

MINNESOTA'S

Environment 2005

How are we doing?



Minnesota Pollution Control Agency

Minnesota's Environment 2005

How are we doing?

Clear lakes for swimming and fishing, clean air to breathe and safe water to drink — all are part of a quality of life that Minnesotans value.

Minnesota has a long history of environmental leadership and state residents overwhelmingly support clean air and water. Since the 1970s, the state has tackled many of the most pressing environmental problems — untreated sewage, belching smokestacks and careless dumping of hazardous wastes — while continuing to have a healthy economy.

Although Minnesota's abundant natural resources can support many people and activities, the state's rising population, energy consumption and land use patterns are putting pressure on the environment.

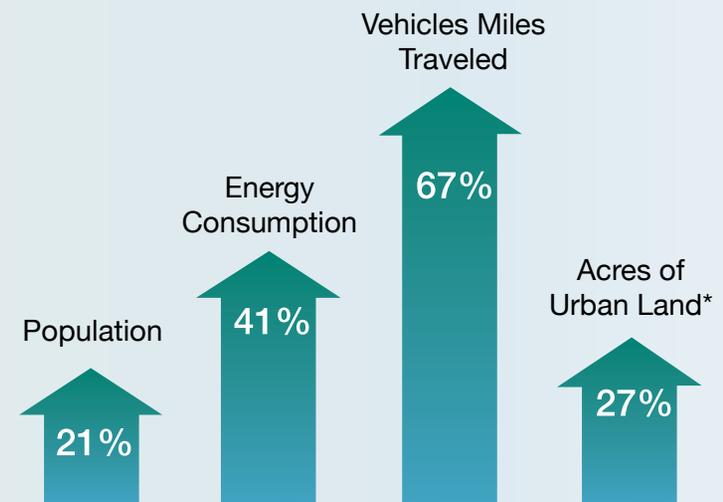
Minnesota's population has swelled to 5 million and is projected to grow 11 percent from 2000 to 2010 according to the state demographer. Projections suggest that while many counties in western Minnesota will lose population over the next few years, counties in the suburban Twin Cities, near Rochester, and in parts of north-central Minnesota will grow faster than the state average.

As more and more people choose to live in cities and surrounding suburbs, land that was once farmland and wetlands becomes shopping centers, schools and roads. The paved areas that result increase the amount and speed of stormwater runoff and the pollutants it carries with it into lakes and streams. More people need new and expanded sewage treatment and transportation systems.

Communities in north-central Minnesota and on the North Shore are also facing growing pains as demand for lakeshore property has skyrocketed in the past decade. The development of resorts, hotels, golf courses and cabins, and conversion of cabins to year-round use have led to significant shifts in land use. Lakeshore development too often removes natural cover near shorelines. More roofs and more pavement in nearby towns results in less land to filter pollutants.

Increasing population and greater urbanization also affect Minnesota's air. The burning of fossil fuels for electricity and pollution from transportation represent Minnesota's principal sources of air pollution. With more people driving more vehicles longer distances, congestion on Minnesota's highways has worsened. As population grows, so does demand for electricity, creating pressure to build new power plants. Polluted air affects people's health. It adds to worldwide mercury exposure and climate change.

Trends Affecting Minnesota's Environment: Percent Change Since 1985



* urban acres measured from 1982

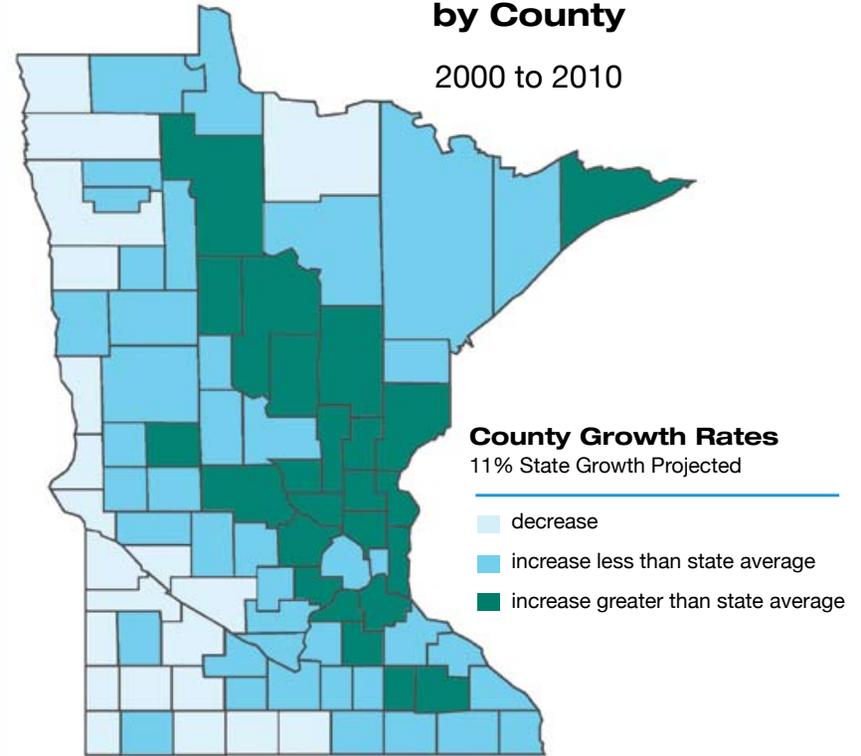
Agriculture, an important sector of the state's economy and the state's largest land use, also affects the health of Minnesota's environment. Erosion of soil by water and wind and runoff from improperly managed manure contribute to water quality problems in lakes and streams. Runoff from farm fields carries nutrients such as phosphorus into lakes and streams, which can harm water quality by causing algae growth and depleting available oxygen.

It's hard to know exactly what Minnesota's environment will look like in 2010 and beyond. But there's no question the quality of the state's water, land and air will be influenced by how Minnesota's residents respond to the environmental challenges created by an increasing population, changing land uses and growing consumption of resources.



Projected Population Growth Rates by County

2000 to 2010



Minnesota's population is projected to grow 11 percent by 2010. The greatest growth is predicted to be concentrated in the Twin Cities suburbs and along a corridor stretching from Rochester to the Brainerd Lakes Area.

Water

Water — lakes, streams, ground water and wetlands — is Minnesota’s treasure. The state boasts 81 watersheds with 92,000 miles of streams and more than 12,000 lakes. Nearly 75 percent of Minnesotans use the state’s vast ground water resources for drinking water. Nine million acres of wetlands provide habitat for aquatic animals, birds and plants.

Minnesotans need to be vigilant about protecting their abundant water resources. The following summary describes the status and trends for the state’s lakes and streams, wetlands and drinking water.

Lakes and Streams



TREND: The quality of many streams and some lakes has improved, but the quality of others has declined.

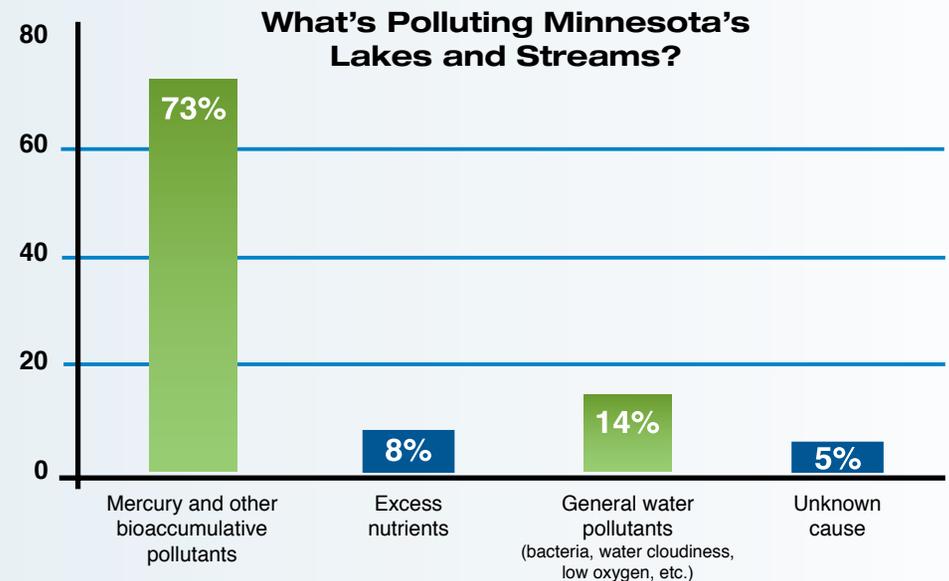
Minnesota’s lake and stream quality ranges from very good in some parts of the state to very poor in others. Although Minnesota has assessed only a small portion of waters, many are unhealthy for aquatic life or unsafe for swimming and other water recreation. Many lakes and streams also have advisories limiting fish consumption because of unsafe mercury levels.

Minnesota uses water quality standards to assess the health of lakes and streams. The standards are designed to protect waters for specific uses:

- Does the water support healthy aquatic life?
- Is it safe for swimming and other water recreation?
- Are the fish safe to eat?

Lakes and streams not meeting the standards are considered “impaired” and must be cleaned up.

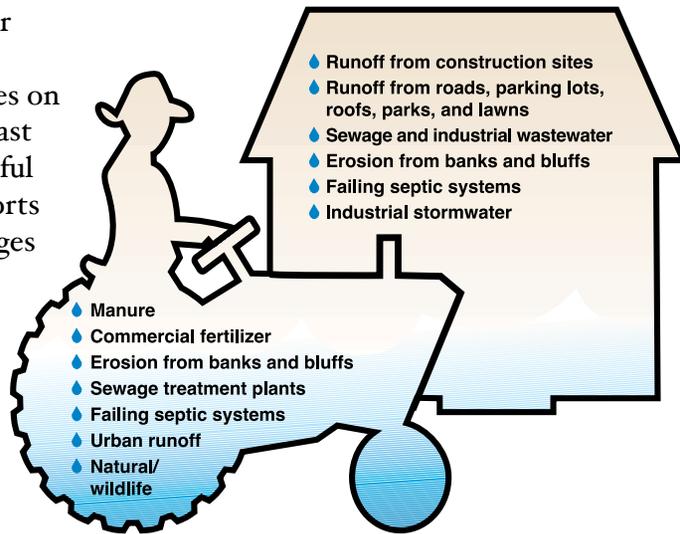
The overall picture of the health of Minnesota’s lakes and streams is limited by a lack of monitoring. Currently, only 8 percent of streams and 14 percent of lakes have been assessed for impairment. Based on this limited monitoring, 916 lakes and 199 streams located across Minnesota are impaired.



Most of the state’s impaired waters are the result of mercury, mainly from airborne sources outside of Minnesota. Other pollutants are the result of human activities on the land and make waters unsuitable for recreation and unhealthy for fish. (See Mercury discussion on page 11.)

Many of the pollutants causing impairments — nutrients, low oxygen levels, bacteria, water cloudiness — come from human activities on the land. Over the past few decades, successful state and federal efforts have limited discharges from wastewater and sewage pipes — called “point sources.” The Mississippi and St. Louis rivers are dramatically improved, with renewed walleye fisheries, as a result of controls on point sources.

Water Pollution Sources in Urban and Agricultural Areas (excluding mercury)

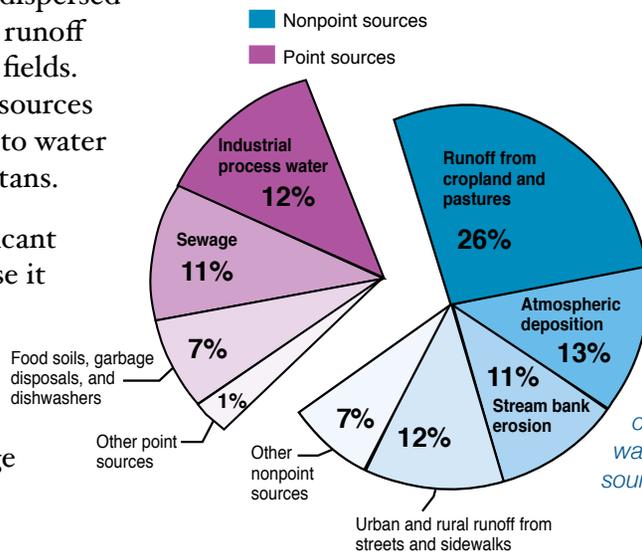


Runoff and sewage and industrial wastewater are estimated to be the largest contributors to water pollution in cities. Manure, commercial fertilizer and bank and bluff erosion are the top three potential contributors in rural areas.

Today, however, about 80 percent of water pollution comes from dispersed “nonpoint” sources — runoff from lawns, roads and fields. Controlling nonpoint sources requires commitment to water quality by all Minnesotans.

Phosphorus is a significant water pollutant because it helps algae grow in water, turning lakes and streams green. Although controls on discharges from sewage

Sources of Phosphorus (average conditions)

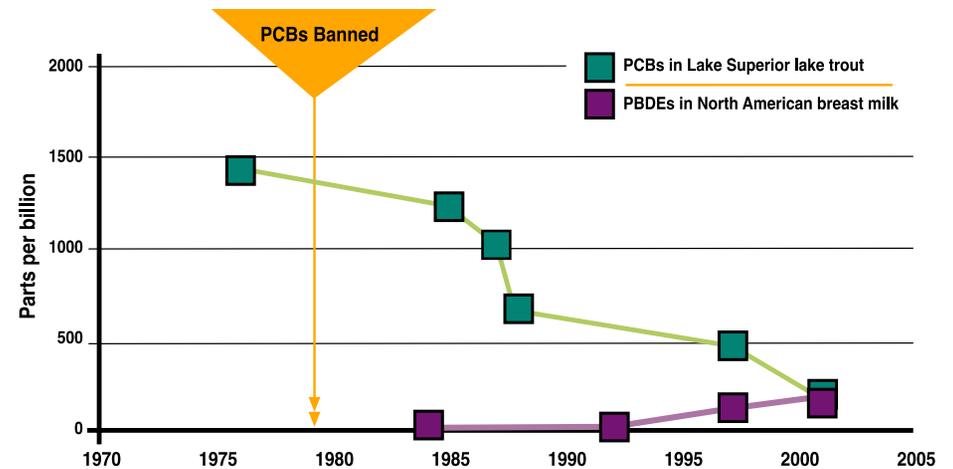


During normal and rainy weather conditions, nonpoint sources contribute the most phosphorus to water bodies. During dry years, point sources are larger contributors.

treatment plants have reduced this nutrient, runoff of phosphorus from fertilizers and other nonpoint sources continues to pollute waters.

Other pollutants are of special concern because they are toxic, remain in the environment for a very long time and increase in concentration as they move up the food chain. These pollutants, called persistent bioaccumulative toxics (PBTs), are used in electronics, carpeting and many other consumer items. When disposed of, PBTs are released and move easily in the environment and are often deposited in lakes and streams, where they accumulate in fish and can harm people and animals that eat fish.

A Tale of Two PBTs



Production of polychlorinated biphenyls (PCBs), coolants/lubricants used in electrical equipment, was banned in 1979. Levels declined steadily but slowly because of the persistent and bioaccumulative nature of the chemicals. Today, PCB concentrations in fish are down 90 percent. In contrast, manufacture of the most toxic types of polybrominated diphenyl ethers (PBDEs), widely used as flame retardants, has only recently ended. Some forms continue to be produced, and levels continue to rise.

Things to watch/concerns

- While most of Minnesota's lakes and streams may be in better shape than other states' waters, it's important for Minnesotans to act now to protect good quality waters and clean up the others so they don't get worse.
- Nationally, there is little information on most new kinds of water pollutants. Pesticides, pharmaceuticals, metals and household cleaners are among products that may end up in water and have harmful effects even at very small concentrations. While Minnesota is beginning to investigate and monitor for some of these chemicals, knowledge about their environmental effects is very limited.
- Invasive species including zebra mussels, Eurasian watermilfoil, purple loosestrife and carp threaten to radically alter native aquatic plant and animal populations.

Physical habitat changes: Not your typical water pollution

Physical changes to lakes and streams can be just as detrimental as chemical pollution. Loss or changes in habitat through drainage, stream straightening and alteration of banks and shorelands can severely affect aquatic organisms' ability to live, feed and reproduce. Even when all chemical pollutant

sources are eliminated and water quality is good, healthy aquatic communities will not be present without necessary habitat. Improvements to habitat can have significant effects. Over the past 30 years, habitat improvements have more than doubled brown trout populations in southeastern Minnesota streams.

Minnesota's Wetlands

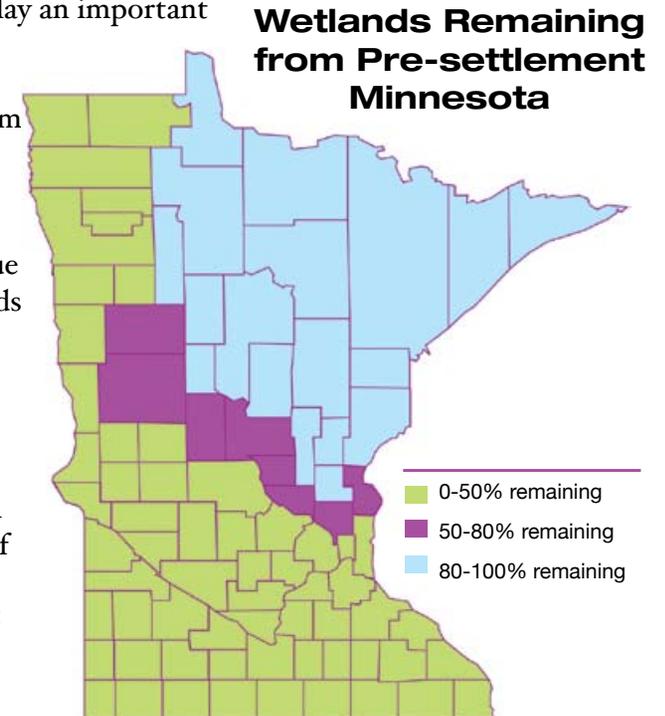
STATUS:  Poor Fair Good

TREND: Wetlands continue to be lost; however, there were net gains in wetlands from 2001 to 2003 due to conservation programs.

Statewide, about 50 percent of Minnesota's original wetlands have been lost, and nearly all of the original wetlands are gone in parts of southern and northwestern Minnesota. Initial efforts to assess the quality of the remaining wetlands suggest many are degraded.

Wetlands — marshes, swamps, ponds and bogs — provide habitat for aquatic animals and plants, including ducks, geese and other waterfowl. Wetlands play an important role in reducing flooding by holding water and slowing storm runoff in wet years and giving back water in times of drought. Because of these unique characteristics, wetlands serve as a critical part of Minnesota's overall water system.

While Minnesota is still rich in wetlands in comparison to much of the U.S., the state has lost about half of its 18 million pre-settlement



Courtesy of Board of Water and Soil Resources

wetland acres to agricultural, urban and other development. Some areas of the state — southern, southwestern and northwestern Minnesota — have lost significantly more than half of their historic wetlands.

State and federal laws are designed to reduce wetland loss. Wetlands destroyed by filling or draining, in most cases, must be replaced by wetland restoration elsewhere. The state's wetlands continue to be lost because a number of development, agricultural and drainage activities are exempt from the laws. However, Minnesota has also experienced significant wetland gains because of state and federal conservation programs to offset losses and restore wetlands.

Things to watch/concerns

- In replacing wetlands, different varieties of wetlands are often used, such as open water ponds. While open water ponds have aesthetic and other benefits, they don't support the healthy plant communities or provide the abundant wildlife habitat of the originals.
- As with lakes, invasive species in wetlands, such as hybrid cattails, reed canary grass, purple loosestrife, carp and Chinese mystery snails threaten the ecology and integrity of vast numbers of Minnesota's wetlands.

Drinking Water

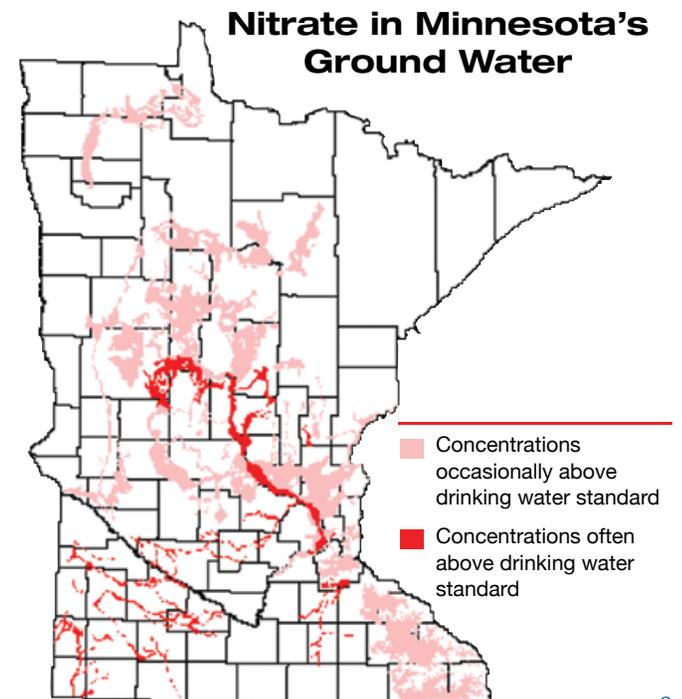


T R E N D: **Steady. Drinking water continues to meet health standards.**

Nearly all of Minnesota's public drinking water supplies meet health standards after treatment. Sampling of private drinking water wells found nitrate as the only widespread human-caused contaminant in drinking water.

Minnesota's drinking water is of very high quality. No matter the source — lakes, rivers or ground water — Minnesotans can have a high degree of confidence in drinking water from public water supplies.

Minnesota's 8,300 public water supplies — those serving communities, businesses, schools, restaurants and highway rest stops — are all routinely tested for nitrate and bacteria, and many are also tested for pesticides, industrial chemicals and



metals. Nitrate can cause health problems in infants, and bacteria can cause intestinal illness.

Since 1998, only a handful of instances of nitrate and bacteria contamination exceeding health standards have been found in public water supplies, and the problems were corrected quickly. Contamination of community water supplies by pesticides and industrial contaminants is rarely found; the last time a city water supply violated a health standard was 1999.

Public water suppliers are required to send out a report card on the quality of the public water supply. The report cards provide detailed information about city water supplies.

Minnesotans also use individual wells as a drinking water source. Today, nitrate is the most widespread human-caused chemical in ground water. A recent statewide study of Minnesota's ground water found approximately 3 percent of the wells tested exceeded the drinking water standard for nitrate. In areas where ground water is susceptible to contamination, however, a much higher percentage of wells exceed the nitrate drinking water standard.

Things to watch/concerns

- Pesticides, chemicals used to kill insects and weeds, may become a concern. Although use has declined recently, Minnesota currently uses 28 million pounds of pesticides annually. Pesticides have been found in ground water, but generally not at levels considered to be unsafe.
- Arsenic, a naturally occurring element, is found in about 15 percent of individual wells, primarily in west-central and northwestern Minnesota, at levels above the drinking water standard. Arsenic is part of the earth's crust and works its way into ground water from underground rock and soil.

Air

Clean air means healthier people. Breathing polluted air can cause itchy throats and burning eyes, make asthma, bronchitis and heart conditions worse, and lead to more cases of cancer. Cleaner air also means cleaner water. Mercury and other PBTs fall out of the air and settle in Minnesota's lakes and streams. Once there, mercury can accumulate in fish. Consumption advisories for mercury in most of the state's lakes limit the type and amount of fish Minnesota anglers can safely eat.

Pollutants in Minnesota's air also reduce visibility, creating a haze that can affect scenic views in places like the Boundary Waters Canoe Area as well as in the state's urban areas. Air pollutants also contribute to global climate change.

This report looks at status and trends in air quality in four areas: air pollutants regulated by standards, cancer-causing air pollutants, mercury and climate-change pollutants.

Key Air Pollutants



TREND: Pollutant levels are steady or decreasing.

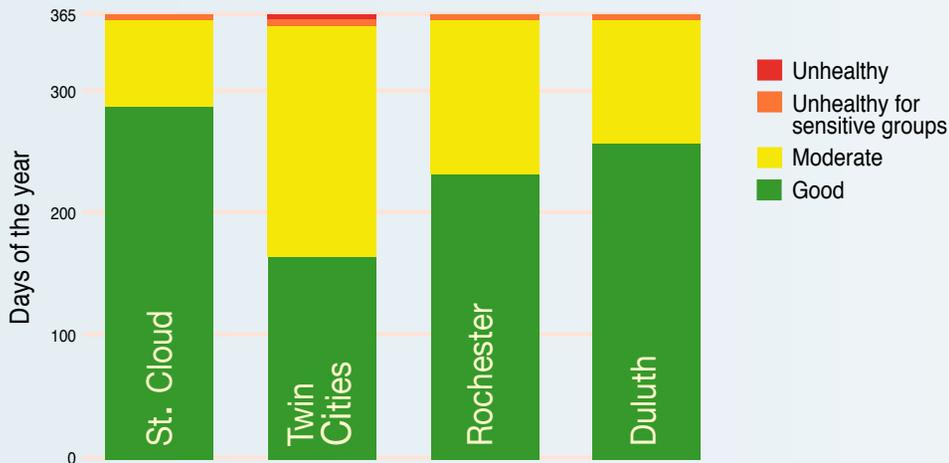
Minnesota meets federal standards for all key air pollutants; however, recent scientific evidence indicates concentrations of fine particles in Minnesota's air are unhealthy for some people. Several times a year ozone and fine particle levels are unhealthy for sensitive individuals and trigger air alerts.

The 1970 Clean Air Act established standards to protect public health for six key air pollutants — sulfur dioxide, nitrogen oxides, particles, ozone, carbon monoxide and lead. Controls on factory emissions, improved pollution equipment on cars and trucks and the removal of lead from gasoline led to lower levels of many of these pollutants in Minnesota’s air. Minnesota’s air currently meets standards for all pollutants.

Despite meeting standards, the state still has several days each year that are unhealthy for sensitive groups such as children, the elderly, athletes and those with heart or lung diseases. Even moderate air quality days are a concern because studies show some people may have adverse health effects on those days.

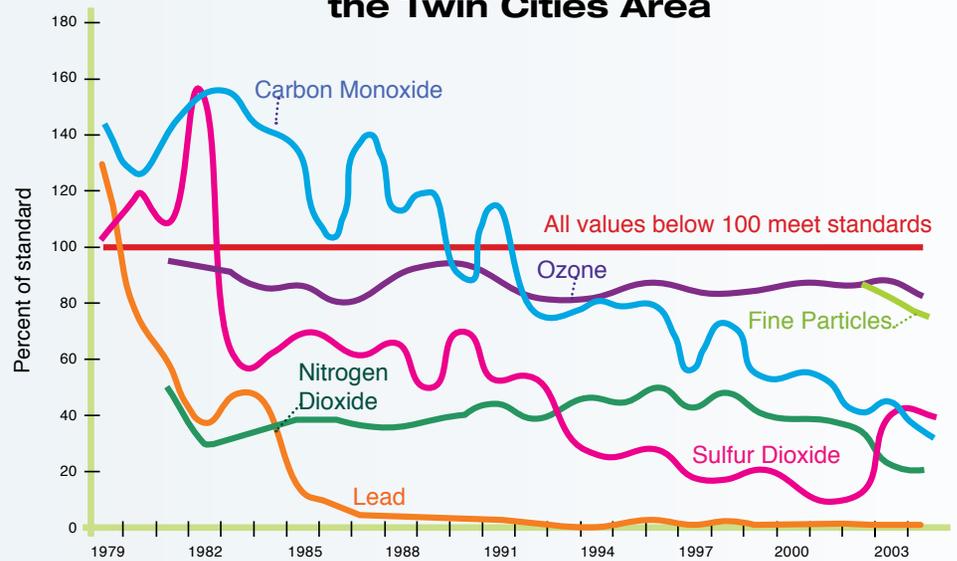
In Minnesota, unhealthy days are primarily caused by fine particles and ozone. Because ozone and fine particles can be carried by the wind for hundreds of miles, unhealthy air in Minnesota can be a mixture of pollution formed in the state and air blown in from elsewhere. Air quality is generally worse in areas with higher population.

2004 Air Quality in Minnesota Cities



In 2004, Minnesota cities had up to seven days that were unhealthy for sensitive groups such as children, the elderly, athletes and those with heart and lung disease. Some people also have adverse health effects on moderate days.

Trends in Key Air Pollutants in the Twin Cities Area



Minnesota has successfully reduced many of the air pollutants regulated by standards to protect public health since 1970. All pollutants are currently below standards.

Fine particles are inhaled deep into the lungs. Recent health studies have linked long-term exposure to fine particle pollution to reduced lung function. Even short exposures to high particle levels can cause asthma attacks and acute bronchitis and are linked to heart attack deaths in people with heart disease. Fine particles suspended in the air also create haze which impairs visibility in areas throughout Minnesota.

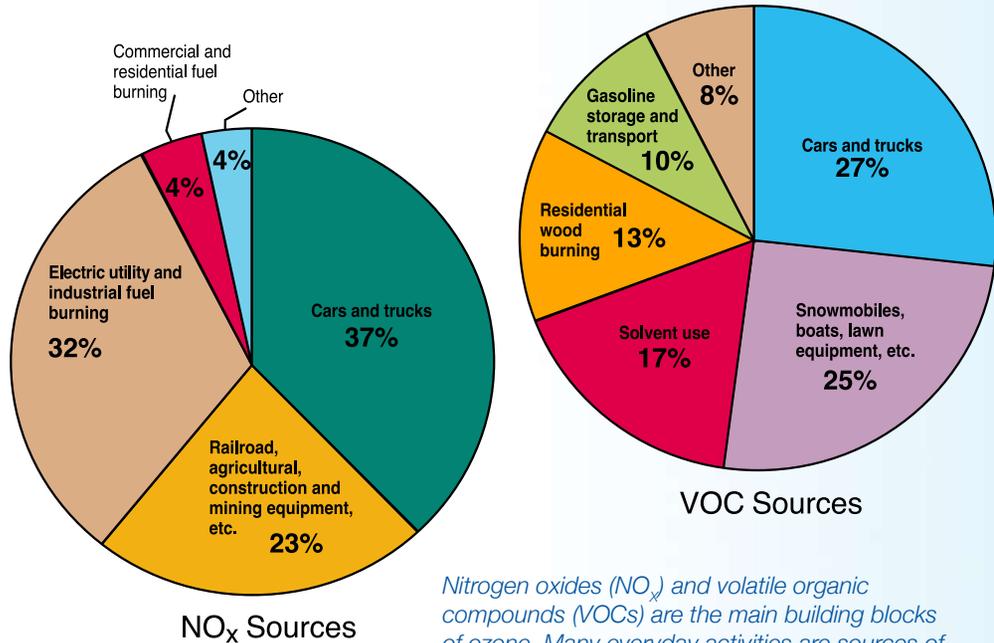
Ozone, the main component of smog, is irritating to the eyes, nose, throat and lungs, and can worsen the symptoms of asthma. Children and adults who exercise outdoors and people with asthma are most at risk from unhealthy levels of ozone in the air.

Ozone is formed on hot sunny days when nitrogen oxides and volatile organic compounds react. Air pollution from cars, trucks, power plants and solvents contribute to the formation of ozone. Trees and plants also release volatile organic compounds into the air.

Things to watch/concerns

- The federal government is currently evaluating health information amid growing concerns that the current fine particle standard is not protective of public health. The fine particle standard will likely be made more stringent.
- Minnesota's air is currently at about 80 percent of the federal ozone standard. Falling out of compliance with the ozone standard would be harmful to human health and would impose significant costs to Minnesota's transportation system.

Sources of Ozone from Human Activities in Minnesota



Nitrogen oxides (NO_x) and volatile organic compounds (VOCs) are the main building blocks of ozone. Many everyday activities are sources of these chemicals in Minnesota's air.



Wood burning stoves

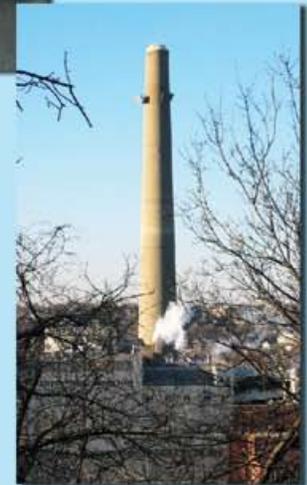


Non-road vehicles



Cars and trucks

Power plants



Agricultural sources



Forest fires

Sources of Fine Particles

Fine particles can be emitted directly or formed in the air from gases.

Cancer-Causing Air Pollutants

STATUS: 
Poor Fair Good

TREND: Pollutant levels are steady or decreasing.

Concentrations of all but one of the toxic air pollutants measured in Minnesota are below cancer health benchmarks at most locations. Formaldehyde consistently exceeds benchmarks in many areas of the state.

Toxic air pollutants are a group of chemicals that can cause or are suspected of causing cancer and other serious health problems. A statewide survey of over 70 of these chemicals was completed in 2001 and Minnesota currently monitors these pollutants in Twin Cities and Duluth neighborhoods. Levels found in Minnesota's air are compared to health benchmarks, when available, to determine if air toxics pose an unacceptable risk of cancer.

Diesel buses, trucks and construction equipment release harmful exhaust to the air. Based on many studies linking lung cancer to diesel particles, several health agencies have concluded that this exhaust probably causes cancer in humans. The particles in vehicle exhaust are also linked to heart disease.



Over the past several years, only two chemicals measured posed such a risk at multiple sites: benzene and formaldehyde. Minnesota has made good progress in reducing benzene in the air, and benzene is now below benchmarks at most locations. This is largely due to reductions in emissions from automobiles, gas station fueling operations and industrial facilities, and to lowered benzene levels in gasoline.

Formaldehyde levels are above benchmarks and have changed little since 1995. Formaldehyde can be directly released from wood burning and from fuel-burning vehicles, as well as industrial processes. It is also formed when other chemicals break down in the environment.

Things to watch/concerns

- People are exposed to many chemicals at any given time, and very little is known about the effects of exposure to multiple pollutants.
- New scientific studies are showing a link between adverse health effects and proximity to major roads and vehicle exhaust. More studies are needed to better understand the risk to people living near busy streets.

Mercury

STATUS:  **Poor** **Fair** **Good**

TREND: Emissions are decreasing in Minnesota but steady worldwide.

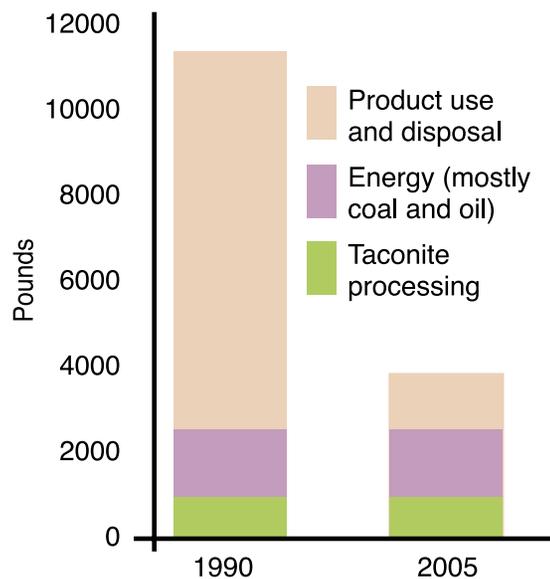
Airborne mercury, from sources inside and outside the state, is at levels that result in fish consumption advisories for nearly all lakes in Minnesota. Health effects may be severe for those not observing consumption advisories.

Mercury is a toxic pollutant that accumulates in fish. The health of people and wildlife that eat contaminated fish is the primary concern about mercury in Minnesota. Mercury can damage the nervous system. Unborn babies and children are most vulnerable.

Nearly all mercury in Minnesota comes from the atmosphere. Mercury can be transported over long distances, and about 90 percent of the mercury that falls on lakes, rivers and wetlands in Minnesota comes from sources outside the state.

Mercury emissions in Minnesota declined about 72 percent between 1990 and 2005 mostly due to removal of mercury in products and control of incinerators.

Mercury Emissions in Minnesota 1990 and 2005



About the same percentage of Minnesota's mercury emissions leave the state and are deposited elsewhere.

Coal combustion, taconite processing, and disposal of consumer products are the main sources of mercury emissions in the state. Minnesota, along with the federal government, has successfully removed mercury from many products including paint and batteries. Statewide mercury emissions declined about 72 percent from 1990 to 2005.

Things to watch/concerns

- Although mercury emissions declined in Minnesota, the United States and Europe between 1990 and 2000, emissions in developing countries increased over the same period. As a result, global emissions have remained relatively constant in recent years.
- If energy consumption in Minnesota continues to rise, additional power will be needed to meet the state's demand for electricity. Electric utilities serving Minnesota customers project that the Upper Midwest will need to add about 6000 megawatts of electric power in the next 15 years. If new coal-fired power plants are built to meet the demand, mercury emissions in Minnesota may rise.

Climate Change

STATUS:  **Poor** **Fair** **Good**

TREND: CO2 emissions are increasing.

Scientific evidence indicates the earth is experiencing warmer temperatures, due in part to increased emissions from the burning of fossil fuels. In Minnesota observed changes in climate include higher temperatures and more frequent heavy rainfalls and flooding.

Around the world, carbon dioxide and other greenhouse gases are increasing in the atmosphere, resulting in increased warming of the earth. Recent warming is linked to the burning of oil, coal and gas for energy in vehicles, businesses and homes. Many scientists are concerned about the effects a shifting climate will have on the world's ecosystems.

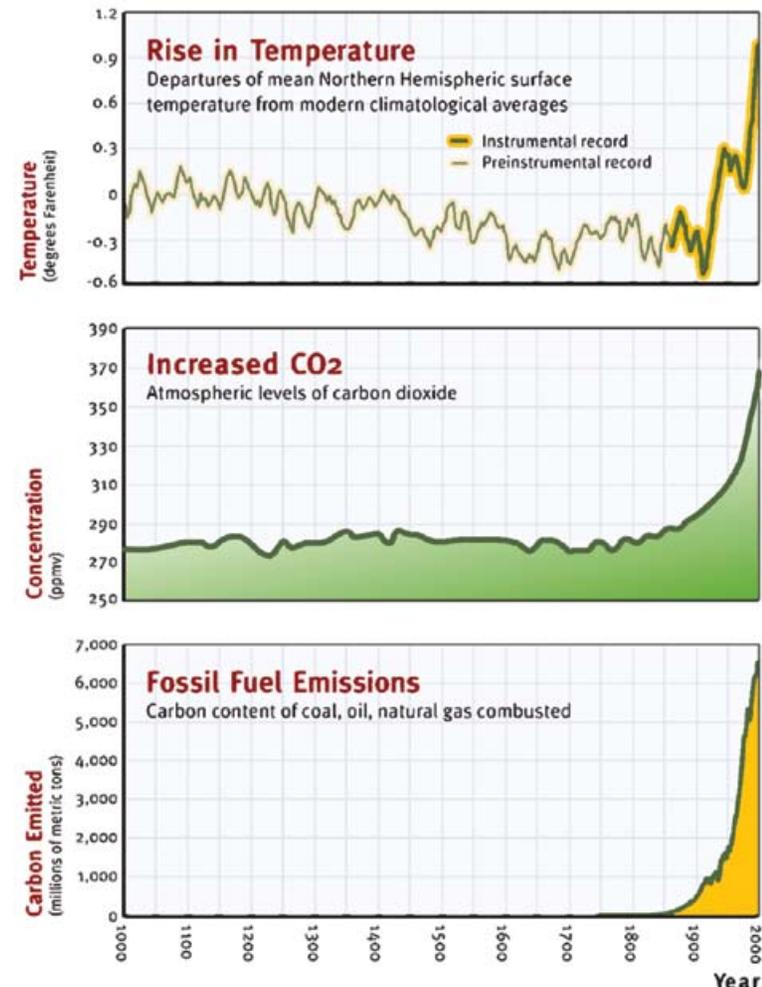
Although climate is extremely variable in Minnesota, over the past 100 years scientists have observed increases in annual average and subsurface temperatures, higher dew points, and a greater frequency of heavy rainfalls.

In Minnesota, emissions of carbon dioxide, the main heat-trapping gas, have increased 37 percent since 1985 despite increases in the energy efficiency of Minnesota's economy. The greatest increases are found in the energy and transportation sectors.

Things to watch/concerns

- It's difficult to know for sure how a warming climate will affect ecosystems in Minnesota. Some possible effects include increased damage from floods and violent storms, shifts in the location of forests and grasslands, loss of species that cannot adapt quickly to new climates, and more poor air quality days during hotter summer months.

Climate Change Trends



Recent warming is linked to the burning of fossil fuels and increased atmospheric levels of carbon dioxide.

Matt Kania, courtesy of Minnesota Conservation Volunteer

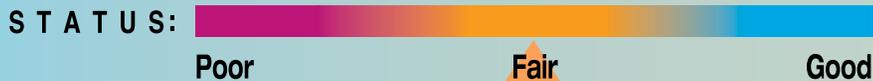
Waste

In the 1970s, Minnesota began to address environmental contamination caused by waste disposal. Today, hazardous wastes produced by businesses are strictly regulated, and programs are in place to address environmental contamination of the past. Due to pollution prevention efforts by businesses, the volume of hazardous wastes produced has remained level, even while economic growth increased.

And, Minnesotans have more access to environmentally correct ways of disposing of household hazardous wastes — paint, lawn and garden chemicals and cleaners — than in other states. Participation rates in household hazardous waste collection programs and volumes of waste collected remain consistent with population growth.

Solid waste — the non-hazardous portion of materials Minnesotans throw away — is also an important focus for Minnesota.

Solid Waste



T R E N D: Recycling rates are steady. Solid waste generation is increasing but has slowed in recent years.

Minnesota ranks among the most successful states for recycling. Yet, Minnesota's gains in recycling are outpaced by the amount of waste generated. Each year Minnesotans increase the overall amount of garbage they produce, resulting in greater energy use, air and water pollution and wasted natural resources.

Minnesota recycles nearly 40 percent of the solid waste it produces, a recycling rate among the best in the nation. In 2003 that recycling rate translated into 2.35 million tons of materials, saving enough energy to power 321,000 homes for one year and reducing net greenhouse gas emissions equivalent to taking more than 1 million cars off the road. Recycling 2.35 million tons also reduced overall air pollution by 1.98 million tons, water pollution by 6,700 tons and natural resource consumption for making steel by 585,000 tons.

While Minnesota's recycling rate is high, Minnesotans still throw away many materials that could be recycled. The state's recycling rate has remained relatively flat in recent years due to the overall growth in waste generation. Although in 2003 the amount of wastes generated experienced only a 1 percent increase, the smallest increase since 1991, this reduction is likely tied most closely to the slowing economy. As the economy improves, the rate of waste generation will likely begin to increase again.

Minnesota's disposal methods for solid waste have changed, too. Solid waste going to landfills — the least-preferred disposal option — has increased 158 percent since 1991, while wastes burned for energy and municipal waste composting operations have declined.

Things to watch/concerns

- The current rate of waste growth and the plateau in the recycling rate may result in the need for new landfills or disposal infrastructure in the future. Efforts are underway to slow the waste increase through increasing waste reduction education, encouraging recycling options for businesses and developing systems for collection, processing and use of wastes that can be composted.

How Much Waste Do We Produce?

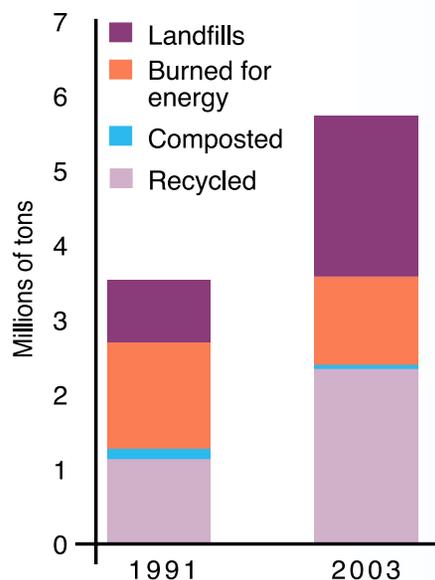
1991-2003



Each Minnesotan produced 1.16 tons in 2003, up from 0.88 tons in 1991.

- Waste burned in backyard fires is one of the largest sources of dioxin, a known human carcinogen. Dioxin in smoke is deposited on plants and crops, which are in turn eaten by animals. People can be exposed to dioxin when they consume meat and dairy products. A 2005 study of rural residents in Minnesota showed that 46 percent of those surveyed used burn barrels to dispose of household garbage.

Where Does Minnesota's Waste Go?



Minnesota Pollution Control Agency

December 2005

Project Team: *David Christopherson, Tom Clark, Patricia Engelking, Elizabeth Gelbmann, Paul Hoff, Frank Koblasch, Jeff Ledermann, Kari Palmer, Mark Rust, Mike Trojan*

Designer: *Peggy A. Hicks*

Editors: *Patricia Engelking, Elizabeth Gelbmann*

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Minnesota Pollution Control Agency
 520 Lafayette Road
 St. Paul, Minnesota 55155
 (651) 296-6300
 TDD (651) 282-5332
 Toll-free/TDD (800) 657-3864
www.pca.state.mn.us

Recycling contaminated land: a record of success

Throughout the 1980s and 1990s, Minnesota placed a priority on removing risks to humans and the environment from land contaminated by chemicals. Contaminated lands that posed the greatest risks were addressed first, and today they pose a much reduced risk. Once cleaned up, the land is recycled

for future uses. From 1994 to 2004, the acres of land recycled voluntarily by land owners increased from 438 acres to more than 55,000 acres, an area more than three times the size of Lake Minnetonka.

Because of these past successes, Minnesota is now able to focus greater attention on new environmental issues.

