earth in rain, snow, fog or dust, and are deposited on the ground and in water, where they can make lakes too acidic for fish and other aquatic life to survive. At least 2,200 Minnesota lakes are vulnerable to acid rain.

In response to this threat, the 1982 Minnesota Legislature passed a law — the first of its kind in the world — that led the MPCA to develop an acid-deposition control standard and plan. Because of the efforts of Minnesota and other states and federal agencies that followed our lead, sulfur dioxide and nitrogen oxide emissions have decreased at many sites throughout the nation.

This does not mean that acid rain can now be ignored. Some lakes in Michigan, Wisconsin and New York's Adirondack Mountains are still becoming more acidic, to the point where certain plants and animals can no longer live in the water. Recent scientific research indicates a connection between sulfuric acid fallout and the process that leads to mercury contamination of fish — even in lakes that are not acidified. This means that to reduce mercury contamination of fish we may need to decrease sulfur dioxide emissions even more than is needed to control acid rain.

MINNESOTA'S AIR, LAND AND WATER

The quality of Minnesota's air, water and land is of keen interest to our citizens. The following sections examine key trends affecting these resources, followed by a closer look at conditions and trends in the diverse geographic regions that comprise our state.

We all pollute the air, directly and indirectly. Polluted air can make people sick. We may not realize it, but the choices we make at home, at work and in transporting ourselves around affect the air we breathe. It's not easy to recognize polluted air, because most of it is invisible to the naked eye. The exhaust from a car, snowmobile or lawnmower drifts off and seemingly disappears. But the collective emissions from all sources, while cleaner in many ways than 30 years ago, are still a concern.

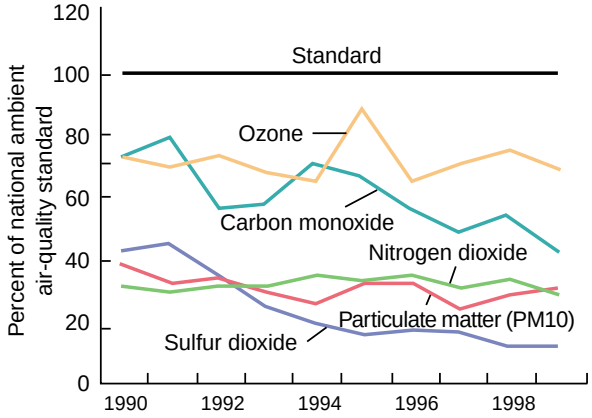
During the 1990s, concentrations of five criteria pollutants measured at sites in the Twin Cities area were consistently below (better than) national ambient air-quality standards. Lead is no longer monitored because levels were reduced significantly after it was removed from gasoline.

Criteria pollutants

The first air-quality issues addressed by society were the most readily obvious ones. The 1970 federal Clean Air Act led to health-based air-quality standards for six chemicals called "criteria pollutants." These chemicals were known to harm health and the environment. They are: sulfur dioxide, nitrogen oxides, particulates, ozone, carbon monoxide and lead.

Federal and state law required emission cuts from large sources such as power plants, oil refineries

Figure 4 — Trends in criteria air pollutants in the Twin Cities area



and factories. Lead was phased out of gasoline. New cars had to meet tight emission standards and get better gas mileage. Thanks to these measures and others, Minnesota's air now meets federal standards for the five pollutants currently monitored (Figure 4).

Air toxics

However, air pollution consists of more than the six criteria pollutants. "Air toxics" are a group of chemicals known or suspected to cause human health or ecological problems. Many are long-lasting and can build up in the environment. Air toxics may also mix with each other to form combinations of chemicals that are even more harmful than a single toxic chemical.

Air toxics are harder to measure and regulate than the six criteria pollutants. We know the concentrations of about 44 air toxics in Minnesota's outdoor air. Many more chemicals have not been monitored. In some cases we do not yet know how to measure them in the air.

One example of an air toxic that has been monitored is benzene, which is found in gasoline. Benzene is known to cause cancer in people who are exposed to too much of this pollutant over time. In some parts of Minnesota, benzene has been measured in the air at levels that may cause adverse health effects.

Another pollutant of growing concern is the small particles in diesel fuel exhaust. Diesel fuel is widely used in trucks, buses, cars, trains, ships, construction equipment and other engines. A 1999 California study indicates that diesel soot may account for up to 70 percent of the cancer risk from toxic pollutants that have been measured in the air.

The sources of air toxic emissions are varied. Metals such as chromium come primarily from point sources such as factories and refineries. Many of the air toxics, including benzene, are emitted mainly by motor vehicles, and other sources such as home furnaces and dry cleaners (Figure 5).

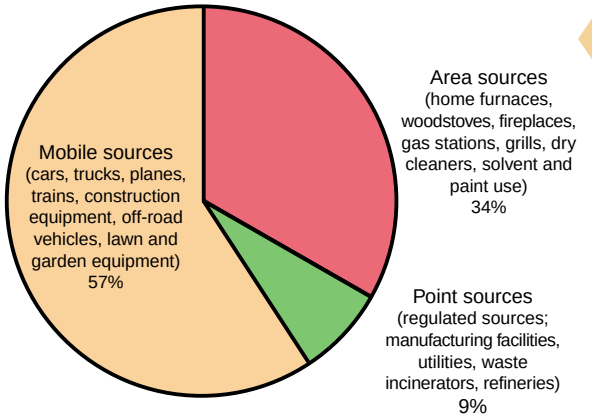
Identifying the general sources of air toxics can often help explain why parts of Minnesota have higher levels compared with other areas of the state. For example, benzene tends to be highest in urban areas, which have many motor vehicles concentrated together. Metals tend to be highest near the facilities that emit them. 4

Individual choices are key

Mobile sources — cars, buses and trucks — contribute heavily to air toxics. While vehicles have become cleaner through the use of control equipment and cleaner fuels, these gains are being undermined by the ever-increasing number of vehicles we purchase and the miles we drive (Figure 6).

Minnesota regulators and industries have successfully cut emissions of criteria pollutants from large sources. If we're to achieve similar

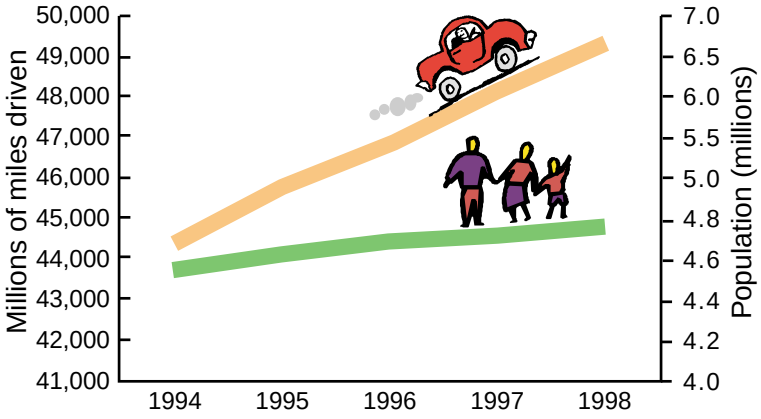
Figure 5 — Sources of air toxics



While some air toxics such as metals are emitted from large, regulated facilities, pollutants like benzene — another air toxic — are released mainly by small, mobile pollution sources.

Data from the 1996 Minnesota Air Toxics Emissions Inventory

Figure 6 — Trends in motor vehicle travel in Minnesota



The total miles driven annually in motor vehicles are increasing faster than the rate of population growth.

Source: Minnesota Department of Transportation, State Demographer's Office

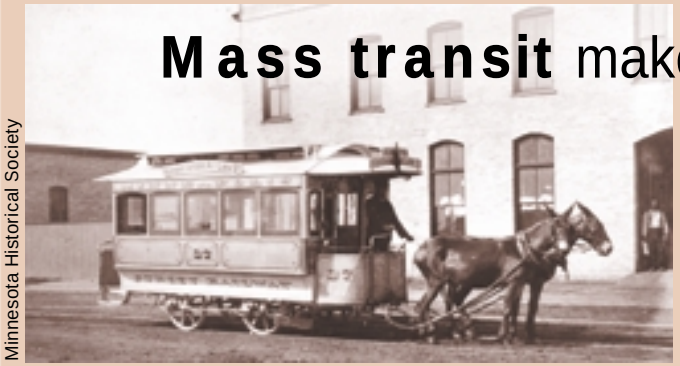
reductions in air toxics, the choices of society and individuals will become more important. Part of the solution may come from the development and use of cleaner fuels and technologies. However, the choices we make as consumers and citizens will play a major role in air quality.

Individuals can choose to buy fewer and less polluting products. Cities can be designed to make walking, biking and public transportation viable options for running errands and getting to work. The choices we make in the future will affect not only our health, but also larger issues such as our children's health, ozone depletion and global climate change.

Minnesota Department of Transportation

Bicycling provides a healthy alternative to driving and helps protect Minnesota's air quality.

Mass transit makes a comeback



Minnesota Historical Society

Early streetcar in Minneapolis, 1885.

In the first days of the new millennium, Minnesota Governor Jesse Ventura toured the state promoting a new strategy for transportation. Over the next 10 years, the governor envisions increasing the availability of mass transit.

In a sense, Minnesota will look to its past to move into the future. A century ago, our governors promoted their ideas on "whistle-stop" tours — actually using trains, a form of mass transit, to travel around the state. By the turn of the last century, there was also an established mass transit system in the Twin Cities.

The first electric streetcars were operating in Stillwater in 1889. Two years later, the St. Paul & White Bear Railroad was formed. This line connected the capital city and the lake community with electric trains. Later this line was absorbed into the Twin City Rapid Transit Company — a transportation network that eventually served a metropolitan area of 600 square miles.

The early forms of mass transit were not primitive conveyances. A passenger traveling from Minneapolis to Wildwood Amusement Park on White Bear Lake would ride in a "roomy, easy-riding, comfortable and handsomely furnished coach."

Competition of diesel-powered buses and trucks, coupled with the advent of the automobile, ended the reign of passenger trains and streetcars. Much has been written concerning the demise of mass transit, but perhaps the automobile was simply irresistible to a society brought up on the notion of personal freedom.

The quest for personal autonomy led to billion-dollar expenditures for new freeways and roads, particularly during the latter half of the 20th century. With increased population, however, has come increased traffic and associated environmental concerns, such as toxic air pollution.

Wisdom is rarely gained without loss. The past network of mass transit may be gone, but not forgotten. Thus, transportation leaders in Minnesota have revitalized a vision of mass transit in the state. This vision includes an increase in Twin City bus service, light rail, commuter rail and bus-way transit connections to all Minnesota counties.

First air pollution alert hits Twin Cities

Minnesota Pollution Control Agency

Air pollution makes downtown Minneapolis nearly invisible from the nearby U of M campus on February 11, 1972. An air pollution alert lasted 28 hours.

A gritty haze covered the downtown Minneapolis skyline, obscuring the nearly completed IDS Tower. Decreased visibility slowed traffic on Interstate 35W in Lino Lakes. And front-page newspaper articles warned people with emphysema, asthma and heart disease to stay indoors.

The cause? Air pollution. Minnesota's first air pollution alert was called on Feb. 10 and 11, 1972, when unhealthy levels of sulfur dioxide and soot particles hung over the Twin Cities metro area. A slow wind and a thermal inversion (warm air sitting atop cooler air) trapped the hazy pollution in place for 28 hours.

"It was pretty grim looking — there was a lot of crud in the air," said Gary Eckhardt, who worked on the MPCA's February 1972 air alert and retired from the agency in 1999. "We had to really scramble to react and get word out about what the public should do."

Alerts are called when pollutant concentrations approach or exceed safe levels. High concentrations of sulfur dioxide, particulate matter or other pollutants can affect breathing and aggravate respiratory and cardiovascular diseases.

The MPCA's first step was to ask the 32 largest-known users of coal and fuel oil to switch to fuels with a lower sulfur content. Some of these facilities included NSP, the University of Minnesota, 3M, and Northwestern Refining (now Koch). Most complied. But it was mainly a change in the weather — a 10- to 15-mph wind and a breakup of the inversion — that finally blew the trapped pollutants away.

What still happens dozens of times *every* year in Los Angeles, Houston, Atlanta and the larger east-coast cities turned out to be quite rare in Minnesota. The MPCA has issued only a dozen air alerts in 32 years, most more than 20 years ago, including one each in Duluth and International Falls, Eckhardt said.

The last alert occurred in 1987, when carbon monoxide approached unsafe levels during another temperature inversion in the Twin Cities. Strong state and federal anti-pollution requirements for smokestacks and cars helped reduce Minnesota concentrations of sulfur dioxide and other major air pollutants in the 1980s and 90s.

Will the Twin Cities area be as fortunate with toxic air pollutants? Perhaps not. Concentrations of these pollutants are similar across the country, including here. Most come from cars, trucks and other mobile sources, less from smokestack industries. Federal and state air-quality officials will be focusing more on toxic pollutants in the continuing effort to achieve healthy air.

© Minnesota Office of Tourism

Minnesota opened up to logging, farming and settlement in the 1800s, marking the start of profound, accelerated changes to the landscape. The great pine forests of the east and north were logged, and the expansive hardwood forests of the southeast were cleared for farms and towns. Prairies were plowed to plant crops in the rich soil.

Minnesota's landscape continues to change today, and our lives and livelihoods still depend on it. We've learned that what happens on the land directly influences the health of the whole environment — including the air, water and ecological communities.

Land use varies widely throughout Minnesota. Farms and forests account for 78 percent of the state's total surface area (Figure 7). Roughly 6 percent of the Land of 10,000 Lakes is covered by water. Even more area (11 percent) consists of bogs, marshes and fens. Developed cities, suburbs and rural lands comprise just less than three percent of the state's nearly 54 million acres.

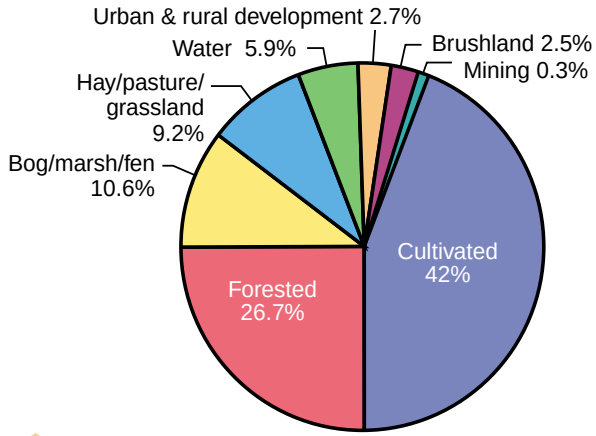
These percentages don't tell the whole story. What kind of development, how it occurs and where it occurs are critical in examining the health of Minnesota land. As in real estate, location is usually the most important factor in how our activities affect nearby air, water, people and ecosystems.

Changing land uses

Since the early 1980s, about 7 percent of our cropland and 13 percent of pasture land has been converted to other uses, according to the U.S. Department of Agriculture (USDA). Much of this change is due to diversion of acreage into the federal Conservation Reserve Program, which pays farmers not to farm environmentally sensitive acres. About 20 percent of those crop and pasture acres was converted to urban "built-up" land, however.

The status of wetlands — which naturally filter pollutants from water, reduce flood damage and provide wildlife habitat — has also changed.

Figure 7 — Land use in Minnesota



The dominant land uses in Minnesota are cultivated land (cropland) and forests.

Source: Minnesota Planning, Land Management Information Center

Minneapolis Community Development Agency

Cleanup spurs new life
for Milwaukee Road Depot

The etched metal hulk of the old Milwaukee Road Depot train-shed canopy provides mute testimony about the consequences of our careless environmental past. The prime downtown Minneapolis 17-acre property, dead empty for 30 years, used to have a dark secret: ground water contaminated with generations of spilled diesel oil, a slowly migrating pollutant reaching like a black glove toward the Mississippi River.

Many cherished development plans became train wrecks at the Depot, sabotaged by cleanup costs that promised to be enormous. Even when the first Metro area "brownfield" redevelopment plans surged onto the scene in the early 1990s, the sheer size and scope of the Depot cleanup defeated even the most energetic developers.

So why are Dick Victor and Ann Calvert, Depot project managers for the Minneapolis Community Development Agency (MCDA), smiling these days?

Because Minnesota state law, technological advances, public investment, and the MPCA's voluntary cleanup programs have finally gotten the Depot on the right track. In the fall of 1999 construction began on a $50 million hotel, restaurant and ice rink complex that may spark a reawakening in the north Washington Avenue corridor.

"We've made the public investment in cleaning up pollution on the site," says Calvert. "Both the timing and the development are right."

The Depot's transformation, like many other tales of brownfield redevelopment, begins with law and ends with technology. A coalition of business, government and environmental interests sought a way to balance the business needs of developers with the environmental responsibilities of the agency. The resulting Land Recycling Act of 1992 breezed through the Minnesota Legislature and strengthened liability protections for developers.

However, the challenge of cleaning up the Depot's thousands of gallons of oil underground remained.

Minnesota state law, technological advances, public investment and the MPCA's voluntary cleanup programs have finally gotten the Depot on the right track.

The MCDA and MPCA found an answer in 1996 worthy of the locomotives of the past — steam. Steam injected into the soil at the right pressure liquifies and vaporizes diesel oil. A soil vapor extraction system then acts as a giant vacuum cleaner to remove it.

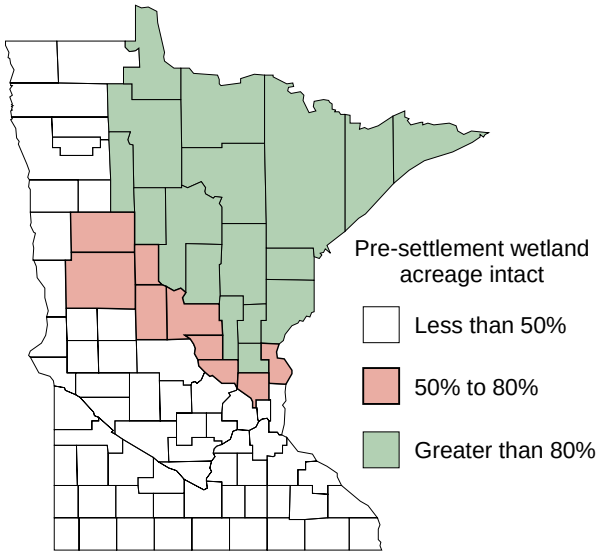
This innovative solution recovered 40,453 gallons of oil over two years, completing the first two phases of the Depot's recovery process. A third phase now underway will clear another large portion of the property for development, and by 2001 the Depot once again will be a bustling focus of civic interest.

According to the Minnesota Board of Water and Soil Resources, more than 5.5 million acres of Minnesota wetlands have been lost since the early 1900s (Figure 8).

In the early to mid-1900s, with government encouragement, landowners drained thousands of acres of wetland. In contrast, during the 1980s and 1990s more wetland acres were lost through urban development than through agriculture, according to USDA figures. Fortunately, we now understand the importance of wetlands. They are much better protected and the loss rate has declined considerably. However, significant losses still occur from actions that do not require approvals or permits, according to the state Wetland Conservation Act report. 5

The clear trend in Minnesota's major cities and in many smaller communities is growth. The USDA estimates that 62,000 acres per year — equal to 170 acres per day — were developed from 1992 through 1997, more than double the rate of the previous decade. If present rates continue, Minnesota will double its current area of developed land in less than 40 years.

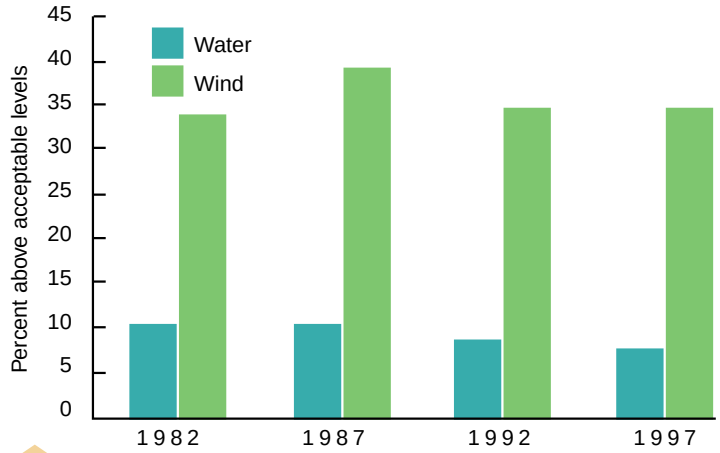
Figure 8 — Pre-settlement wetlands (acreage remaining)



Since the mid-1800s, significant acres of Minnesota wetlands have been lost through draining and filling. In many parts of the state, less than 50 percent of the wetlands that existed prior to European settlement are still around today.

Source: Minnesota Board of Water and Soil Resources

Figure 9 — Erosion trends on rural lands



In 1997, more than 30 percent of Minnesota's rural land experienced wind erosion at rates above acceptable levels. In comparison, slightly more than 7 percent of rural land experienced excessive water erosion.

Source: U.S. Department of Agriculture

Impacts of growth on the environment

How exactly does our use of the land connect with the health of our environment? One clear connection is soil erosion. Erosion removes irreplaceable soils, and carries pesticides, organic (oxygen-consuming) materials and excess nutrients into surface waters, where they cause harm. Erosion is strongly influenced by surface cover — the kinds of plants and soil tillage patterns most common in the area. USDA data suggest that soil loss by water appears to be declining. Loss by wind erosion, however, is much more prevalent and appears steady to slightly declining (Figure 9).

Agricultural drainage (tile lines and constructed ditches) can improve crop yields by drying fields faster and preventing water from pooling on the land. Much of Minnesota's cropland uses drainage systems, and 200 million feet of new tile are installed each year. The environmental tradeoffs are declines in water quality and undesirable changes in water quantity, such as increased frequency and intensity of flooding.

Development can have many consequences in our watersheds as well. More roads, roofs and parking lots accelerate runoff, which gathers contaminants along its way into our waters. Without proper management of urban runoff, nutrients, toxic chemicals and organic materials pollute nearby waters.

Air quality and noise also can be affected by certain land uses. Sprawling development has led to more cars and trucks being driven more miles each year, with more total pollutant emissions (see page 7). Excessive noise also is an increasing concern in rapidly developing areas. Land-use authorities should carefully evaluate development proposals for noise impacts, which if left uncontrolled can harm health and quality of life.

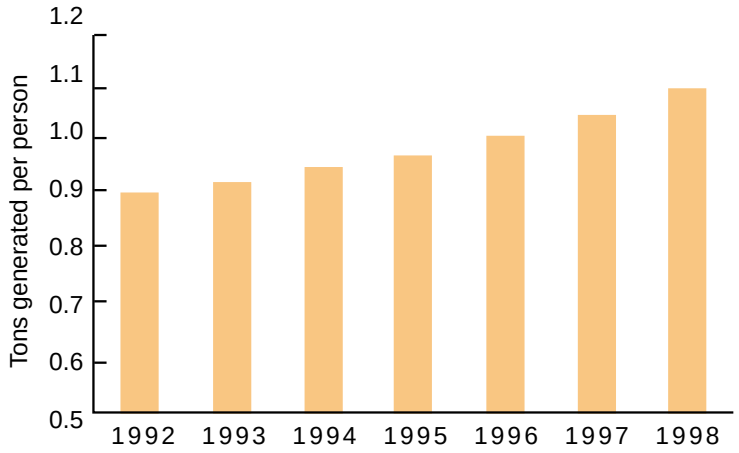
Everything must go somewhere

Open garbage dumps and uncontrolled disposal of hazardous waste once spoiled parts of the land, and leaked pollutants into ground water. But efforts by government and industry to clean up contaminated sites and soils have greatly lowered the risks to ground water, and made once-polluted sites available for new uses. 6

The amount of garbage generated in Minnesota is growing faster than the state's population. Between 1992 and 1998, municipal solid waste generation grew 30 percent statewide, while the population grew only 7 percent. This resulted in a 21 percent increase in the amount of garbage produced per person each year.

Source: County SCORE data, State Demographer's Office

Figure 10 — Garbage generation in Minnesota, per person



Compliance with hazardous waste laws has improved every year since the mid-1970s. Pollution prevention, where industries curb waste by changing processes, recapturing wastes for raw material, and finding non-hazardous substitutes, has made a big difference in the amount of waste needing disposal. 7

But several trends in recent years suggest there is still much work to do to keep solid and hazardous waste off the land. Despite progress in recycling, yard-waste composting and waste reduction by incineration, the yearly amount of garbage generated per person increased 21 percent between 1992 and 1998 (Figure 10).

It's not clear whether overall use of hazardous chemicals is increasing or decreasing. Disposal of some chemicals such as benzene and silver seems to be decreasing, while others — cadmium, nickel and xylene — are increasing.

The new millennium finds Minnesota in the midst of an unprecedented economic boom, which has also brought growth in overall waste generation. The Minnesota Office of Environmental Assistance forecasts a shortage in landfill capacity by about 2010, if present landfill disposal rates continue. It will take public commitment, stewardship by industries and manufacturers, and even more effective prevention and management to avoid converting more land into disposal space. 8

Drainage systems that remove water from the land send pollutants into Minnesota streams and increase the frequency and intensity of flooding.

Everyone knows Minnesota is the "Land of 10,000 Lakes." But actually, we have 11,842 lakes of 10 acres or larger. Add smaller lakes and the total is above 14,000. We also have more than a trillion gallons of ground water, and 92,000 miles of streams and rivers. Three continental watersheds originate here, sending our waters north to Hudson Bay, east to the Atlantic Ocean, and south to the Gulf of Mexico via the Mississippi.

Water is the dominant feature of Minnesota's landscape. Ask any Minnesotan about his or her top environmental concern and the likely response will be, "clean water." A 1999 series of citizen forums on the environment, co-sponsored by Governor Ventura and the MPCA, showed clean water as a top priority. 9

Minnesotans have made great progress in cleaning up "point sources" of pollution — discharges of municipal and industrial wastewater. It's the "nonpoint sources" — pollutants that rain and snow-melt pick up off the land and carry to surface waters, or that falls from the sky with the rain or snow — that now pose the greater challenge. Both must be controlled and prevented to reach the Clean Water Act goal of fishable, swimmable waters.

Numerous toxic pollutants also affect Minnesota's waters. Some pollutants, such as mercury, eventually find their way into the tissues of fish. Health officials have issued advisories to inform anglers how much fish of certain types and sizes can be safely eaten.

Let's look in more detail at the key issues facing our abundant, yet vulnerable, water resources.

Streams

The 1972 federal Clean Water Act began the process of eliminating pollution discharges and helped build wastewater treatment systems across the nation. This investment, along with regulatory programs, helped significantly reduce pollution from cities and industries discharging wastewater to Minnesota streams.

The best long-term data about Minnesota streams comes from measuring six key pollutants at 80 stream locations over the past four decades. On average, they show significant reductions in ammonia, biochemical oxygen demand, phosphorus, total suspended solids and fecal coliform bacteria (Figure 11). However, nitrogen has increased over the same period.

It's important to keep in mind that some streams that show overall improvement still do not meet standards designed to protect human health, aquatic life and wildlife. Further, it is not possible to measure conditions of all 92,000 miles of streams. 10

Well-operated wastewater treatment systems have generally been effective at keeping harmful pollutants out of our streams and lakes. But this equipment is aging and will need to be upgraded

or replaced. Some community systems are beginning to fail.

Federal grants, once provided for treatment plants, are no longer available. The state Legislature has tried to fill the gap, but there is still not enough funding to help the 150 smaller cities that cannot afford upgrades or new systems on their own. There are also some 500 unincorporated areas of homes across the state without collection and treatment. These areas rely on individual septic systems that often do not treat sewage adequately.

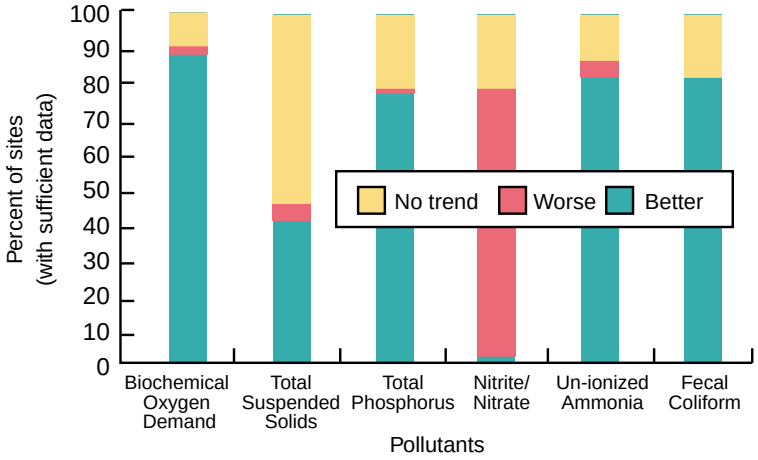
Ground water

Two-thirds of us draw our drinking water from the ground, and we are increasingly tapping ground-water aquifers for other uses. Irrigation, mainly from ground water, doubled between 1986 and 1996. Filling wetlands, drain-tiling fields and covering land with buildings and pavement hinders natural recharge (refilling) of aquifers. Droughts increase our ground water demand, straining available supply, particularly in western Minnesota where ground water is less plentiful.

Ground water is vulnerable to contamination from above — what goes on the ground can get into drinking water, including seepage from old waste dumps and overapplied chemicals. Ground water close to the land surface is particularly vulnerable, especially where soil conditions favor rapid infiltration.

Nitrate, a pollutant of concern for very young children, is found frequently in Minnesota's ground water (Figure 12). While some nitrate occurs naturally, higher-than-normal concentrations come from activities on or near the surface, such as use of fertilizers containing nitrogen and failing septic systems. The heavy fertilization and irrigation used for some crops, for instance, can put chemically enriched water directly into shallow aquifers.

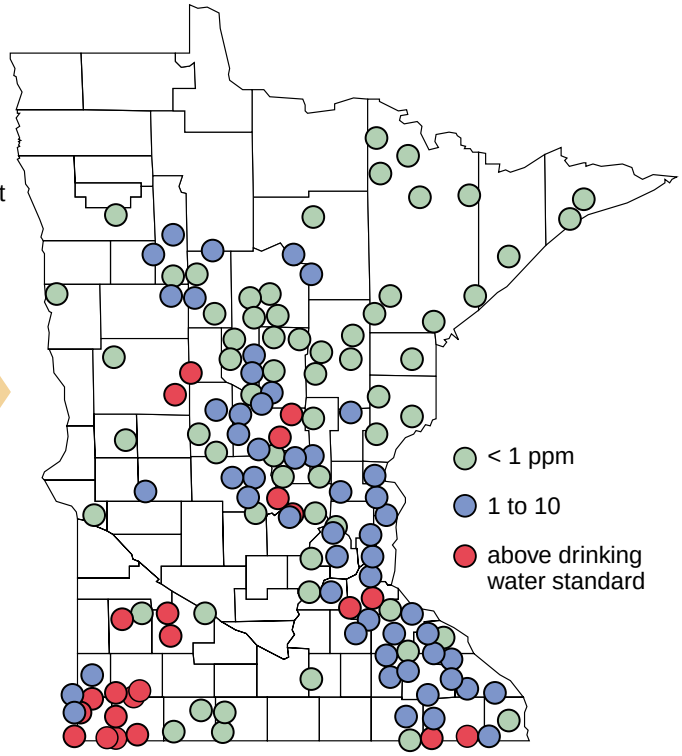
Figure 11 — Pollution trends at stream-monitoring sites



This chart shows trends for six pollutants monitored at 80 streams across the state. While the concentrations of four of the six chemicals have decreased over time at most of the sites, nitrogen — which is generally associated with nonpoint sources of pollution — has increased.

Data collected between 1992 and 1996 show that in aquifers that are sensitive to nitrate contamination, 60 percent of the monitoring wells had nitrate levels above one part per million (ppm). Of these, 18 percent contained nitrates above the state drinking-water standard of 10 parts per million.

Figure 12 — Nitrate levels in Minnesota ground water



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Metro Mississippi rebounds

Metropolitan Council Environmental Services

European immigrants to the Minnesota territory were drawn to the banks of the Mississippi. It provided power for fledgling industries and transportation for commerce.

Residents of the young cities of Minneapolis and St. Paul relied entirely upon the natural capacity of the Mississippi to treat whatever was thrown into its waters. Garbage and sewage disposal were personal matters, not municipal responsibilities. Citizens were encouraged to dump their refuse in the river rather than let it rot on the ground.

By the mid-1800s, the lack of adequate sewage disposal alarmed health officials, who realized the connection between the spread of infectious disease and primitive sanitation practices. A St. Paul health officer's comments in 1886 were typical of the time: "Out of the 50 cases of scarlet fever and diphtheria, 48 resulted where there was no sewer drainage, and only two where there was."

Sewers were installed to replace backyard privies and cesspools starting in the 1870s, but the collected sewage ran straight to the river. Spring floods scoured the encrusted sludge and debris from the river's banks and allowed people to ignore the signs of pollution as heavier and heavier loads of waste were dumped in the water.

In 1917, something happened that forced the public to look more closely at the river and wake up to the fact that it had become an open sewer. That event was the building of the lock and dam below what is now the Ford Bridge. The dam slowed the current and significantly diminished the force of the spring flood waters.

Three years later, an estimated 3 million cubic yards of sewage sludge had settled in the pool above the dam. The decaying matter released gases and lifted mats of sludge to the river's surface (see photo). The stench from the river was something residents could no longer ignore.

A 1928 report by the Minnesota and Wisconsin Boards of Health concluded that "a zone of heavy pollution extends from Minneapolis to the mouth of the St. Croix at Prescott. The river in this zone ... is unfit for use as a source of water supply, or for bathing, and is a potential danger from a health standpoint to persons and livestock coming in contact with the water ... fish life has been practically exterminated."

It was clear that some form of sewage treatment was essential. A commission was set up to plan a treatment facility. Six years later, in 1938, a wastewater treatment plant serving Minneapolis and St. Paul opened at Pig's Eye Lake, the first anywhere on the Mississippi.

Four months after the plant opened, the sludge and scum mats disappeared. The levels of dissolved oxygen — a critical water quality indicator — rapidly improved. But dissolved oxygen dropped to alarming levels again in the mid-1950s, caused by two major factors: more people and less water. The Twin Cities' population had rapidly increased, and there were low flows in the river. Primary treatment wasn't enough to keep the river clean.

The plant at Pig's Eye, now called the Metro Plant, added a secondary form of treatment in 1966 that used bacteria to remove more solids than possible with only screens and settling tanks. The river continued its recovery.

Further upgrades, such as ammonia removal, pretreatment of industrial wastes, and separation of storm and sanitary sewers, improved the river even more. Mayflies — insects that cannot tolerate much pollution — returned to the Mississippi's metro area stretch in 1987. Anglers now pursue trophy walleyes and other gamefish here.

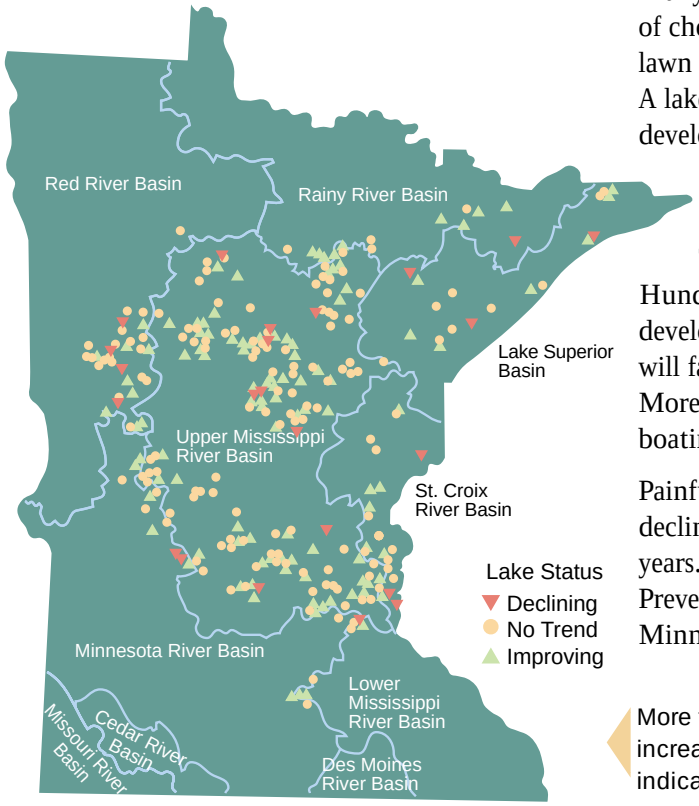
The story isn't over. The Metropolitan Council is adding phosphorus removal to the Metro Plant, which will be on line by 2005. These investments and others in the watershed will help the Mississippi's waters run cleaner in the coming decades.

Lakes

Lakes are Minnesota's most visible and valuable natural resource — the cornerstone of the recreation and tourism industry and a significant portion of many local economies.

Gauging the overall health of Minnesota's lakes is difficult chiefly because they are so numerous. Fortunately, an increasing number of citizens are getting personally involved by volunteering their time to monitor our lakes regularly. Their data show water quality improving or holding steady in more than 90 percent of monitored lakes (Figure 13).

Figure 13—Water-quality trends in Minnesota lakes



More than 90 percent of monitored lakes have increasing or steady water transparency, a useful indicator of overall water quality.

However, Minnesota lakes face an uncertain future. Shoreland and watershed development, expanding uses and users, the spread of exotic species and water pollution all threaten lakes. Too much phosphorus and nitrogen, which act as fertilizer to algae and weeds, are reaching our lakes, carried in soil erosion and runoff from roads, yards, farms and septic systems.

Many of the stresses that affect lakes are the result of choices that individuals make every day, such as lawn care, watercraft operation and waste disposal. A lake is also profoundly affected by decisions of developers, farmers and businesses in the lake's watershed, and in the way we build cabins and homes on the lakeshore.

The coming decade will be pivotal. Hundreds of crucial decisions about lakeshore development, nearby development and land use will face citizens, developers and government. More people will flock to the lakes to enjoy fishing, boating and swimming.

Painful experience has taught that once a lake declines, recovery is costly and can take many years. Full recovery may not be possible. Prevention is the key. What happens to Minnesota lakes and their watersheds in the next 10 years — how well we handle all the converging pressures — will essentially determine the quality of those lakes for the next 100 years. 12

A job for all of us

Clean water is a necessity — people and industries, fish and wildlife, crops and forests, city and country — all need clean water to thrive. Whether we live in urban or rural areas, clean water depends on the thoughtful, informed choices of every individual, when in the house, in the yard, at work, enjoying the outdoors or being involved in our government.

Minnesota Pollution Control Agency

Chaska High School students collect samples from East Chaska Creek.

Frogs: What are they telling us?

A group of middle-school students first noted an unusual number of malformed frogs in a wetland they studied near Henderson, Minnesota, in 1995. With help from citizen observers, the MPCA confirmed that frogs with extra legs, missing legs, malformed limbs and other abnormalities were popping up across the state. Other states began finding them, too. The MPCA began a multi-agency investigation that continues working to understand this complex problem.

Frogs quickly became one of the biggest environmental stories to come out of Minnesota. In 199798 newspapers and magazines around the world carried stories about the phenomenon, and requests for photos and interviews keep coming. Students, teachers and others have logged millions of visits to the frog pages on the MPCA worldwide web site. It seems that nearly everyone cares about frogs and what their plight may mean for other animals, including humans.

Minnesota Pollution Control Agency

Malformed frogs like the one shown here have been discovered throughout much of Minnesota.

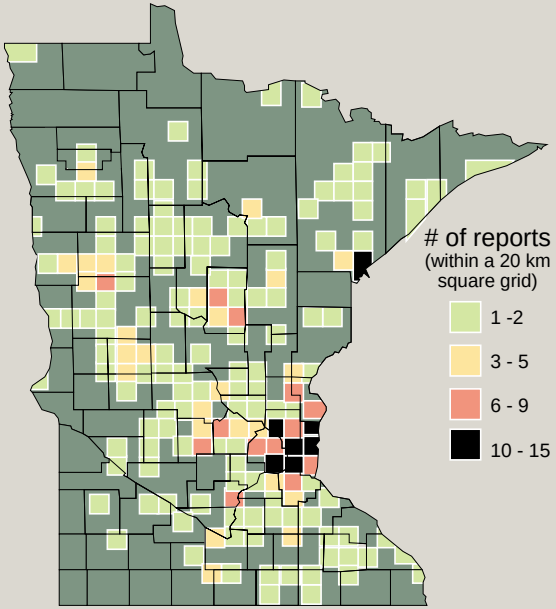
The MPCA continues to find malformed frogs at its study sites. Researchers around the country are studying frogs, too. Results to date indicate there may be multiple causes. Ultraviolet radiation, parasites and exposure to waterborne chemicals that disrupt the frogs' normal development all may play a role.

The National Institute of Environmental Health Sciences, one of the MPCA's principal research partners, found that water from ponds with abnormal frogs produces deformed frog larvae in the laboratory. The same study found that water from sites with no malformed frogs produces normal larvae — strong evidence that something in the water is a cause.

Parasites also may cause some of the abnormalities, though the MPCA and its research partners do not think parasites are the primary agent affecting Minnesota's frogs. Ultraviolet radiation also may deform frogs directly or by transforming chemicals in the frogs' environment.

Since the 1940s, the use of synthetic chemical compounds has permeated every aspect of human activities. Where these compounds and their breakdown products end up in the environment is nearly impossible to track. The scope of the problem is unknown, but certainly one important question driving the frogs investigation is whether there could be potential human effects as well. Will the frogs be the next *Silent Spring* story? Researchers are working hard to find out. 13

Citizen reports of malformed fogs

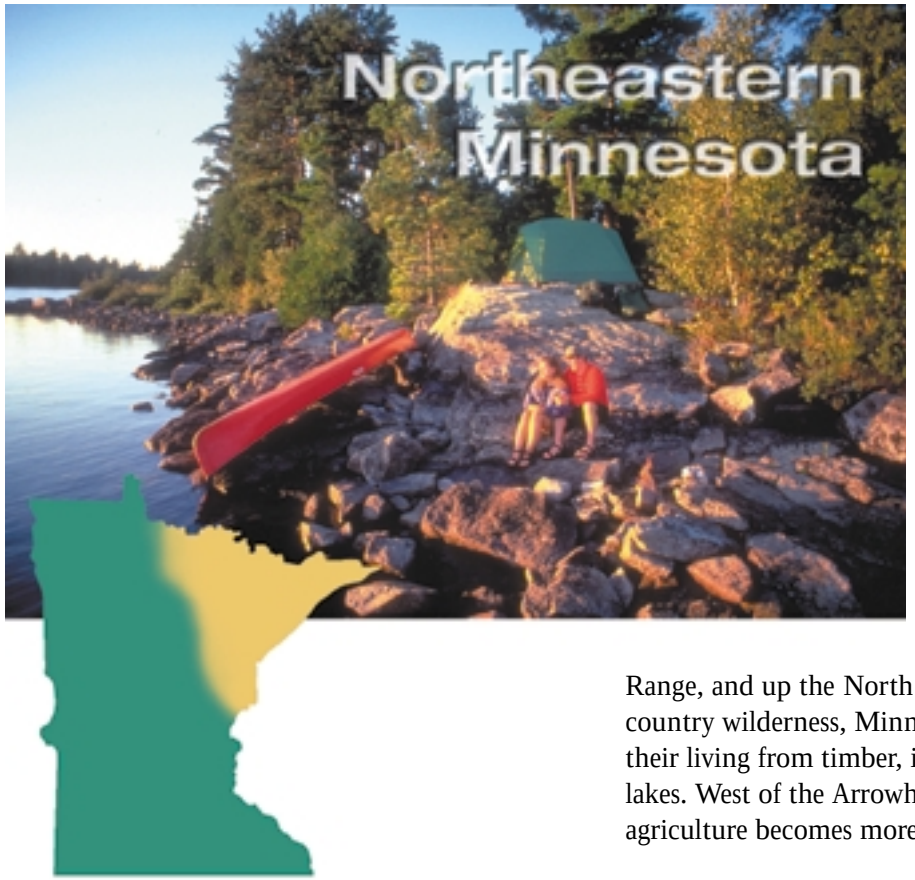


Since 1995, the MPCA has received 536 citizen reports of malformed frogs sighted in 69 Minnesota counties.

MINNESOTA'S REGIONAL ENVIRONMENTS

Minnesota is probably best known for its lakes, woods and winter. But a closer look reveals a state rich in diversity. Each part has its own history, natural resources and landscapes, social and economic bases and environmental challenges. Interdependent, they form a great state in which to live, work and enjoy the outdoors.

The following section offers an environmental tour of the different geographic regions.



Of Minnesota's scenic regions, perhaps none stirs the imagination like the northeast, including the famed Arrowhead region. Residents and visitors treasure the lakes, forests, tumbling rivers, vast tracts of wild lands and the rugged Lake Superior shore where they can fish, hunt, hike, paddle or just enjoy the scenery.

From International Falls to Grand Rapids, Duluth to the Iron Range, and up the North Shore to the canoe country wilderness, Minnesotans continue to make their living from timber, iron ore, and clean, clear lakes. West of the Arrowhead into Aitkin County agriculture becomes more prevalent.

Industrial legacy

The paper, wood products and mining industries changed the Minnesota landscape starting in the 1800s. These and other industries operated with little worry about their effects on air, water and land, which at the time had seemingly limitless capacity. But after public health and environmental concerns led to new laws in the 1960s and 70s, government, industries and citizens pitched in to protect the environment.

The Rainy River downstream from International Falls, the Mississippi River near Grand Rapids, and the St. Louis River between Cloquet and Duluth share a common legacy of severe pollution, cleanup, and ongoing recovery from manufacturing, paper mills and a number of other sources. Industrial air pollution in cities on the Range, in paper-mill towns, and in Duluth once was severe, but the air now meets national air-quality standards. Acid rain, once a major threat to northeastern Minnesota lakes, has been held at bay by reductions in acid-forming emissions here and in other states (see page 5).

But polluted sediments from old industrial and shipping sites still pose challenges in the Duluth-Superior harbor. While the St. Louis River flows much cleaner into the harbor thanks to vastly improved wastewater treatment, contaminants in the river such as mercury, PCBs and coal-tar wastes remain at more than a dozen sites.

With the river's former wetlands mostly filled and converted to boat slips, currents accelerate and resuspend these pollutants in the water. This exposes wildlife, fish, their food sources, and people who eat fish to toxic effects. Concerned citizens, industries, the city of Duluth, and state, federal and international agencies are conducting a comprehensive investigation and cleanup aimed at restoring the ecological health of this waterway.

Rainy Lake, Voyageurs National Park.

New challenges

Despite the many environmental successes of recent decades, this region faces continuing environmental challenges. Consumption advisories for some gamefish remain in effect due to mercury in numerous lakes. Some smaller communities lack adequate wastewater treatment. Hundreds of small businesses need technical assistance to prevent pollution and comply with environmental laws.

Minnesota's mining and ore processing industry, often volatile and influenced by national and world business cycles, has enjoyed a decade of strong demand for taconite despite fierce competition from foreign steel suppliers. The industry is poised to begin using new technology to make a higher grade of steel directly from taconite ore. State and federal agencies will carefully review these new facilities, which are located near Lake Superior and the Boundary Waters Canoe Area, to ensure they prevent air and water pollution.

Among the foremost challenges for the Arrowhead is rapid development on lakes, including the North Shore of Lake Superior, which is growing faster than anywhere else around the big lake. The region's spectacular scenery and recreational opportunities are drawing more developers hoping to serve increasing numbers of tourists and year-round residents.

The density of growth around lakeshores has been limited to some extent by the availability of wastewater treatment. Many homes and small businesses outside of cities rely on septic systems that require more space and soil for drainfields necessary to protect lakes and ground water. While the area's population keeps growing, the amount of undeveloped lakeshore is shrinking.

Back from the lakeshore, development in watersheds adds more roofs, roads and impervious surfaces, sending more contaminants into lakes. Centralized sewage systems, while helpful, are not a complete cure — they also allow houses, fertilized lawns and driveways to be built closer together, thus increasing polluted runoff.

No one wants to harm these Minnesota treasures, but our love for lakes and desire for homes near them threatens their water quality and the surrounding ecosystems. Unless development occurs thoughtfully and carefully, and property owners work to prevent harmful runoff, these lakes will not survive as the gems that attracted people here in the first place.

Outdoor recreation and tourism, dependent on healthy natural resources, are growing rapidly and will be even more prominent in the regional economy in the future as mining and timber-harvesting activities reach their expected growth limits. Careful balancing among multiple interests and land uses will be key to a sustainable environment, economy and quality of life in this region.

Photo by Reserve Mining Co., Minnesota Historical Society

View of the Reserve Mining taconite plant, Silver Bay, 1962. Note the delta of taconite tailings extending into Lake Superior.

Mining the Mesabi

Mesabi is an Ojibwe word for "giant buried in the earth." From a distance, the Mesabi Range resembles a giant asleep under a blanket. And for centuries, the range was a sleeping giant, but by the late 19th century it had awakened to become the largest iron-mining district in the world.

The Mesabi was discovered in 1890 by Leonidas Merritt and his six brothers. They had searched for iron ore for years, but made their discovery in a haphazard way — traces of the ore in a fresh wagon rut. What followed their discovery rivaled the gold rushes of the western states.

In a short time, the landscape was dramatically altered over the 100-mile-long range, first by pick and shovel, then by giant machines in open pits — drills, derricks and mammoth steam shovels.

As the mines grew, so did the towns of Hibbing, Eveleth, Chisholm and Virginia. Iron ore was also mined in the Vermilion Range, which runs through Ely, and the Cuyuna Range near Brainerd.

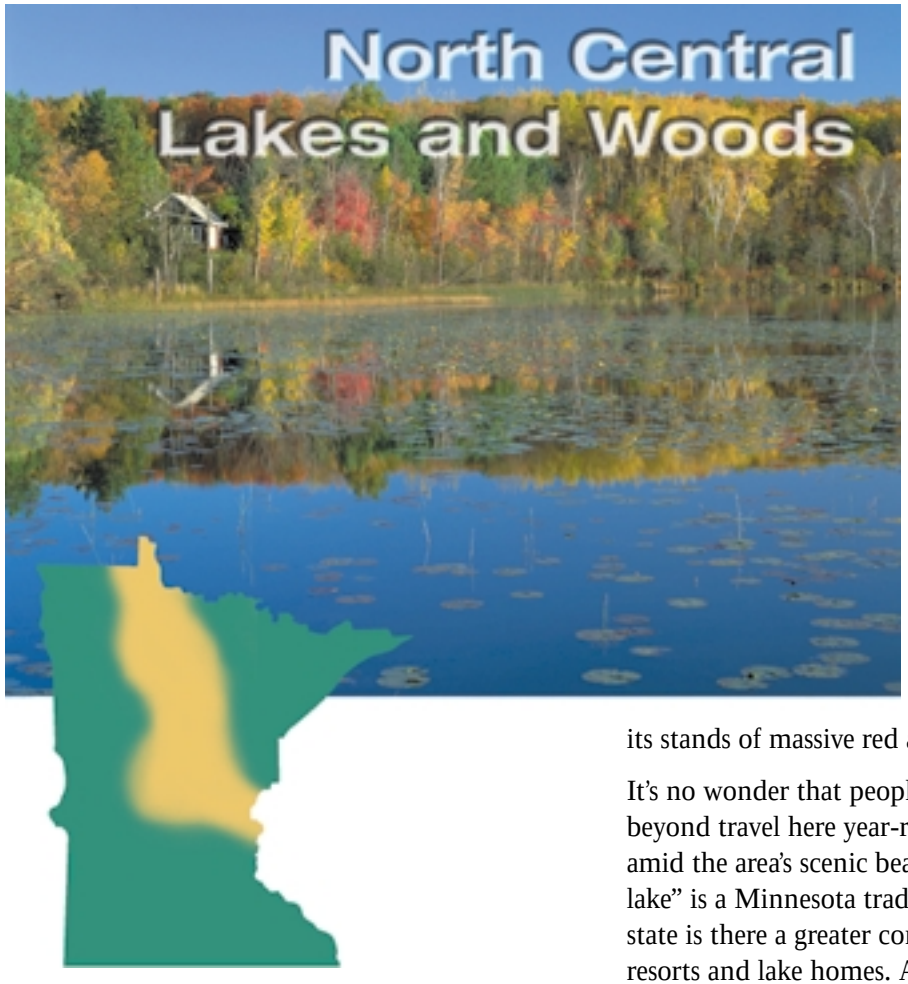
The amount of iron ore taken from the land is staggering. Between 1901 and 1910 alone, 200 million tons of ore were exported from Minnesota. The wars of the 20th century made even greater demands on iron deposits — more than 70 million tons in the single year of 1942.

The story of iron ore is a saga filled with colorful explorers, hard-muscled immigrants and robber barons. The environmental ramifications were also great, from the transformation of the landscape in Minnesota, to the steel mills of Duluth, to the enormous lock system at Sault Sainte Marie. A recent chapter in this epic was the Reserve Mining controversy of the 1970s.

In 1970, Reserve Mining was ordered to comply with MPCA water-quality standards. For over a decade, Reserve's processing plant at Silver Bay had been dumping taconite tailings into the bay — an estimated 67,000 tons per day. By 1973, the U.S. Environmental Protection Agency had discovered asbestiform fibers in Duluth's drinking water. The dispute between the company and the state was strident, but finally resolved in 1978 when the Minnesota Supreme Court ordered on-land disposal of taconite tailings.

After slumping in the 1980s, mining has been strong across the range. Plans for a new plant to process pig iron are on the drawing board. Again, the interests of the economy of the region interface with the welfare of the environment. The MPCA is currently researching the project to determine its environmental impact.

Mining communities "founded in high hope often end in deep despair." But some of the range communities have turned the old mines into parks — the Hill Annex Mine State Park at Calumet and the Soudan Underground Mine. These sites, along with the Ironworld Discovery Center and Minnesota Museum of Mining at Chisholm, have contributed to a vibrant tourist economy throughout the Iron Range.



© Bob Firth/Firth Photobank

Retreating glaciers formed a multitude of lakes in this heavily forested region, including some of the state's largest — Leech, Winnibigoshish, Cass, Bemidji and Mille Lacs. The Brainerd lakes area alone, centering on the communities of Brainerd, Baxter, Nisswa, Pequot Lakes, Crosslake and Pine River, includes more than 450 lakes. The headwaters of the Mississippi River begin at Itasca State Park, with its stands of massive red and white pine.

It's no wonder that people from Minnesota and beyond travel here year-round to recreate and relax amid the area's scenic beauty. "Going up to the lake" is a Minnesota tradition and nowhere in the state is there a greater concentration of cabins, resorts and lake homes. Although known for its lakes, north central Minnesota supports a mix of agriculture, manufacturing and tourism. It's part of a transition zone that separates the state's predominately agricultural areas from its northern forests.

Growth affects water quality

Growth has exploded in much of this region during the past decade as demand for lakefront property has increased. Regional centers such as Brainerd are also experiencing rapid year-round growth and urbanization. This growth and the development that accompanies it stretches along a corridor from St. Cloud to Bemidji, and is especially evident in several of the area's lake-rich counties, including Aitkin, Beltrami, Cass, Crow Wing and Itasca.

Another aspect of growth in this region is an annual explosion of seasonal residents and tourists. The Crow Wing County Highway Department estimates the number of people in the greater Brainerd area balloons from 50,000 year-round residents to nearly a quarter of a million during summer weekends.

As more and more people flock to this region, they create new environmental challenges and put added pressure on the lakes. The development of resorts, hotels, golf courses and cabins, and conversion of cabins to year-round use have caused significant changes in land use. Development brings more

© Minnesota Office of Tourism

pavement, leaving less plant cover to slow runoff carrying contaminants, sediment and nutrients into area lakes. Natural vegetation at the shoreline and in the water helps preserve water quality and ecological integrity in lakes; yet new lakeshore development too often removes natural cover.

More development also increases the need for handling sewage and wastewater. As the number of individual septic systems increases, so does the potential to contaminate surface and ground water. In some cases, cabins and homes are so densely concentrated that individual septic systems are no longer a viable option. Some communities opt to build central wastewater treatment systems, but that can spur more development. Agriculture, though not as dominant a land use as in other parts of the state, also contributes to water-quality problems through runoff from feedlots, pastures and cropland.

Sprawl an issue

The north central lakes area is not immune to the issues of sprawl. The Brainerd-Baxter region is one example (see photo). Large highway-development projects along state highways 371 and 169 are adding more paved surfaces to the region, and will make travel to the lakes region quicker and ultimately increase development pressure. The past five years have brought strip malls, supermarkets, large discount stores and one of the largest auto dealerships in the Midwest to this corridor. Increased traffic leads to concerns about noise, congestion and toxic air pollutants.

There are no simple solutions for addressing the environmental pressures this region is experiencing. Careful planning ... (and) innovative strategies will be needed ...

With these trends come complaints from residents, cabin owners and vacationers about the loss of the “up north” feel. Some members of the business community now are concerned about this as well. They feel that once the area loses its charm, everyone will suffer, including the businesses that now are thriving.

Careful planning needed to protect the lake country

There are no simple solutions for addressing the environmental pressures this region is experiencing. Careful planning will be needed, with cities, counties and the state working together to develop effective land-management policies and practices with a watershed and lake-protection view.

Innovative strategies will be needed for new investments in green space, conservation easements, wetland preservation, clustered development and buffer zones. Ultimately, the continued quality of these natural resources will depend on the stewardship of the people who live, work and vacation here.

Steve Kohls, Brainerd Dispatch

The Brainerd lakes area, long prized for its “up north” feel, is starting to look in some areas more like a Twin Cities suburb. This recent photo looks north from the intersection of state highways 210 (bottom) and 371, near Baxter.

Photo by Whitney, Minnesota Historical Society

Lumbermen from Elias Moses' logging camp driving logs on the Rum River, 1864.

Timber!

Logging Minnesota's pine forests

Daniel Stanchfield, a Maine lumberman, explored the Rum River in the 1840s. "Seventy mills in seventy years," he observed, "couldn't exhaust the white pine I have seen on Rum River."

The white pine can grow to 200 feet tall and measure five feet in diameter. As a building material, it is unsurpassed. Strong, yet easy to work, it supplied planks, beams, siding and even shingles. Moreover, logging the pine forest provided an immediate livelihood for thousands of Swedish and Finnish immigrants, who arrived in a wilderness with only their dreams.

Logs from the Rum River in Mille Lacs and Isanti counties flowed into the Mississippi, and downstream to the sawmills at St. Anthony Falls. Billions of board feet had been cut by the 1880s, yet in some of the north woods, virgin stands of pine remained due to lack of access to water transport.

In some areas — the headwaters region of the Mississippi, for example — rivers were shallow or lost in a succession of lakes. The problem of access was solved by construction of a series of dams on the Mississippi River.

Non-power dams were constructed on the Upper Mississippi at Winnibigoshish Lake, Leech Lake, Pokegama Falls, Pine River, Sandy Lake and Gull River. These dams reserved water for the "slack flow" season of late summer.

The dams also opened Itasca and Cass counties to the mills at Bemidji and Grand Rapids. Ecological ramifications of the dams included disruption of wildlife habitat and wild-rice fields.

Logging affected the environment in many ways. The clear-cutting of the great pine forests left vast tracts of land open to soil erosion. Runoff into nearby lakes and streams clouded the water and affected the plants and animals living there. Average stream temperatures likely rose as trees shading the banks were removed. Water-level fluctuations caused by dam operation increased shoreline and stream bank erosion.

While the construction of non-power dams provided greater access to Minnesota forests, large tracts of trees remained untouched due to lack of nearby water transport. Even after decades of intensive logging, there were still great forests in northern Minnesota. For example, according to historian Frank King, "the area surrounding Leech Lake ... contained immense stands of timber. Due to its inaccessibility to streams large enough to float logs, this region was practically untouched."

But the advent of the logging railroad provided Minnesota lumberjacks access to these remote woods. By the early 1900s, the seemingly endless supply of pine was almost completely cut over — the natural resource that literally built the cities of the Midwest had been exhausted.

The Red River of the North defines the northwestern corner of Minnesota. Its basin contains both an immense flat plain left thousands of years ago by glacial Lake Agassiz, and the adjacent glacial hills, or moraines, where many of the major tributaries on the Minnesota side of the Red River originate. The river flows northward to Hudson Bay from its headwaters, where the Bois de Sioux and Otter Tail rivers join near Breckenridge.

Much of the ancient lake bed of the Red River basin once was covered with vast bog wetlands, prairie potholes and tall prairie grasses. This geologic heritage has made the Red River basin one of the most fertile regions in the world. The northern lake plain and surrounding hills also grew mixed stands of hardwood and coniferous forest.

Settlers extensively cleared and drained the basin to make the land more suitable for farming. Many residents now make their living growing wheat, sugar beets, barley, sunflowers, potatoes, corn and soybeans. Farm-products processing also is important in this region. The cities of Moorhead, Minnesota, and Fargo, North Dakota, form an important regional center.

Sedimentation

The change in the basin's land use from prairie, wetland and forest to cultivated croplands and pasture significantly increased the runoff from spring snowmelt and summer rains. This increased runoff, coupled with extensive agricultural drainage, has placed tremendous stress on the Red River and its tributaries.

As with other river systems throughout the Midwest, rivers in the Red basin have responded to these changes by cutting deeper channels. Streams first cut downward, then sideways, producing widespread streambed and bank erosion. The removal of trees on the landscape, especially near streams, and increased cultivation of marginal land have also increased wind erosion, providing another route for sediment to reach the river system.

One result is that suspended sediment in Red basin streams has more than doubled in the past 15 years. In an effort to reverse this trend, many streambank stabilization and other erosion control projects are underway.

More sediment has brought harm to the natural habitat for fish, plants and animals that make their homes in the Red basin's streams. Water once slowed by bends, pools and downed trees moves faster when the stream is cleared and straightened. Some of the sediment carried by fast-flowing water is deposited downstream. Many fish species are unable to use the sediment-laden stream bottoms for reproduction, feeding or cover. These pollution-sensitive fish are often replaced by a few fish species that are more tolerant of polluted water

such as the common carp. The net result is a decrease in the biological diversity of the Red and its tributaries.

Flooding

Changes to the landscape also can aggravate flooding. Runoff is carried more quickly from tributary streams to the river's main channel. After many disastrous floods, a partnership of local, state, federal and environmental groups began working on a new initiative to reduce flood damage and better manage the region's natural resources.

This initiative began as a mediated agreement involving a wide range of interests and has evolved into a work group representing local landowners and local, state and federal water-resource managers. The agreement developed in December 1998 has set the framework for new approaches to resolving water management issues in the Red River basin.

Regional growth

Like most urban centers in Minnesota, the Moorhead/Fargo area is experiencing growing pains as jobs and development spur expansion. Growth brings with it associated issues of wastewater treatment, storm-water management, and flood protection to an already stressed Red River. Further collaboration and partnerships will be needed to improve the river while the region grows.

Wetlands of the Red River Valley

Minnesota Historical Society

Installing drain tile in the Red River Valley, 1918.

In 1862, the U.S. Congress passed the Homestead Act. The act gave applicants 160 acres of land under the condition they live on the land for five years and make improvements. Improvements were defined as land "cleared and used for grazing, grass, tillage, which is now fallow."

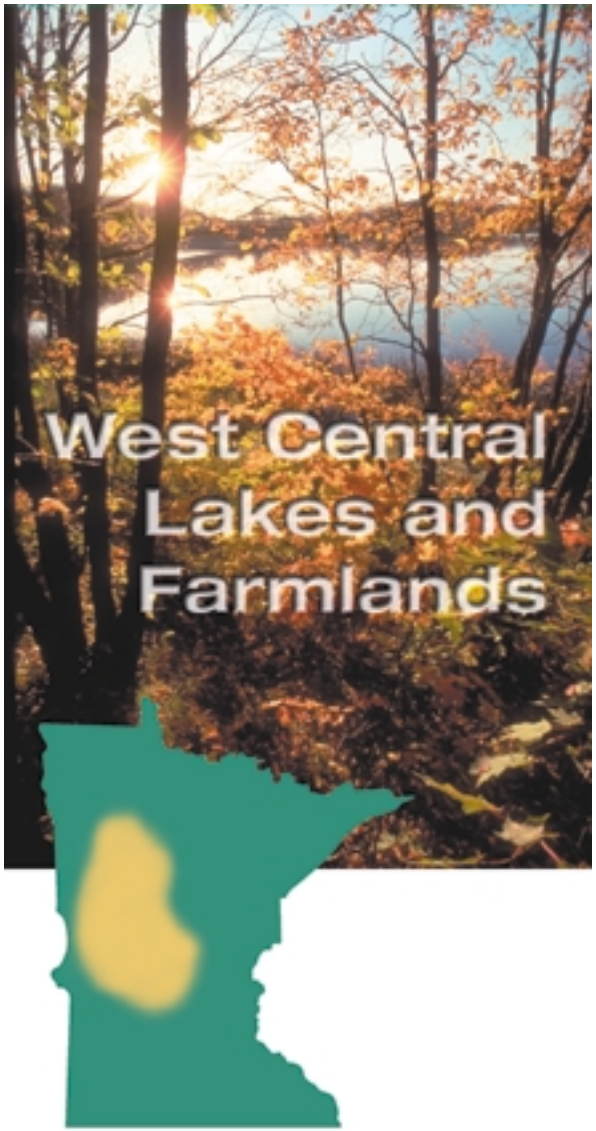
Ditching and draining the land qualified as an "improvement." Thousands of Scandinavian immigrants, eager for the opportunity to own land, settled in the Red River Valley. But spring rains had no place to run off the flat land, nor could they be easily absorbed in the wet "gumbo soil." And so, the pioneers altered this vast ecological system of prairies and wetlands. Habitat for waterfowl was lost as farmland was drained. The flowers and grasses of the native prairie, with their absorbent root systems, disappeared under the furrows of the plow.

State laws also encouraged the draining of wetlands. In 1883, county commissioners were authorized to drain "shallow, grassy, meandered lakes under four feet in depth." This encouragement lasted until the great drought of the 1930s.

Over time, conservation concerns reversed the official attitude toward wetlands. In 1951 the "Save the Wetlands" program was inaugurated. This program used federal funds to acquire wetlands for wildlife. A decade later, it became state policy to conserve wetlands. By the 1990s, there were both state and national programs in place with a goal to restore "prior-converted wetlands and adjacent upland."

One example of these restoration efforts is the Hamden Slough National Wildlife Refuge near Audubon, Minnesota, which was established in 1989. Here work is being done to meet a goal of restoring or enhancing 3,000 acres of wetlands and 2,250 acres of upland grasslands. The restored prairie wetland ecosystem will support many kinds of migratory and nesting birds, including waterfowl, songbirds and raptors.

The restoration of 200 wetlands and 800 upland acres completed to date is already paying off in increased numbers and diversity of waterfowl and songbirds, and the return of native plants. Since 1993, area bird watchers describe the results as "explosive," with two new bird species observed, and four new species found nesting for the first time in Becker County.



Scandinavian and German immigrants settled west central Minnesota in the late 1800s, as the railroads made their way across the state. Many of the area's cities — Alexandria, Perham, Sauk Centre and Detroit Lakes — grew rapidly once trains provided quick and reliable transportation. The railroad also allowed tourists from the east and as far south as Texas and Oklahoma to spend their summers in this area, known as the "Park Region."

Hundreds of lakes are sprinkled alongside farmlands and pastures in this region, which includes the rolling hills of the Otter Tail lakes country, the Alexandria lakes area and a number of recreational lakes near Willmar. Swimming, fishing and boating are popular during the summer months. Farming, food-processing industries and tourism are economic mainstays.

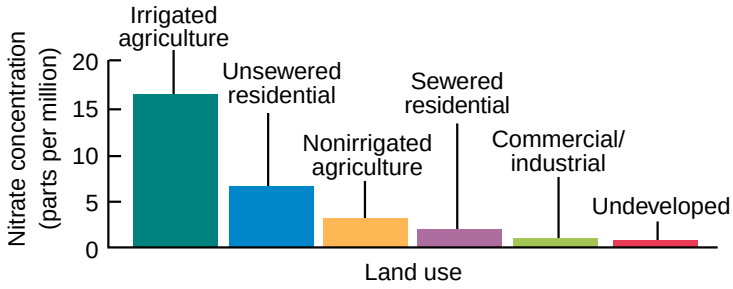
Ground water impacts

The shallow sand aquifers found in parts of this region are particularly vulnerable to ground-water contamination. Land uses such as irrigated agriculture, septic systems, lakeshore development and development away from centralized wastewater treatment all are potential sources of pollutants.

Elevated levels of nitrates in ground water, particularly from irrigated agriculture, are becoming a growing concern in some areas. Drinking water with high nitrates is unsafe for infants and certain vulnerable adult populations. Irrigation, especially on coarse-textured sandy soils, increases the likelihood that applied nitrogen fertilizer will enter ground or surface waters before it's absorbed by crops (Figure 14).

The types of crops in an area also can affect the amount of nitrate in water supplies. Recent years have seen substantial increases in the amount of irrigated potato farming and processing in this part of the state. Potato farming uses more nitrogen fertilizer than many other types of farming, as noted in a U.S. Geological Survey study on croplands near the Straight River, a trout stream. Potato growers are beginning to rein in their nitrogen use in response to concern for ground water quality.

Figure 14 — Land-use impacts on ground-water nitrate levels



In a study conducted in the St. Cloud area, nitrate levels were highest in the ground water below irrigated agriculture, as compared with other land uses. The ground water samples were taken from monitoring wells installed at the surface of the water table.

Declining lakes

Declining water quality of the lakes in this region is a concern, according to a majority of citizens attending a 1999 environmental forum in Detroit Lakes. More than 80 percent of those at the forum said area lakes were declining and adversely affecting the local economy. Reasons for the decline include pollution from feedlots and agricultural fields, stormwater runoff, and increasing development near lakes.

Overcrowding is troublesome for lake communities in Otter Tail and Douglas counties, where secondary development now is occurring away from lakeshores. This creates new challenges in managing increased wastewater and runoff from developed areas. Some communities are installing sewers around lakes, while others are relying on cluster septic systems, which treat waste from several homes in centralized locations.

Further partnership will be needed to ensure that the lakes of the "Park Region" maintain the quality that continues to draw so many tourists and new residents to this area.

Becker County Historical Society and Museum

Workers from the Fargo-Detroit Ice Company remove giant blocks of ice from Detroit Lake.

A chilly harvest

In the warm summer days in west central Minnesota, local resorts beckon — offering vacationers the opportunity to fish, boat, swim or relax at one of the area's many lakes. So it has been since the late 1800s, when this region first became a favorite vacation destination. Each year scores of wealthy tourists traveled to various lakeside resorts to spend a summer of relaxation and leisure.

Tourism wasn't the only early industry dependent upon the clean lakes in this region, however. Some early businesses relied on a winter product of the lakes — abundant ice.

The first major industry in the town of Detroit Lakes was the Fargo-Detroit Ice Company. The ice company, formed in the late 1880s, supplied block ice to the community of Detroit Lakes and the railroads that came through town.

While ice harvesting was a common winter activity on many lakes in the region, few if any surpassed Detroit Lake in the total amount of ice removed. Each winter, employees of the Fargo-Detroit Ice Company braved cold winds and frigid temperatures to harvest as much as 200,000 tons of ice from Detroit Lake. Huge blocks of ice were cut by hand from the frozen lake, then hauled to town or the waiting railroad cars in horse-drawn sleighs. Each ice block — called a "cake" — measured nearly two feet wide by three feet long and weighed more than 400 pounds.

Some of the ice was stored by the company and used to meet the community's refrigeration needs. The majority was supplied to the Northern Pacific and other railroads to keep perishable cargo cool on its journey to the Dakotas, Wisconsin, Illinois, Texas, Washington and Florida, among other states.

The Fargo-Detroit Ice Company ceased operation in 1970. By then railroad boxcars were equipped with electric refrigeration, and the huge blocks of lake ice were no longer needed to keep the cargo cool.

Minnesota Dpartment of Natural Resources

The wide-open prairies of the Great Plains once characterized much of southern Minnesota. From the steep ridges of the Coteau des Prairies near Pipestone one can still get a glimpse of the grasslands that once covered much of the landscape. With settlement, much of the prairie was plowed under to grow crops on the fertile soils.

The Minnesota River is a dominant feature of this rich agricultural region, winding 360 miles from its headwaters in Big Stone Lake to its confluence with the Mississippi River at Fort Snelling. Many southern Minnesota cities grew up along the river, including St. Peter, Mankato, New Ulm, Redwood Falls, Granite Falls and Montevideo. Marshall also is an important regional center.

A number of large, shallow prairie lakes are popular recreation spots in the region, including Big Stone, Shaokatan, Washington and Jefferson. The marshes, sloughs and prairie grasslands from Lac qui Parle to Heron Lake draw scores of hunters each fall. Many residents make their living from agriculture, which accounts for more than 90 percent of the land use here. Corn and soybeans are the most widely grown crops, with hog, beef, turkey and poultry farming also important.

Minnesota River

The Minnesota River, scene of rich history but largely ignored until recently, has received a great deal of attention in the last decade. One of the state's most polluted waters, the river's condition reflects how land is managed within its watershed. High levels of sediment, nutrients and bacteria pollute the river.

Citizens have worked alongside government in recent years to improve this picture. Groups such as the Coalition for a Clean Minnesota River and Clean Up Our River Environment have raised awareness and organized grass-roots efforts to address the river's problems.

While much work remains, small successes are starting to add up for the Minnesota. The amount of sediment measured during average flow from 1986 through 1995 dropped 25 percent compared to a similar period in the 1970s.

One example is the increasing use of permanent conservation easements along the river. These are legal agreements under which landowners keep their property in a particular type of land use. Farmers who accept easements are paid to remove flood-prone marginal cropland from production and restore it with grasses, shrubs and trees. By slowing and filtering runoff, such easements help clean up the Minnesota River.

More than 15,000 acres have been enrolled in easements through the Conservation Reserve Enhancement Program, a partnership between farmers and the state and federal governments. Organizers hope to enroll 100,000 acres by 2002. This would substantially reduce sediment and

phosphorus polluting the Minnesota and Mississippi rivers, while providing new wildlife habitat in an intensively farmed region.

Drainage

Drainage is a high-profile environmental concern in this region. As in the Red River basin, farmers in this area have ditched and tiled extensively to improve their yields. Ditching began in the late 1800s and was encouraged by government policies in the mid-1900s. Since that time, many farmers have installed drainage systems, which help dry cropland in the spring and prevent water from pooling on the fields during the growing season.

But drainage has vastly reduced the number of prairie pothole wetlands that once dotted the landscape. It also greatly increases the volume of water that flows off the land and the speed with which it comes first into ditches and then to rivers, contributing to increases in flooding. This runoff carries with it bacteria and nutrients from agriculture and septic systems. Ultimately, the pollutants entering the Minnesota contribute to the "dead zone" in the Gulf of Mexico (see page 5).

Feedlots

Another important issue in southern Minnesota is the environmental impact of feedlots. Since the early 1990s, livestock and poultry operations in Minnesota have grown larger with greater concentrations of livestock. This change in feedlot size has led to increased concerns about inadequate manure storage capacity for winter months, over-application of manure on cropland, and odors from large facilities.

Minnesota Department of Natural Resources

Citizen activists and volunteers are a critical part of cleaning up the Minnesota River. Here volunteers remove 2 million pounds of automotive and industrial scrap from the river bottoms of Belle Plaine in 1999.

Livestock and poultry manure could supply about one-quarter of the nutrients needed for all Minnesota's crops. Livestock farmers often apply commercial fertilizer to cropland that has already received enough nutrients from manure. Combined, manure and commercial fertilizer can exceed cropland needs, and the excess can leach to ground water or run off to nearby lakes and streams.

Odors from some large feedlots have triggered contentious debates in southern Minnesota. Gas and odor emissions, particularly hydrogen sulfide, from large manure-storage facilities can pose a nuisance and a potential health problem for nearby residents.

Runoff from older, smaller feedlots also contributes to water pollution. Often these smaller feedlots were built many years ago before their environmental impacts were well known.

State and local government, producer groups, farmers and concerned citizens continue to wrestle with the many changes and challenges facing animal agriculture. These interests are helping to guide a comprehensive study of the environmental, economic and social aspects of animal agriculture now underway at the Minnesota Environmental Quality Board.

Nitrate

Nitrate contamination of ground-water supplies is a concern in the far southwestern corner of the state, where the geology of the area makes it difficult to find plentiful ground water. Nitrate concentrations above 10 milligrams per liter can make drinking water unsafe, particularly for infants. The majority of nitrates in ground water are due to agricultural practices, but other sources such as homes and communities with poorly constructed wells or inadequate septic systems can be significant.

Minnesota's farm belt is undergoing many changes and challenges that will require close collaboration and partnership among interests that often seem far apart. Many forces influence the farm economy from afar. There is reason for optimism, however, as exemplified by area residents pulling together to clean up the Minnesota River.

Minnesota Department of Commerce

Hundreds of state-of-the-art wind turbines rise over the landscape of Buffalo Ridge in southwestern Minnesota.

Harvesting energy from the wind

Before the Rural Electric Administration brought electricity to the farms of Mille Lacs County, darkness came early to the winter landscape. By late afternoon, the country was cold and desolate — the long night brightened only by the flicker of candles or a kerosene lamp.

But the home of one farmer was an oasis of light in the night. Electric lights! The machines in this farmer's workshop, the appliances in his kitchen, and the radio tuned to big-band music were all powered by electricity. The power for this electricity was generated by that same cold wind that whipped the snow outside Martin Jopp's home.

For nearly 50 years, until his death in 1980, Jopp provided power to his farm with five wind generators. He carved his first propeller out of wood, smelted his own metal for parts, and built his own machines. Each of his generators produced 3,000 volts. The electricity was stored in rows of batteries inside his shop.

Jopp's work on wind generators went largely unnoticed for decades. Then in the 1970s, Jopp was discovered by young environmentalists interested in alternate forms of energy. After spending a lifetime in obscurity, the inventor lived to see Governor Rudy Perpich declare August 27, 1977, "Martin Jopp Day" throughout the state of Minnesota.

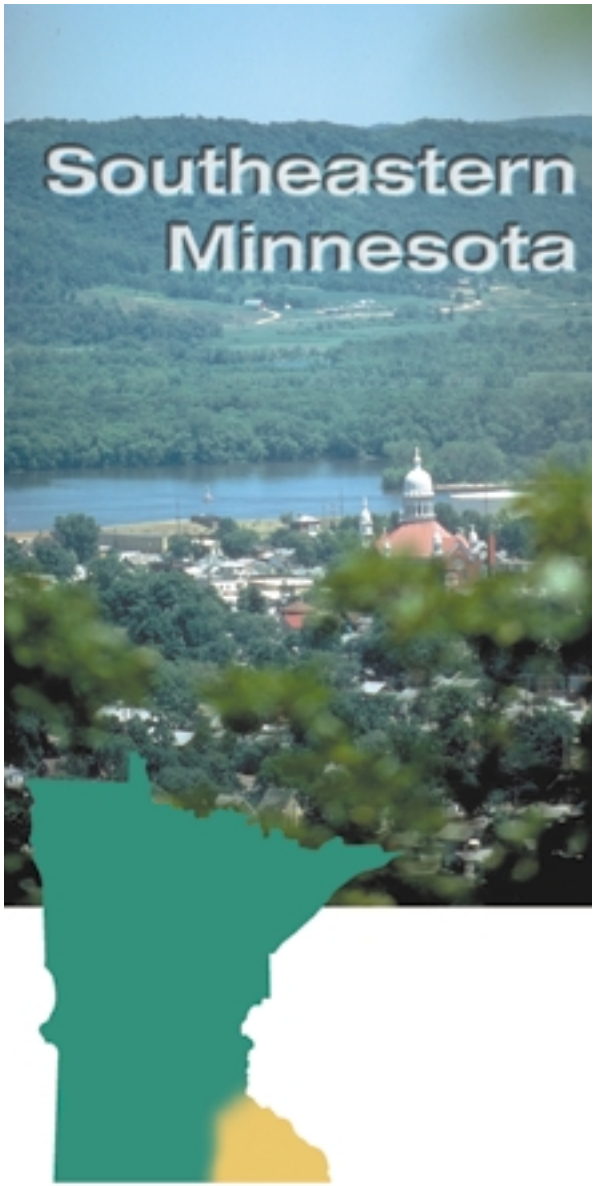
Since the early days of harvesting the wind to power individual farms, wind power has come a long way in the state. Particularly exciting are the new wind farms being installed in southwestern Minnesota.

In 1992, five Wind World generators were installed on a five-acre farm in Marshall. The wind farm was originally built as a demonstration project for the city, and was later acquired by Northern Alternative Energy.

Northern Alternative Energy has developed two sites along Buffalo Ridge in Lincoln County. Buffalo Ridge is a strip of land 75 miles long and 20 miles wide that runs diagonally from North Dakota into southwestern Minnesota. It rises 200 feet higher than the surrounding land, and is an excellent location for wind energy projects.

The first project, at Lakota Ridge, with 15 turbines, is expected to produce 30 million kilowatt-hours annually. The second site, Shaokatan Hills Wind Farm, will produce slightly more energy with 18 turbines.

In addition to the above examples, several large wind farms near Lake Benton, Minnesota supply electricity to Northern States Power. All told, more than 300 wind towers dot the landscape of southwestern Minnesota today.



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The glaciers that sculpted much of Minnesota left one large section alone — the bluffs, sinkholes and Big Woods of southeastern Minnesota's "Driftless" area. Here the forces of nature shaped the landscape into a scenic beauty very different from the typical image of Minnesota lakes and evergreens.

Limestone bedrock underlies much of the area, with spring-fed streams threading through bluffs, rolling hills, and remnants of the hardwood forests that once reached west and north from the Mississippi River coulees for many miles. The fractured bedrock and free-flowing ground water (geology called "karst") have given this corner of Minnesota some unique features below ground — spectacular caves, underground streams, thousands of sinkholes and plentiful but vulnerable ground water. West of this region, glacial soils mark the change from karst to the cornbelt plains.

European immigrants in the 1800s cleared most of the big woods for farms and cities, and through succeeding generations agriculture has remained at the heart of the region's economy. Manufacturing, health care, computers and recreation have broadened the economic base in such cities as Red Wing, Rochester, Winona, Owatonna, Faribault, Austin and Northfield.

Sensitive water resources

As the region grew through the 20th century, environmental problems emerged here as elsewhere. Municipal wastewater, industrial and agricultural chemicals, and runoff from cities and farms began to contaminate the rivers and ground water, which in karst often are directly connected. Drinking water was fouled by leaking landfills, hazardous waste, industrial activity, feedlots and faulty septic systems.

Preventing degradation of streams and ground water will require creative leadership and partnership.

The Mississippi from St. Paul to Lake Pepin suffered terribly from pollutants coming from the Twin Cities and the Minnesota River. Algae blooms and severe bacterial contamination were frequent. Southeastern Minnesota's trout streams became polluted as intensified cropping accelerated runoff of sediment and nutrients, altering the habitat and water quality that trout need to survive.

The 1970s and 80s demonstrated to all Minnesotans that what we do on the land has a profound effect on water, both above and below ground. The vulnerability of southeastern Minnesota's water resources prompted improvements in wastewater treatment, management of solid and hazardous waste, and ground-water protection.

Separation of the Twin Cities' storm and sanitary sewers and improved wastewater treatment throughout the Mississippi watershed have significantly improved the river's water quality and spurred a boom in recreational boating and fishing. Cleanup efforts in the Minnesota River basin will bring further improvements. In the late 1980s, county officials and resource managers teamed up in a local water-planning effort to better integrate soil and water conservation, zoning decisions and water-quality projects in the watersheds of the Root, Zumbro, Cannon and other rivers.

Land and water — a changing view

No longer do landowners view the riverbanks and sinkholes of this region as convenient places to dump garbage and other wastes. Today, these direct conduits to ground water are handled more carefully. Cleaner rivers and recreational trails connect communities such as Lanesboro, Rushford, Cannon Falls and Red Wing, and attract thousands of bikers, anglers and other tourists. Substandard septic systems in these sensitive areas are being upgraded, with lending institutions recognizing the risks of faulty systems and the value of up-to-date systems. A growing number of farmers in this region are adopting "river friendly" practices geared at keeping soil and nutrients on the land and out of the water.

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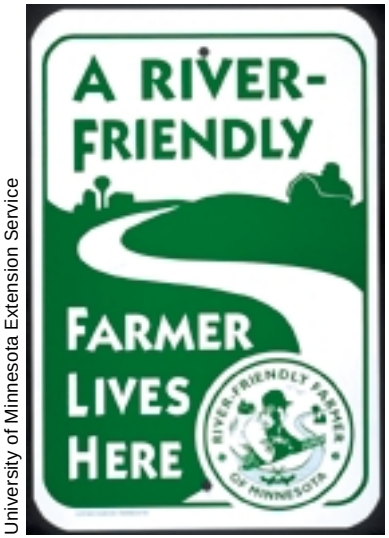
Bicyclists enjoy the Root River Trail.



University of Minnesota Extension Service

A growing number of farmers in southeastern Minnesota are recognized by the River-Friendly Farmer Program for adopting practices that help protect Minnesota's streams.

Many challenges remain for southeastern Minnesota's environment. For example, coliform bacteria levels in some rivers made them unswimmable for certain periods in the summer of 1999, signs that livestock and human wastes still find their way into the water. Notable fish kills have occurred in some of the region's streams in the past few years, due primarily to accidental or illegal discharges. A disastrous die-off of trout in Hay Creek in 1997 is still unexplained. Local officials suspect illegal dumping of chemicals.

Growth in communities such as Northfield and Cannon Falls exemplifies the continuing encroachment on farmland by developers building country homes for commuters willing to drive long distances to city jobs. Rochester, long considered part of an urban growth corridor stretching northwest to St. Cloud, continues to expand. Limestone is being mined at a faster pace for road construction throughout the region, and homes are popping up on new "lakeshore" next to quarries filling with ground water, another resource vulnerable to polluted runoff.

Pressure to convert smaller livestock farms to home sites or more intensive crop production will continue. Preventing degradation of streams and ground water will require creative leadership and partnership. More aware of the fragility of their land and water supply, southeast Minnesotans are helping to lead the rest of Minnesota in the search for a sustainable future.

Pearls of the **Mississippi**

The Mississippi River is the state's eastern border for the counties of Wabasha, Winona and Houston. The sandstone and limestone bluffs along the river provide spectacular vistas. Eagles, buzzards and hawks circle in the blue sky. Below flows the river with its sandbars, eddies and islands.

Beneath the waters, in the sloughs, amongst the silt and sunken logs, are the rich mussel beds that have attracted shell and pearl hunters for more than a century.

Mussels, often called clams, were sought first for their pearls. Before commercial pearl cultivation, pearls found in the Upper Mississippi were worth a year's income for many clam harvesters. The most valuable pearl was found at the Minnesota-Iowa border, a tremendous gem worth $65,000 in 1902!

In the late 19th century, a tariff on mother-of-pearl shell created a secondary market for freshwater mussels. Mussel shells were used in button manufacturing, a significant industry in river towns until the advent of plastic. Even today, the mussels in the Upper Mississippi are of some value, for the shell contains unique properties advantageous to commercial pearl growers.

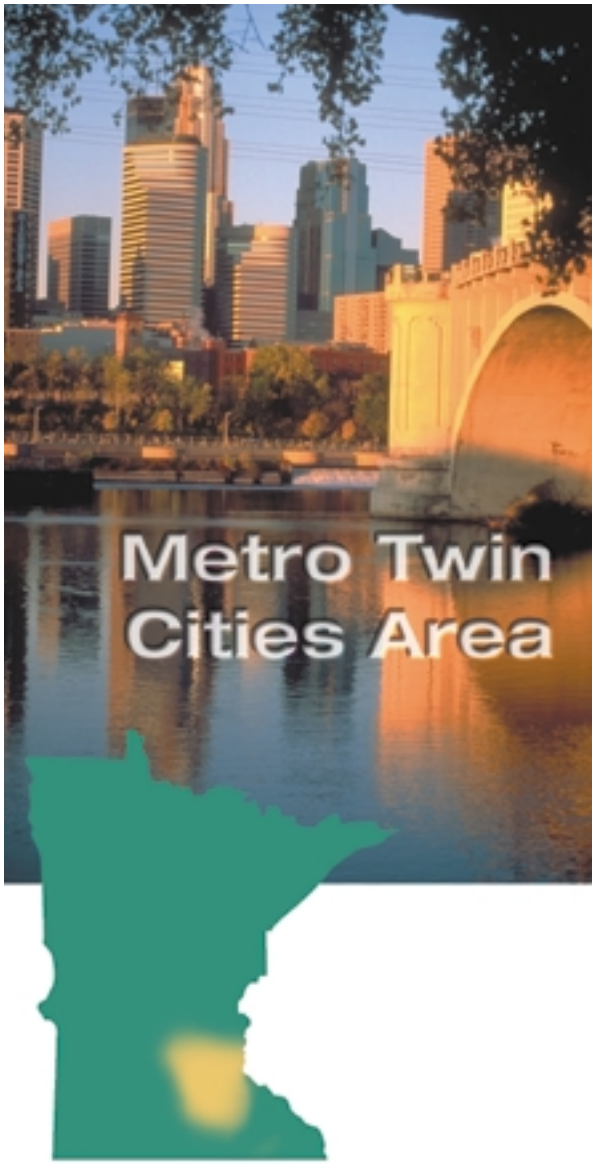
Mussels have undergone many environmental challenges to their survival. Initially, mussels were almost harvested to extinction in Upper Mississippi waters. In the early 1900s, millions of tons of clams were taken from the river bottoms. Lake Pepin produced 8 million tons of shell in 1914 — less than 10 years later, the lake produced only a fraction of this amount.

The advent of wing dams, which reach out from shore part way into the river, has not been kind to mussels. These dams buried some mussel beds in silt and scoured other beds out of existence. The process of dredging for channel maintenance has also been disruptive to beds. Organic and industrial pollution also have harmed mussels, which can only survive in relatively clean water.

Some changes over the past 20 years have been good for mussels, however, including pollution reductions and greater awareness of the need to protect existing mussel beds. Still, due to years of ill treatment species such as the rock pocketbook, elephant-ear, and wartyback mollusk are on the state endangered species list, and more than a dozen other mussels remain threatened species in Minnesota.

Minnesota Historical Society photos

Clam harvesting on the Mississippi River near Red Wing,1904.



© Minnesota Office of Tourism

From its colorful 19th century origins, the Twin Cities metropolitan area has grown to include seven counties and nearly 200 municipalities, home to more than half the state's residents.

The first European explorers and settlers used the Mississippi and Minnesota rivers as highways for travel and commerce, as had the Dakota people for centuries before them. Fort Snelling was built in 1821 on the bluffs overlooking the strategic junction of the two rivers.

Downstream from the fort, the city of St. Paul grew from Pierre "Pig's Eye" Parrant's riverside cave saloon into a thriving capital of commerce and transportation. Upriver, the falls of St. Anthony were harnessed to power the area's first sawmill and grain mill in the 1820s, marking the beginnings of Minneapolis as the center of grain and lumber milling in the United States.

From these riverbanks emerged two major cities and expanding rings of suburbs, home to hundreds of lakes and a visionary parks system. But population and industrial growth brought such urban pollution problems as inadequate sewage treatment, poor air quality, oil spills into waterways, mounting piles of garbage and industrial chemical waste. Rivers, historically a convenient dumping place, became severely polluted (see page 16). Finally, in the 1960s, Minnesota and the nation woke up to the unfolding environmental crisis. A profound change had begun.

Mississippi River cleanup

Federal and state laws compelled cleanup of wastewater discharges and established liability for spills into public waters. Millions of federal and state dollars helped pay for improved wastewater treatment facilities serving the Twin Cities area. The Legislature authorized funds for complete separation of combined storm and sanitary sewers, which overflowed raw sewage into the Mississippi during wet periods. With 10 years of construction completed in 1996, the Twin Cities became the first metropolitan area on the entire river, and indeed among the few in the nation, to finish this task.

Boaters and anglers in the Twin Cities and downstream now enjoy a much cleaner river, though much work remains. St. Paul, Minneapolis and other communities along the Mississippi are turning again to the river as a valuable asset to be protected, its waters and banks cleaned up and redeveloped to make the river a featured attraction in the urban environment. Government, citizens and businesses are working together to curtail polluted runoff throughout the metro area and to clean up old industrial "brownfields" sites for redevelopment.

Cleanup on land

On and under the land, dumps, spills and leaks of various wastes and petroleum products during the past century left the Twin Cities with areas of soil and ground-water contamination. Fortunately, an aggressive effort to find and clean up these sites began in the late 1970s. A nationally recognized voluntary process that bypasses liability hurdles

Minnesota Pollution Control Agency

Sediment near storm sewer at new housing development.

and accelerates cleanup is moving many sites toward beneficial redevelopment. Federal and state regulations aim to prevent the creation of new problems, although spills, leaks and occasional illegal dumping still occur.

Through it all, we've learned a painful lesson — it's much less costly to prevent pollution than to clean it up. Industries now work hard to reduce the amount of waste needing disposal by eliminating or recycling waste and substituting nonhazardous materials. Holistic, system-wide approaches are key to healthy businesses and a clean environment in the 21st century.

New air-quality challenges

In the 1960s and 70s, air pollution in the Twin Cities area was visible and markedly unhealthy. Emissions from coal- and oil-fired electric plants, refineries, factories, motor vehicles, and other sources put the Twin Cities' air in the unhealthy range for sulfur dioxide, carbon monoxide, particulates, ozone and lead. Federal, state and local efforts began in the early 70s to reduce emissions of these "criteria" pollutants (see page 6).

Today Minnesota's air meets health standards for criteria pollutants. Industry and utility emissions have been reduced significantly, even during growth in the economy and population. Cars were made cleaner and more fuel-efficient, and lead removed from gasoline.

However, as new information emerges about toxic air pollutants coming from cars, trucks and industries, it is evident that healthy air is not yet secured. Such pollutants as benzene, chromium and diesel-fuel particles can cause cancer, birth defects or other serious health problems with long-term exposure. Because much of the problem is attributed to motor vehicle use, solutions must go beyond controlling industrial emissions.

Rapid growth

Our fondness for the automobile continues to shape the Twin Cities-area landscape. Population and commerce have sprawled outward from the central cities and suburbs into the surrounding countryside, enabled by publicly funded roads and sewers.

Based on population forecasts from the U.S. Census Bureau, this urban region is the ninth fastest-growing among the largest 25 metro areas across the country. And the number of miles we travel annually in our vehicles is increasing faster than the rate of population growth.

Most would agree that our current rate of sprawl cannot continue indefinitely without seriously compromising the Twin Cities' environment and quality of life. In this new century we will need new ways to grow the economy, provide housing, maintain healthy communities, and efficiently move people and goods.

"Smart growth" is one such approach. It includes providing viable public transit, protecting open spaces and urban greenways, conserving farmland, and encouraging reinvestment in our core communities. Growing smart will require innovation, leadership and partnering among the many interests, communities and households that make up the wonderfully diverse Twin Cities area.

Minnesota Department of Transportation

Congestion on Minnesota roads is one consequence of increasing urban sprawl.

Minnesota Department of Natural Resources

Boiling Springs in Scott County is a sacred place to the Mdewakanton Dakota, and is the headwaters of Eagle Creek.

Eagle Creek — urban trout

The Mdewakanton Dakota Indians of Scott County are among the oldest native Minnesotans. The location of their village at Shakopee, just below the confluence of the Mississippi and the Minnesota Rivers, made it an early center of commerce with French-Canadian fur traders. The bounty of the forest — pelts of beaver and mink — were traded for steel knives, copper cooking utensils, woven cloth and firearms.

In the past 150 years, commerce in Scott County has not slowed. Growth has been dramatic, both for the tribe as well as the descendants of the Irish and German settlers of the county. From the glittering casino at Prior Lake to the beautiful suburban homes along Eagle Creek, there are intensive new developments.

Scott County was one of the fastest-growing counties in the state in the 1990s. According to data from the State Demographic Center and the Metropolitan Council, between 1990 and 1998 the population in Scott County increased almost 35 percent, and the number of households increased 38 percent. Along with this rapid growth came consequences to the environment.

But it is along Eagle Creek that people with diverse interests have united to protect this unique metro stream. The source of this waterway is the artesian Boiling Springs, historically a sacred place for the Mdewakanton Dakota. For anglers, the creek is one of the few remaining trout streams in the Twin Cities metropolitan area. Yet by the 1990s, extensive development along Eagle Creek had begun to degrade the stream.

The pollution was subtle, but it grew over time. Lawn chemicals, yard clippings and stormwater runoff combined to despoil this cold-water trout habitat. Accumulated debris blocked fish movement in the stream. Conditions were beginning to threaten the ability of the creek to support a trout fishery, for trout need cold and clean water to survive.

The community confronted the subtle contamination in 1995. A group of public and private interests joined together that year as the Eagle Creek Advisory Committee to save the creek. Among the participants were anglers (Trout Unlimited) and conservationists (Sierra Club), along with public officials, local residents and the Mdewakanton Community.

The advisory group purchased a 52-acre corridor along the stream, and over the next five years replanted native vegetation. Debris was removed from the creek, as were three culverts. The upland near-stream areas were restored to oak savanna. Efforts also were made to control exotic plants and to restore native grasses along the bank.

Local citizens are working with government to restore and protect urban trout streams elsewhere in Minnesota. At Miller Creek in Duluth, efforts include tree plantings, adding trout-habitat structures, and trapping sediments before they reach the creek. For Brown's Creek near Stillwater, volunteers planted wildflowers and trees to stabilize the banks and shade the water. A portion of the creek was re-channeled out of a wetland back to its original course, and future plans include diversion of warm runoff water away from the creek to improve cold-water habitat.

The work along Eagle Creek is an example of the cooperation needed to preserve an ecosystem — for the native plants and brown trout that live in the cold, clear waters, as well as the diverse people who live along its banks.

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HOW DO WE MAKE A DIFFERENCE?

Although we've made good progress in environmental protection since the 1960s, many challenges remain. More people call Minnesota home today than ever before and that number is growing faster than in surrounding states. If our children are to have clean air, clear water, and uncontaminated land, we all need to:

- Prevent pollution whenever possible.
- Manage water resources holistically in watersheds and river basins.
- Pay more attention to air pollution, especially in transportation planning and addressing mobile sources.
- Reclaim and reuse land damaged by past activities.
- Preserve land not yet developed for its best possible use.
- Learn about and practice "smart growth."

The goals of Governor Ventura's Smart Growth Initiative, supported by a growing network of organizations, are to:

- "Maximize economic opportunity for all while protecting and enhancing the assets that make Minnesota a great place to live — healthy communities, clean air and water, and Minnesota's unique natural, cultural and historical areas.
- "Manage natural resources and agricultural land to ensure they are sustained for future generations.
- "Be fiscally prudent by building on existing public investments and avoiding future costs down the road."

Much of the above list represents actions government, businesses and industry can take to protect and improve Minnesota's environment. But everyone — including the public — plays a role. We are all part of the problem, and part of the solution. Given the apparent complexity of the issues, where can individual citizens begin to make a real difference?

The best place to start, among the dozens of possibilities, is by focusing on a few activities over which you as a consumer or a property owner have the most influence. Target the areas where the benefits will be the greatest.

Here are some steps you can take to maximize your efforts to protect the environment.

Consume less gasoline

Gasoline burned by cars, light trucks, minivans and sport utility vehicles accounts for consumers' biggest contribution to air pollution and global warming. Calculate your household's annual gasoline consumption: the total of each vehicle's annual miles driven divided by the average miles per gallon. If your household gasoline consumption exceeds the national average of 900 gallons per year, cut back. Consider driving a more fuel-efficient car, or drive fewer miles by sharing rides. Using the bus or biking are other options.

Choose your home carefully

The size and location of your home are two high-impact factors. Large houses require more energy to heat and cool and require more building materials. It is the production of that energy and those building materials where the impacts to our air and water occur. The location of your home matters since the commute to work typically accounts for the largest share of vehicle miles traveled.

Cut back on energy use in the home

The big offenders here are home heating and hot water. Also contributing significantly are lighting and appliances (especially refrigerators). You'll help the environment and save big bucks in the long term by installing more energy-efficient heating systems, appliances and lighting (such as compact fluorescent bulbs).

Reduce the amount of garbage you produce

Though Minnesotans recycle about 40 percent of their garbage, rates of solid-waste production per person are still increasing. You can reduce the amount of garbage you generate by buying products with minimal packaging, composting yard and kitchen waste, reusing household items whenever possible and continuing to recycle.

Develop an awareness about how and where your food was produced

Some agricultural practices are more damaging than others. Consider selecting foods that are raised using practices that minimize environmental impacts. This means purchasing foods grown with fewer added fertilizers and pesticides and that leave land less vulnerable to erosion.

Pay attention to certain "high-impact" activities

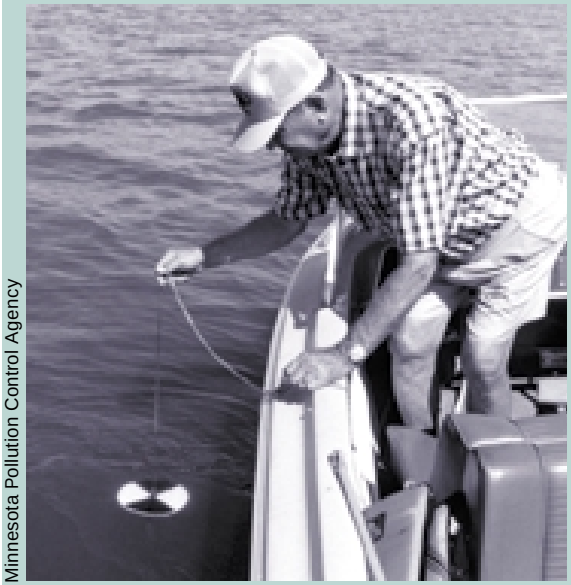
Some activities have a disproportionately high environmental impact. Minimize use of lawn equipment powered by two-cycle engines, which emit more air pollution (consider electric or battery-powered equipment instead). Other high-impact activities include fertilizer and pesticide use in our yards (cut back — we use far more than we need!) and improper disposal of household hazardous wastes (such as paints, chemicals, and certain batteries).

Get involved

Get involved in environmental issues. One key place to start is in the arena of land-use planning in your community. Start by attending a public meeting. Then maybe volunteer your time on a committee. Your input and involvement do make a difference. Help keep government, businesses and citizens accountable for decisions and activities that affect the environment.

Report complaints or suspected violations to the MPCA

You can file complaints electronically at **www.pca.state.mn.us/complaints.html** or call (800) 857-3864.



Minnesota Pollution Control Agency

Volunteer!

Volunteer monitoring is another opportunity for you to make a difference. The MPCA relies on volunteer monitoring data on Minnesota lakes and streams to make statewide and regional comparisons, look at changes over time, and develop assessments for local, state and federal resource managers.

To learn more about volunteer monitoring opportunities at the MPCA, contact the agency at (651) 296-6300 or (800) 657-3864. Many other environment-related volunteer opportunities (including other types of volunteer monitoring) are available through your city, county or other local organizations.

RESOURCES

To learn more about the environment and how you can help protect it, check out the following web sites. Telephone numbers are also listed for Minnesota organizations.

State agencies and U.S. EPA

Minnesota Pollution Control Agency
www.pca.state.mn.us
(651) 296-6300
Detailed information on air, land and water conditions. Also kids' page, hot topics, and thousands of environmental documents and reports.

Minnesota Department of Natural Resources
www.dnr.state.mn.us
(651) 296-6157
Recreation, hunting, wildlife and ecosystems, public water access, lake finder.

Minn. Office of Environmental Assistance
www.moea.state.mn.us
(651) 296-3417
Reducing waste, environmental education, sustainable communities.

U.S. Environmental Protection Agency
www.epa.gov
Huge site with lots of information including useful stuff for teachers, kids (Explorer's Club), home and office.

Metropolitan Council
www.metrocouncil.org/
(651) 602-1000
Metro rivers and lakes, smart growth, wastewater treatment, watersheds.

Minnesota Department of Health
www.health.state.mn.us
(651) 215-5800
Fish consumption advisories, lead safety information, drinking water supply information, ground water.

Energy use and efficiency

Energy Efficiency and Renewable Energy Network
www.eren.doe.gov
U. S. Dept. of Energy's customer service center. Fact sheets on energy-efficient transportation, building materials, landscaping, other topics. "Ask an expert" feature.

Energy Star Programs and Products
(www.epa.gov/energystar.html)

General environmental information

Environmental Organization Web Directory
www.webdirectory.com
Billed as the "Earth's biggest environment search engine."

The Environment: A Global Challenge
http://library.thinkquest.org/26026
Oriented toward students and teachers. Many links to environmental articles and sites.

National Library For The Environment Online
www.cnie.org/nle
Links to papers, congressional reports, environmental news sources, job opportunities in the environment.

Lakes

Minnesota Lakes Association
www.mnlakesassn.org
800 515-LAKE or (218) 825-1909
Lake planning, management and education resources.

North American Lake Management Society (NALMS)
www.nalms.org
Lakes Appreciation Week, publications, U.S. lakes facts, volunteer monitoring.

Pollution prevention

Minnesota Technical Assistance Center
www.mntap.umn.edu
(612) 624-1300
Tips for businesses to prevent pollution.

Smart growth

1000 Friends of Minnesota
www.1000fom.org
(651) 312-1000
Smart growth issues and maintaining Minnesota's quality of life.

What you can do

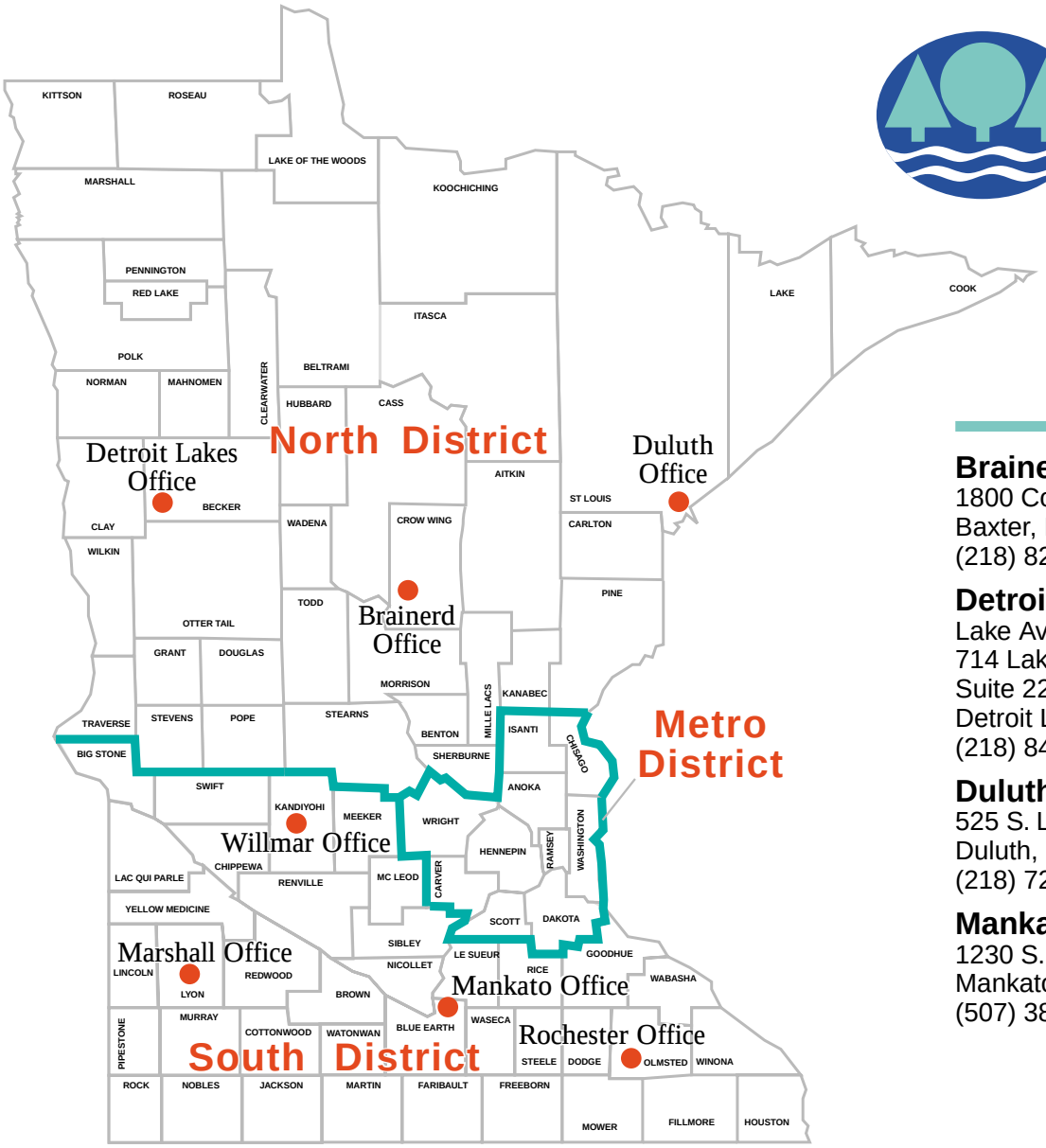
Center for a New American Dream
www.newdream.org
Reducing and shifting consumption, sound practices, simple living, building strong families and communities.

Earthshare
www.earthshare.org
Everyday tips to improve the earth, topics such as green gifts, camping, recycling, paper reduction.

Green Guide to Cars and Trucks
http://greenercars.com
Information on least and most polluting vehicles.

Union of Concerned Scientists
www.ucsusa.org
Suggestions on what individuals can do to influence policy at community, state, and national levels.

U.S. Environmental Protection Agency
www.epa.gov/epahome/home.htm
What you can do in your home and garden to prevent pollution.



Minnesota Pollution Control Agency

520 Lafayette Road N.
St. Paul, MN 55155-4194
(651) 296-6300 or (800) 657-3864

Area Offices:

Brainerd Office
1800 College Road S.
Baxter, MN 56425
(218) 828-2492

Detroit Lakes Office
Lake Avenue Plaza
714 Lake Ave.
Suite 220
Detroit Lakes, MN 56501
(218) 847-1519

Duluth Office
525 S. Lake Ave., Suite 400
Duluth, MN 55802
(218) 723-4660

Mankato Office
1230 S. Victory Dr.
Mankato, MN 56001
(507) 389-5235

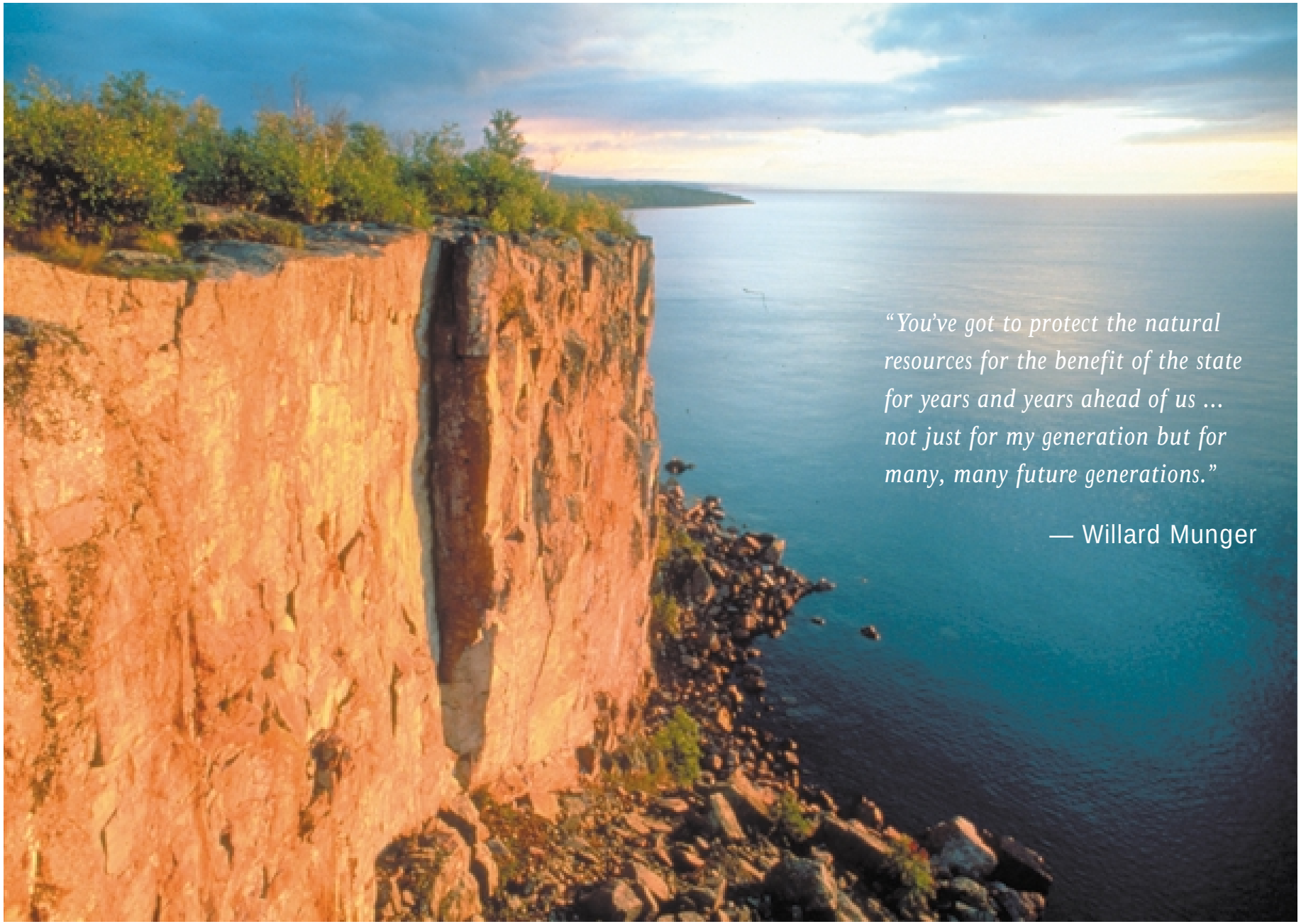
Marshall Office
1420 E. College Dr., Suite 900
Marshall, MN 56258
(507) 537-7146

Rochester Office
18 Wood Lake Dr. S.E.
Rochester, MN 55904
(507) 285-7343

Willmar Office
201 28th Ave. S.W.
Willmar, MN 56201
(320) 214-3786

TTY users may contact any staff through the agency's teletypewriter (651) 282-5332 or (800) 657-3864.

www.pca.state.mn.us


"You've got to protect the natural resources for the benefit of the state for years and years ahead of us ... not just for my generation but for many, many future generations."
— Willard Munger