

# SECTION TWO: WATERS AND WATERSHEDS

## GOAL: MINNESOTA'S WATER RESOURCES AND WATERSHEDS WILL BE CONSERVED AND ENHANCED

DNR and partners are working for a future where healthy watersheds are found throughout Minnesota. There are abundant supplies of



clean water for people and nature. Aquatic ecosystems are healthy and sustainable. Fish and wildlife populations and natural communities that depend on them are adaptive and self-sustaining. People respect and appreciate the interrelationships among lands and waters. This goal for the future envisions:

- **Waterways have integrity.**

Natural characteristics of shorelines, aquifers, and wetlands are protected. Formerly disrupted stream flow has

been restored whenever possible. Storm water is managed in ways that protect downstream resources. Point and nonpoint source pollution is minimized. Harmful invasive species have been reduced, and no new invaders are introduced.

- **Water resources are conserved.** Ground water and other water resources are used in a way that preserves their integrity for future generations. They are shared among recreation, residential, and commercial uses while retaining their ability to sustain natural systems. Sensitive and rare aquatic communities, such as trout streams and calcareous fens, are protected.

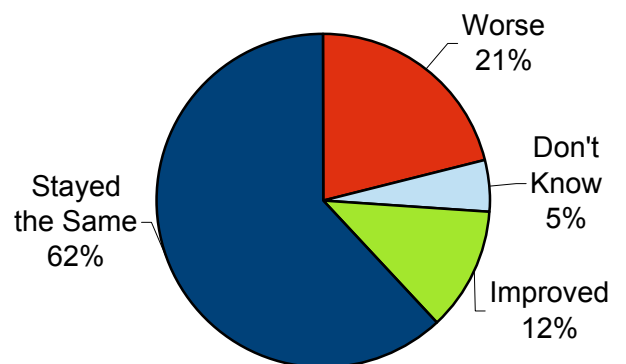


DNR provides water resources information to citizens and local governments. Here, a DNR hydrogeologist discusses ground-water chemistry with a farmer in Otter Tail County.

### DNR - WHAT WE DO

- Collect water data and coordinate technical analysis for Minnesota's ground water and surface water
- Regulate activities that affect the state's waters, such as water use, shoreland alterations, and other land uses
- Provide technical assistance to local units of government on water management and safety issues, e.g., those related to flooding
- Assist local watershed planning through information and education, e.g., related to storm-water management

### Perceptions of Lake Quality



Perceptions of lake quality. About one in five Minnesota lake users responding to a 1998 statewide survey perceived the lake they used most to be in a state of decline. About three in five thought it was remaining the same, and about one in 10 thought it was improving.

## POSITIONING DNR FOR THE FUTURE

In 2010 DNR created the new Division of Ecological and Water Resources to expand watershed conservation and integrate clean water and habitat management work. This new division will improve results such as:

- ensuring all water clean-up (TMDL) plans incorporate ecological and hydrological expertise to produce habitat and clean water benefits
- supporting efforts to conserve wetland-grassland habitat needed to restore 1 million breeding ducks to Minnesota by 2056

## CRITICAL TRENDS

**Shoreline development** is a major factor in maintaining and improving lakes and rivers for natural habitat and recreation. The median number of homes per lakeshore mile in Minnesota has grown from fewer than three in 1950 to more than 16 today. Along with homes come septic systems, recreational impacts, introduction of invasive species, and changes in shorelines and near-shore vegetation. As baby boomers retire, we expect shoreline development to become even more intensive. Small, single-lot changes to the shore can add up to a huge negative impact on the environment and all life that depends on it.



DNR partners with citizens and local groups to restore shoreline habitat and promote water quality.

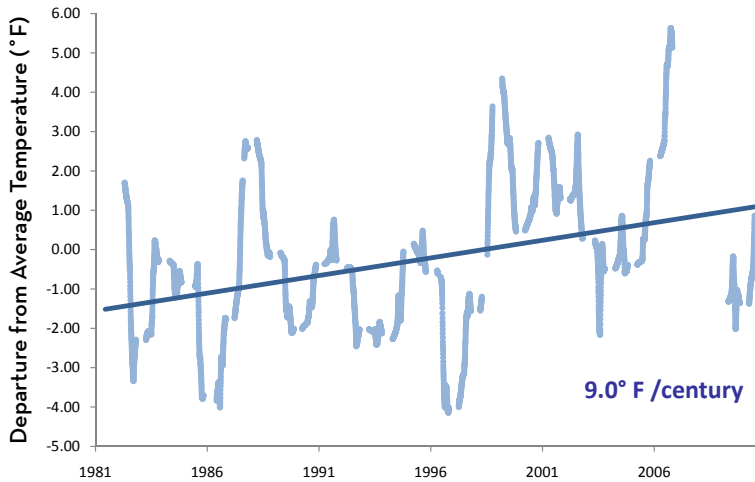
**Trends in water use** are a sobering reminder of the need to think and act creatively and strategically to meet the needs of an increasing—and increasingly demanding—population within the constraints of a finite resource. Demand for water is increasing faster than population growth is increasing. As demand grows, some communities are struggling to find adequate supplies of clean water.

There are increasing numbers of **impaired waters**. Of the 10 percent of Minnesota surface water bodies tested, 40 percent are impaired in some way. Impairments include excessive nutrients, sediment, bacteria, mercury, and other contaminants. As testing proceeds, the number of impaired waters will increase and the challenge of restoring them while protecting our healthiest waters will become even greater.

Continued **wetland loss** will be a significant impediment to efforts to renew and sustain Minnesota's water resource. Wetlands provide habitat and protect water quality in lakes and streams. Nearly half of Minnesota's wetland acres have been drained or filled. In the prairie region of the state, over ninety percent of the wetlands have been lost. High-quality prairie wetland complexes, important for healthy waterfowl populations, are in short supply. Although the Wetland Conservation Act of 1991 has slowed wetland loss in some settings, we are still losing wetlands. Drain tiling continues to remove water off the landscape. Efforts to measure specific trends are underway and will help guide decision making.

Trends in **stream management** have the potential to affect water resources in positive ways. Local community interest in restoring natural stream flows and removing many of the state's unsafe and unsound dams bodes well for water and ecological resources. These efforts will enhance habitat, improve water quality, and benefit river recreation and public safety.

## Lake Superior Surface Water Temperature



©State Climatology Office, DNR Eco-Waters, Supt. 2010

**This graph shows the trend in Lake Superior surface water temperature from 1981-2010 in terms of departure from average temperatures, measured at a buoy near the center of the lake. The water temperature has increased about 2.7° F. over the past 29 years, or 9° F. per century.**

To make progress we can no longer treat water issues as isolated problems. We must manage our land, wetlands, surface waters, and ground water as interdependent systems. DNR is one of many partners (individuals, nongovernmental organizations, public agencies, businesses) committed to protecting Minnesota's valuable and vulnerable water resources. DNR's new Division of Ecological and Water Resources and the passage of the 2008 Legacy Amendment provide a significant opportunity to improve water quality and realize our envisioned future. The indicators and targets that follow illustrate just some parts of this broader picture.

**Climate** has a fundamental influence on aquatic habitats. Air temperature is a key determinant of water temperature, and water temperature determines which species can live in an area and how fast they can grow. Climate changes in the recent past appear to be impacting aquatic systems. For example: Cisco (cold-water fish) have declined by 77% since 1975, and largemouth bass and bluegill (warm-water fish) are expanding north. In the last 29 years, average Lake Superior water temperature has increased by 2.7 degrees F. This translates to a warming rate of 9.0 degrees F per century, one of the fastest warming rates observed in the region. Climate change and human alterations to watersheds are also expected to increase flood events. The net outcome of these changes on our lakes and streams will likely be complex and difficult to predict. As resource managers, we must be prepared to face a shifting climate and modify our management practices to keep pace with change.



**Local governments use water resources information to guide local water planning efforts. Here, DNR staff train county staff to use County Geologic Atlas data.**

# WATER RESOURCES INDICATORS & TARGETS

INDICATOR	TARGET	PAGE
<b>Mapping and Monitoring</b>		
Gallons of public water use	Distribute water conservation education materials to DNR facilities and encourage implementation of water conservation practices	14
Number of counties with a County Geologic Atlas or a Regional Hydrogeological Assessment	Complete two atlases each fiscal year through 2012	15
Number of hydrologic monitoring sites	Establish and maintain a hydrologic monitoring network that provides timely, accurate and necessary information for emergency response and sustainable natural resource management in coordination with federal, state and local partners	16
<b>Flood Damage Reduction</b>		
Number of buildings removed from flood plains to prevent flood damages	Maintain or increase efforts to remove buildings from flood plains	17
<b>Lake, River and Stream Conservation</b>		
Number of shoreline miles protected in Aquatic Management Areas (AMAs)	Acquire 100 miles of trout-stream access and permanently protect 75 miles of lakeshore in AMAs from 2010-2017; Acquire 33 miles of trout-stream access and permanently protect 23 miles of lakeshore in AMAs from 2018-2033	18
Amount of lakeshore habitat restored	Restore 10,000 to 15,000 linear feet of shoreline in FY 2011	19
Number of mine pit lakes and associated watersheds restored	All new permits incorporate watershed planning	20
Number of river and stream restoration projects; Number of unsafe or unsound dams removed or modified	Complete seven additional river and stream restoration projects by FY 2013	21
Number of water bodies with current mussel data; number of long-term mussel monitoring sites	Resurvey mussels in watersheds of highest priority by 2012; Establish 16 long-term mussel monitoring sites by 2012	22
<b>Clean Water Legacy</b>		
Fish contaminant levels in important fishing waters	Resample major lakes and rivers for fish contamination on an approximate five-year cycle; work with PCA for mercury trend lake resampling on a two to five year cycle; collect and test additional amples to support the Clean Water Legacy Initiative	23

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# WATER RESOURCES INDICATORS & TARGETS

INDICATOR	TARGET	PAGE
<b>Wetlands Conservation</b>		
Ability to monitor 'no net loss' of Minnesota wetlands; net change in MN wetland acres	Continue to monitor trends in wetland gains and losses to assess progress toward meeting Minnesota's no net loss goal	24
<b>Aquatic Invasive Species</b>		
Number of water bodies infested with Eurasian watermilfoil and zebra mussels	Limit the rate of spread of Eurasian watermilfoil to no more than 10 new water bodies per year, and prevent spread of zebra mussels to waters not connected to previous infestations	25
Number of watercraft users contacted about aquatic invasive species	Maintain or increase aquatic invasive species enforcement and education efforts	26

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# WATER USE

## INDICATOR: Gallons of public water use

### WHY IS THIS INDICATOR IMPORTANT?

In Minnesota, growth in demand for water resources is outstripping population growth. To protect water-related resources and help prevent water shortages, we need to plan water supply. Tracking water use helps us maintain the integrity of Minnesota's lakes, rivers, and ground water.

### WHAT IS DNR DOING?

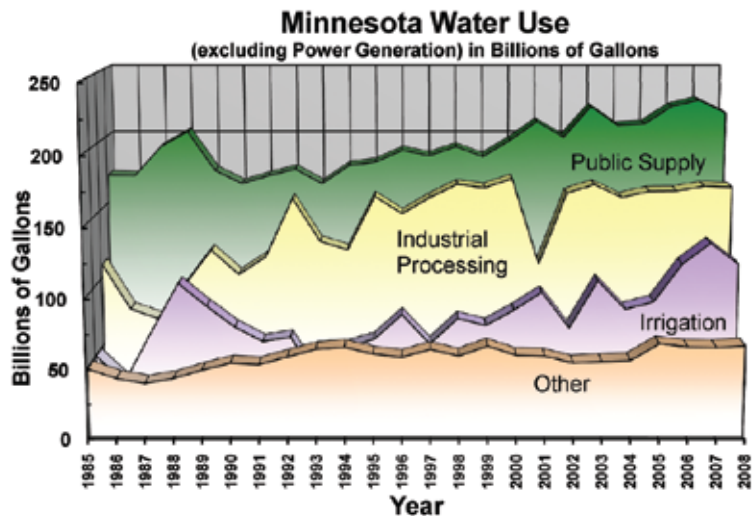
DNR administers Minnesota's water appropriation program, which was established in 1937 to develop and manage water resources to assure adequate supplies for domestic, municipal, industrial, agricultural, fish and wildlife, recreational, power, navigation, and quality-control purposes. The program resolves water use conflicts and well interferences caused by competing demands, and helps municipalities and others with long-term water supply planning.

Users that exceed 10,000 gallons per day or 1 million gallons per year must obtain permits and submit annual water use reports. There are currently 7,242 active permits. Water use data helps to identify impacts of water withdrawals on natural resources and other users.

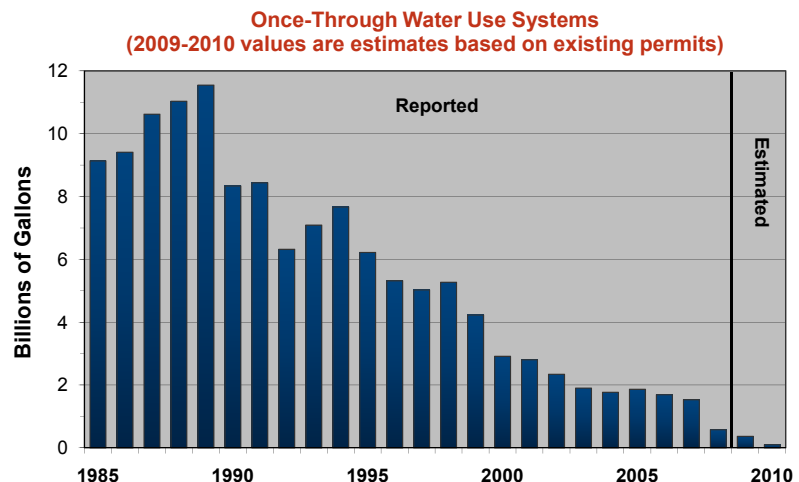
Protecting water supplies for high-priority uses requires reducing waste. In 1988, some 11 billion gallons of ground water were used for once-through heating and air conditioning. DNR is working to help phase out such use by 2010.

### TARGET: Distribute water conservation education materials to DNR facilities and encourage implementation of water conservation practices.

Water use is related to a number of factors, including climate, population, and economic conditions, so it is difficult to set annual targets. However, general information on water use will help DNR and local communities maintain sustainable water resources. Developing water-use protection thresholds is another activity that will help communities and other users with long-term water supply planning.



Minnesota water use (excluding power generation), 1985 to 2008. At approximately 850 billion gallons per year power generation is the largest user and accounts for 60% of total water use and 74% of all surface water use.



Ground water used for once-through heating and air-conditioning. DNR is working to phase this use out by 2010.

### LEARN MORE ABOUT:

- Water supply data from DNR: [www.mndnr.gov/waters/data](http://www.mndnr.gov/waters/data)
- Water quality data from the Pollution Control Agency: [www.pca.state.mn.us/water/groundwater](http://www.pca.state.mn.us/water/groundwater)

# WATER RESOURCES DATA

**INDICATOR: Number of counties with a County Geologic Atlas or a Regional Hydrogeological Assessment**

## WHY IS THIS INDICATOR IMPORTANT?

Hydrogeology is the study of the distribution and movement of water in the ground. Hydrogeologic information helps communities find reliable sources of water and manage water and land in a way that sustains high-quality water resources.

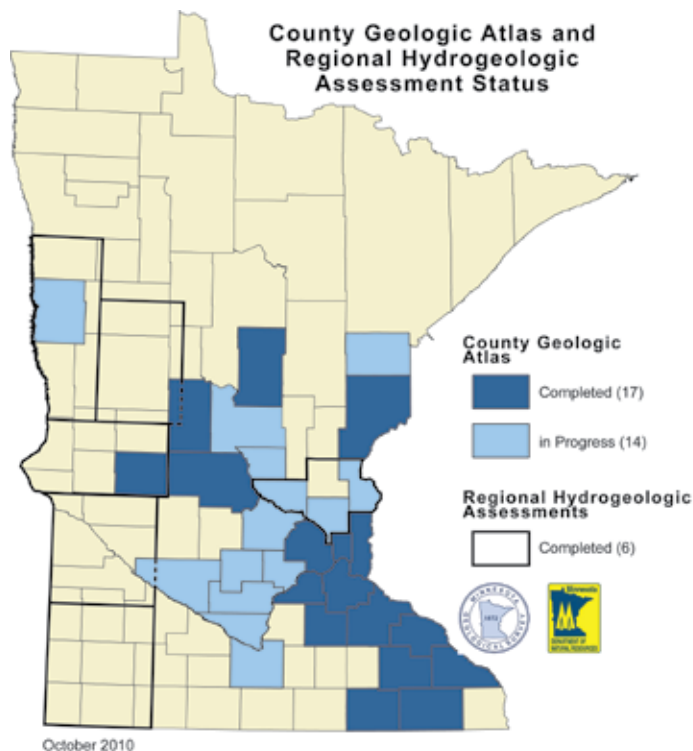
Without informed water supply planning, public water shortages may occur and surface waters (wetlands, lakes, rivers, and unique resources such as trout streams and fens) may be degraded from groundwater pumping or land-use changes.

## WHAT IS DNR DOING?

DNR works with the Minnesota Geological Survey (MGS) to develop County Geologic Atlases and Regional Hydrogeological Assessments to convey geologic and hydrogeologic information and interpretations to government units at all levels, but particularly to local governments.

These studies provide information about the region's geology and groundwater's presence, direction of flow, natural quality, age, and pollution sensitivity. This information is used in planning and environmental protection efforts. Source water protection and well sealing programs are examples of local programs that need geologic and groundwater information. Other typical uses include providing information for permit applications, resource management, monitoring needs, and emergency response to contaminant releases.

**TARGET: Complete two atlases each fiscal year through 2012.** At this rate we will provide statewide coverage of geologic atlases within 25 years and improve our understanding of the hydrogeologic setting so that decision-makers have the best available information to aid in sustainable land and water resource management decisions. Seventeen atlases and six assessments have been completed and fourteen atlases are underway. Completed and in-progress atlases and assessments include 83 percent of the state's population and 45 percent of the state's area. We also aim to update older atlases to incorporate current data and the latest science and technology.



Information for local communities. DNR and the Minnesota Geological Survey help communities manage water resources by working together to provide hydrogeologic information.



DNR hydrogeologists collect data and develop useful information and maps for citizens and local governments.

## LEARN MORE ABOUT:

- Atlases and assessments at: [www.mndnr.gov/waters/groundwater\\_section/mapping/index.html](http://www.mndnr.gov/waters/groundwater_section/mapping/index.html)
- County maps at: [www.mndnr.gov/waters/groundwater\\_section/mapping/status.html](http://www.mndnr.gov/waters/groundwater_section/mapping/status.html)
- The Minnesota Geologic Survey at: [www.geo.umn.edu/mgs/index.html](http://www.geo.umn.edu/mgs/index.html)

# HYDROLOGIC MONITORING NETWORK

**INDICATOR:** Number of hydrologic monitoring sites

## WHY IS THIS INDICATOR IMPORTANT?

Water constantly moves among air, lakes, streams, soil, and aquifers. Natural and human alterations of this cycle can result in problems such as rapid runoff, high lake levels, altered subsurface water levels, and changes in water supply. A quality hydrologic monitoring network informs decision-making that fosters a healthy economy, environment, and communities. More accurate and timely data improve flood warning and response, water supply management, clean water, and many other decisions that affect quality of life in Minnesota.

## WHAT IS DNR DOING?

DNR uses a variety of methods to monitor and maintain the quantity and quality of Minnesota's waters. Working with citizen observers and other agencies, DNR measures precipitation, lake levels, streamflow, and groundwater levels at more than 2,800 locations. Information gathered forms a baseline against which to evaluate fluctuations and determine if they are natural or human induced.

The County Geologic Atlas Program (see Water Resources Data indicator), in combination with the improved groundwater monitoring network being established for the 11-county Twin Cities metropolitan area, will help local, regional, and state water managers understand how to sustainably manage aquifers and protect groundwater quantity and quality.

Looking forward, DNR will continue to improve monitoring and mapping to better address climate change, clean water goals, and local planning needs, and to help ensure we have sustainable quantities and quality of water to meet Minnesota's future needs.

**TARGET: Establish and maintain a hydrologic monitoring network that provides timely, accurate information needed for emergency response and sustainable natural resource management in coordination with federal, state and local partners.** We will establish new data collection locations and maintain old ones based on the needs of agency and local partners. Our 10-year goal includes completing the 11-county groundwater monitoring network, establishing at least five groundwater management areas for greater Minnesota based on interagency priorities, creating an integrated interagency surface water and groundwater data input and retrieval system, and establishing a stream flow monitoring network that supports MPCA's TMDL efforts in the 81 major watersheds and improves advance flood warning for communities most susceptible to flood damage. Recent accomplishments include evaluating 1,018 wells (61% of the state's monitoring well network), replacing several hundred rain gages used by state volunteers, and installing more than 75 multiple-use, real-time telemetry stream gages.



DNR and partners measure precipitation, lake levels, stream flow, and well water levels around the state.

## LEARN MORE ABOUT:

- Minnesota's water resources at: [www.mndnr.gov/waters](http://www.mndnr.gov/waters)



# PREVENTING FLOOD DAMAGE

**INDICATOR:** Number of buildings removed from flood plains to prevent flood damage

## WHY IS THIS INDICATOR IMPORTANT?

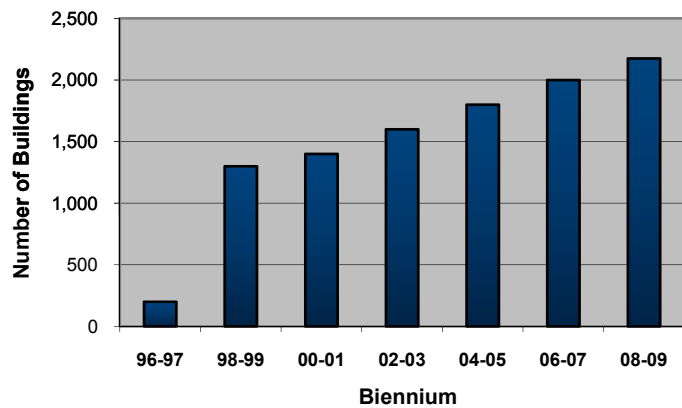
Flooding is a natural part of lake & river systems, but flood extremes can harm people and property. While some causes of flooding—climate and precipitation—are beyond our control, we can reduce flood damage by protecting healthy watersheds, removing people and structures from harm's way, and preparing for floods when they do occur.

## WHAT IS DNR DOING?

DNR monitors 38 stream gages around the state to provide data for flood forecasting and promotes sound land use in flood plains. DNR works with communities throughout the state to get them enrolled in the National Flood Insurance Program and to adopt and update the local floodplain management regulations. DNR also provides communities with technical assistance and guidance in administering the local ordinances. Since 2004, FEMA efforts and funding for updating the Flood Insurance Rate Maps has accelerated. DNR plays a critical role in providing data, coordinating with communities, and reviewing these maps.

DNR also helps local governments fund flood damage reduction measures. Since 1987, DNR has provided funds to communities to build flood-control structures, define flood hazard areas, and buy and remove flood-prone buildings. Austin, for example, spent \$13 million of federal, state, and local funds to acquire flood-prone homes and businesses. When major flooding occurred there in 2000, 2004, and 2008, cost savings due to removal of flood-prone buildings far exceeded the cost of acquiring the structures.

**Cumulative Number of Buildings Removed from Flood Plains**



Number of buildings removed from flood plains. By removing homes and businesses from flood plains, DNR and communities save the expense and danger of protecting them when floods occur.



Oslo, Minnesota, largely protected during the devastating Red River flood of 1997. A \$2 million flood project in 1984 reduced the damage to Oslo from the 1997 flood and has prevented over \$50 million in flood damages since its construction.

**TARGET: Maintain or increase efforts to remove buildings from flood plains with available funding and through other cooperative efforts.** DNR supports local flood plain management zoning and regional flood control efforts, such as those in the Red River Valley. DNR will work with the Governor's Initiative in the Red River Valley to develop indicators and targets related to flood damage.

## LEARN MORE ABOUT:

- Flood damage reduction programs at: [www.mndnr.gov/waters/watermgmt\\_section/flood\\_damage](http://www.mndnr.gov/waters/watermgmt_section/flood_damage)
- Flood plain management at: [www.mndnr.gov/waters/watermgmt\\_section/floodplain](http://www.mndnr.gov/waters/watermgmt_section/floodplain)

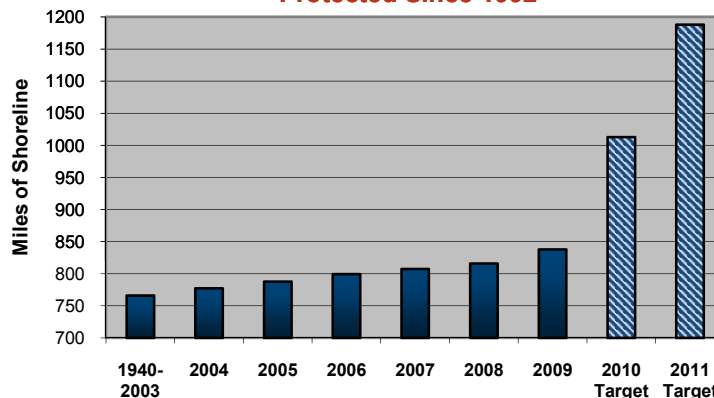
# AQUATIC MANAGEMENT AREAS

**INDICATOR: Number of shoreline miles protected in Aquatic Management Areas (AMAs)**

## WHY IS THIS INDICATOR IMPORTANT?

Fishing is a key component of Minnesota's quality of life. Minnesota has approximately 1.5 million licensed anglers, and fishing-related activities contribute \$2.8 billion annually in direct expenditures to the state's economy. Demand for shoreline property is high, and these areas are rapidly being developed. DNR's acquisition of riparian shoreline parcels called Aquatic Management Areas (AMAs) ensures that critical fish and wildlife habitat will be conserved, non-boat public access to water resources will always be available, and habitat can be developed on previously disturbed areas. Acquisition of AMAs is a critical step in maintaining Minnesota's reputation for providing excellent fishing opportunities and an outstanding quality of life for those who visit and live here.

**Cumulative Miles of Shoreline Protected Since 1992**



The AMA program officially started in 1992, however, protection of riparian shoreline areas began much earlier. These lands are now managed under the AMA program.

## WHAT IS DNR DOING?

The AMA program, created by the 1992 Legislature as part of the Outdoor Recreation Act, administers more than 838 AMA shoreland miles across Minnesota. This is in addition to 23 miles of shoreland previously acquired, and still managed as Fish Management Areas (FMAs). AMAs provide angler and management access, protect critical shoreland habitat, and provide areas for education and research.

In October of 2007 "Minnesota's Aquatic Management Area Acquisition Plan 2008-2033" was developed by a citizen's planning committee. This plan set ambitious AMA acquisition goals, which will promote the continued conservation of this important resource.

**TARGET: Acquire 100 miles of trout-stream access and permanently protect 75 miles of lakeshore in AMAs from 2010-2017. Acquire 33 miles of trout stream access and permanently protect 23 miles of lakeshore in AMAs from 2018-2033.**

During calendar years 2008-09 DNR acquired around 30.5 miles of lake and stream shore to be permanently protected as AMAs. With additional funding the goals of the citizen's planning committee can be reached. DNR will continue efforts to acquire permanent conservation easements on Minnesota's designated trout streams consistent with evolving management needs, angler access opportunities, and funding availability. DNR will continue to acquire appropriate fee title and conservation easements on lakes and warmwater streams whenever non-motorized public access to water resources is available and as parcels with critical habitat become available, partnership opportunities arise, and annual funding allows.



### LEARN MORE ABOUT:

- DNR Trout Stream Easement Program at: [www.mndnr.gov/fisheries/management](http://www.mndnr.gov/fisheries/management)

# SHORELAND HABITAT CONSERVATION

**INDICATORS:** Amount of lakeshore habitat restored

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## WHY IS THIS INDICATOR IMPORTANT?

Healthy shorelines have long been recognized as critical for water quality, aquatic plants, and fish and wildlife that live in or near Minnesota's lakes and streams. In 2003, a Bemidji State University study showed that lake water clarity is significantly related to lakeshore property values. The study states that the worst land-use practices include the removal of trees, native plants, and aquatic vegetation along shorelines. As native shoreline habitat is lost to development, shorelines lose their ability to support the fish, wildlife, and clean water that are so appealing to the people attracted to Minnesota's water resources.

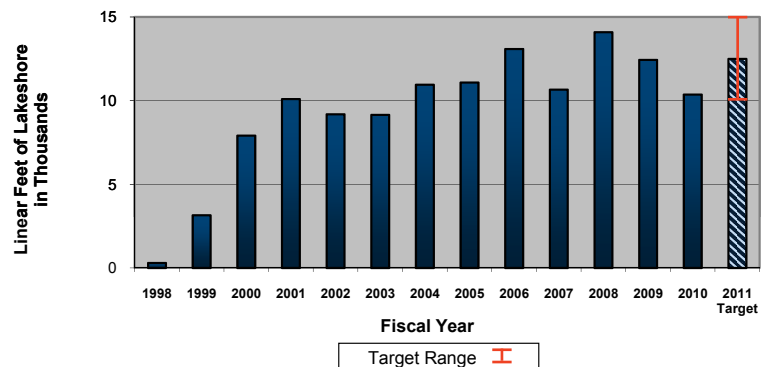
## WHAT IS DNR DOING?

DNR provides education, technical assistance, and grants to conservation organizations and local governments to restore altered shoreline habitat in order to expand diversity and abundance of native aquatic plants, improve and protect quality of shoreline habitat, and enhance and protect water quality. Since 1998, DNR has helped restore shoreland on over 339 sites, comprising 112,121 linear feet and over 88 acres of shoreland habitat.

Despite these accomplishments, there are still many more potential partners and projects that could accelerate shoreland restoration efforts. To identify barriers to participation in shoreland restoration efforts, DNR is working with the University of Minnesota on a human dimensions study of landowner attitudes and beliefs about vegetative buffers on Minnesota lakes. This study will help to tailor future communications and technical assistance to landowners and will assist in the prioritization and allocation of shoreland restoration grants and site selection.

**TARGET: Restore 10,000 to 15,000 linear feet of shoreline in FY 2011.**

Amount of Lakeshore Habitat Restored



Amount of lakeshore habitat restored. DNR has helped restore over 112,000 linear feet of lakeshore.



This restored private shoreline property on Red Rock Lake in Douglas County improves habitat and water quality.

## LEARN MORE ABOUT:

- Shoreland habitat and fisheries management at: [www.mndnr.gov/fisheries/management/habitat.html](http://www.mndnr.gov/fisheries/management/habitat.html)
- Shoreline restoration interactive CD-ROM and books at: [www.mndnr.gov/restoreyourshore](http://www.mndnr.gov/restoreyourshore)
- Natural shorelands at: [www.mndnr.gov/shorelandmgmt/ecosystems/natural\\_shoreland.html](http://www.mndnr.gov/shorelandmgmt/ecosystems/natural_shoreland.html)

# MINE PIT WATERSHED RESTORATION

**INDICATOR: Number of mine pit lakes and associated watersheds restored**



View of the Hull-Rust Mine near Hibbing, Minnesota.

## WHY IS THIS INDICATOR IMPORTANT?

Mining on the Mesabi Iron Range has resulted in major watershed alterations, including the formation of new lakes as depleted open-pit mines fill with water. Some of the mine pits are more than 5 miles long and a mile wide; water depths can exceed 300 feet. Management of these lakes will improve their potential for recreation, water storage, and post-mining development.

## WHAT IS DNR DOING?

Mineland Reclamation Rules and water law require watershed restoration based on sound hydrologic principles, which creates a need for information on natural factors that affect both surface and ground water accumulation and movement. During fiscal year 2004-2005, DNR conducted a project to compile all known hydro-geologic data from across the Iron Range. Using these data with additional site-specific information, DNR is continuing to test a water balance model to help predict future pit water levels, outflow locations, and outflow volumes. Modeling is used to determine potential hydrologic impacts and to help develop restoration plans carried out during and after mining. A recent example is the Central Iron Range Initiative that evaluated pit water hydrology of five pits near Chisholm where the ultimate water elevations are needed for directing future land development surrounding the five pits.

DNR and partners are finalizing a watershed restoration plan for the Canisteo natural iron ore pit near Bovey. Because this pit was deactivated before the promulgation of reclamation rules, there is no longer a mining company available to perform restoration. Instead, DNR is working with local governments, Iron Range Resources, and the U.S. Army Corps of Engineers to secure funding to stabilize rising water and provide for an appropriate outflow.

Finally, long-range watershed restoration planning has been initiated with U.S. Steel for their Minntac Mine, and Northshore Mining Company for their Peter Mitchell Pit. This long-range planning includes cooperatively developing plans for in-pit stockpile construction that will ultimately result in a higher percentage of littoral area and enhanced biological productivity for their mine pit lakes.

**TARGET: All new permits incorporate watershed planning.**

## LEARN MORE ABOUT:

- Mineland educational resources at: [www.mndnr.gov/lands\\_minerals/pubs.html](http://www.mndnr.gov/lands_minerals/pubs.html)

# STREAM RESTORATION

**INDICATOR:** Number of river and stream restoration projects; Number of unsafe or unsound dams removed or modified

## WHY IS THIS INDICATOR IMPORTANT?

Dams, culverts, ditches, agricultural and urban runoff, degraded riparian zones, and pollution make rivers and streams among the most degraded ecosystems in Minnesota. Degradation harms water quality, biological condition, and aquatic habitat by increasing erosion, reducing connectivity, and altering water and sediment transport. Removal or modification of dams and restoration of stream function and stability eliminates safety hazards and improves property values, fish and wildlife habitat, water quality, water availability, and recreational value.

## WHAT IS DNR DOING?

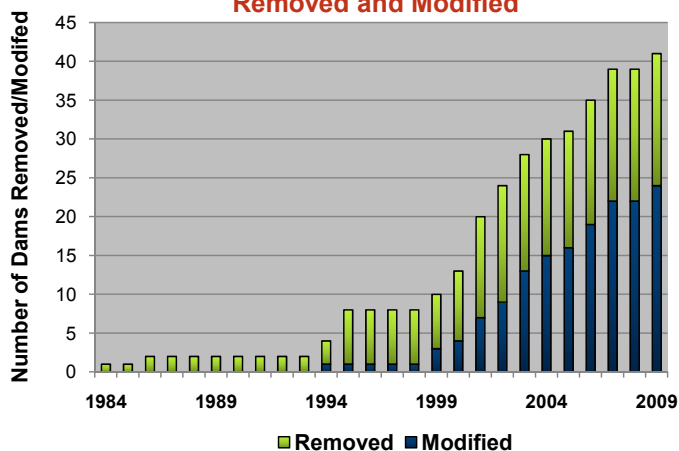
Restoration involves returning a stream to a natural shape so its dimension, pattern, and profile are suited to the water and sediment supply from the watershed. A stream should be able to maintain its shape without accumulating or removing too much sediment and should be connected to a naturally vegetated floodplain. To plan a restoration, we identify the natural, stable channel form and reshape the stream accordingly. DNR has designed and carried out five types of river restoration projects: 1) channel restoration, 2) bank stabilization, 3) dam removal and channel restoration, 4) dam conversion, and 5) fish passage. DNR's dam safety program provides information and funding for removing (up to 100% of costs) or modifying (up to 50% of costs) dams. DNR has helped remove or modify 41 dams and has completed numerous river restorations.

**TARGET: Complete seven additional river and stream restoration projects by FY 2013.** DNR maintains a stream restoration priority list and will pursue funding for top priority restoration projects that have local support. DNR will seek funding of at least \$1 million per year for priority dam projects, including dam modifications and removals. We continue to monitor stream geomorphology and establish an information database to assist with designs and ensure successful restorations.



DNR worked with local communities and agencies to remove a dam and restore the natural meandering shape of the Pomme de Terre River in Appleton. River restoration removes dam hazards, restores stream function and stability, benefits fish and wildlife, and improves water quality and aquatic habitat.

**Cumulative Number of Dams Removed and Modified**



DNR provides funds to help communities remove or modify river dams that are aging, unsafe, or bad for the river environment. So far 41 dams have been removed or modified around the state.

## LEARN MORE ABOUT:

- New publication: "Reconnecting Rivers: Natural Channel Design in Dam Removal and Fish Passage": [www.dnr.state.mn.us/eco/streamhab](http://www.dnr.state.mn.us/eco/streamhab)
- Dam safety at: [www.dnr.state.mn.us/waters/surfacewater\\_section/damsafety](http://www.dnr.state.mn.us/waters/surfacewater_section/damsafety)
- The health of Minnesota's watersheds using the Watershed Assessment Tool: [www.dnr.state.mn.us/watershed\\_tool](http://www.dnr.state.mn.us/watershed_tool)

# FRESHWATER MUSSELS

**INDICATORS:** Number of water bodies with current mussel data; number of long-term mussel monitoring sites

## WHY ARE THESE INDICATORS IMPORTANT?

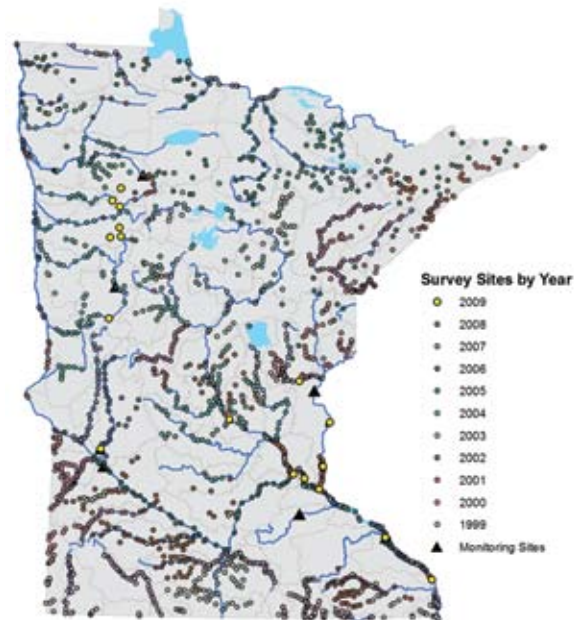
Freshwater mussels are among the most imperiled organisms in North America. Of Minnesota's 49 native species, 27 are listed as either extirpated, endangered, threatened, or of special concern under the state endangered species law. Freshwater mussels thrive in unpolluted streams and lakes with stable bottoms. For this reason they are excellent indicators of aquatic health and water quality. The health of Minnesota's freshwater habitats is threatened by physical and chemical changes from many causes, including drainage, polluted runoff, wastewater discharge, and the loss of mussel communities that are themselves important aquatic habitats for fish. Healthy streams and lakes are important to a myriad of other aquatic organisms, to water-based recreation, and to the economy.

## WHAT IS DNR DOING?

Since the inception of the statewide mussel survey project, 2,260 sites in 406 water bodies have been surveyed. These surveys laid the groundwork for establishing 8 long-term monitoring sites in 2009 at strategic areas around the state to measure success of stream restoration efforts as well as providing a baseline for understanding stream and mussel population health over time. DNR is also actively involved in re-establishing populations of rare mussel species. This work involves studying mussels' early life history so rare species can be cultured and reintroduced into historic habitats. To support this effort and summarize what is known to date, DNR produced a *Field Guide to Freshwater Mussels of Minnesota* and a *Mussels of Minnesota* poster, and contributed to the publication of two scientific articles.

**TARGET: Resurvey mussels in watersheds of highest priority by 2012. Establish 16 long-term mussel monitoring sites by 2012.** Field crews wade, snorkel, and scuba dive to obtain data on species composition and general abundance of mussel populations at selected sites. Monitoring populations provide data on mussel density or abundance, species diversity, and size structure within species (an indicator of reproductive success).

Mussel Sampling Sites 1999-2009



Status of statewide mussel survey. Native mussels are indicators of river health. Despite some water quality improvements in recent decades, surveys in southern Minnesota reveal that native mussels are still on the decline.



Examples of Minnesota's mussel diversity. Minnesota has 49 native mussel species. Of these, 27 are either extirpated, endangered, threatened, or of special concern under the state endangered species law.

## LEARN MORE ABOUT:

- Minnesota mussels and surveys at: [www.mndnr.gov/eco/nhnrp/mussel\\_survey](http://www.mndnr.gov/eco/nhnrp/mussel_survey)

# FISH CONTAMINATION

**INDICATOR:** Fish contaminant levels in important fishing waters

## WHY IS THIS INDICATOR IMPORTANT?

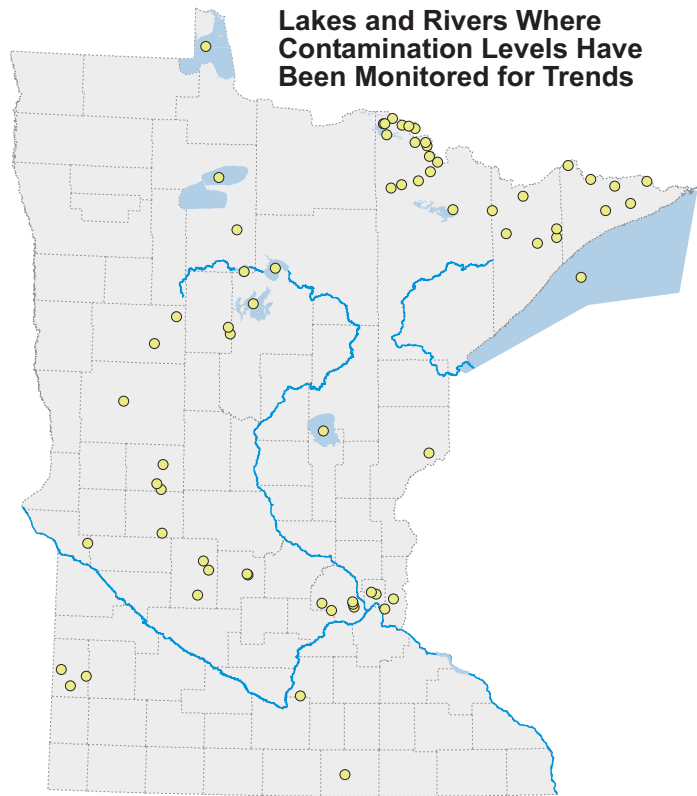
Many outdoor recreationists enjoy fishing and eating the fish they catch. Unfortunately, much of the fishery is contaminated with chemicals, primarily mercury. This has resulted in the issuance of numerous consumption advisories. Fish contaminant data provide the basis for these advisories. They also provide some measure of the threat to other fish-consuming species, including mink, otter, and loons. In addition, the measurement of mercury levels in fish provides an important indicator of progress in attempts to decrease the release of additional mercury into the environment.

## WHAT IS DNR DOING?

Since 1990, DNR has managed the Minnesota Fish Contaminant Monitoring Program (FCMP), and has collaborated closely with other agencies to identify appropriate monitoring goals and to gather and disseminate fish contaminant data. As of 2009, more than 1,080 lakes (out of 6,000 fishable lakes) and more than 100 river reaches had been sampled, including all the state's 11 large lakes, six major rivers, and certain more highly contaminated waters. The FCMP has a plan for resampling the state's 11 large lakes and six major rivers approximately every five years. DNR also is resampling selected mercury trend lakes for Minnesota Pollution Control Agency (PCA) studies on a cycle of two to five years.

## TARGETS: Resample major lakes and rivers for

**fish contamination on an approximate five-year cycle; work with PCA for mercury trend lake resampling on a two-to five-year cycle; collect and test additional samples to support the Clean Water Legacy Initiative.** DNR received new funding in 2006 through the Clean Water Legacy Act for expanded testing of mercury in fish from other water bodies throughout the state. With this funding up to 80 additional water bodies are tested annually, resulting in data that can be used for determining consumption advisories, impairment status, and trend markers for those sites.



Minnesota waters monitored for trends in fish contaminant levels. DNR works with the Minnesota Pollution Control Agency and the Minnesota departments of Health and Agriculture to monitor important fishing waters, analyze trends, and report on fish consumption advisories to Minnesota citizens.

## LEARN MORE ABOUT:

- Minnesota's Fish Contaminant Monitoring Program at: [www.pca-state.mn.us/publications/p-p2s4-05.pdf](http://www.pca-state.mn.us/publications/p-p2s4-05.pdf)
- Minnesota lakes at: [www.mndnr.gov/lakes/index.html](http://www.mndnr.gov/lakes/index.html)
- Lake water quality at: [www.pca.state.mn.us/water/lake.html](http://www.pca.state.mn.us/water/lake.html)
- Fish consumption advisories at: [www.mndnr.gov/lakefind/fca/index.html](http://www.mndnr.gov/lakefind/fca/index.html)

# WETLANDS QUANTITY, QUALITY, AND BIOLOGICAL DIVERSITY

**INDICATORS:** Ability to monitor “no net loss” of wetlands; net change in wetland acres

## WHY IS THIS INDICATOR IMPORTANT?

Minnesota Statutes, Sec. 103A.201 notes: “The legislature finds that the wetlands of Minnesota provide public value by conserving surface waters, maintaining and improving water quality, preserving wildlife habitat, providing recreational opportunities, reducing runoff, providing for floodwater retention, reducing stream sedimentation, contributing to improved subsurface moisture, helping moderate climatic change, and enhancing the natural beauty of the landscape, and are important to comprehensive water management, and that it is in the public interest to: 1) achieve no net loss in the quantity, quality, and biological diversity of Minnesota’s existing wetlands; 2) increase the quantity, quality, and biological diversity of Minnesota’s wetlands by restoring or enhancing diminished or drained wetlands.”

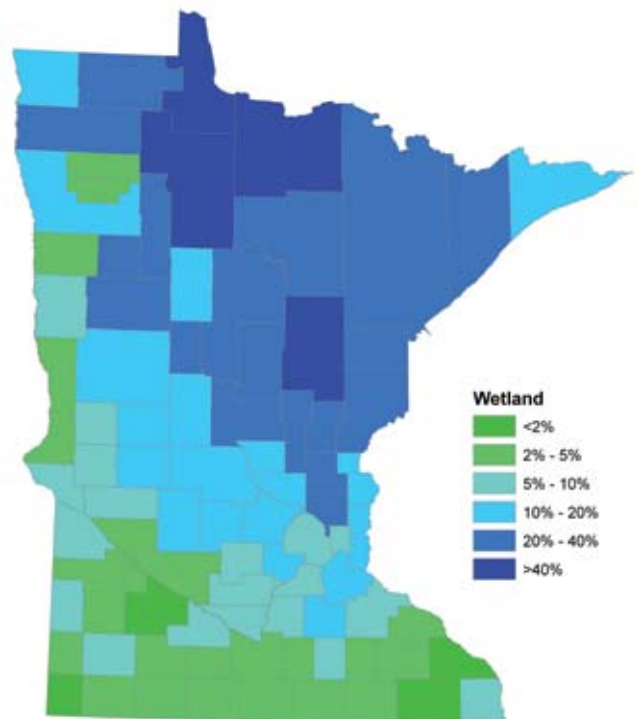
## WHAT IS DNR DOING?

DNR influences impacts to wetlands through the Public Waters and Waters Appropriation Permit Programs and by providing technical information and onsite reviews for other regulatory programs. DNR acquires and restores wetlands on state lands. DNR staff help develop regulations and policies affecting wetlands.

DNR, in cooperation with the Minnesota Pollution Control Agency, operates the only statistically-designed monitoring program to provide a comprehensive, state-wide assessment of wetland quantity and quality trends. This program uses a cyclical design to monitor nearly 5000 random plots. The program was initiated in 2006 and the first full 3 year sampling cycle was completed in fall 2009. These data provide the most comprehensive and up-to-date assessment of wetland status in Minnesota. Initial results for trends in wetland gain or loss will be available beginning in 2010.

## TARGET: Continue to monitor trends in wetland gains and losses to assess progress toward meeting Minnesota’s no net loss goal.

DNR cannot achieve no net loss of wetlands on its own because most wetlands are not on land administered by the state. To promote the conservation of wetlands and achieve the goal of no net loss, DNR has a three point strategy. First, DNR will provide scientifically sound, publicly available monitoring information on wetland gains and losses which can be used to help shape wetland policy and management decisions. Second, DNR will manage wetlands on DNR administered land according to an internal policy which is stricter than state or federal laws. Third, DNR will work with other agencies, non-governmental organizations, and landowners to promote stewardship practices that help achieve the no net loss goal.



Current wetlands in Minnesota: Data from the 2006-2008 cycle of the wetland monitoring program show the current distribution of wetlands across Minnesota. Most counties in northern Minnesota have wetlands covering more than 20% of the land. Most counties in southern Minnesota have less than 5% of their land cover in wetlands. The overall average cover of wetlands and water for Minnesota is 19.6%.

## LEARN MORE ABOUT:

- Minnesota wetlands at: [www.mndnr.gov/wetlands](http://www.mndnr.gov/wetlands)
- Wetland monitoring strategy: [www.mndnr.gov/eco/wetlands/wstm\\_prog.html](http://www.mndnr.gov/eco/wetlands/wstm_prog.html)



# AQUATIC INVASIVE SPECIES

**INDICATORS:** Number of water bodies infested with Eurasian watermilfoil and zebra mussels

## WHY ARE THESE INDICATORS IMPORTANT?

Eurasian watermilfoil and zebra mussels are invasive species that harm Minnesota waters. Eurasian watermilfoil can displace native plants, degrade habitat for fish and wildlife, and limit lake recreation. Zebra mussels can block industrial water intakes (increasing operating costs), alter aquatic food webs, and eliminate populations of native mussels. Unintentional transport on trailered watercraft and water-related equipment is believed to be the primary means of spread for these aquatic species.

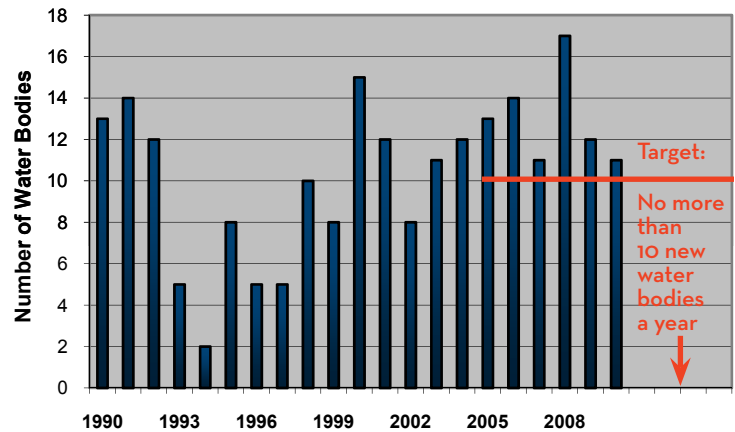
## WHAT IS DNR DOING?

DNR works to increase public awareness and enforce related laws. DNR stations some 90 seasonal watercraft inspectors each year at public water accesses, primarily on infested water bodies, where they inspect boats and inform boaters about invasive species and actions they can take to prevent spread. Numbers of water bodies with Eurasian watermilfoil and zebra mussels likely are much lower than they would have been without these efforts. DNR surveys Minnesota boaters and monitors the distribution of these non-native species to evaluate containment efforts. Although a vast majority of Minnesota boaters said they took action to prevent the spread, more efforts are needed as new infestations continue to be found in the state.

**TARGET:** Limit the rate of spread of Eurasian watermilfoil to no more than 10 new water bodies per year, and prevent spread of zebra mussels to waters not connected to previous infestations.

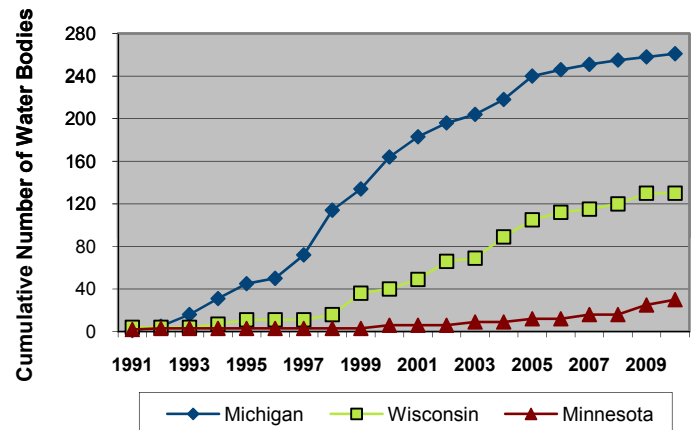
The best way to reduce impacts of harmful invasive nonnative organisms is to prevent their establishment. DNR is working to prevent introductions of new invasive species such as Asian carp.

**Number of Additional MN Water Bodies Where Eurasian Watermilfoil was Found**



DNR control efforts have helped keep Eurasian watermilfoil from spreading to additional water bodies at a rate slightly higher than the target of 10 new water bodies per year.

**Number of Water Bodies with Zebra Mussels in the Upper Great Lakes States**



Minnesota populations of zebra mussels are relatively low—and DNR aims to keep them that way.

## LEARN MORE ABOUT:

- Other aquatic invasive species at: [www.mndnr.gov/invasives/index.html](http://www.mndnr.gov/invasives/index.html)

# AQUATIC INVASIVE SPECIES ENFORCEMENT AND EDUCATION

**INDICATOR:** Number of watercraft users contacted about aquatic invasive species

## WHY IS THIS INDICATOR IMPORTANT?

Watercraft users are the primary means of spreading aquatic invasive species. Direct contact with users helps limit the rate of aquatic invasive species spread (see Aquatic Invasive Species indicator).

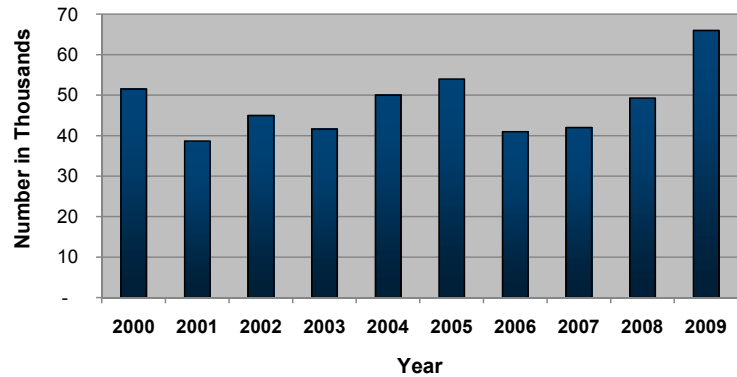
## WHAT IS DNR DOING?

DNR's efforts to reduce the spread of aquatic invasive species focus on legislation, education, and enforcement. The new "drain plug" law requires boaters to remove the plug and drain water before leaving any lake or river in Minnesota. This is intended to prevent the spread of invasive organisms such as zebra mussels, spiny water fleas, and viral hemorrhagic septicemia. DNR-sponsored education campaigns, which include radio spots and billboards, help spread the word about aquatic invasives. In 2010 more than 90 watercraft inspectors spoke with watercraft users to help them understand the impacts of, and laws related to, aquatic invasive species. In response to growing concerns about invasive species, DNR increased its number of watercraft inspectors from 60 to 90 in the past four years and substantially increased enforcement of invasive species laws. Eight conservation officers now spend at least half their time on invasive species enforcement. With increasing awareness of aquatic invasive species laws, conservation officers are issuing many more citations. DNR continues to work with stakeholders to increase the effectiveness of aquatic invasive species laws.

## TARGET: Maintain or increase aquatic invasive species enforcement and education.

In 2009 watercraft inspectors conducted more than 66,000 watercraft inspections, a 60 percent increase over 2006. We expect 2010 inspection numbers to be higher than in 2009. Conservation officers spent 12,357 hours enforcing invasive species laws in FY 2010, four times as many hours as in FY 2006.

Number of Watercraft Inspections for Aquatic Invasive Species



Watercraft inspectors conducted more than 66,000 watercraft inspections in FY 2009, a 60 percent increase over 2006.



Watercraft inspectors help watercraft users understand how they can comply with laws.

## LEARN MORE ABOUT:

- Stop Aquatic Hitchhikers: [www.mndnr.gov/invasives/preventsread.html](http://www.mndnr.gov/invasives/preventsread.html)
- Minnesota invasive species laws: [www.mndnr.gov/eco/invasives/laws.html](http://www.mndnr.gov/eco/invasives/laws.html)

# WATERS AND WATERSHEDS KEY INDICATOR GAPS

## INDICATORS IN DEVELOPMENT:

New indicators were identified to better measure and communicate progress as we pursue the eight strategic directions detailed in *Part I: Strategic Directions*.

The indicators in development include:

Indicator to measure the proportion of tested waters that are impaired and the proportion of TMDL plans with DNR involvement



## INDICATOR GAPS:

Although the indicators in this report have data of sufficient quality and coverage to support trend reporting, we recognize gaps in our ability to report on important natural resources trends. The following is a preliminary list of important indicators that require either additional data or new monitoring efforts. When baseline and trend data for new indicators are available, cooperative efforts will be needed to establish conservation targets. In some cases these gaps are being addressed by a Clean Water Interagency Outcomes and Measures Team.

A preliminary list of indicator gaps includes:

Indicator to measure water storage capacity and flood damage reduction in the Red River Valley

Indicators to track shoreline development and habitat loss trends (see Fisheries and Wildlife)

Indicators to measure of lake quality and pressures related to septic systems, development, etc.

Indicators to measure nonpoint source pollution

Indicators to measure the state's drainage infrastructure; trends in tile line construction; and consequences for flooding, habitat conservation, and water quality