Metadata worksheets for 2014 Clean Water Fund Performance Report

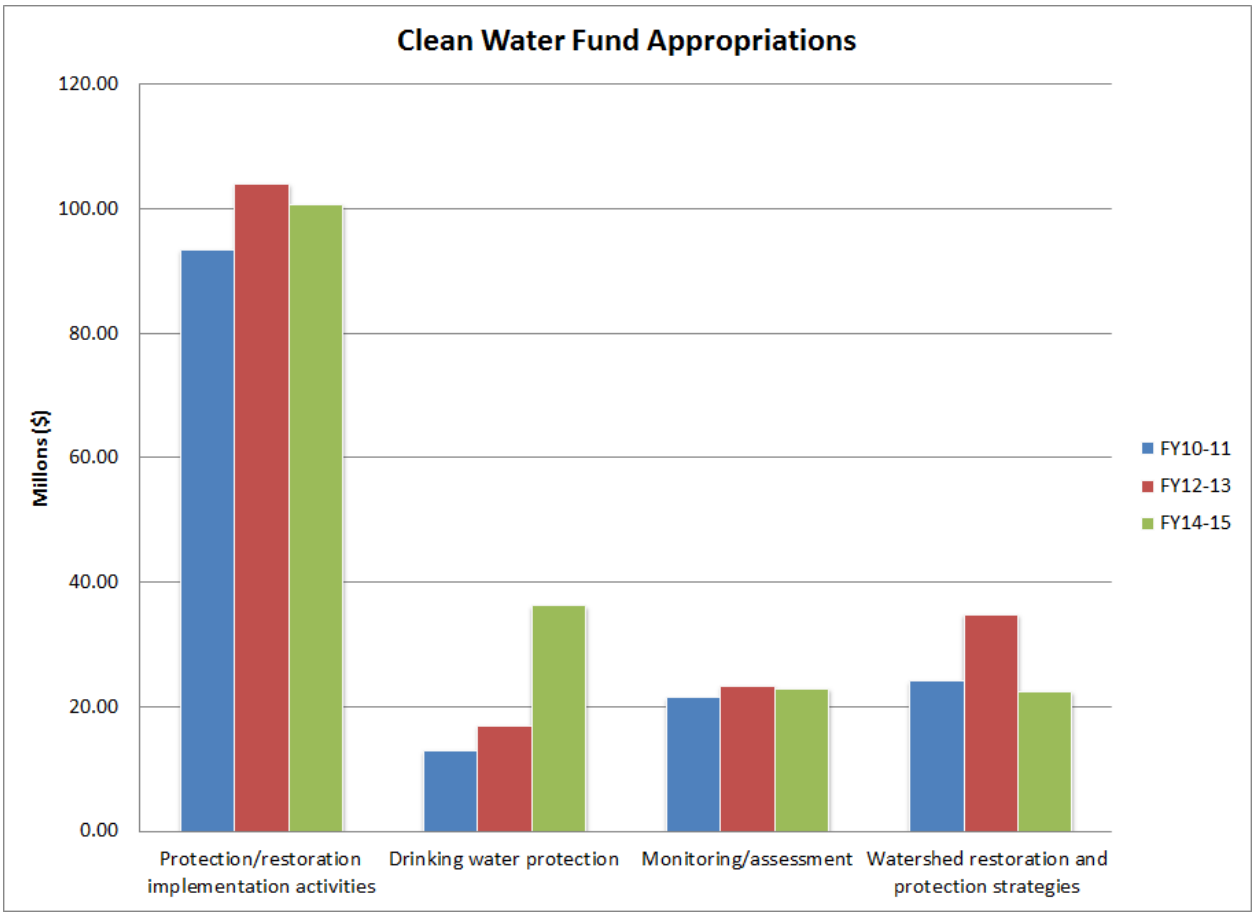
The following metadata worksheets provide detailed information on each of the 24 performance measures and three external drivers listed in the "Clean Water Fund Performance Report," covering fiscal years 2012-2013. Each metadata worksheet includes measure background, methodology used, target or goal, supporting data, caveats and limitations, staff contacts and other useful information. The metadata serves as the foundation for the performance measures and provide documentation necessary to collect consistent and accurate data for the measures over time.

Investment Measures

Total Clean Water Fund dollars appropriated by activity

Measure Background

Visual Depiction



Measure Description

This measure communicates the overall amount of Clean Water Legacy Act funding allocated in a particular year and provides a break-down of that funding in specific categories to demonstrate funding trends over time. This measure provides context for the other financial measures and can be tracked in future years to determine overall appropriation trends. It is the primary investment that enables resources to be spent on the actions that will ultimately help achieve outcomes.

Associated Terms and Phrases

Drinking water protection includes:

- *Source water protection strategies*: Wellhead protection, source water assessment, and surface water intake protection activities that protect water from streams, rivers, lakes, or aquifers that is used for drinking.

- *Water supply planning:* Activities to maintain a safe and sustainable water supply, including the development of local public water supply plans, regional water supply plans, and groundwater management area plans.

Groundwater: The water beneath the land surface that fills the spaces in rock and sediment. It is replenished by precipitation. Groundwater occurs everywhere in Minnesota and supplies about 75 percent of Minnesota's drinking water and nearly 90 percent of the water used for agricultural irrigation. Groundwater also discharges to surface water and allows streams to flow beyond rain and snowmelt periods and sustains lake levels during dry spells.

Protection/restoration implementation includes:

- *Restoration implementation activities*: Implementation of best management practices, improved sewage treatment or other pollution reduction measures to bring an impaired waterbody into attainment with water quality standards. These activities are often funded in response to an approved Total Maximum Daily Load study (TMDL) that determines how much pollution needs to be reduced in order to achieve water quality standards.
- *Protection implementation activities*: Implementation of best management practices to prevent degradation and/or improve waterbodies or aquifers currently meeting water quality standards.

Monitoring and assessment includes:

- *Condition monitoring* – Monitoring consistently throughout the open water season with the objective of assessing the ambient, or background, condition of a lake or stream reach. Results are compared against water quality standards to determine if designated uses are supported.
- *Load monitoring* - Flow and chemistry monitoring conducted at the mouth (or outlet) of each major watershed. Monitoring is conducted at least monthly, and more frequently during events (i.e., snowmelt or rain events). The objective of load monitoring is to capture the entire hydrograph (or variation in the amount of water flowing past a location per unit time), and to determine the pollutant load carried by a stream or river. Results are compared against water quality standards to determine if designated uses are supported.
- *Problem investigation monitoring* – Monitoring with the objective of supporting water quality goals, often in cooperation with other interested agencies. May be conducted in response to accidental wastewater spills or discharges that may affect surface waters. Results are compared against water quality standards to determine if designated uses are supported.
- *Surface Water Assessment Grant (SWAG):* An MPCA grant that passes through funding to local partners for the purpose of conducting condition monitoring. Results are compared against water quality standards to determine if designated uses are supported.
- *Groundwater level monitoring* – Monitoring with the objective of collecting baseline data on groundwater level fluctuations and trends in local and regional aquifers.
- *Groundwater quality monitoring* – Monitoring with the objective of collecting baseline data on groundwater chemistry fluctuations and trends in local and regional aquifers.

Watershed: The surrounding land area that drains into a lake, river or river system. The watershed size used for this measure is at the "major watershed" scale. There are 81 major watersheds in Minnesota.

Watershed restoration and protection strategies includes:

- *Restoration strategies*: Planning activities to restore waterbodies not meeting water quality standards ("impaired"), including the development of a Total Maximum Daily Load study (TMDL) for an impaired water. A "TMDL" means a scientific study that contains a calculation of the maximum amount of a pollutant that may be introduced into a surface water and still ensure that applicable water quality standards for that water are restored and maintained. It results in pollution reduction goals for all sources of a pollutant in a watershed.
- *Protection strategies*: Planning activities to protect high quality ground and surface waters that are currently achieving water quality standards.

Target
There is no specific numeric target for this measure to date. A numeric target for this measure may be appropriate after funding trends over time are established.

Baseline
FY 10-11 serves as the baseline for this measure.

Geographical Coverage
Statewide

Data and Methodology

Methodology for Measure Calculation
The information for this measure is calculated every biennium according to appropriations for each major category.

Data Source
The data for this measure are provided by the Clean Water Fund Interagency Team following biennial appropriations.

Data Collection Period
Data for this measure span fiscal year (FY) 2010-2011, 2012-2013, and 2014-2015.

Data Collection Methodology and Frequency

Supporting Data Set

Clean Water Fund Appropriations	FY10-11	FY12-13	FY14-15
Protection/restoration implementation activities	$93.5M	$104.1M	$100.7M
Drinking water protection	$13.0M	$17.0M	$36.3M
Monitoring/assessment	$21.5M	$23.4M	$23.0M
Watershed Restoration and protection strategies	$24.2M	$34.9M	$22.5M

Caveats and Limitations
None at this time.

Future Improvements
None at this time.

Financial Considerations

Contributing Agencies and Funding Sources
Funding displayed in this measure are for the programs and activities of the Minnesota Pollution Control Agency, Board of Water and Soil Resources, Department of Natural Resources, Department of Health, Department of Agriculture and Public Facilities Authority. These agencies also direct funding to a myriad of local government and nonprofit agencies.

Communication Strategy

Target Audience
Stakeholders with interest in this measure include the State legislature, the Clean Water Council, and state agency partners.

Associated Messages
This measure is intended to demonstrate a focus on funding implementation activities. Although there are no numeric targets for this measure, the trend should demonstrate a majority of CWF funding going to implementation activities.

Outreach Format
The principle outreach format for this measure is on the websites of state agencies and possibly the Legislative Coordinating Commission's site.

Other Measure Connections
This measure doesn't explicitly link to other measures, but does help to shed light on what types of projects are receiving funding, which affects progress in under other measure categories. In other words, this measure shows the source of much "inputs" for the "output" and "outcome" measures.

Measure Points of Contact

- BWSR contact: Marcey Westrick, marcey.westrick@state.mn.us
- DNR contact: Julie Westerlund, julie.westerlund@state.mn.us
- MDA contact: Margaret Wagner, margaret.e.mangan@state.mn.us
- MDH contact: Tannie Eshenaur, tannie.eshenaur@state.mn.us
- MPCA contact:
    - Monitoring and assessment – Pam Anderson, pam.anderson@state.mn.us
    - Watershed restoration and strategy development – Denise Leezer (TMDLs, CWP) – denise.leezer @state.mn.us

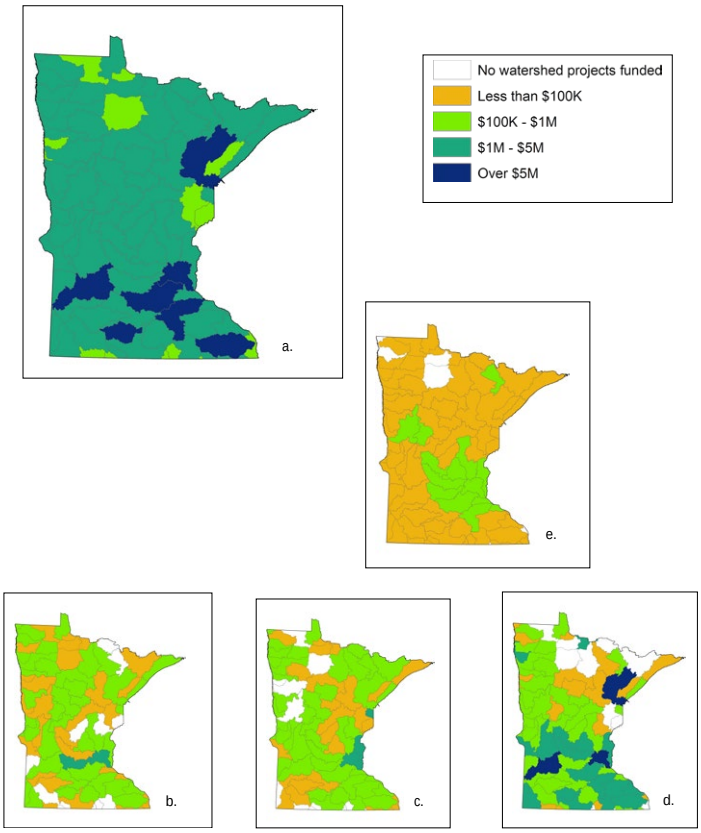
    - Bill Dunn (wastewater/stormwater) – bill.dunn@state.mn.us
- PFA contact: Jeff Freeman, jeff.freeman@state.mn.us
- Metropolitan Council contact: Lanya Ross, lanya.ross@metc.state.mn.us

Total Clean Water Fund dollars invested per watershed or statewide for: 1) monitoring/assessment, 2) watershed restoration/protection strategies, 3) protection/restoration implementation activities, and 4) drinking water protection

Measure Background

Visual Depiction

The figures on the next page illustrate the total FY10-13 Clean Water Fund allocations by watershed for (a) combined watershed-specific projects and statewide activities and technical assistance that benefit all watersheds; (b) monitoring and assessment; (c) watershed restoration/protection strategies; (d) protection/restoration implementation activities; and (e) drinking water protection.



Measure Description

This measure provides a relative sense of the amount of allocations per watershed for each of Minnesota's 81 major watersheds, as well as spending for activities that are more statewide in scope. This data is consistent with data submitted to the Minnesota Legacy website, located at http://www.legacy.leg.mn/funds/clean-water-fund.

Associated Terms and Phrases

Aquifer: Water-bearing porous soil or rock that yield significant amounts of water to wells.

Drinking water protection includes:

- *Source water protection strategies*: Wellhead protection, source water assessment, and surface water intake protection activities that protect water from streams, rivers, lakes, or aquifers that is used for drinking.
- *Water supply planning:* Activities to maintain a safe and sustainable water supply, including the development of local public water supply plans, regional water supply plans, and groundwater management area plans.

Groundwater: The water beneath the land surface that fills the spaces in rock and sediment. It is replenished by precipitation. Groundwater occurs everywhere in Minnesota and supplies about 75 percent of Minnesota's drinking water and nearly 90 percent of the water used for agricultural irrigation. Groundwater also discharges to surface water and allows streams to flow beyond rain and snowmelt periods and sustains lake levels during dry spells.

Implementation includes:

- *Restoration activities*: Implementation of best management practices, improved sewage treatment or other pollution reduction measures to bring an impaired waterbody into attainment with water quality standards. These activities are often funded in response to an approved Total Maximum Daily Load study (TMDL) that determines how much pollution needs to be reduced in order to achieve water quality standards.
- *Protection activities*: Implementation of best management practices to prevent degradation and/or improve waterbodies or aquifers currently meeting water quality standards.

Monitoring and assessment includes:

- *Condition monitoring* – Monitoring consistently throughout the open water season with the objective of assessing the ambient, or background, condition of a lake or stream reach. Results are compared against water quality standards to determine if designated uses are supported. *Load monitoring* - Flow and chemistry monitoring conducted at the mouth (or outlet) of each major watershed. Monitoring is conducted at least monthly, and more frequently during events (i.e., snowmelt or rain events). The objective of load monitoring is to capture the entire hydrograph (or variation in the amount of water flowing past a location per unit time), and to

determine the pollutant load carried by a stream or river. Results are used to calculate loads, yields, and means for pollutants at the outlet of basins, watersheds, and subwatersheds.

- *Problem investigation monitoring* – Monitoring with the objective of supporting water quality goals, often in cooperation with other interested agencies. May be conducted in response to accidental wastewater spills or discharges that may affect surface waters. Results are compared against water quality standards to determine if designated uses are supported.
- *Surface Water Assessment Grant (SWAG):* An MPCA grant that passes through funding to local partners for the purpose of conducting condition monitoring. Results are compared against water quality standards to determine if designated uses are supported.
- *Watershed Pollutant Load Monitoring Network*: An MPCA grant that passes through funding to local partners for the purpose of conducting subwatershed load monitoring. Results are used to calculate loads, yields, and means for pollutants at the outlet of watersheds and subwatersheds.
- *Groundwater level monitoring* – Monitoring with the objective of collecting baseline data on groundwater level fluctuations and trends in local and regional aquifers.
- *Groundwater quality monitoring* – Monitoring with the objective of collecting baseline data on groundwater chemistry fluctuations and trends in local and regional aquifers.

Partners: According to the Clean Water Legacy Act, partners are eligible regional and local government units, state agencies, political subdivisions, joint powers organizations, tribal entities, special purpose units of government, as well as the University of Minnesota and other public education institutions, according to the rules of the funding program (MN Statutes 114D.15). Partners can also include eligible nonprofit or other nongovernmental organizations, depending on the rules of the funding program.

Public Agencies: According to the Clean Water Legacy Act, public agencies means all state agencies, political subdivisions, joint powers organizations, and special purpose units of government with authority, responsibility, or expertise in protecting, restoring, or preserving the quality of surface waters, managing or planning for surface water and related lands, or financing waters-related projects. (MN Statutes 114D.15). Public agencies includes the University of Minnesota and other public education institutions.

Statewide: Spending for activities that are more statewide in scope. This includes projects with more of a statewide orientation than a watershed one, as well as technical assistance for projects provided by stat**e** agencies.

Watershed: The surrounding land area that drains into a lake, river or river system. The watershed size used for this measure is at the "major watershed" scale. There are 81 major watersheds in Minnesota.

Watershed restoration and protection strategies includes:

- *Restoration strategies*: Planning activities to restore waterbodies not meeting water quality standards ("impaired"), including the development of a Total Maximum Daily Load study (TMDL) for an impaired water. A "TMDL" means a scientific study that contains a calculation of the maximum amount of a pollutant that may be introduced into a surface water and still ensure

that applicable water quality standards for that water are restored and maintained. It results in pollution reduction goals for all sources of a pollutant in a watershed.

- *Protection strategies*: Planning activities to protect high quality ground and surface waters that are currently achieving water quality standards.

Target
Not applicable

Baseline
FY 2010-11 – the first biennium of appropriations from the Clean Water Fund.

Geographical Coverage
Coverage is by watershed or statewide.

Data and Methodology *(Note: Data is consistent with data submitted to the Minnesota Legacy website, http://www.legacy.leg.mn/funds/clean-water-fund)*

Methodology for Measure Calculation
Due to the wide variation in state agency program objectives and project management structures, each agency and even units within agencies may use different methods to calculate the dollars reported by this measure. For detailed methodology employed by each agency, contact the people listed in this report. These general guidelines were adopted by all agencies for this report to provide consistency:

Watershed-specific allocations: Best professional judgment was used to determine the distribution of spending for projects occurring in multiple watersheds or projects with unclear boundaries. In general, funding in projects benefiting multiple watersheds was divided equally among those watersheds.

Statewide and technical assistance: The amount of spending on statewide work and technical assistance is consistent with values reported to the Minnesota Legacy website. This category generally includes the total annual cost of projects with a "statewide" benefit including costs of state agency staff providing oversight and technical assistance for all statewide or watershed-specific projects; program activities; and money passed through to partners and contractors working on state-wide projects. Total cost does not include easements.

See "caveats and limitations" below for more information.

Data Source
The primary data source used to develop this measure is the website "Minnesota's Legacy: Watch the Progress" at http://www.legacy.leg.mn/funds/clean-water-fund.

Details needed to allocate spending by watershed were derived from the following sources:

- BWRS's database eLINK4WEB
- DNR's project databases

- Metropolitan Council's database EIMS
- MDA's project databases
- MDH's databases for grant programs
- MPCA's databases including: MAPs/SWIFT, EQuIS, Watershed DELTA, and individual project databases
- PFA's project databases

Data Collection Period

Fiscal year 2010-2013

Data Collection Methodology and Frequency

Data should be collected annually.

It should be noted that monitoring and assessment data collection is complicated by the SWAG contract process. SWAG contracts are finalized the spring after the start of a new fiscal year, and sites monitored through SWAGs are established in EQuIS in early summer after a contract has been executed. Therefore, the earliest the watershed estimates can be made is 1.25 years after the start of a new fiscal year (i.e., can report on FY11 by the end of the first quarter of FY12). Staff salary estimates per watershed could be developed within 6 months after the start of a new fiscal year (i.e., can report on FY11 by the start of the second quarter of FY11).

Supporting Data Set

The table on page 8 provides the data used to report on this measure.

Caveats and Limitations

Overall: The process for collecting data for this measure is a complex process and the results do not represent an exact accounting of funding allocations. Rather, the measure is intended to provide a general sense of how funds are allocated across the state using watersheds as the common geographic unit. For many projects, funding was not allocated by watershed boundaries (county, city, region, etc.) so best professional judgment was employed to determine how to assign project allocations to one or more watershed. Likewise, best professional judgment was used to determine how to allocate funding for projects that had spending in more than one activity category (i.e. monitoring and strategy development and implementation). For detailed information for funding allocations in this measure for a particular project or state agency, contact the agency representative listed below ("Measure Points of Contact").

Monitoring/assessment: Making estimates by fiscal year is difficult, as the FY divides the field season. Note that the monitoring/assessment FY estimate will actually be the cost to monitor and assess the watershed sites begun the summer of the new FY (i.e., FY11 estimate will be the cost to monitor and assess the 2010 watershed sites). Because the monitoring and assessment work is split between MPCA staff and local partners, data is stored in many areas, and much of the data manipulation must be done manually, a large amount of work must be undertaken to break expenses down by watershed.

Future Improvements

It is anticipated that this measure will continue to evolve in future years as agencies improve their process for collecting data. For example, the state agencies are investigating an automated computer system to collect this data in a coordinated way.

Financial Considerations

Contributing Agencies and Funding Sources

BWSR, DNR, MDA, MDH, MetCouncil, MPCA, PFA

Measure Points of Contact

- BWSR contact: Marcey Westrick, marcey.westrick@state.mn.us
- DNR contact: Julie Westerlund, julie.westerlund@state.mn.us
- MDA contact: Margaret Wagner, margaret.e.mangan@state.mn.us
- MDH contact: Tannie Eshenaur, tannie.eshenaur@state.mn.us
- MPCA contact:
    - Monitoring and assessment – Pam Anderson, pam.anderson@state.mn.us
    - Watershed restoration and strategy development – Densie Leezer (TMDLs, CWP) – denise.leezer@state.mn.us
    - Wastewater and Stormwater –Bill Dunn, bill.dunn@state.mn.us
- PFA contact: Jeff Freeman, jeff.freeman@state.mn.us
- Metropolitan Council contact: Lanya Ross, lanya.ross@metc.state.mn.us

Supporting Data Set – FY 10-13(in millions of dollars)

		Monitoring					Watershed Restoration & Protection Strategies			Implementation						Drinking Water					TOTAL
		DNR	Met Council	MDA	MPCA	*Sub-Total*	DNR	MPCA	*Sub-Total*	BWSR	DNR	MDA	MPCA	PFA	*Sub-Total*	DNR	Met Council	MDA	MDH	*Sub-Total*	
STATEWIDE PROJECTS & TECHNICAL ASSISTANCE		$8.21	$0.00	$1.35	$7.6	***$17.16***	$4.29	$23.94	***$28.23***	$0.00	$4.37	$4.67	$0.00	$0.00	***$9.04***	$4.67	$0.00	$0.59	$5.72	***$10.98***	**$70.91**
WATERSHED PROJECTS (BY NAME AND HUC #)																					
Big Fork River	09030006	$0.00	$0.00	$0.00	$0.83	**$0.83**	$0.00	$0.18	**$0.18**	$0.00	$0.00	$0.00	$0.03	$0.00	**$0.03**	$0.00	$0.00	$0.00	$0.01	**$0.01**	***$1.05***
Blue Earth River	07020009	$0.00	$0.00	$0.00	$0.09	**$0.09**	$0.00	$0.19	**$0.19**	$0.61	$0.00	$0.26	$0.00	$0.74	**$1.61**	$0.00	$0.00	$0.00	$0.03	**$0.03**	***$1.92***
Bois De Sioux River	09020101	$0.00	$0.00	$0.00	$0.68	**$0.68**	$0.00	$0.40	**$0.40**	$0.13	$0.00	$0.00	$0.00	$0.07	**$0.20**	$0.00	$0.00	$0.00	$0.00	**$0.00**	***$1.28***
Buffalo River	09020106	$0.00	$0.00	$0.00	$0.11	**$0.11**	$0.00	$0.33	**$0.33**	$0.37	$0.00	$0.11	$0.03	$0.00	**$0.51**	$0.00	$0.00	$0.00	$0.03	**$0.03**	***$0.98***
Cannon River	07040002	$0.00	$0.05	$0.00	$0.49	**$0.54**	$0.00	$0.12	**$0.12**	$0.79	$0.00	$0.99	$0.03	$2.29	**$4.10**	$0.00	$0.17	$0.00	$0.03	**$0.20**	***$4.96***
Cedar River	07080201	$0.00	$0.00	$0.00	$0.00	**$0.00**	$0.00	$0.31	**$0.31**	$0.18	$0.00	$0.45	$0.00	$0.95	**$1.58**	$0.00	$0.00	$0.00	$0.01	**$0.01**	***$1.90***
Chippewa River	07020005	$0.00	$0.00	$0.00	$0.14	**$0.14**	$0.00	$0.34	**$0.34**	$0.55	$0.00	$0.09	$0.09	$1.20	**$1.93**	$0.00	$0.00	$0.00	$0.04	**$0.04**	***$2.45***
Clearwater River	09020305	$0.00	$0.00	$0.00	$0.13	**$0.13**	$0.00	$0.08	**$0.03**	$0.08	$0.00	$0.00	$0.03	$0.08	**$0.19**	$0.00	$0.00	$0.00	$0.01	**$0.01**	***$0.36***
Cloquet River	04010202	$0.00	$0.00	$0.00	$0.01	**$0.01**	$0.00	$0.07	**$0.07**	$0.00	$0.00	$0.00	$0.00	$0.02	**$0.02**	$0.00	$0.00	$0.00	$0.02	**$0.02**	***$0.12***
Cottonwood River	07020008	$0.00	$0.00	$0.00	$0.07	**$0.07**	$0.00	$0.06	**$0.06**	$0.39	$0.00	$0.60	$0.03	$0.00	**$1.02**	$0.00	$0.00	$0.00	$0.02	**$0.02**	***$1.17***
Crow Wing River	07010106	$0.00	$0.00	$0.00	$0.71	**$0.71**	$0.00	$0.47	**$0.47**	$0.23	$0.00	$0.10	$0.06	$0.00	**$0.39**	$0.00	$0.00	$0.00	$0.02	**$0.02**	***$1.59***
Des Moines River - Headwaters	07100001	$0.00	$0.00	$0.00	$0.00	**$0.00**	$0.00	$0.06	**$0.06**	$0.75	$0.00	$0.03	$0.03	$0.00	**$0.81**	$0.00	$0.00	$0.00	$0.01	**$0.01**	***$0.88***
East Fork Des Moines River	07100003	$0.00	$0.00	$0.00	$0.00	**$0.00**	$0.00	$0.00	**$0.00**	$0.17	$0.00	$0.00	$0.00	$0.00	**$0.17**	$0.00	$0.00	$0.00	$0.02	**$0.02**	***$0.19***
Kettle River	07030003	$0.00	$0.00	$0.00	$0.04	**$0.04**	$0.00	$0.07	**$0.07**	$0.00	$0.00	$0.00	$0.06	$0.00	**$0.06**	$0.00	$0.00	$0.00	$0.00	**$0.00**	***$0.17***
Lac Qui Parle River	07020003	$0.00	$0.00	$0.00	$0.00	**$0.00**	$0.00	$0.29	**$0.29**	$0.16	$0.00	$0.00	$0.29	$0.00	**$0.45**	$0.00	$0.00	$0.00	$0.02	**$0.02**	***$0.76***
Lake of the Woods	09030009	$0.00	$0.00	$0.00	$0.22	**$0.22**	$0.00	$0.73	**$0.73**	$0.17	$0.00	$0.00	$0.03	$0.00	**$0.20**	$0.00	$0.00	$0.00	$0.00	**$0.00**	***$1.15***
Lake Superior - North	04010101	$0.00	$0.00	$0.00	$0.66	**$0.66**	$0.00	$0.10	**$0.10**	$0.07	$0.00	$0.00	$0.03	$0.00	**$0.10**	$0.00	$0.00	$0.00	$0.02	**$0.02**	***$0.88***
Lake Superior - South	04010102	$0.00	$0.00	$0.00	$0.47	**$0.47**	$0.00	$0.47	**$0.47**	$0.24	$0.00	$0.00	$0.25	$0.00	**$0.49**	$0.00	$0.00	$0.00	$0.03	**$0.03**	***$1.46***

		Monitoring					Watershed Restoration & Protection Strategies			Implementation						Drinking Water					TOTAL
		DNR	Met Council	MDA	MPCA	*Sub-Total*	DNR	MPCA	*Sub-Total*	BWSR	DNR	MDA	MPCA	PFA	*Sub-Total*	DNR	Met Council	MDA	MDH	*Sub-Total*	
Le Sueur River	07020011	$0.00	$0.00	$0.00	$0.12	**$0.12**	$0.00	$0.56	**$0.56**	$0.68	$0.00	$0.19	$0.03	$0.00	**$0.90**	$0.00	$0.00	$0.00	$0.02	**$0.02**	***$1.60***
Leech Lake River	07010102	$0.00	$0.00	$0.00	$0.57	**$0.57**	$0.00	$0.16	**$0.16**	$0.08	$0.00	$0.00	$0.03	$0.00	**$0.11**	$0.00	$0.00	$0.00	$0.03	**$0.03**	***$0.87***
Little Fork River	09030005	$0.00	$0.00	$0.00	$0.15	**$0.15**	$0.00	$0.20	**$0.20**	$0.00	$0.00	$0.00	$0.00	$0.02	**$0.02**	$0.00	$0.00	$0.00	$0.01	**$0.01**	***$0.38***
Little Sioux River	10230003	$0.00	$0.00	$0.00	$0.03	**$0.03**	$0.00	$0.00	**$0.00**	$0.06	$0.00	$0.00	$0.00	$0.00	**$0.06**	$0.00	$0.00	$0.00	$0.01	**$0.01**	***$0.10***
Long Prairie River	07010108	$0.00	$0.00	$0.00	$0.38	**$0.38**	$0.00	$0.19	**$0.19**	$0.06	$0.00	$0.19	$0.06	$0.00	**$0.31**	$0.00	$0.00	$0.00	$0.02	**$0.02**	***$0.90***
Lower Big Sioux River	10170203	$0.00	$0.00	$0.00	$0.40	**$0.40**	$0.00	$0.00	**$0.00**	$0.22	$0.00	$0.09	$0.00	$1.04	**$1.35**	$0.00	$0.00	$0.00	$0.01	**$0.01**	***$1.76***
Lower Des Moines River	07100002	$0.00	$0.00	$0.00	$0.00	**$0.00**	$0.00	$0.00	**$0.00**	$0.05	$0.00	$0.00	$0.00	$0.00	**$0.05**	$0.00	$0.00	$0.00	$0.01	**$0.01**	***$0.06***
Lower Minnesota River	07020012	$0.00	$0.17	$0.00	$0.16	**$0.33**	$0.00	$0.12	**$0.12**	$3.17	$0.00	$0.33	$0.29	$1.14	**$4.93**	$0.11	$0.17	$0.00	$0.12	**$0.40**	***$5.78***
Lower St. Croix River	07030005	$0.00	$0.09	$0.00	$0.63	**$0.72**	$0.00	$1.04	**$1.04**	$1.64	$0.00	$0.02	$0.19	$0.07	**$1.92**	$0.22	$0.17	$0.00	$0.12	**$0.51**	***$4.19***
Minnesota River - Headwaters	07020001	$0.00	$0.00	$0.00	$0.08	**$0.08**	$0.00	$0.05	**$0.05**	$0.12	$0.00	$0.00	$0.00	$0.90	**$1.02**	$0.00	$0.00	$0.00	$0.02	**$0.02**	***$1.17***
Minnesota River - Mankato	07020007	$0.00	$0.00	$0.00	$0.74	**$0.74**	$0.00	$0.05	**$0.05**	$0.21	$0.00	$0.21	$0.00	$0.37	**$0.79**	$0.00	$0.00	$0.00	$0.01	**$0.01**	***$1.59***
Minnesota River - Yellow Medicine River	07020004	$0.00	$0.00	$0.00	$0.82	**$0.82**	$0.00	$0.28	**$0.28**	$0.17	$0.00	$0.33	$0.07	$4.55	**$5.12**	$0.00	$0.00	$0.00	$0.02	**$0.02**	***$6.24***
Mississippi River - Brainerd	07010104	$0.00	$0.00	$0.00	$0.03	**$0.03**	$0.00	$0.00	**$0.00**	$0.70	$0.00	$0.01	$0.06	$0.00	**$0.77**	$0.00	$0.00	$0.00	$0.02	**$0.02**	***$0.82***
Mississippi River - Grand Rapids	07010103	$0.00	$0.00	$0.00	$0.06	**$0.06**	$0.00	$0.02	**$0.02**	$0.02	$0.00	$0.00	$0.00	$0.00	**$0.02**	$0.00	$0.00	$0.00	$0.07	**$0.07**	***$0.17***
Mississippi River - Headwaters	07010101	$0.00	$0.00	$0.00	$0.88	**$0.88**	$0.00	$0.09	**$0.09**	$0.05	$0.00	$0.00	$0.00	$0.02	**$0.07**	$0.00	$0.00	$0.00	$0.06	**$0.06**	***$1.10***
Mississippi River - La Crescent	07040006	$0.00	$0.00	$0.00	$0.01	**$0.01**	$0.00	$0.02	**$0.02**	$0.05	$0.00	$0.00	$0.03	$0.00	**$0.08**	$0.00	$0.00	$0.00	$0.00	**$0.00**	***$0.11***
Mississippi River - Lake Pepin	07040001	$0.00	$0.00	$0.00	$0.01	**$0.01**	$0.00	$0.23	**$0.23**	$0.17	$0.00	$0.05	$0.08	$0.00	**$0.30**	$0.00	$0.17	$0.00	$0.03	**$0.20**	***$0.74***
Mississippi River - Reno	07060001	$0.00	$0.00	$0.00	$0.01	**$0.01**	$0.00	$0.03	**$0.03**	$0.00	$0.00	$0.00	$0.00	$0.00	**$0.00**	$0.00	$0.00	$0.00	$0.03	**$0.03**	***$0.07***
Mississippi River - Sartell	07010201	$0.00	$0.00	$0.00	$0.00	**$0.00**	$0.00	$0.07	**$0.07**	$0.69	$0.00	$0.02	$0.03	$0.00	**$0.74**	$0.00	$0.00	$0.00	$0.08	**$0.08**	***$0.89***
Mississippi River - St. Cloud	07010203	$0.00	$0.00	$0.00	$0.11	**$0.11**	$0.00	$0.07	**$0.07**	$0.88	$0.00	$0.00	$0.20	$0.71	**$1.79**	$0.22	$0.00	$0.00	$0.19	**$0.41**	***$2.38***
Mississippi River - Twin Cities	07010206	$0.00	$0.21	$0.00	$0.81	**$1.02**	$0.00	$1.21	**$1.21**	$5.89	$0.29	$0.37	$0.83	$2.32	**$9.70**	$0.22	$0.17	$0.07	$0.27	**$0.73**	***$12.66***

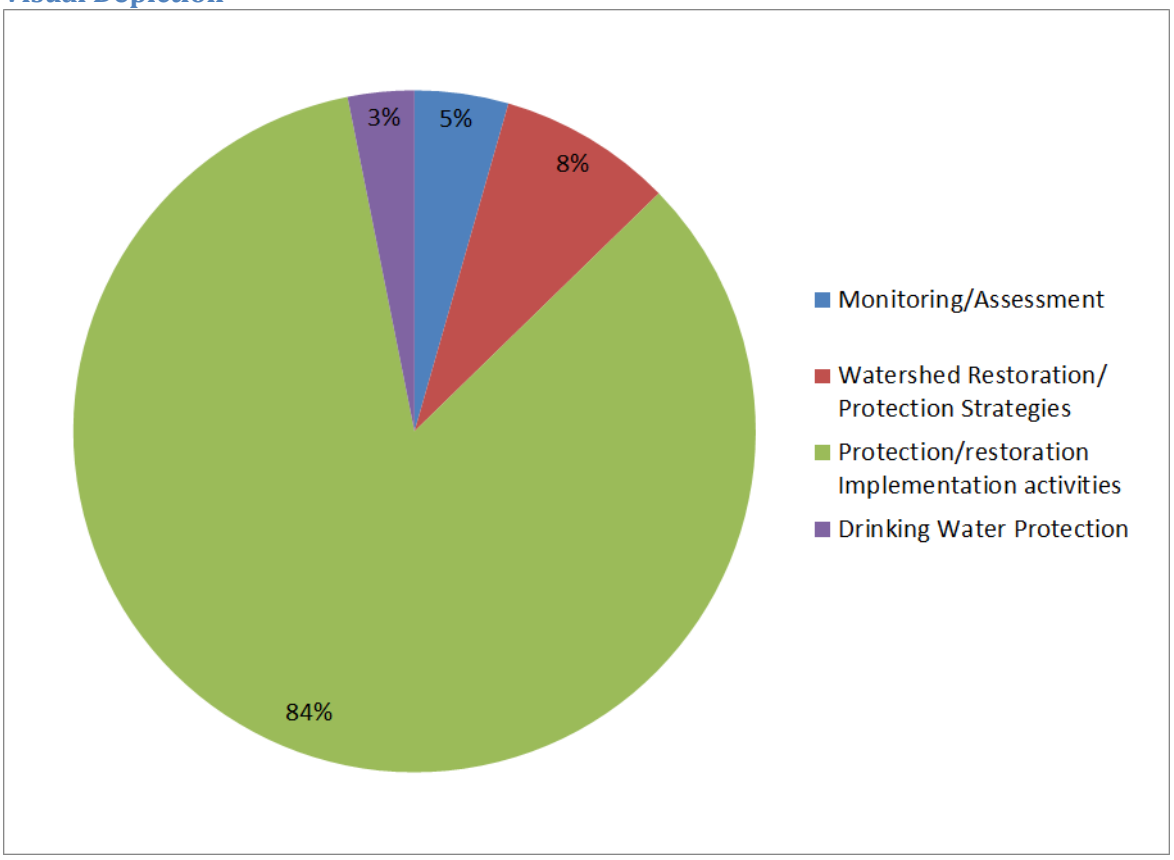
		Monitoring					Watershed Restoration & Protection Strategies			Implementation						Drinking Water					TOTAL
		DNR	Met Council	MDA	MPCA	*Sub-Total*	DNR	MPCA	*Sub-Total*	BWSR	DNR	MDA	MPCA	PFA	*Sub-Total*	DNR	Met Council	MDA	MDH	*Sub-Total*	
Mississippi River - Winona	07040003	$0.00	$0.00	$0.00	$0.65	**$0.65**	$0.00	$0.31	**$0.31**	$0.29	$0.00	$0.45	$0.09	$1.01	**$1.84**	$0.00	$0.00	$0.00	$0.04	**$0.04**	***$2.84***
Mustinka River	09020102	$0.00	$0.00	$0.00	$0.68	**$0.68**	$0.00	$0.26	**$0.26**	$0.04	$0.00	$0.23	$0.03	$0.00	**$0.30**	$0.00	$0.00	$0.00	$0.00	**$0.00**	***$1.24***
Nemadji River	04010301	$0.00	$0.00	$0.00	$0.46	**$0.46**	$0.00	$1.09	**$1.09**	$0.01	$0.00	$0.00	$0.25	$0.00	**$0.26**	$0.00	$0.00	$0.00	$0.02	**$0.02**	***$1.83***
North Fork Crow River	07010204	$0.00	$0.05	$0.00	$0.02	**$0.07**	$0.00	$0.50	**$0.50**	$1.25	$0.00	$0.73	$0.37	$0.11	**$2.46**	$0.11	$0.17	$0.00	$0.09	**$0.37**	***$3.40***
Otter Tail River	09020103	$0.00	$0.00	$0.00	$0.02	**$0.02**	$0.00	$0.00	**$0.00**	$0.79	$0.00	$0.00	$0.00	$0.07	**$0.86**	$0.00	$0.00	$0.14	$0.14	**$0.28**	***$1.16***
Pine River	07010105	$0.00	$0.00	$0.00	$0.49	**$0.49**	$0.00	$0.09	**$0.09**	$0.12	$0.00	$0.00	$0.00	$0.00	**$0.12**	$0.00	$0.00	$0.00	$0.02	**$0.02**	***$0.72***
Pomme de Terre River	07020002	$0.00	$0.00	$0.00	$0.01	**$0.01**	$0.00	$0.16	**$0.16**	$0.43	$0.00	$0.04	$0.25	$0.00	**$0.72**	$0.00	$0.00	$0.00	$0.01	**$0.01**	***$0.90***
Rainy River - Baudette	09030008	$0.00	$0.00	$0.00	$0.01	**$0.01**	$0.00	$0.10	**$0.10**	$0.01	$0.00	$0.00	$0.00	$0.00	**$0.01**	$0.00	$0.00	$0.00	$0.01	**$0.01**	***$0.13***
Rainy River – Black River	09030004	$0.00	$0.00	$0.00	$0.03	**$0.03**	$0.00	$0.10	**$0.10**	$0.00	$0.00	$0.00	$0.00	$1.35	**$1.35**	$0.00	$0.00	$0.00	$0.01	**$0.01**	***$1.49***
Rainy River - Headwaters	09030001	$0.00	$0.00	$0.00	$0.01	**$0.01**	$0.00	$0.33	**$0.33**	$0.00	$0.00	$0.00	$0.00	$0.00	**$0.00**	$0.00	$0.00	$0.00	$0.01	**$0.01**	***$0.35***
Rainy River - Rainy Lake	09030003	$0.00	$0.00	$0.00	$0.00	**$0.00**	$0.00	$0.11	**$0.11**	$0.00	$0.00	$0.00	$0.00	$0.00	**$0.00**	$0.00	$0.00	$0.00	$0.03	**$0.03**	***$0.14***
Rapid River	09030007	$0.00	$0.00	$0.00	$0.03	**$0.03**	$0.00	$0.10	**$0.10**	$0.00	$0.00	$0.00	$0.00	$0.00	**$0.00**	$0.00	$0.00	$0.00	$0.00	**$0.00**	***$0.13***
Red Lake River	09020303	$0.00	$0.00	$0.00	$0.43	**$0.43**	$0.00	$0.23	**$0.23**	$0.31	$0.00	$0.00	$0.11	$0.00	**$0.42**	$0.00	$0.00	$0.00	$0.00	**$0.00**	***$1.08***
Red River of the North – Grand Marais Creek	09020306	$0.00	$0.00	$0.00	$0.13	**$0.13**	$0.00	$0.12	**$0.12**	$1.13	$0.00	$0.00	$0.00	$0.00	**$1.13**	$0.00	$0.00	$0.00	$0.01	**$0.01**	***$1.39***
Red River of the North – Marsh River	09020107	$0.00	$0.00	$0.00	$0.02	**$0.02**	$0.00	$0.00	**$0.00**	$0.00	$0.00	$0.00	$0.00	$0.00	**$0.00**	$0.00	$0.00	$0.00	$0.02	**$0.02**	***$0.04***
Red River of the North – Sandhill River	09020301	$0.00	$0.00	$0.00	$0.53	**$0.53**	$0.00	$0.25	**$0.25**	$0.45	$0.00	$0.00	$0.00	$0.00	**$0.45**	$0.00	$0.00	$0.00	$0.02	**$0.02**	***$1.25***
Red River of the North – Tamarac River	09020311	$0.00	$0.00	$0.00	$0.13	**$0.13**	$0.00	$0.18	**$0.18**	$0.00	$0.00	$0.00	$0.00	$0.00	**$0.00**	$0.00	$0.00	$0.00	$0.00	**$0.00**	***$0.31***
Redeye River	07010107	$0.00	$0.00	$0.00	$0.37	**$0.37**	$0.00	$0.12	**$0.12**	$0.03	$0.00	$0.00	$0.00	$0.00	**$0.03**	$0.00	$0.00	$0.23	$0.01	**$0.24**	***$0.76***
Redwood River	07020006	$0.00	$0.00	$0.00	$0.07	**$0.07**	$0.00	$0.06	**$0.06**	$0.04	$0.00	$0.33	$0.00	$0.31	**$0.68**	$0.00	$0.00	$0.00	$0.02	**$0.02**	***$0.83***
Rock River	10170204	$0.00	$0.00	$0.00	$0.10	**$0.10**	$0.00	$0.03	**$0.03**	$1.12	$0.00	$0.01	$0.03	$0.03	**$1.19**	$0.00	$0.00	$0.00	$0.03	**$0.03**	***$1.35***
Root River	07040008	$0.00	$0.00	$0.00	$0.11	**$0.11**	$0.00	$0.35	**$0.35**	$2.31	$0.00	$1.77	$0.00	$0.03	**$4.11**	$0.00	$0.00	$0.00	$0.03	**$0.03**	***$4.60***

		Monitoring					Watershed Restoration & Protection Strategies			Implementation						Drinking Water					TOTAL
		DNR	Met Council	MDA	MPCA	*Sub-Total*	DNR	MPCA	*Sub-Total*	BWSR	DNR	MDA	MPCA	PFA	*Sub-Total*	DNR	Met Council	MDA	MDH	*Sub-Total*	
Roseau River	09020314	$0.00	$0.00	$0.00	$0.02	**$0.02**	$0.00	$0.00	**$0.00**	$0.00	$0.00	$0.00	$0.03	$0.00	**$0.03**	$0.00	$0.00	$0.00	$0.01	**$0.01**	***$0.06***
Rum River	07010207	$0.00	$0.00	$0.00	$0.57	**$0.57**	$0.00	$0.34	**$0.34**	$0.39	$0.00	$0.03	$0.03	$0.50	**$0.95**	$0.11	$0.09	$0.00	$0.04	**$0.24**	***$2.10***
Sauk River	07010202	$0.00	$0.00	$0.00	$0.07	**$0.07**	$0.00	$0.29	**$0.29**	$2.13	$0.00	$0.04	$0.46	$0.00	**$2.63**	$0.00	$0.08	$0.20	$0.05	**$0.33**	***$3.32***
Shell Rock River	07080202	$0.00	$0.00	$0.00	$0.00	**$0.00**	$0.00	$0.00	**$0.00**	$0.05	$0.00	$0.01	$0.00	$0.00	**$0.06**	$0.00	$0.00	$0.00	$0.05	**$0.05**	***$0.11***
Snake River	07030004	$0.00	$0.00	$0.00	$0.00	**$0.00**	$0.00	$0.49	**$0.49**	$0.07	$0.00	$0.00	$0.00	$0.00	**$0.07**	$0.00	$0.00	$0.00	$0.01	**$0.01**	***$0.57***
Snake River	09020309	$0.00	$0.00	$0.00	$0.02	**$0.02**	$0.00	$0.21	**$0.21**	$0.20	$0.00	$0.00	$0.00	$0.00	**$0.20**	$0.00	$0.00	$0.00	$0.06	**$0.06**	***$0.49***
South Fork Crow River	07010205	$0.00	$0.05	$0.00	$1.27	**$1.32**	$0.00	$0.62	**$0.62**	$0.05	$0.00	$0.51	$0.15	$0.03	**$0.74**	$0.11	$0.17	$0.00	$0.04	**$0.32**	***$3.00***
St. Louis River	04010201	$0.00	$0.00	$0.00	$0.10	**$0.10**	$0.00	$0.57	**$0.57**	$0.19	$0.00	$0.00	$0.28	$5.17	**$5.64**	$0.00	$0.00	$0.00	$0.05	**$0.05**	***$6.36***
Thief River	09020304	$0.00	$0.00	$0.00	$0.44	**$0.44**	$0.00	$0.11	**$0.11**	$0.52	$0.00	$0.00	$0.00	$0.00	**$0.52**	$0.00	$0.00	$0.00	$0.01	**$0.01**	***$1.08***
Two Rivers	09020312	$0.00	$0.00	$0.00	$0.30	**$0.30**	$0.00	$0.09	**$0.09**	$0.18	$0.00	$0.00	$0.00	$0.00	**$0.18**	$0.00	$0.00	$0.00	$0.05	**$0.05**	***$0.62***
Upper Big Sioux River	10170202	$0.00	$0.00	$0.00	$0.37	**$0.37**	$0.00	$0.00	**$0.00**	$0.16	$0.00	$0.00	$0.00	$0.00	**$0.16**	$0.00	$0.00	$0.00	$0.00	**$0.00**	***$0.53***
Upper Iowa River	07060002	$0.00	$0.00	$0.00	$0.01	**$0.01**	$0.00	$0.00	**$0.00**	$0.16	$0.00	$0.01	$0.00	$0.00	**$0.17**	$0.00	$0.00	$0.00	$0.01	**$0.01**	***$0.19***
Upper Red River of the North	09020104	$0.00	$0.00	$0.00	$0.03	**$0.03**	$0.00	$0.14	**$0.14**	$0.74	$0.00	$0.01	$0.00	$0.00	**$0.75**	$0.00	$0.00	$0.00	$0.01	**$0.01**	***$0.93***
Upper St. Croix River	07030001	$0.00	$0.00	$0.00	$0.00	**$0.00**	$0.00	$0.06	**$0.06**	$0.00	$0.00	$0.00	$0.00	$0.00	**$0.00**	$0.00	$0.00	$0.00	$0.01	**$0.01**	***$0.07***
Upper Wapsipinicon River	07080102	$0.00	$0.00	$0.00	$0.00	**$0.00**	$0.00	$0.00	**$0.00**	$0.00	$0.00	$0.00	$0.00	$0.00	**$0.00**	$0.00	$0.00	$0.00	$0.00	**$0.00**	***$0.00***
Upper/Lower Red Lake	09020302	$0.00	$0.00	$0.00	$0.05	**$0.05**	$0.00	$0.00	**$0.00**	$0.00	$0.00	$0.00	$0.00	$0.00	**$0.00**	$0.00	$0.00	$0.00	$0.00	**$0.00**	***$0.05***
Vermilion River	09030002	$0.00	$0.00	$0.00	$0.00	**$0.00**	$0.00	$0.11	**$0.11**	$0.19	$0.00	$0.00	$0.00	$0.00	**$0.19**	$0.22	$0.00	$0.00	$0.02	**$0.24**	***$0.54***
Watonwan River	07020010	$0.00	$0.00	$0.00	$0.60	**$0.60**	$0.00	$0.10	**$0.10**	$0.18	$0.00	$0.16	$0.00	$4.24	**$4.58**	$0.00	$0.00	$0.00	$0.02	**$0.02**	***$5.30***
Wild Rice River	09020108	$0.00	$0.00	$0.00	$0.08	**$0.08**	$0.00	$0.00	**$0.00**	$0.27	$0.00	$0.03	$0.03	$0.00	**$0.33**	$0.00	$0.00	$0.00	$0.02	**$0.02**	***$0.43***
Winnebago River	07080203	$0.00	$0.00	$0.00	$0.00	**$0.00**	$0.00	$0.00	**$0.00**	$0.00	$0.00	$0.00	$0.00	$0.00	**$0.00**	$0.00	$0.00	$0.00	$0.00	**$0.00**	***$0.00***
Zumbro River	07040004	$0.00	$0.00	$0.00	$0.78	**$0.78**	$0.00	$0.28	**$0.28**	$1.57	$0.00	$0.09	$0.03	$0.34	**$2.03**	$0.00	$0.00	$0.00	$0.05	**$0.05**	***$3.14***

Total Clean Water Fund dollars awarded in grants and contracts to non-state agency partners

Measure Background

Visual Depiction



Measure Description

This measure provides statewide numbers for the amount of Clean Water funding awarded to non-state agency partners on monitoring/assessment, watershed restoration and protection strategies, restoration and protection implementation activities, and drinking water protection. The data collected for this measure is consistent with the information provided to the Minnesota Legacy website: http://www.legacy.leg.mn/.

Associated Terms and Phrases

Aquifer: Water-bearing porous soil or rock that yield significant amounts of water to wells.

Groundwater: The water beneath the land surface that fills the spaces in rock and sediment. It is replenished by precipitation. Groundwater occurs everywhere in Minnesota and supplies about 75

percent of Minnesota's drinking water and nearly 90 percent of the water used for agricultural irrigation. Groundwater also discharges to surface water and allows streams to flow beyond rain and snowmelt periods and sustains lake levels during dry spells.

Protection/restoration implementation includes:

- *Restoration implementation activities*: Implementation of best management practices, improved sewage treatment or other pollution reduction measures to bring an impaired waterbody into attainment with water quality standards. These activities are often funded in response to an approved Total Maximum Daily Load study (TMDL) or Watershed Restoration and Protection Strategy Document that determines how much pollution needs to be reduced in order to achieve water quality standards.
- *Protection implementation activities*: Implementation of best management practices to prevent degradation and/or improve waterbodies or aquifers currently meeting water quality standards. These activities are often funded in response to a Watershed Restoration and Protection Strategy Document

Monitoring/Assessment includes:

- *Condition monitoring* – Monitoring consistently throughout the open water season with the objective of assessing the ambient, or background, condition of a lake or stream reach. Results are compared against water quality standards to determine if designated uses are supported.
- *Load monitoring* - Flow and chemistry monitoring conducted at the mouth (or outlet) of each major watershed. Monitoring is conducted at least monthly, and more frequently during events (i.e., snowmelt or rain events). The objective of load monitoring is to capture the entire hydrograph (or variation in the amount of water flowing past a location per unit time), and to determine the pollutant load carried by a stream or river.
- *Problem investigation monitoring* – Monitoring with the objective of supporting water quality goals, often in cooperation with other interested agencies. May be conducted in response to accidental wastewater spills or discharges that may affect surface waters. Results are compared against water quality standards to determine if designated uses are supported.
- *Surface Water Assessment Grant (SWAG):* An MPCA grant that passes through funding to local partners for the purpose of conducting condition monitoring. Results are compared against water quality standards to determine if designated uses are supported.
- *Watershed Pollutant Load Monitoring Network* – Flow and chemistry monitoring conducted at the outlet of primarily subwatersheds via MPCA pass through grant funding. Monitoring is conducted at least monthly, and more frequently during events (i.e., snowmelt or rain events). The objective of load monitoring is to capture the entire hydrograph (or variation in the amount of water flowing past a location per unit time), and to determine the pollutant load carried by a stream or river.

- *Groundwater level monitoring* – Monitoring with the objective of collecting baseline data on groundwater level fluctuations and trends in local and regional aquifers.

- *Groundwater quality monitoring* – Monitoring with the objective of collecting baseline data on groundwater chemistry fluctuations and trends in local and regional aquifers.

Partners: According to the Clean Water Legacy Act, partners are eligible regional and local government units, state agencies, political subdivisions, joint powers organizations, tribal entities, special purpose units of government, as well as the University of Minnesota and other public education institutions, according to the rules of the funding program (MN Statutes 114D.15). Partners can also include eligible nonprofit or other nongovernmental organizations, depending on the rules of the funding program.

Public Agencies: According to the Clean Water Legacy Act, public agencies means all state agencies, political subdivisions, joint powers organizations, and special purpose units of government with authority, responsibility, or expertise in protecting, restoring, or preserving the quality of surface waters, managing or planning for surface water and related lands, or financing waters-related projects. (MN Statutes 114D.15). Public agencies includes the University of Minnesota and other public education institutions.

Research: The collection of information about watershed or aquifer health including mapping and modeling.

Statewide projects and technical assistance: Spending for activities that are more statewide in scope. This includes projects with more of a statewide orientation than a watershed one, as well as technical assistance for projects provided by state agencies.

Watershed: The surrounding land area that drains into a lake, river or river system. The watershed size used for this measure is at the "major watershed" scale. There are 81 major watersheds in Minnesota.

Watershed restoration and protection strategies includes:

- *Restoration strategies*: Planning activities to restore waterbodies not meeting water quality standards ("impaired"), including the development of a Total Maximum Daily Load study (TMDL) for an impaired water. A "TMDL" means a scientific study that contains a calculation of the maximum amount of a pollutant that may be introduced into a surface water and still ensure that applicable water quality standards for that water are restored and maintained. It results in pollution reduction goals for all sources of a pollutant in a watershed.
- *Protection strategies*: Planning activities to protect high quality ground and surface waters that are currently achieving water quality standards.
- *Source water protection strategies*: Wellhead protection, source water assessment, and surface water intake protection activities that protect water from streams, rivers, lakes, or aquifers that is used for drinking.
- *Water supply planning:* Activities to maintain a safe and sustainable water supply, including the development of local public water supply plans, regional water supply plans, and Groundwater Management Area *plans.*

Implementation activities

- *Point source projects*: These are regulated wastewater and stormwater via the NPDES permit.
- *Non-Point source projects*: These are best management practices or conservation practices that are addressing diffuse sources of pollution in both rural and urban areas.

- **BWSR** – Minnesota Board of Water and Soil Resources
- **DNR** – Minnesota Department of Natural Resources
- **MDA** – Minnesota Department of Agriculture
- **MDH** – Minnesota Department of Health
- **MPCA** – Minnesota Pollution Control Agency
- **PFA** - Minnesota Public Facilities Authority

Target
Not applicable

Baseline
Fiscal Year 2010-2011 – the first full biennium of appropriations from the Clean Water Fund.

Geographical Coverage
Grants and contracts to non-state agencies are presented as statewide totals per category, though much of it has been allocated to watershed-specific projects.

Data and Methodology

Methodology for Measure Calculation
Due to the wide variation in state agency program objectives and project management structures, each agency and even units within agencies may use different methods to calculate the dollars reported by this measure. For detailed methodology employed by each agency, contact the people listed in this report. The general guidelines were adopted by all agencies for this report to provide consistency.

Data Source
The primary data source used to develop this measure is the Minnesota Legacy website at http://www.legacy.leg.mn/funds/clean-water-fund.

Additional details needed to determined awards to non-state agency partners were derived from the following sources:

- BWRS's database eLINK4WEB
- DNR's project databases
- Metropolitan Council's database EIMS
- MDA's project databases

- MDH's databases for grant programs
- MPCA's databases including: MAPs/SWIFT, EQuIS, Watershed DELTA, and individual project databases
- PFA's project databases

Data Collection Period

Fiscal year 2010-2013 – the first two biennium's of appropriations from the Clean Water Fund.

Data Collection Methodology and Frequency

Overall: Data for this measure should be collected annually.

Monitoring: Condition monitoring and load monitoring funds are passed through to partners annually. The amounts of those contracts and the grantee/contractor's names are all captured in MAPS/SWIFT. This information is combined with other data required to be reported to the Minnesota Legislature for its web page annually. Other types of contracts with external partners are executed as needed, and are not on a set schedule.

Implementation activities: For data that is entered in eLINK, BWSR staff extracts the data by querying eLINK for BMPs implemented with Clean Water Fund dollars. Local grant recipients enter financial information into eLINK every six months, recording only those BMPs that are fully implemented at that time.

Supporting Data Set

2010-13 Total Dollars Awarded in Grants or Contracts to Partners

Agency	Monitoring/ Assessment	Watershed Restoration/ Protection Strategies	Protection/restoration Implementation activities	Drinking Water Protection	Total
BWSR	$0	$0	$70,180,940	$0	$70,180,940
DNR	$476,071	$7,007	$2,352,870	$584,331	$3,420,279
MDA	$0	$0	$13,577,553	$988,726	$14,566,279
MDH	$0	$0	$0	$2,722,115	$2,722,115
MetCouncil	$0	$0	$0	$177,000	$177,000
MPCA	$5,835,671	$11,743,603	$3,510,780	$0	$21,090,054
PFA	$0	$0	$29,957,003	$0	$29,957,003
Total	$6,311,742	$11,750,610	$119,579,146	$4,472,172	$142,113,670

Approximately 43 percent of the total FY10-13 $331.6 million appropriation from the Clean Water Fund was awarded in grants and contracts to non-state agency partners. The balance of the remaining appropriation is largely used by state agencies to provide statewide monitoring, watershed protection and restoration strategy development, technical assistance and oversight on Clean Water Fund-supported projects.

Caveats and Limitations

Overall: The data collected for this measure do not represent an exact accounting of funding allocations to non-state agency partners but are intended to provide a general sense on the level of funding awarded and for what purpose. Best professional judgment was used to determine how to allocate funding for projects that had spending in more than one activity category (i.e. monitoring and strategy development and implementation). Due to law, some funds are allocated in phases, and thus, over time the information in this measure will change. For detailed information for funding allocations in this measure for a particular project or state agency, contact the agency representative listed below ("Measure Points of Contact").

Future Improvements

It is anticipated that this measure will continue to evolve in future years as agencies improve their process for collecting data.

Financial Considerations

Contributing Agencies and Funding Sources

BWSR, DNR, MDA, MDH, Met Council , MPCA, PFA

Measure Points of Contact

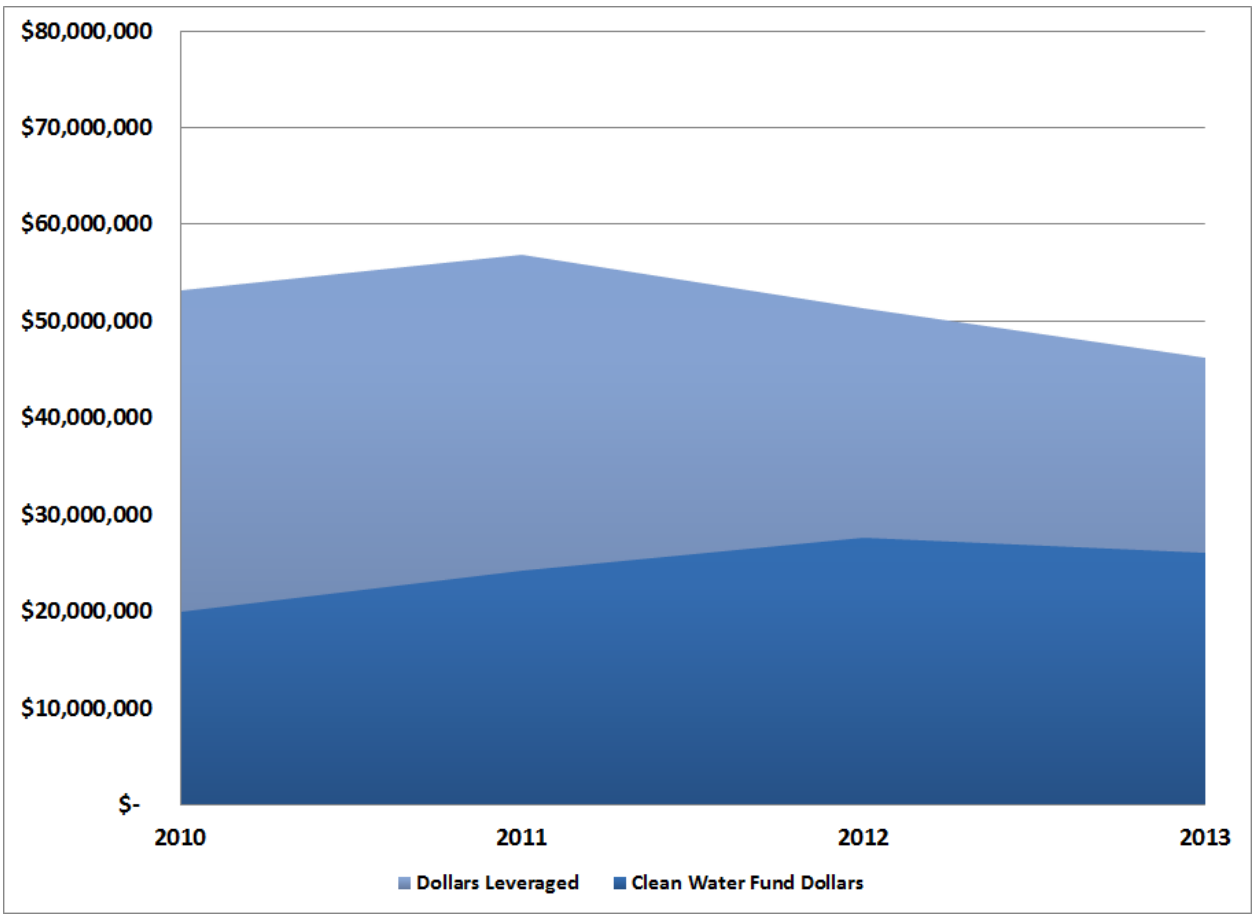
- BWSR contact: Marcey Westrick, marcey.westrick@state.mn.us
- DNR contact: Julie Westerlund, julie.westerlund@state.mn.us
- MDA contact: Margaret Wagner, margaret.wagner@state.mn.us
- MDH contact: Tannie Eshenaur, tannie.eshenaur@state.mn.us
- MPCA contact:
    - Monitoring and assessment -- Pam Anderson, pam.anderson@state.mn.us
    - Watershed restoration and strategy development -- Denise Leezer (TMDLs, CWP) – denise.leezer@state.mn.us
    - Bill Dunn (wastewater/stormwater) – bill.dunn@state.mn.us
- PFA contact: Jeff Freeman, jeff.freeman@state.mn.us
- Metropolitan Council: Lanya Ross, lanya.ross@metc.state.mn.us

Total dollars leveraged by the Clean Water Fund

Measure Background

Visual Depiction

The graphics depict the annual amount of leveraged dollars calculated statewide by the various agencies receiving Clean Water funding for implementation projects.



Measure Description

This measure communicates the dollars leveraged through Clean Water Fund appropriations, from FY 2010-2013. The Clean Water appropriations comprise funding from multiple state contract, grant and loan programs as well as individual on-farm demonstration projects (Discovery Farms Minnesota and Root River Field-to-Stream Partnership). It is a direct financial measure of dollars spent on implementation activities.

Associated Terms and Phrases

To better understand this measure, it is necessary to understand the following terms and phrases:
Leveraged Funds: For this measure, leveraged funds means the amount paid from any source other than Clean Water Funds. The amount of leveraged funds is calculated by summing all non-Clean Water funding sources contributing funding towards the project as identified at the time of award.

Clean Water Funding: For this measure, the term Clean Water Funding refers to Clean Water grants and AgBMP loans distributed through local governments for BMP implementation through special Clean Water Fund appropriations to various State grant and loan programs starting in FY10. This measure also includes dollars leveraged from on-farm demonstration projects that focus on implementing best management practices. A list of CWF programs can be found at http://www.cdf.leg.mn/.

TMDL Grant Program is designed to fund up to 50% for a maximum of $3 million for mandates resulting from an USEPA approved TMDL and Agency approved implementation plan that requires capital improvements that are beyond their current NPDES permit.

Phosphorus Reduction Grant program is designed to fund up to 75% (until June 30, 2010), and after that 50% for a maximum of $500,000 for more stringent treatment for phosphorus treatment to 1.0 mg/L or less due to a permit requirement.

Point Source Implementation Grant program is designed to fund up to 50% for a maximum of $3 million for mandates resulting in 1) Wasteload reduction to meet an EPA approved TMDL and Agency approved implementation plan that requires capital improvement that are beyond their current NPDES permit, 2) more stringent treatment for phosphorus treatment to 1.0 mg/L or less due to a permit requirement 3) Water Quality Based Effluent Limit (WQBEL, pronounced "Q-bell"), or 4) Land based discharging systems with a nitrogen limit greater than secondary standards. Starting in FY 2014, this program is replacing the TMDL and Phosphorus grant programs listed above.

Ag BMP Loan Program: This program provides low interest loans (typically 3%) with local financial institutions to farmers, agriculture supply businesses, and rural landowners. The loans are for proven pollution prevention practices that are recommended in an area's water and environmental plans. The program uses a perpetual revolving loan account structure where repayments from prior loans are continually reused to fund new loans. This program prioritizes the use of Clean Water funds to areas for implementation of practices recommended in approved TMDL Implementation Plans.

Clean Water Fund Grant Program – A grant program administered through BWSR with Clean Water Fund appropriations. More information regarding his program can be found at http://www.bwsr.state.mn.us/cleanwaterfund/index.html .

BWSR – Minnesota Board of Water and Soil Resources

DNR – Minnesota Department of Natural Resources

MDA – Minnesota Department of Agriculture

MDH – Minnesota Department of Health

MPCA – Minnesota Pollution Control Agency

PFA - Minnesota Public Facilities Authority

Target
There is no specific numeric target for this measure.

Baseline
FY 2010 serves as the baseline for this measure in which data collection began.

Geographical Coverage
Statewide

Data and Methodology

Methodology for Measure Calculation
For the purpose of this measure, any funds that are not Clean Water funds, including landowner contributions, local government unit aid, equity, and any loan, even if required as matching dollars, are included as part of the dollar amount leveraged. To calculate this measure, state agency staff collects financial information by each program and sum these figures to provide a single count for each watershed and the state.

Data Source

Component programs of the Clean Water Fund Grants	Responsible State Agency	Funding Availability*	Data Source for Leveraged Funds
TMDL Grant Program	PFA	FY2010-FY2013	PFA spreadsheet Project applications MPCA reviewed and approved accepted as-bid
Phosphorus Reduction Grant Program	PFA	FY2010-FY2013	PFA spreadsheet Project applications MPCA reviewed and approved accepted as-bid

Component programs of the Clean Water Fund Grants	Responsible State Agency	Funding Availability*	Data Source for Leveraged Funds
Point Source Implementation Grant Program (Note: this program was created when the TMDL and Phosphorus grant programs were merged and eligibility was expanded)	PFA	FY2014-FY2015	PFA spreadsheet Project applications MPCA reviewed and approved accepted as-bid
Clean Water Fund Grants	BWSR	FY2010-FY2013	eLINK
Ag BMP Loans	MDA	FY2010-FY2013	AgBMP Loan Program database
On-Farm Demonstrations (Discovery Farms, Root River Field-to-Stream Partnership)	MDA	FY10-FY2013	Project work plans and progress reports
Clean Water Partnership Grants	MPCA	FY2010-FY2013	Project work plans and progress reports
St. Louis River Direct Appropriation	MPCA	FY2010-FY2013	Project work plans and progress reports
Source Water Protection Grants	MDH	FY11	Project work plans and progress reports

Data Collection Period

FY 2010 - FY 2013

Data Collection Methodology and Frequency

For programs administered by PFA, data collection involves reviewing accepted as-bid contract awards as compared to accepted grant award.

For programs administered by BWSR, funding cycles are on an annual basis. Local grant recipients are required to enter financial information regarding leveraged funds in eLINK, BWSR's web-based reporting and tracking tool. More information on eLINK is available at www.bwsr.state.mn.us/outreach/eLINK/manual/index.html.

The AgBMP Loan program has a revolving loan structure with regular borrower repayments. It also received periodic infusion of capital into the corpus of the program revolving pool. Data is maintained by the program in an internal database system in coordination with the state's SWIFT accounting system (data prior to July 1, 2011 is stored in MAPS accounting system). Status updates can be recalculated for any period or geographical area as needed.

- The total amount leveraged for the AG BMP Loan program equals non-state financing for loan-assisted projects. This money comes from the borrower, financing from private lenders, and other conservation financial assistance programs.
- The AgBMP loan program is supported by multiple funding sources. It is important to note that this program prioritizes the use of Clean Water funds to areas for implementation of practices recommended in approved TMDL Implementation Plans. All other funding sources, primarily federal funds, are used to finance any priority or practice identified in local comprehensive water or environmental plans.

Supporting Data Set

Clean Water Grants

Table 1. PFA Clean Water Grant Funds

Fiscal Year	TMDL and Phosphorus Grants	TMDL and Phosphorus Grants Leveraged Dollars	Small Community Grant and Loan Dollars*
2012	$ 7,782,087	$ 8,391,951	$ 81,000
2013	$ 4,953,874	$ 5,041,517	$ 462,130

*The small community grant and loan program is statutorily designed to provide full funding of the projects, thus there is no required local match or leverage

Table 2. BWSR Clean Water Competitive Grant Funds

Fiscal Year	BWSR Clean Water Funding	Leveraged Dollars
2010	$ 11,807,597	$ 21,901,021
2011	$ 12,619,876	$ 15,268,561
2012	$ 16,874,452	$ 9,204,587
2013	$ 18,315,397	$ 6,683,571

* Does not included CWF Rim Easements

Table 3. MPCA Clean Water Partnership Grant Funds

Fiscal Year	MPCA Clean Water Partnership Funding	Leveraged Dollars
2010	$ 619,970	$ 1,799,510
2011	$ 1,314,165	$ 2,688,530
2012	$ 802,792	$ 442,392
2013	$ 790,471	$ 2,762,596

Table 4. MPCA St. Louis River Grant Funds

Fiscal Year	MPCA St. Louis River Grant Funds	Leveraged Dollars
2010/2011	$ 950,000	$ 2,692,400
2012/2013	$ 1,495,020	$ 2,903,100

Table 5. St. Croix River Association Grant Funds (implementation portion)

Fiscal Year	SCRA Grant Funds (implementation)	Leveraged Dollars
2010	$ $216,717	$ 224,416

Table 6. MDH Clean Water Fund Source Water Protection Grant Funds

Fiscal Year	MDH Clean Water Source Water Protection Funding	Leveraged Dollars
2011	$ 374,895	$ 608,835
2012/13	$ 2,383,655	$ 1,031,814

Table 7. Clean Water Fund supported AgBMP Loans

Fiscal Years	AgBMP Loans Issued	Cumulative Dollars Leveraged
2010/11	$ 3,427,020	$ 2,276,148
2012/2013	5,706,707	$ 5,784,367

Table 8. Dollars leveraged for on-farm demonstrations

Fiscal Years	Name of project	Clean Water Fund Investment	Non-state matching Funds
2010/11	Discovery Farms Minnesota	$ 250,000	$ 420,000
2012/13	Discovery Farms Minnesota	$ 400,000	$ 649,119
2010/11	Root River Field-to-Stream Partnership	$ 395,000	$ 125,000
2012/13	Root River Field-to-Stream Partnership	$ 50,000	$ 80,000
2010/11	Rosholt Farm	$ 23,882	$125,000

Table 9. Cumulative Clean Water Funding and Leveraged Dollars

Fiscal Year	Cumulative Clean Water Fund Dollars	Cumulative Dollars Leveraged
2010	$ 19,981,802	$ 33,241,232
2011	$ 24,182,613	$ 32,692,630
2012	$ 27,598,668	$ 23,682,383
2013	$ 25,998,609	$ 20,234,752

Caveats and Limitations

For PFA, the above estimates account for only TMDL or Phosphorus eligible costs. Often other facility improvements are also pursued at the same time to utilize economies of scale and other fixed costs such as equipment mobilization.

For most Clean Water Fund programs, BWSR requires a 25% match requirement for all grant dollars. BWSR also has a $30,000 grant minimum as well.

In FY11, up to $300K from AgBMP loan program may be used for administrative purposes; any amount not used for that purpose by the end of the fiscal year will be added to the program's revolving loan funds.

Future Improvements

Nothing identified at this time

Communication Strategy

Target Audience

Stakeholders with interest in this measure include the State legislature, the Clean Water Council, and state agency partners.

Associated Messages

This measure depicts how much non-state funds the Clean Water Fund is leveraging and is a direct measure of dollars being spent of implementation.

Measure Points of Contact

- Bill Dunn, Clean Water Revolving Fund Coordinator, Minnesota Pollution Control Agency
  bill.dunn@state.mn.us
- Conor Donnelly, Board of Water and Soil Resources
  conor.donnelly@state.mn.us

- Margaret Wagner, Minnesota Department of Agriculture
  margaret.wagner@state.mn.us

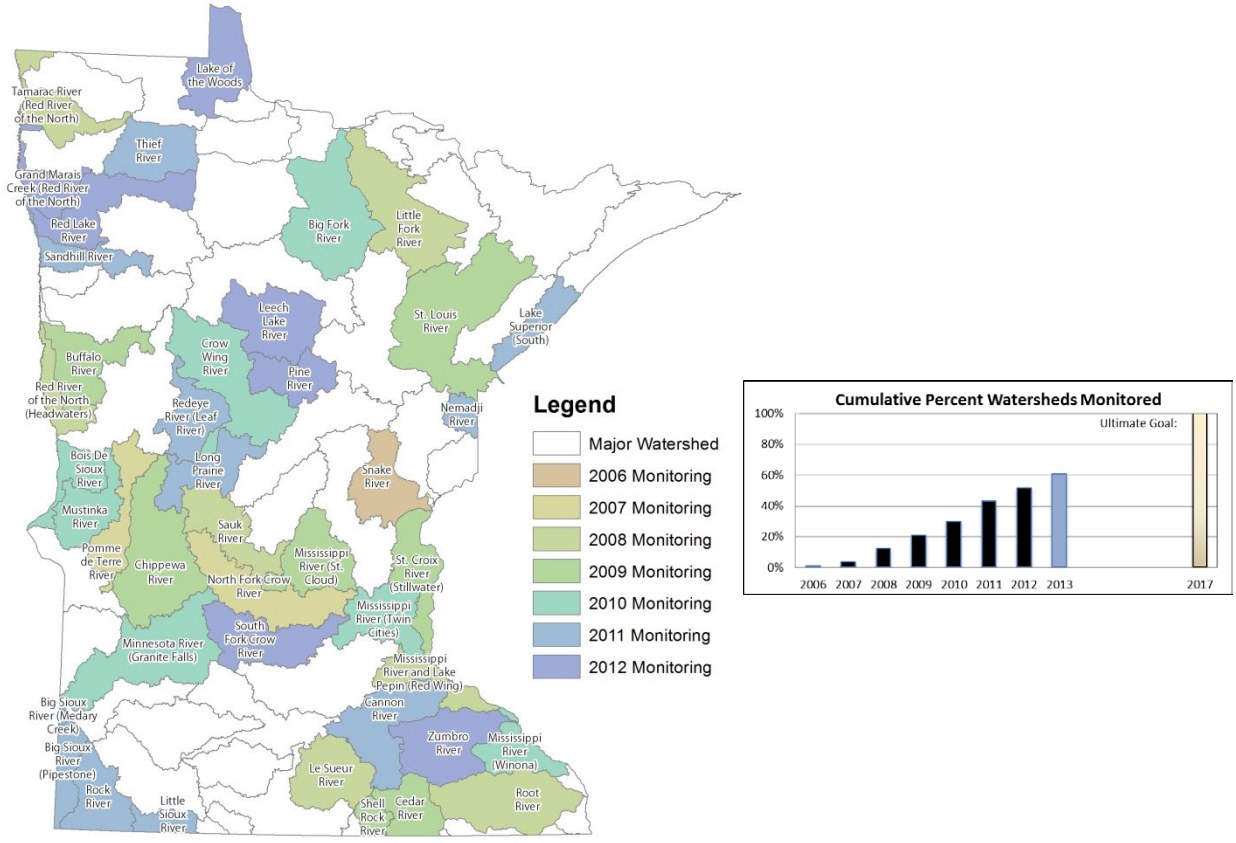
- Tannie Eshenaur, Minnesota Department of Health
  tannie.eshenaur@state.mn.us

Surface Water Measures

Percent of State's Major Watersheds Intensively Monitored through the Watershed Approach

Measure Background

Visual Depiction



Measure Description

Percent of the state's major watersheds that have been intensively monitored for background condition for water chemistry and biology through the MPCA's intensive watershed monitoring approach.

Associated Terms and Phrases

Condition monitoring: Monitoring the background, or ambient, condition of a lake or stream reach. This type of monitoring typically requires monitoring once or twice per month during the open water season for a minimum of two years. The resulting data are compared to state and federal water quality standards put in place to support various uses (drinking water, aquatic recreation, aquatic life, consumption, etc.) to determine if the resource is exceeding standards (i.e., is "impaired") and in need of restoration or is meeting standards and in need of protection.

Intensive watershed monitoring (IWM): A ten-year rotational cycle wherein an average of 8 of Minnesota's 81 major (8-digit hydrologic unit code) watersheds are intensively monitored each year. The outlet of each major watershed is monitored for physical and chemical parameters monthly on a continual basis for baseflow and more frequently during "events", such as snowmelt and storms (termed 'load monitoring'). During intensive watershed monitoring, additional focus is placed on monitoring the outlets of subwatersheds (12 -digit hydrologic unit code) for biota (fish and invertebrates) and physical habitat, and to sample for chemical parameters ten times. One-time biological, physical and chemical sampling is also conducted at the outlet of the 14 -digit hydrologic unit code watersheds. During intensive watershed monitoring, all lakes ≥500 acres and at least 25% of lakes 100-499 acres are monitored for physical and chemical parameters (there is currently no tool that allows us to assess lakes for biology).

Load monitoring: Flow and chemistry monitoring conducted at the mouth (or outlet) of each major (8-digit hydrologic unit code scale) watershed. Monitoring is conducted at least monthly, and then more frequently during events (i.e., snowmelt or rain events). As with the intermediate load monitoring, the objective is to capture the entire hydrograph, and to determine the pollutant load carried by a stream or river. Watershed loads are also used to assess trends in the stream water quality of a watershed over time, and to see how data from a given year compare to the long-term record for a watershed.

Major watershed: 8-digit hydrologic unit code (HUC) watersheds in Minnesota; there are 81 in Minnesota.

Target

Intensively monitor ~10 percent of the state's major watersheds per year; 100% through 2017 (end of the first cycle).

Baseline

The first watershed was intensively monitored for stream biology in 2006 as a pilot project. Two additional watersheds were intensively monitored for stream biology in 2007, but 2008 marks the year the state was fully ramped up for the full IWM monitoring effort. Therefore, the last year of the first 10-year intensive monitoring cycle will be 2017.

Geographical Coverage

Statewide.

Data and Methodology

Methodology for Measure Calculation

The number, cumulative percent and the identity of watersheds that have been intensively monitored is kept in a spreadsheet (OPM1_watersheds intensively monitored.xls) that automatically updates the bar graph. The total number and cumulative percent is added to the GIS project tables (OPM1.mxd) each January to develop the statewide map. Both the spreadsheet and the GIS project are found in this

folder on the MPCA's server: X:\Agency_Files\Water\Condition Monitoring\Measures\Lakes & Streams\OPM1_Watersheds intensively monitored.

Data Source

MPCA spreadsheet tracks the IWM schedule. The number, cumulative percent and the identity of watersheds that have been intensively monitored is kept in a spreadsheet (OPM1_watersheds intensively monitored.xls).

Data Collection Period

2006-2017 for the first IWM cycle.

Data Collection Frequency

Updated annually (each January) based on new watershed monitoring starts; a schedule has been developed for the full 10 years and is updated annually.

Supporting Data Set

IWM year	# watersheds intensively monitored	Cumulative % completed	Names of watersheds
2006	1	1%	Snake River
2007	2	4%	Pomme de Terre, North Fork Crow River
2008	7	12%	Tamarac R, Upper Red R, Root R, Le Sueur, Little Fork, Mississippi R (Lake Pepin)
2009	7	21%	Buffalo R, Chippewa R, St. Louis R, Lower St. Croix R, Cedar R, Shell Rock R, Mississippi R (St. Cloud)
2010	7	30%	Big Fork R, Crow Wing R, Minnesota R (Yellow Medicine R), Mississippi R (Winona), Bois de Sioux R, Mustinka R, Mississippi R (Twin Cities)
2011	11	43%	Lake Superior (South), Nemadji River, Redeye River, Long Prairie River, Cannon River, Red River of the North – Sandhill River, Thief River, Upper Big Sioux River, Lower Big Sioux River, Rock River, Little Sioux River
2012	7	52%	Leech Lake River, Pine River, South Fork Crow River, Zumbro River, Red Lake River, Red River – Grand Marais Creek, Lake of the Woods
2013	7	60%	Two Rivers, Snake River, Lake Superior (N), Rum River, Mississippi River (Headwaters), Minnesota River (Mankato), Watonwan River
2014			

IWM year	# watersheds intensively monitored	Cumulative % completed	Names of watersheds
2015			
2016			
2017			

Caveats and Limitations

It takes two years to complete the IWM monitoring, so this measure tracks start dates only; assessment follows after the second year of intensive monitoring. This won't always show a steady 10% of watersheds per year since the size of watersheds (and their associated number of sites) will vary from year to year. The 10-year schedule requires us to start between 6 and 8 watersheds each year to stay on track.

Future Improvements

NA

Financial Considerations

Contributing Agencies and Funding Sources

Funding for monitoring that supports the MPCA's Intensive Watershed Monitoring design comes from the Minnesota Clean Water Fund.

Communication Strategy

Target Audience

Local, state and federal agencies and the general public.

Associated Messages

This measure conveys our progress in meeting our statewide monitoring responsibilities. Since restoration and protection planning work follows condition monitoring and assessment, this measure also conveys to other MPCA staff and local partners when restoration and protection planning may begin in their regions.

Outreach Format

TBD.

Other Measure Connections

The “rate of impairment/unimpairment of surface water statewide and by watershed” measure reports findings from condition monitoring data that has been assessed, including the percentage of lakes and streams that are meeting or exceeding water quality standards statewide and by watershed.

Measure Points of Contact

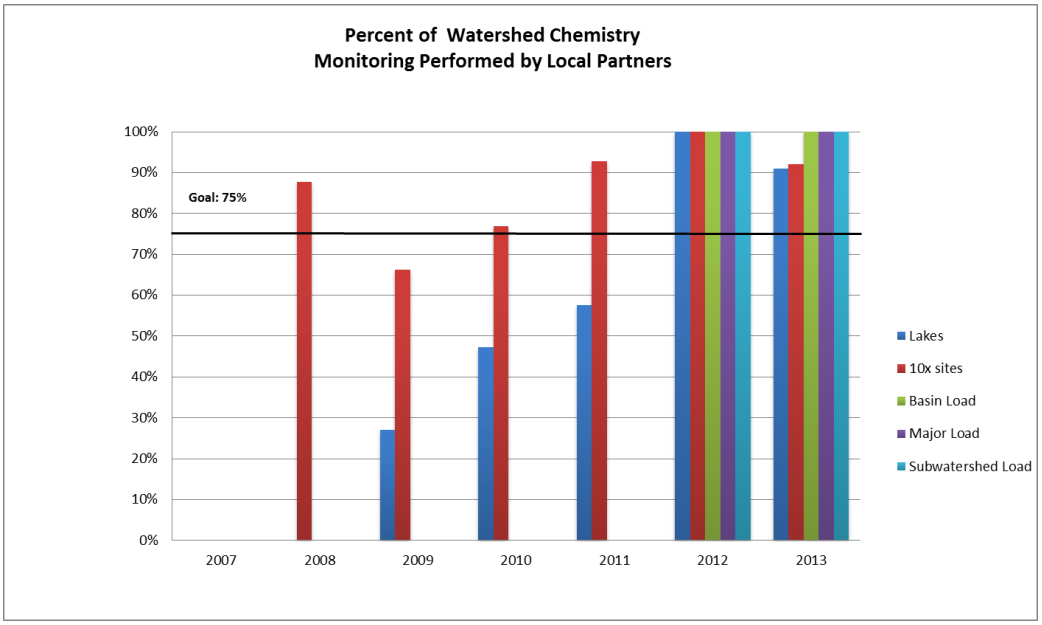
Agency Information

Pam Anderson, MPCA, Water Quality Monitoring Unit supervisor, pam.anderson@state.mn.us.

Percent of intensive watershed chemistry monitoring performed by local partners

Measure Background

Visual Depiction



Measure Description

This measure tracks the percentage of intensive lake and stream chemistry monitoring that is performed by local partners. 2007-2013 reporting shows only lake and stream condition monitoring conducted by local partners. Reporting local monitoring of basin, major and intermediate load monitoring sites will begin in 2012.

Associated Terms and Phrases

Condition monitoring: Monitoring the background, or ambient, condition of a lake or stream reach. This type of monitoring typically requires monitoring once or twice per month during the open water season for a minimum of two years. The resulting data are compared to state and federal water quality standards put in place to support various uses (drinking water, aquatic recreation, aquatic life, consumption, etc.) to determine if the resource is exceeding standards (i.e., is "impaired") and in need of restoration or is meeting standards and in need of protection.

Intensive watershed monitoring: A ten-year rotational cycle wherein an average of 8 of Minnesota's 81 major (8-digit hydrologic unit code) watersheds are intensively monitored each year. The outlet of each major watershed is monitored for physical and chemical parameters monthly on a continual basis for baseflow and more frequently during "events", such as snowmelt and storms (termed 'load monitoring'). During intensive watershed monitoring, additional focus is placed on monitoring the outlets of subwatersheds (aggregated 12 -digit hydrologic unit code) for biota (fish and invertebrates) and physical habitat, and to sample for chemical parameters ten times. One-time biological, physical

and chemical sampling is also conducted at the outlet of the 14 -digit hydrologic unit code watersheds. During intensive watershed monitoring, all accessible lakes ≥500 acres and at least 25% of lakes 100-499 acres are monitored for physical and chemical parameters (indices of biological integrity are currently under development by MPCA and the Department of Natural Resources).

Intermediate load monitoring: Flow and chemistry monitoring conducted at the mouth (or outlet) of some 12-digit watersheds (12-digit or smaller hydrologic unit code scale). Monitoring is conducted at least monthly, and then more frequently during events (i.e., snowmelt or rain events). The objective of load monitoring, in general, is to capture the entire hydrograph, and to determine the pollutant load carried by a stream or river. Intermediate watershed load monitoring data are critical for developing watershed restoration plans by providing finer scale data to calibrate numerical watershed flow models, to inform "stressor identification" efforts, and to better define areas of concern.

Load monitoring: Flow and chemistry monitoring conducted at the mouth (or outlet) of each major (8-digit hydrologic unit code scale) watershed. Monitoring is conducted at least monthly, and then more frequently during events (i.e., snowmelt or rain events). As with the intermediate load monitoring, the objective is to capture the entire hydrograph, and to determine the pollutant load carried by a stream or river. Watershed loads are also used to assess trends in the stream water quality of a watershed over time, and to see how data from a given year compare to the long-term record for a watershed. Sites are located at the outlet of 8-digit hydrologic unit code watersheds and at the outlet of 4-digit hydrologic unit code basin watersheds.

Local partners: Includes soil and water conservation districts, watershed districts, watershed management organizations, local units of government (i.e., counties, cities, townships, lake associations, and lake improvement districts), regional governmental groups, Minnesota colleges and universities, nonprofit organizations, and American Indian Tribal governments in Minnesota.

Major watershed: 8-digit hydrologic unit code (HUC) watersheds in Minnesota; there are 81 in Minnesota.

Surface Water Assessment Grants (SWAG): Clean Water Fund pass-through grants from MPCA to local partners for condition monitoring, including intensive watershed monitoring, activities.

Watershed Pollutant Load Monitoring Network Grants (WPLMN): Clean Water Fund pass-through grants from MPCA to local partners for intermediate, major watershed, and basin load monitoring activities.

Target

An annually goal of 75% participation has been set.

Baseline

The baseline year is 2007, which is the first year that the MPCA encouraged local partners to help conduct monitoring in support of the intensive watershed approach. Lakes and load monitoring were first brought into the intensive watershed monitoring design in 2009. Intermediate load monitoring (WPLMN) was brought into this design starting in 2012.

Geographical Coverage
Watershed (major watershed scale)

Data and Methodology

Methodology for Measure Calculation
The MPCA tracks the list of watershed stream sites and lakes offered annually and those that were picked up by local partners (Master Lakes_10X_EBS site spreadsheet.xlsx). For streams, the percentage monitored by partners is calculated by dividing the total number of stream sites the MPCA chosen to represent the major watershed by the number of those sites being sampled by local partners. For lakes, the total number of priority lakes (those less than 500 acres that have not yet been monitored or assessed) is divided by the total number of those monitored by local groups. The percentage of sites monitored by local partners is updated each January on a spreadsheet (PL2_Watershed sites monitored by locals.xls) that automatically updates the bar graph. Both the Priority sites and PL2_Watershed sites monitored by locals spreadsheet are found in this folder on the MPCA's server: X:\Agency_Files\Water\Condition Monitoring\Measures\Lakes & Streams\PL2_Watershed sites monitored by locals.

Data Source
Spreadsheets tracked by MPCA Water Quality Monitoring Unit supervisor and the SWAG and WPLMN Grant Coordinator.

Data Collection Period
The first IWM cycle will span from 2006-2017. This measure is updated annually when IWM monitoring by the local partner first begins.

Data Collection Frequency
Updated annually (each January), after the SWAG grants have been awarded.

Supporting Data Set

IWM year	IWM lakes	IWM 10X stream sites	Basin sites	Major load sites	Intermediate load sites
2007		0%			
2008		88% (50/57 sites)			
2009	27% (62/230 lakes)	67% (53/79 sites)			
2010	47% (66/140 lakes)	76% (53/70 sites)			
2011	58% (42/73 lakes)	93% (64/69 sites)			
2012	100% (34/34 lakes)	100% (62/62 sites)	100% (44/44 sites)	100% (10/10 sites)	100% (3/3 sites)
2013	91% (52/57 lakes)	92% (77/84 sites)	100% (37/37 sites)	100% (8/8 sites)	100% (3/3 sites)

Recruitment for local monitoring of lakes and major load sites within the watershed approach began in 2009. Intermediate load monitoring began in 2012.

Caveats and Limitations

This measure only considers lakes and stream sites that have been offered to local partners through requests for proposals (RFPs) and other contracting avenues. There are types of lake and stream monitoring that are specialized and are not routinely offered to external partners, and sites that fall into these specialized categories and are held for monitoring by MPCA staff are not counted in the measure totals. For instance, the 92% figure cited for 2013 IWM streams reflects the fact that 77 of the 84 stream sites offered to local partners in the Surface Water Assessment Grant RFP were picked up by local partners.

The variability surrounding how much of the intensive watershed monitoring is conducted by locals is largely due to capacity. Many local partners are simply not able to take on additional work, even when funding is offered. We strive to improve our communication with local partners to ensure that they are aware that monitoring opportunities exist and to seek ways to ease any burden to them; however, there may always be cases where the mix of watersheds in a given year is one in which we have little local capacity.

MPCA's Water Monitoring Strategy indicates that agency monitoring will occur on the largest lakes and a percentage of smaller lakes. Local monitoring will be steered towards medium and small sized lakes (< 500 acres). For this reason, lake priorities for Surface Water Assessment Grants tend to be smaller lakes (<500 acres).

Note: This measure only captures local efforts towards condition monitoring needed to assess resources for use support. It does not capture local efforts towards restoration/protection plan development, investigative monitoring, or implementation activities.

Future Improvements

N/A

Financial Considerations

Contributing Agencies and Funding Sources

Funding for monitoring that supports the MPCA's Intensive Watershed Monitoring design comes from the Minnesota Clean Water Fund.

Communication Strategy

Target Audience

Local, state and federal agencies and the general public.

Associated Messages

This message conveys the extent to which local partners are involved in MPCA lake and stream chemistry condition monitoring.

Outreach Format

TBD

Other Measure Connections

This measure could be connected to "percent of major watersheds that have been intensively monitored" because these efforts of local partners in this measure are a large component of our overall condition monitoring effort.

Measure Points of Contact

Agency Information

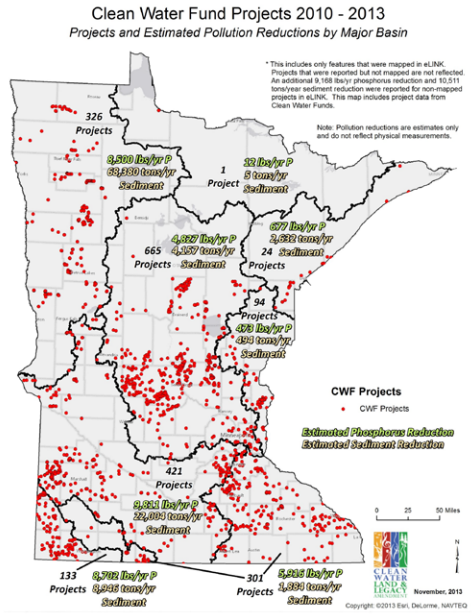
Pam Anderson, MPCA, Water Quality Monitoring Unit supervisor, pam.anderson@state.mn.us.

Number of nonpoint source best management practices implemented with Clean Water funding and estimated pollutant load reductions

Measure Background

Visual Depiction

Graphics should depict number of best management practices (BMPs) implemented statewide, annually and then cumulatively over the 25 year period of the Clean Water Fund.



Measure Description

This measure communicates the number of BMPs implemented with Clean Water funds and the estimated associated reduction in sediment and phosphorus reaching surface waters. It does not reflect BMPs implemented through other programs aimed at accelerating BMP adoption. This measure is strictly concerned with Clean Water funded implementation programs.

It is an indirect or surrogate measure of environmental response. It does not provide information on watershed health, but does provide information on efforts to reduce pollutant loads over time that are likely to improve watershed health.

Associated Terms and Phrases

To better understand this measure, it is necessary to understand the following terms and phrases. Definitions used in this measure are as follows:

BMPs: Conservation practices that improve or protect water quality in agricultural, forested, and urban areas.

Clean Water Funding: For this measure, the term Clean Water Funding refers to Clean Water Grants distributed to local governments for BMP implementation through special Clean Water Fund appropriations to various State grant programs. Clean Water funding also refers to AgBMP loans issued to local governments for the implementation of any practice that protects or restores water quality. A list of CWF grant and loans programs can be found at http://www.legacy.leg.mn/.

Phosphorus: In this measure, we report the estimated reduction in the amount of total phosphorus reaching surface waters as a result of runoff or soil erosion (sheet, rill, gully erosion, or steam channel).

Sediment Loss: The estimated amount of sediment reaching the nearest surface water body as a result of soil erosion from water (sheet, rill, gully erosion, or stream channel).

Target
There is no specific numeric target for this measure to date.

Baseline
FY 2010 serves as the baseline for this measure.

Geographical Coverage
Statewide and by watershed

Data and Methodology

Methodology for Measure Calculation
The Clean Water Fund comprises funding from multiple state grant and loan programs. To calculate this measure, state agencies first collect data on the number of BMPs implemented with Clean Water Funds by each program and then sum these figures to provide a single count for each watershed and for the state.

Pollutant estimates are entered into the Minnesota Board of Water and Soil Resources' (BWSR's) web-based grant reporting and tracking tool, eLINK, by grant recipients when entering BMP data. The State of Minnesota does not require a specific methodology for developing pollutant load estimates. Pollutant load reductions using existing models developed for estimating pollutant load are acceptable. BWSR provides pollutant estimators for eLINK based on soil erosion (sheet, rill, gully and stream channel). Sediment reduction estimates in eLINK are based on the distance to the nearest surface waters and soil loss calculations using USDA's Revised Universal Soil Loss Equation (RUSLE2). Phosphorus reduction estimates are derived from sediment reduction estimates. Detailed information on the calculations used in eLINK for estimating pollutant load reductions is available from at: http://www.bwsr.state.mn.us/outreach/eLINK/manual/index.html.

Estimates of pollutant load reductions for AgBMP loans are based on tabled values reported in scientific literature. Values are determined using empirical data; however they are averages and are not site-specific. The MDA continues to gather information about the effectiveness of agricultural BMPs and

support research projects that provide more comprehensive empirical data on practices that the loan program supports.

Estimating the environmental benefit of specific management practices can be done numerous ways. The most common are to develop computer models, use values in from the scientific literature, or base estimates on the best professional judgment of experts. Regardless of the method used, some uncertainty remains in every estimate. State agencies continue to improve and refine estimates, enabling them to better quantify the environmental benefits of conservation practices.

The table below shows the source of the BMP data for each of the Competitive Clean Water Grants component programs.

Data Source

Clean Water Fund programs	Responsible Agency	Funding availability by fiscal year*	Database
Competitive Clean Water Fund Grants	BWSR	10,11,12,13	eLINK
Clean Water Fund Ag BMP Loans (CWF is one of five funding sources that support this loan program, CWF supported loans must be issued in areas with completed TMDL plans)	MDA	10,11,12,13	AgBMP Loan Program database

For programs administered by BWSR, local grant recipients are required to enter BMP data in eLINK. More information on eLINK is available at www.bwsr.state.mn.us/outreach/eLINK/manual/index.html.

Data Collection Period

The data collection period is FY10 through FY13 for Clean Water Grants and for AgBMP loans. As explained below in Caveats and Limitations, there is a lag time between grants being awarded and BMPs being fully implemented and recorded. The dataset will be complete once all of the BMPs funded with FY2010-2013 are fully implemented and recorded. Until then, the dataset for this measure only provides a snapshot in time. Data collection will continue for the duration of the Clean Water Fund (until 2034).

Data Collection Methodology and Frequency

Data on the number of and type of BMPs implemented with Clean Water Funds are extracted from various databases established by state agencies to track Clean Water Grants programs (see Data Source above). The data collection methods and frequency vary by program. The programs and respective databases existed well before Clean Water Funds became available and therefore were not designed specifically with Clean Water Fund tracking in mind.

For data that is entered in eLINK, BWSR staff extracts the data by querying eLINK for BMPs implemented with Clean Water Fund dollars. Local grant recipients enter BMP information into eLINK every six months, recording only those BMPs that are fully implemented at that time. BMP data is analyzed by the fiscal year the grant was awarded rather than the calendar year the BMP was installed.
AgBMP loan information is stored in MDA's AgBMP loan database. It is updated whenever new loans are issues. Reports can be generated at any time and for any geographic region.

Supporting Data Set

Below are data sets from each of the state agencies participating in data collection for this measure (see Data Source above).

Cumulative Non-Point Source BMPs funded by Clean Water Fund

Watershed	Reported Number of BMPs					Estimated Pollutant Load Reductions	
	FY10	FY11	FY12	FY13	Total	Sediment (T/yr)	Phosphorus (lbs/yr)
Statewide	949	916	540	353	2,758	119,013	48,085

Caveats and Limitations

- This measure only tracks BMPs implemented with funding from Clean Water Fund Grants and Loans.
- Clean Water Fund Grants are for two years, resulting in a lag time between when funds are awarded and when BMPs are fully implemented and recorded in eLINK. This measure reports only BMPs that are fully implemented; it does not report on those that are planned or in progress.
- Pollution reductions entered into eLINK are calculated at the field scale, not the watershed scale.
- BMPs vs. Projects: The Minnesota Department of Agriculture's AgBMP Loan Program database does not record BMPs implemented per se, but rather loan projects completed. Most loan projects involve a single BMP or cluster of related BMPs. For example, a loan might finance an entire feedlot runoff control system or just one component. The same is true for most other conservation financial assistance programs. A BMP crosswalk is being developed to facilitate multi-program tracking.
- Potential Double-Counting of BMPs: An individual BMP may be co-funded by several Clean Water Fund implementation programs. For example, a gully/grade stabilization structure might be funded 75% through a BWSR grant and 25% by an AgBMP loan—with both programs counting the same structure in their respective databases. In another example, a BWSR grant might provide financial incentives for a farmer to switch to no-till, while an AgBMP loan finances the farmers' purchase of a no-till drill —again, both programs might record the same structure. Until a method is developed to identify such projects and coordinate the way they are recorded, it is necessary to report eLINK-entered data and AgBMP Loan data as separate figures or, if totaled, it should be noted that data might overlap and result in double-counted BMPs.
- Incomplete Data on Pollutant Load Reductions: Currently, pollutant load reductions can be calculated only for BMPs recorded in eLINK. As noted under Data Source above, not all Clean Water funded BMPs are recorded in eLINK at this time; some are recorded only in other program-specific databases.

Future Improvements

Improvements to this measure will be made over time. The type of pollutant reductions estimated in eLINK will expand in the short-term; therefore, this measure will track additional estimated pollutant load reductions associated with BMPs implemented with Clean Water funding.

Ideally this measure will be able to compare estimated pollutant load reductions in a particular watershed with pollutant load reduction targets established through TMDLs and other plans. However, accurate comparisons would require tracking all BMPs in a watershed, not just those implemented using Clean Water funding, as well as point source pollutant load reductions.

Eventually the tracking of BMPs in this measure may be replaced by measures of targeted implementation.

Financial Considerations

Contributing Agencies and Funding Sources

This measure only tracks BMPs funded with Clean Water funding, although eLINK tracks a larger universe of BMPs funded through a wide array of funding sources.

Communication Strategy

Target Audience

Stakeholders with interest in this measure include the State legislature, the Clean Water Council, and state agency partners.

Associated Messages

This primary message associated with this measure is to demonstrate the amount of implementation occurring as a result of available funds. In addition, this measure provides information on expected pollutant load reductions associated with implementation. Therefore, a secondary message is that pollutant load reductions in the short-term will help to create water quality improvements in the long-term.

Other Measure Connections

This measure doesn't explicitly link to other measures, but will help to provide an understanding of trends in key water quality and quantity parameters for lakes, streams, and groundwater measure.

Measure Points of Contact

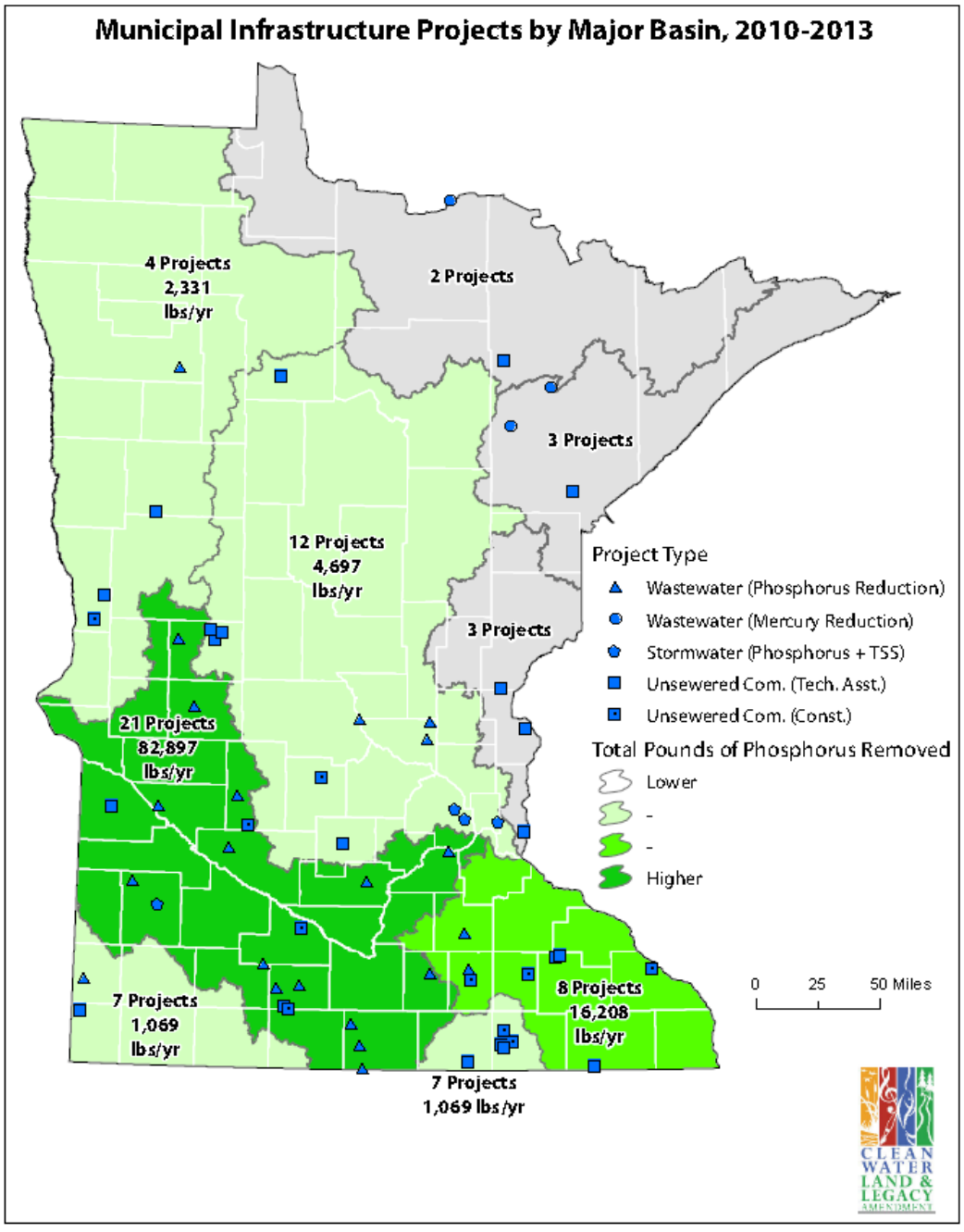
Agency Information

Conor Donnelly, Board of Water and Soil Resources, conor.donnelly@state.mn.us
Dwight Wilcox, Minnesota Department of Agriculture, dwight.wilcox@state.mn.us

Number of municipal point source construction projects implemented with Clean Water Funding and estimated pollutant load reductions

Measure Background

Visual Depiction



Measure Description

This measure is designed to document and track outcomes on the wastewater and stormwater point source construction projects initiated with Clean Water Funds and the estimated reduction in pollutant loadings reaching surface waters.

The focus of this measure is focused on phosphorus, mercury in wastewater projects, total suspended solids in stormwater projects and non-compliant sub-surface sewage treatment system as it provides the easiest means to compare progress across the broad range of pollutants affected by TMDL's waste load allocations. It does not provide information or contextual outcomes on other federal and state funded projects and their resulting environmental progress.

These projects are a result of increased treatment requirements resulting from a TMDL waste load allocation, statewide permit requirements or water quality based effluent limits (WQBEL or "Q-bell" are pre-TMDL discharge limits that wastewater facilities must meet in order not to contribute or create an impairment). As a result of these capital investment and resulting construction projects, a municipality is able to achieve the required treatment to adhere to an enforceable permit condition.

Associated Terms and Phrases

Water quality based effluent limit (WQBEL or "Q-bell") are pre-TMDL discharge limits that wastewater facilities must meet in order not to create or contribute to an impairment.

Target

No specific numeric target exists in this measure. Clean Water Funds are provided as grants and loans to municipalities to build projects to provide additional wastewater and stormwater treatment in order to meet the more stringent discharge limits. The appropriations are available for a five year period because these projects are complex and require significant time for planning and design. For the past four years, all municipal entities that have applied and completed all program administrative requirements have been fully funded. The agencies are committed to meeting the entire demand resulting from permit limits that exceed secondary treatment standards due to the degraded water quality. Additionally, there are delays in construction because these projects are complex and require significant time for planning and design.

Baseline

No base year is needed for this measure.

Geographical Coverage

This measure has both statewide, basin and watershed impacts and protection or restoration investments.

Funding for this program is based on the ranking and points on the state's Clean Water Project Priority List (PPL) which prioritizes a variety of receiving waters criteria factors

Data and Methodology

Methodology for Measure Calculation

There are 3 primary types of pollutants (bacteria, mercury and phosphorus) that are addressed by CW funds for municipal projects. Pollutant reduction estimates are based, for the most part, on how projects are expected to function after initiation of operations. Currently pollution loading reductions is only calculated for phosphorus in wastewater projects.

Data Source

The data source for this measure is based on engineer calculations of future facility operation or documented facility operation.

Data Collection Period

Data used is from projects receiving an award in Fiscal Years 2010-2013. In some cases, longer time frames are used in order to establish trend lines or provide a more historical context to resulting environmental improvements.

Data Collection Methodology and Frequency

This is a brief description the calculation methods used for TMDL and Phosphorus reduction grant projects, where the pollutant of concern to be reduced is phosphorus, or phosphorus reductions estimates are desired for other pollutants of concern as an indicator of success of the project to show positive environmental benefits.

The before project annual phosphorus load value (pounds per year or lb/yr) in the spreadsheet tables came from a calculation using before project discharge monitoring report data (DELTA data from 2012) for average daily phosphorus concentration and average daily flow.

The after project annual phosphorus load (lb/yr) calculations were prepared one of two ways. First, if the construction project has been completed with one full year of operation discharge monitoring report data available, the average daily phosphorus concentration and average daily flow were used to calculate the annual load (lb/yr). Second, if the construction project was not complete, the after project annual load was estimated using the permit phosphorus average daily concentration effluent limit (typically 1.0 mg/L) and the design average daily wet weather flow for the project location.

The projected reduction load calculation was then the before project calculated load minus the after project calculated load.

Please note: in two project cases the facilities getting mercury effluent limits (listed as mercury for the pollutant of concern) already had existing permit phosphorus effluent limits of 1.0 mg/L and were already reducing phosphorus at or below their required effluent phosphorus concentration limit. At these project locations, the construction project was not targeted at reducing phosphorus, but at reducing mercury. Both facilities are constructing new filtration systems that will likely reduce the particulate phosphorus in the facilities treated effluent, however it is not possible to quantify this potential reduction in effluent phosphorus at this time. The projected reduction load calculations for these two projects were assigned zero (0) lb/yr.

Phosphorus reduction estimates for the 2013 TMDL Grant Projects that had Fecal Coliform as the identified pollutant of concern were calculated by selecting the number of failing onsite systems from their respective Project Priority List (PPL) applications, and assuming that there were 2.5 residents per home, and assigning a phosphorus load of 1.76 lb/person/day. The number of homes figure was then multiplied by 2.5 and by 1.76 to give an estimate of the possible phosphorus load per day that is estimated to be reduced from the receiving water at those project locations (assuming that those failing onsite systems were directly impacting that receiving water by a direct straight pipe discharge).

Supporting Data Set

Phosphorus load reduction from CWL point-source funding programs

2010 Projects		**Projected Phosphorus Load Reduction (lb/yr)**
Blue Earth - Phase 2	Blue Earth River	0
Comfrey	Minnesota River (Mankato)	158
Faribault	Cannon River	5,421
MCES Blue Lake Plant Improvements	Lower Minnesota River	9,664
Renville	Minnesota River (Yellow Medicine River)	8,012
St. Cloud - Ph 1	Mississippi River (St. Cloud)	4,355
St. James	Watonwan River	7,036
Waseca	Cannon River	0
Willmar - Phase 1b	Minnesota River (Yellow Medicine River)	55,315
Zimmerman	Mississippi River (St. Cloud)	173
		90,134
2011 Projects		
Arlington	Lower Minnesota River	0
Butterfield	Watonwan River	0
Crystal - Stormwater	Mississippi River (Twin Cities)	120
Doran	Bois de Sioux River	32
Elmore	Blue Earth River	188
Essig	Cottonwood River	93
Forest City Twp	North Fork Crow River	18
Mantorville - Mantor Drive	Zumbro River	482
Marshall - Stormwater	Redwood River	1,062
Minneota	Minnesota River (Yellow Medicine River)	299
Odin	Watonwan River	(included in Ormsby)
Ormsby	Watonwan River	481
Owatonna	Cannon River	10,291
Pipestone	Lower Big Sioux River	1,069
Princeton	Rum River	0
Red Rock Twp - Nicolville	Cedar River	28
Watson	Chippewa River	116
Winnebago	Blue Earth River	0
		14,279

2012 Projects		
Evansville	Chippewa River	65
Fosston	Clearwater River	2,331
Minneapolis - Stormwater	Mississippi River - Twin Cities	20
Minnesota City	Mississippi River - Winona	14
North Koochiching Area SD	Rainy River - Black River	0
RWMWD - Stormwater	Mississippi River - Twin Cities	29
Starbuck	Chippewa River	407
Virginia	St. Louis	3,906
		6,772

2013 Projects		
Hibbing	St. Louis	0
Lansing Twp	Cedar River	66
Roseland Twp	Minnesota River - Yellow Medicine River	194
Steele County - Bixby	Cannon River	84
		344
	Grand total	111,529

Caveats and Limitations

- This measure only tracks projects implemented with funding from Clean Water Fund Grants.
- Projects that record zero pounds of phosphorus removed are a result of an expansion in treatment capacity while still operating the facility at less than design flows.

Future Improvements

Additional data measures will be developed to address the two other pollutants – fecal coliform (bacteria) and mercury. Cost per pollutant unit removed may also consider if there is value in pursuing that type of performance indicator.

Financial Considerations

Contributing Agencies and Funding Sources

Not applicable

Communication Strategy

Target Audience

Municipal entities

Measure Points of Contact

Agency Information

Bill Dunn
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Minnesota Pollution Control Agency
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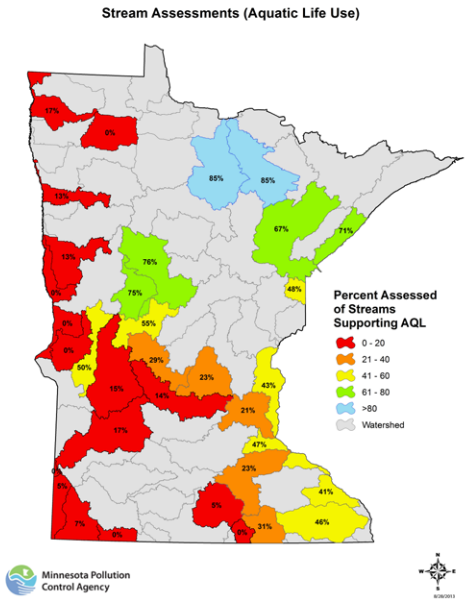
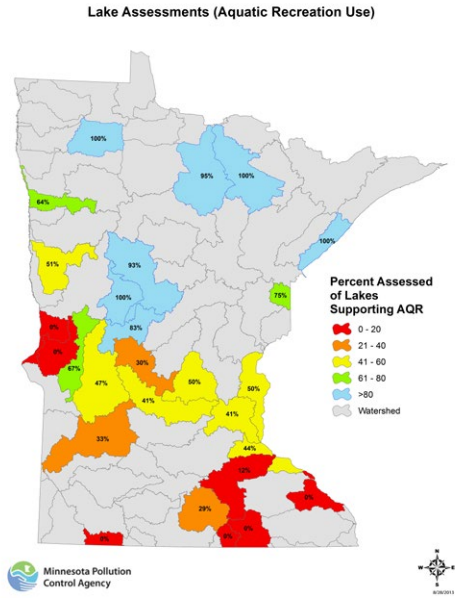
http://www.positivelyminnesota.com/pfa

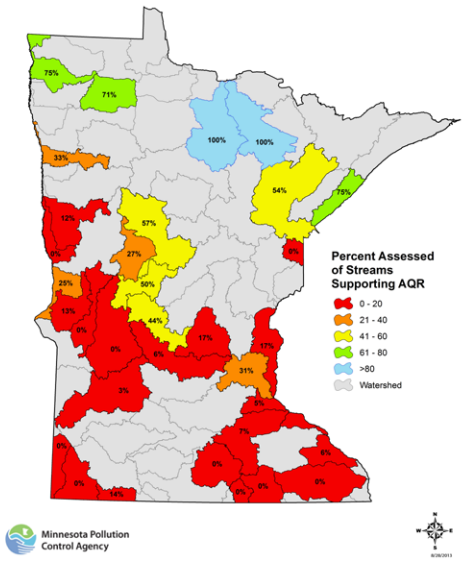
Rate of impairment/unimpairment of surface water statewide and by watershed

Measure Background

Visual Depiction







Measure Description

The intent of this measure is to communicate the impairment "rate" of lakes and streams, by designated use, statewide and also by watershed. While we have the ability to report data for each main category

of designated use for which we have standards, the focus at least initially will be on aquatic recreation for lakes and streams and aquatic life for streams. This measure will be presented at statewide and watershed scales, with a separate map for each use/resource type combination (i.e., aquatic recreation/lakes, aquatic recreation/streams, etc.).

Associated Terms and Phrases

Assessment: The process of summarizing the biological, chemical and physical data available for a lake or stream site and comparing the data against water quality standards to determine if designated uses are supported.

Condition monitoring: Monitoring the background, or ambient, condition of a lake or stream reach. This type of monitoring typically requires monitoring once or twice per month during the open water season for a minimum of two years. The resulting data are compared to state and federal water quality standards put in place to support various uses (drinking water, aquatic recreation, aquatic life, consumption, etc.) to determine if the resource is exceeding standards (i.e., is "impaired") and in need of restoration or is meeting standards and in need of protection.

Designated use: The identified use for which a waterbody is managed (support of aquatic communities, recreation in or on the water, consuming the water or fish taken from the water).

Impairment: One or more designated use is not being met, as determined by a comparison to applicable water quality standards.

Impairment rate: Percentage of lakes or streams impaired for a specific designated use (statewide, or watershed-by-watershed).

Intensive watershed monitoring (IWM): A ten-year rotational cycle wherein an average of 8 of Minnesota's 81 major (8-digit hydrologic unit code) watersheds are intensively monitored each year. The outlet of each major watershed is monitored for physical and chemical parameters monthly on a continual basis for baseflow and more frequently during "events", such as snowmelt and storms (termed 'load monitoring'). During intensive watershed monitoring, additional focus is placed on monitoring the outlets of subwatersheds (aggregated 12 -digit hydrologic unit code) for biota (fish and invertebrates) and physical habitat, and to sample for chemical parameters ten times. One-time biological, physical and chemical sampling is also conducted at the outlet of the 14-digit hydrologic unit code watersheds. During intensive watershed monitoring, all accessible lakes $\geq$500 acres and at least 25% of lakes 100-499 acres are monitored for physical and chemical parameters (tools to allow for the assessment of biology are in development).

Load monitoring: Flow and chemistry monitoring conducted at the mouth (or outlet) of each major (8-digit hydrologic unit code scale) watershed. Monitoring is conducted at least monthly, and then more frequently during events (i.e., snowmelt or rain events). As with the intermediate load monitoring, the objective is to capture the entire hydrograph, and to determine the pollutant load carried by a stream or river. Watershed loads are also used to assess trends in the stream water quality of a watershed over time, and to see how data from a given year compare to the long-term record for a watershed.

Major watershed: 8-digit hydrologic unit code (HUC) watersheds in Minnesota; there are 81 in Minnesota.

Target
Ultimately, the target is 100% of Minnesota's waters supporting designated uses, or a 0% impairment "rate" for all designated uses.

Baseline
Five watersheds (those monitored intensively in 2007 and three in 2008) were comprehensively assessed in 2010 to pilot a new assessment process. Eleven more watersheds were assessed in 2011. On average, eight watersheds are expected to be assessed annually from 2012 on.

Geographical Coverage
Statewide and watershed.

Data and Methodology

Methodology for Measure Calculation
We will calculate the impairment "rate" for each designated use for which we have data by dividing the total number of resources assessed by those resources not meeting standards. For example, the impairment rate for aquatic recreation for lakes will be the total number of lakes that we assessed in a watershed divided by the number of those lakes found to be impaired for aquatic recreational use support. The statewide rate will be calculated by adding the total number of lakes assessed divided by the number of lakes statewide found to be impaired for aquatic recreational use support.

Assessment data are queried from the MPCA's Assessment database (ADB) and combined with lake/stream and watershed information found in Core_WU tables. The assessment results are summarized in a spreadsheet (AssessmentResults.xls), which is loaded into an Access database (AssessmentResults.mdb). The tables in this database are joined to four separate GIS projects each July to develop the statewide maps showing watershed assessment results. AssessmentResults.xls, AssessmentResults.mdb and the GIS projects can all be found in X:\Agency_Files\Water\Condition Monitoring\Measures\Lakes & Streams\EDWOM1_ImpairmentUnimpairment Rate on the MPCA's server. Detailed methods for querying database systems for the assessment data, manipulating it and loading it to the GIS projects are also found in AssessmentResults_procedure.docx in this folder.

Data Source
The MPCA's Assessment database (or ADB) stores results of the MPCA's annual assessments. Lake/stream watershed information is found in MPCA's Core_WU data tables.

Data Collection Period
The MPCA uses the most recent ten years of monitoring data in the EQuIS surface water data management database when assessing a lake or stream reach. Monitoring data are collected by the MPCA annually with each major watershed intensively sampled every 10 years. The majority of monitoring occurs in the year we start intensively monitoring a given watershed (all biological, half of the chemical); additional sampling for water chemistry occurs in the following year. Additional data comes into EQuIS (the state's water quality data management system) from a variety of state, local and

citizen partners from their own monitoring efforts and programs, which follow various schedules (i.e., may be a one year sampling project or an ongoing monitoring effort, etc.). These externally collected data are also used to assess lake and stream condition, if this data meets the MPCA's quality standards.

Data Collection Frequency

On average, eight watersheds are comprehensively assessed each winter, and assessment maps are updated each July.

Supporting Data Set

Stream aquatic life and aquatic recreation assessment data:

Watersheds	AQL NS (count/%)	AQL FS (count/%)	Assessed AQL Streams (count)	AQR NS (count/%)	AQR FS (count/%)	Assessed AQR Streams (count)
Lake Superior - South 04010102	11 (29%)	27 (71%)	38	3 (25%)	9 (75%)	12
St. Louis River 04010201	24 (33%)	49 (67%)	73	17 (46%)	20 (54%)	37
Nemadji River 04010301	11 (52%)	10 (48%)	21	2 (100%)	0 (0%)	2
Crow Wing River 07010106	10 (24%)	31 (76%)	41	10 (43%)	13 (57%)	23
Redeye River 07010107	4 (25%)	12 (75%)	16	8 (73%)	3 (27%)	11
Long Prairie River 07010108	10 (45%)	12 (55%)	22	3 (50%)	3 (50%)	6
Sauk River 07010202	22 (71%)	9 (29%)	31	14 (56%)	11 (44%)	25
Mississippi River (St. Cloud) 07010203	17 (77%)	5 (23%)	22	20 (83%)	4 (17%)	24
North Fork Crow River 07010204	19 (86%)	3 (14%)	22	15 (94%)	1 (6%)	16
Mississippi River (Twin Cities) 07010206	26 (79%)	7 (21%)	33	20 (69%)	9 (31%)	29
Pomme de Terre River 07020002	6 (50%)	6 (50%)	12	2 (100%)	0 (0%)	2
Minnesota River (Granite Falls) 07020004	30 (83%)	6 (17%)	36	30 (97%)	1 (3%)	31
Chippewa River 07020005	22 (85%)	4 (15%)	26	22 (100%)	0 (0%)	22

Watersheds	AQL NS (count/%)	AQL FS (count/%)	Assessed AQL Streams (count)	AQR NS (count/%)	AQR FS (count/%)	Assessed AQR Streams (count)
Le Sueur River 07020011	20 (95%)	1 (5%)	21	8 (100%)	0 (0%)	8
St. Croix River (Stillwater) 07030005	16 (57%)	12 (43%)	28	19 (83%)	4 (17%)	23
Mississippi River (Red Wing) 07040001	8 (53%)	7 (47%)	15	19 (95%)	1 (5%)	20
Cannon River 07040002	40 (77%)	12 (43%)	52	43 (93%)	3 (7%)	46
Mississippi River (Winona) 07040003	19 (59%)	13 (41%)	32	15 (94%)	1 (6%)	16
Root River 07040008	45 (54%)	38 (46%)	83	20 (100%)	0 (0%)	20
Cedar River 07080201	24 (69%)	11 (31%)	35	16 (100%)	0 (0%)	16
Shell Rock River 07080202	2 (100%)	0 (0%)	2	3 (100%)	0 (0%)	3
Bois de Sioux River 09020101	7 (100%)	0 (0%)	7	3 (75%)	1 (25%)	4
Mustinka River 09020102	13 (100%)	0 (0%)	13	7 (88%)	1 (12%)	8
Red River of the North (Headwaters) 09020104	6 (100%)	0 (0%)	6	5 (1%)	0 (0%)	5
Buffalo River 09020106	14 (88%)	2 (12%)	16	22 (88%)	3 (12%)	25
Red River of the North - Sandhill River 09020301	7 88%)	1 (12%)	8	4 (67%)	2 (33%)	6
Thief River 09020304	3 (100%)	0 (0%)	3	2 (29%)	5 (71%)	7
Tamarac River (Red River of the North) 09020311	5 (83%)	1 (17%)	6	1 (25%)	3 (75%)	4
Little Fork River 09030005	6 (15%)	33 (85%)	39	0 (0%)	12 (100%)	12

Watersheds	AQL NS (count/%)	AQL FS (count/%)	Assessed AQL Streams (count)	AQR NS (count/%)	AQR FS (count/%)	Assessed AQR Streams (count)
Big Fork River 09030006	6 (15%)	33 (85%)	39	0 (0%)	11 (100%)	11
Upper Big Sioux River 10170202	1 (100%)	0 (0%)	1			
Lower Big Sioux River 10170203	19 (95%)	1 (5%)	20	7 (100%)	0 (0%)	7
Rock River 10170204	27 (93%)	2 (7%)	29	18 (100%)	0 (0%)	18
Little Sioux River 10230003	4 (100%)	0 (0%)	4	6 (86%)	1 (14%)	7

AQL = aquatic life; AQR = aquatic recreation; NS = non-support for designated uses; FS = full support for designated uses

Lake aquatic recreation assessment data:

Watersheds	AQR NS (count/%)	AQR FS (count/%)	Assessed Lakes (count)
Lake Superior - South 04010102	0 (0%)	6 (100%)	6
St. Louis River 04010201	7 (28%)	18 (72%)	25
Nemadji River 04010301	2 (25%)	6 (75%)	8
Crow Wing River 07010106	8 (7%)	106 (93%)	114
Redeye River 07010107	0 (0%)	14 (100%)	14
Long Prairie River 07010108	10 (17%)	49 (83%)	59
Sauk River 07010202	32 (70%)	14 (30%)	46
Mississippi River (St. Cloud) 07010203	35 (50%)	35 (50%)	70
North Fork Crow River 07010204	41 (59%)	29 (41%)	70
Mississippi River (Twin Cities) 07010206	89 (59%)	63 (41%)	152

Watersheds	AQR NS (count/%)	AQR FS (count/%)	Assessed Lakes (count)
Pomme de Terre River 07020002	4 (33%)	8 (67%)	12
Minnesota River (Granite Falls) 07020004	14 (67%)	7 (33%)	21
Chippewa River 07020005	34 (53%)	30 (47%)	64
Le Sueur River 07020011	5 (71%)	2 (29%)	7
St. Croix River (Stillwater) 07030005	53 (50%)	54 (50%)	107
Mississippi River (Red Wing) 07040001	5 (56%)	4 (44%)	9
Cannon River 07040002	36 (88%)	5 (12%)	41
Mississippi River (Winona) 07040003	2 (100%)	0 (0%)	2
Root River 07040008			
Cedar River 07080201	1 (100%)	0 (0%)	1
Shell Rock River 07080202	5 (100%)	0 (0%)	5
Bois de Sioux River 09020101	3 (100%)	0 (0%)	3
Mustinka River 09020102	3 (100%)	0 (0%)	3
Red River of the North (Headwaters) 09020104			
Buffalo River 09020106	17 (49%)	18 (51%)	35
Red River of the North - Sandhill River 09020301	4 (36%)	7 (64%)	11
Thief River 09020304	0 (0%)	1 (100%)	1

Watersheds	AQR NS (count/%)	AQR FS (count/%)	Assessed Lakes (count)
Tamarac River (Red River of the North) 09020311			
Little Fork River 09030005	0 (0%)	15 (100%)	15
Big Fork River 09030006	6 (5%)	111 (95%)	117
Upper Big Sioux River 10170202			
Lower Big Sioux River 10170203			
Rock River 10170204			
Little Sioux River 10230003	9 (100%)	0 (0%)	9

AQR = aquatic recreation; NS = non-support for designated uses; FS = full support for designated uses

Caveats and Limitations

We do not randomly select the watersheds or sites/lakes that are intensively monitored, so the impairment/unimpairment rates must be characterized as representative of the body of lakes or streams sampled. The rates cannot be characterized as an unbiased statewide picture of lake and stream condition.

Also, the watersheds assessed to date are largely located in central and southern Minnesota. Since water quality in lakes and streams alike tends to be more degraded in central and southern Minnesota than in the north, the statewide rates will be skewed towards high impairment rates until we have assessed more watersheds in northern Minnesota. The rates may always be biased towards impairment, as a portion of the monitoring conducted on the state and local level is aimed at resources that are suspected to have pollution problems.

At this point, we are not able to report an impairment rate for aquatic life use support for lakes. The only standard currently being applied to lakes for aquatic life use is chloride toxicity, which is a localized problem. Indices of biotic integrity for lakes are under development with Minnesota Department of Natural Resources.

Sites and lakes are delisted as water integrity is restored or as corrections to the impaired waters list are made. For this reason, we may see impairment/unimpairment rates change for a given watershed from one year to the next, and we also expect to see impaired rates diminish over time for some watersheds.

This measure reflects the lakes and stream reach assessment decisions made for those resources for which we have sufficient data for assessment and whose datasets allow us to make a clear assessment decision. Each year, there are a number of resources for which the assessment data indicates the

resource is hovering near the impairment thresholds. In such cases, we delay an assessment decision to allow additional time to gather more data.

Future Improvements

As new standards or tools are available (for example, indices of biotic integrity for lakes), we will be able to report additional impairment/unimpairment results.

Financial Considerations

Contributing Agencies and Funding Sources

Funding for core monitoring that supports the MPCA's Intensive Watershed Monitoring design comes from the Minnesota Clean Water Fund, though it should be noted that the MPCA considers all surface water monitoring data stored in EQuIS when assessing the condition of Minnesota's lakes and streams. Additional data beyond that collected through the IWM design is collected through local and other state programs supported by Clean Water and non-Clean Water Funds. For example, a lake association may monitor their lake annual through member dues and submit these data to EQuIS.

Communication Strategy

Target Audience

Local, state and federal agencies and the general public.

Associated Messages

This measure conveys our progress in assessing lakes and streams statewide. Since restoration and protection planning work follows condition monitoring and assessment, this measure also conveys to other MPCA staff and local partners when restoration and protection planning may begin in their regions. This measure also has enormous interest for citizens who want to know how resources in their area are faring. The impairment/unimpairment rates must be carefully understood, though, as they come with many caveats (see Caveats and Limitations). The impairment/unimpairment rate does not provide any direct information on resources that have been delisted, so this measure alone gives no real sense of progress being made to improve water quality.

Outreach Format

TBD. [where will this measure be used, such as newsletters, websites, reports, etc.; include frequency of each format and any specifics about how presentation of the measure should vary for each outreach format]

Other Measure Connections

This measure replicates the MPCA strategic measure on impairment and unimpairment rates in Minnesota.

Measure Points of Contact

Agency Information

Pam Anderson, MPCA, Water Quality Monitoring Unit supervisor, pam.anderson@state.mn.us.

Changes over time in key water quality parameters for lakes, streams, and wetlands

Measure Background

Measure Description

This measure features a variety of graphics intended to show changes over time in the chemical, biological and physical characteristics of lakes, streams and wetlands, on a statewide scale or within a major watershed or ecoregion. It is important to understand that the broader the scale, the longer it generally takes to detect water quality changes. For this reason, it will take many years of monitoring to detect improvements or declines in water quality at a statewide scale. We may be able to detect trends in watersheds in a shorter amount of time. Monitoring a given lake or stream reach consistently for a decade or more is prohibitively expensive. Therefore, there is a balance between tracking trends on a scale that is meaningful, but that can also be supported financially long-term.

We have selected several monitoring programs to provide water quality information to detect the general condition and changes in lake, stream, and wetland water quality in Minnesota over time. Annually, we will be reporting statewide trends from the MPCA's Citizen Lake Monitoring Program, estimates of watershed pollutant yields from the MPCA's Major Watershed Load Monitoring network, and pesticide detection and concentration trends from the Minnesota Department of Agriculture (MDA) for streams and rivers from agricultural areas. Every five years, we will be presenting the results from either the National Aquatic Resources Surveys (lakes) or the state probabilistic surveys (streams and wetlands), which are financially supported and coordinated by USEPA and produce snapshots in time of lake, stream and wetland condition. The MPCA has been conducting comprehensive watershed lake and stream monitoring on a 10-year rotational basis (termed 'Intensive Watershed Monitoring') since 2008 (piloted in 2006 and 2007). Every ten years, we will be able to report on changes in water quality to a watershed since the last time it was monitored. For each resource type (lake, stream, and wetland), we have chosen a handful of 'key' parameters to track, those factors that tend to be the key indicators of pollution.

The differing types of water resources, key parameters and temporal scales combined to create enough complexity to warrant breaking this measure into three major categories. Those categories are:

EDWOM 2a) Changes in lakes over time in total phosphorus, chlorophyll-a, transparency and pesticides (This category includes Citizen Stream Monitoring)

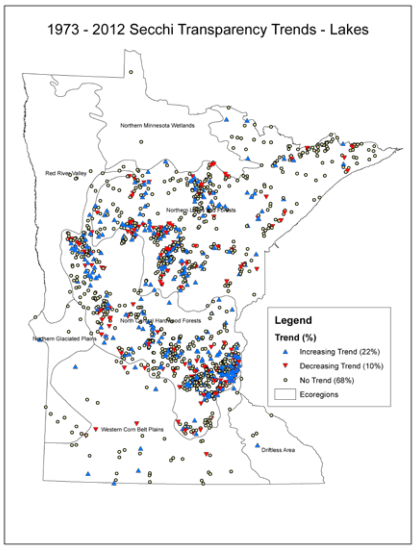
EDWOM 2b) Changes in streams over time in nitrite-nitrate, total suspended solids, total phosphorus, pesticides and biology (fish, plants, invertebrates); and

EDWOM 2c) Changes in wetlands over time in biology (plants, invertebrates).

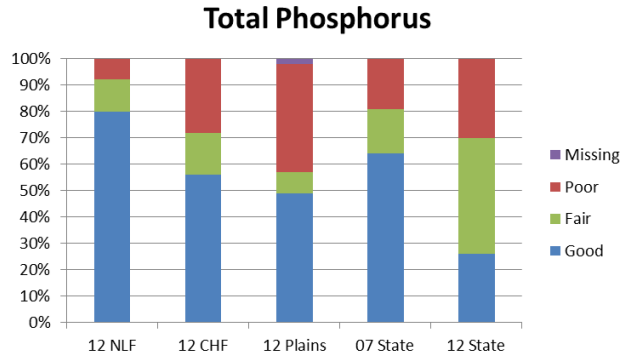
Visual Depiction

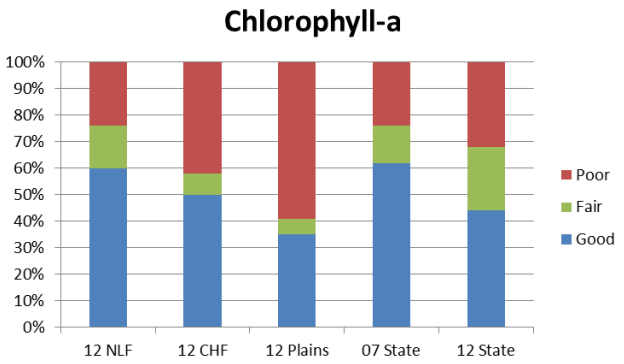
EDWOM 2a) Changes in lakes over time in total phosphorus, chlorophyll-a, and transparency, and pesticides

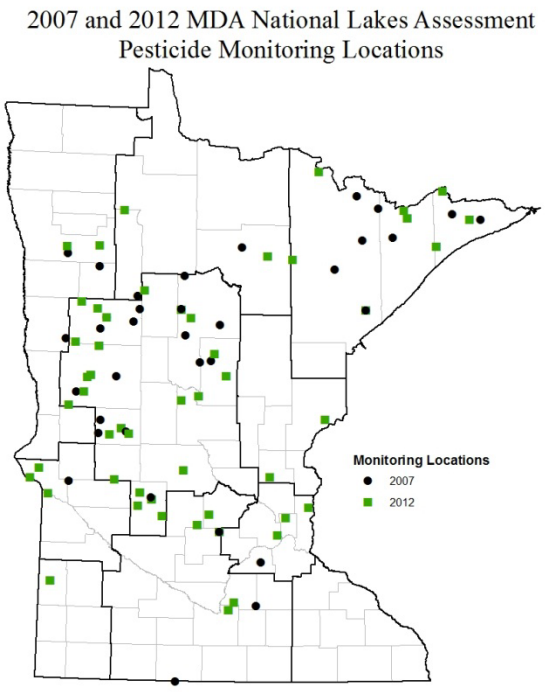
Annual reporting (Citizen Monitoring Program data)

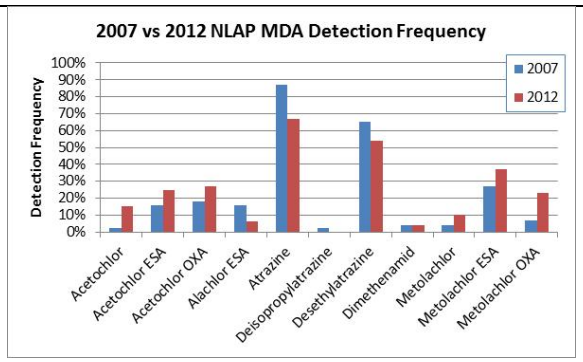


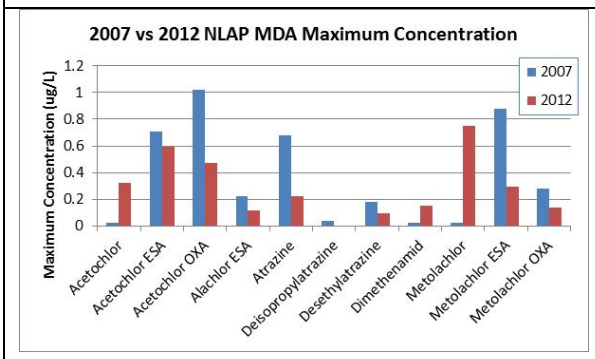
Every 5 years (National Lake Assessment survey data)











Reference values (pesticide (1-day acute/4-day chronic)): Acetochlor (86 µg/L/3.6 µg/L), Atrazine (323 µg/L/ 10 µg/L), Dimethenamid (5.1 µg/L), Metolachlor (271 µg/L/ 23 µg/L)

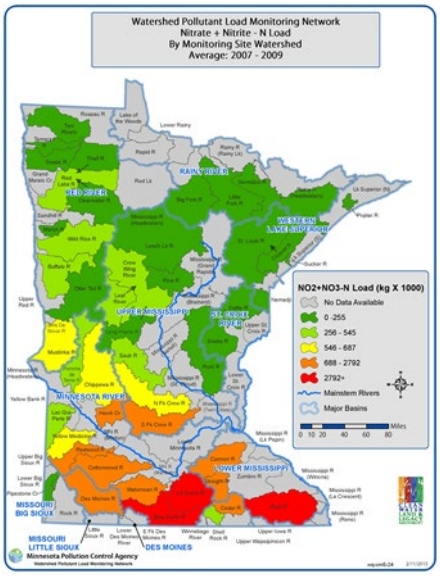
Every ten years (Intensive Watershed Monitoring report out):

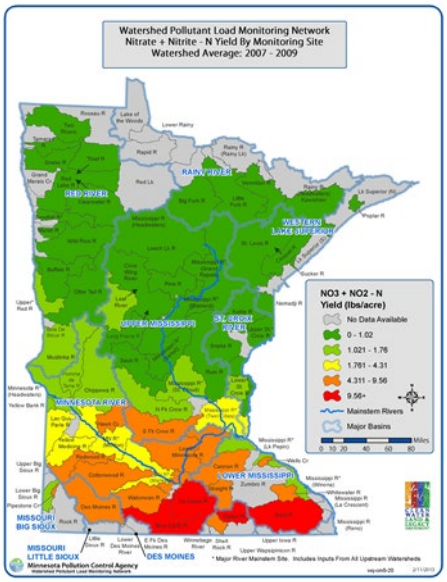
To be developed ~2018 after completion of first 10-year IWM cycle

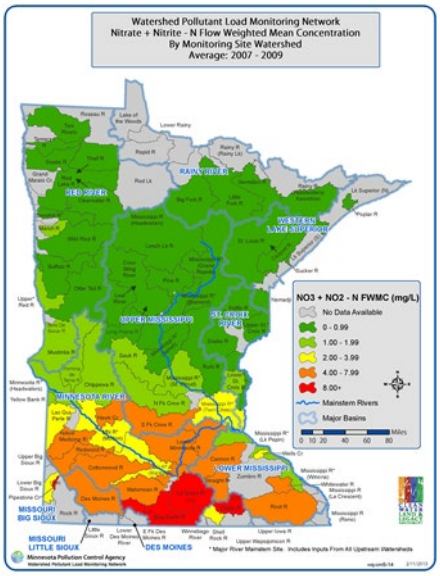
EDWOM 2b) Changes in streams over time in nitrite-nitrate, total suspended solids, total phosphorus, pesticides and biology (fish, plants, invertebrates)

Annual reporting (pollutant maps for loads, flow-weighted means, and yields)

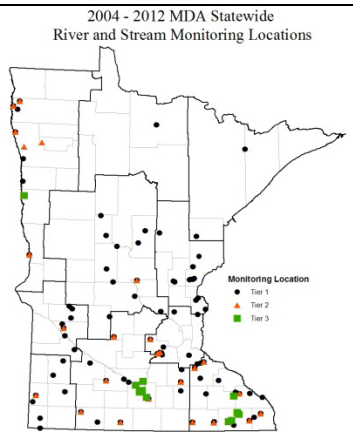
Example provided for nitrate-nitrogen.

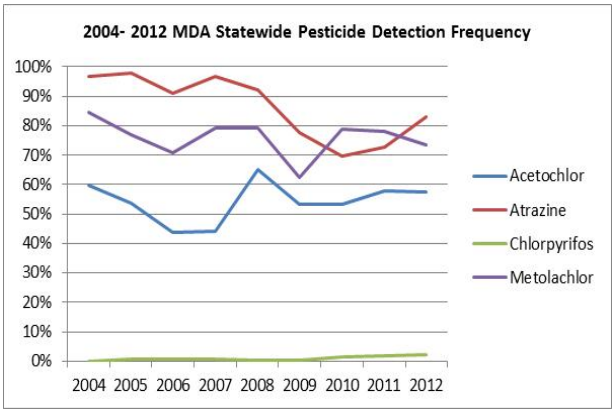


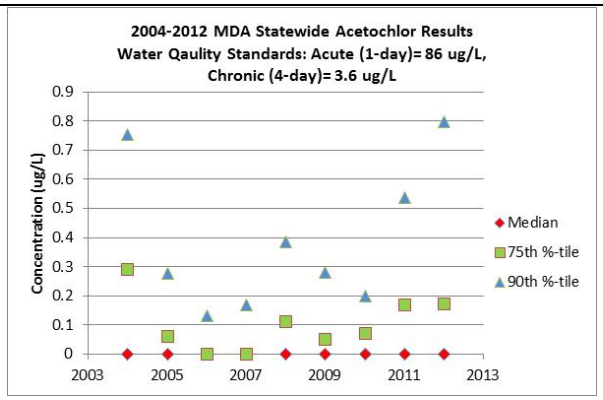




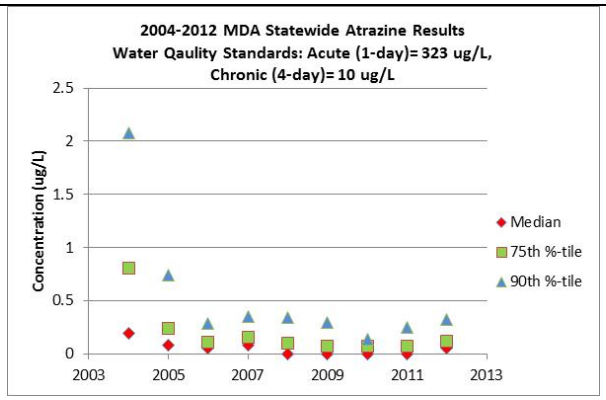
MDA Annual Pesticide Reporting Streams and Rivers



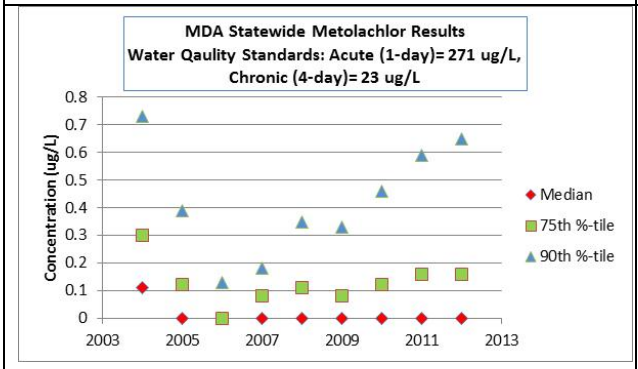




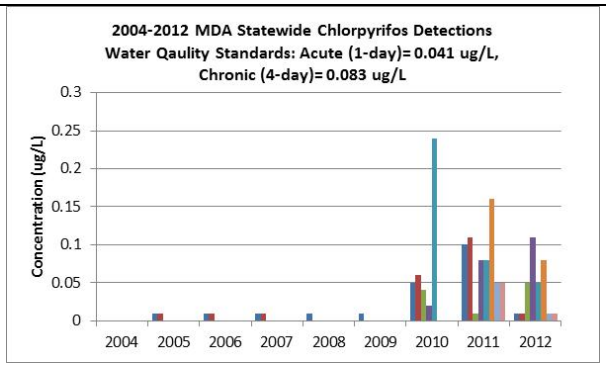
Acetochlor is a herbicide used on corn and soybeans



Atrazine is a herbicide used on corn.



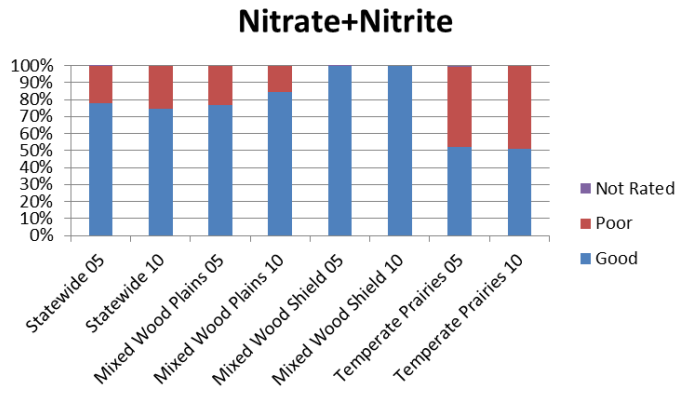
Metolachlor and s-metolachlor are herbicides used on corn and soybeans.



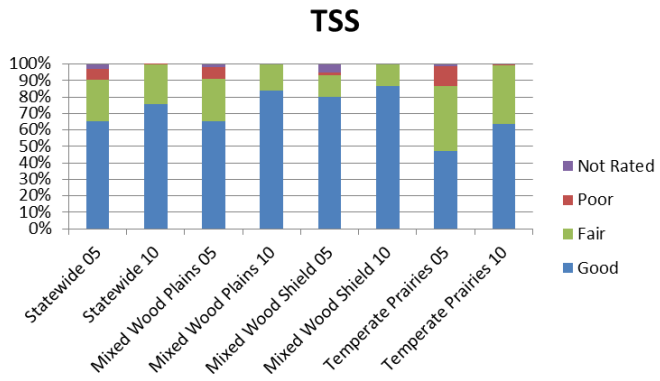
Chlorpyrifos is an organophosate insecticide used on alfalfa, corn, soybeans, sugarbeets, and wheat.

Every 5 years (National Rivers and Streams survey data)

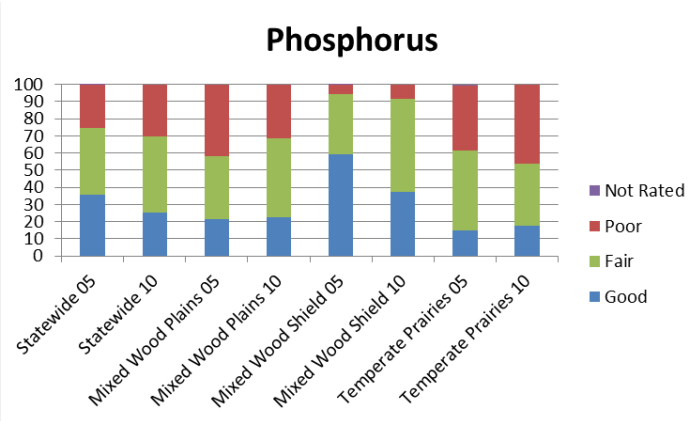
NO2+NO3-N rivers and streams, statewide and by major ecoregion, 1996-2005



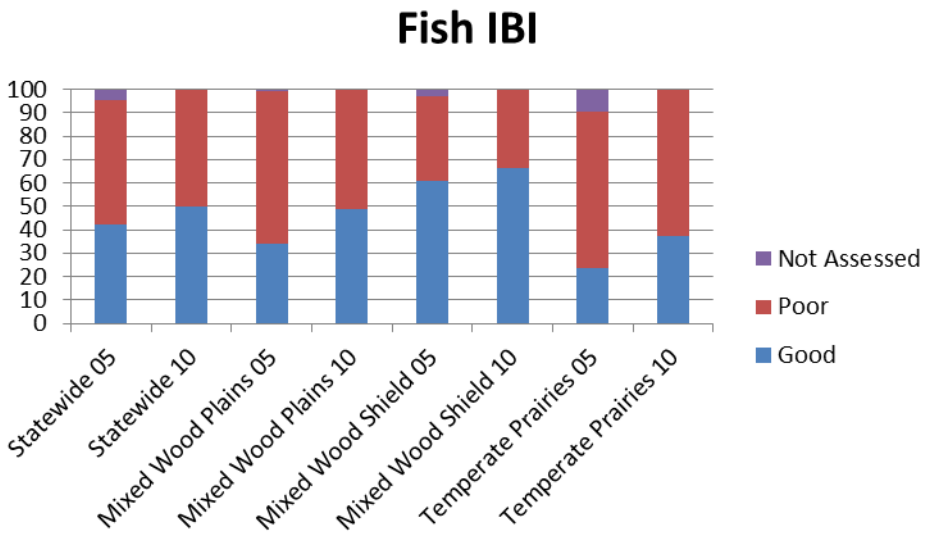
TSS-rivers and streams, statewide and by major ecoregion, 1996-2005 and 2010



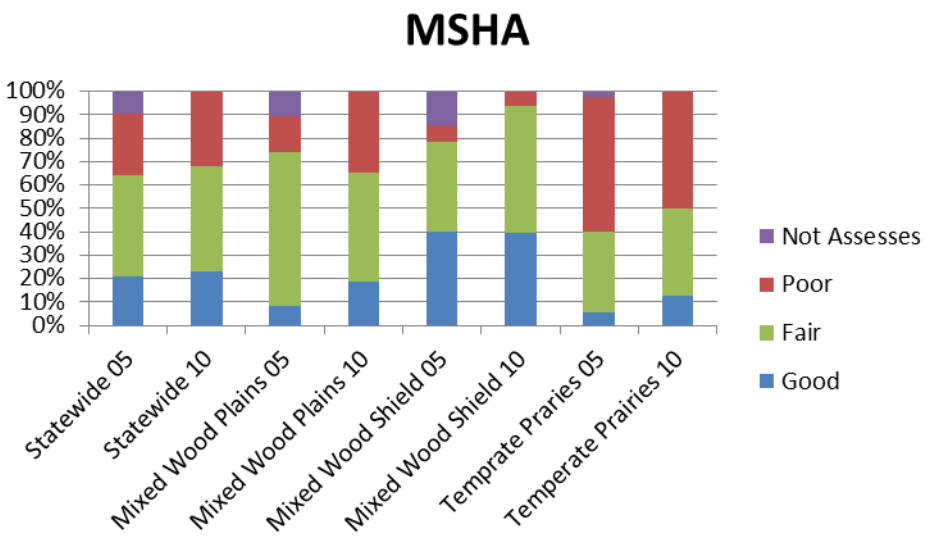
Total Phosphorus - rivers and streams, statewide and by major ecoregion, 1996-2005 and 2010



Fish IBI - rivers and streams, statewide and by major ecoregion, 1996-2005 and 2010



Minnesota Stream Habitat Assessment (MSHA) rivers and streams, statewide and by major ecoregion, 1996-2005 and 2010



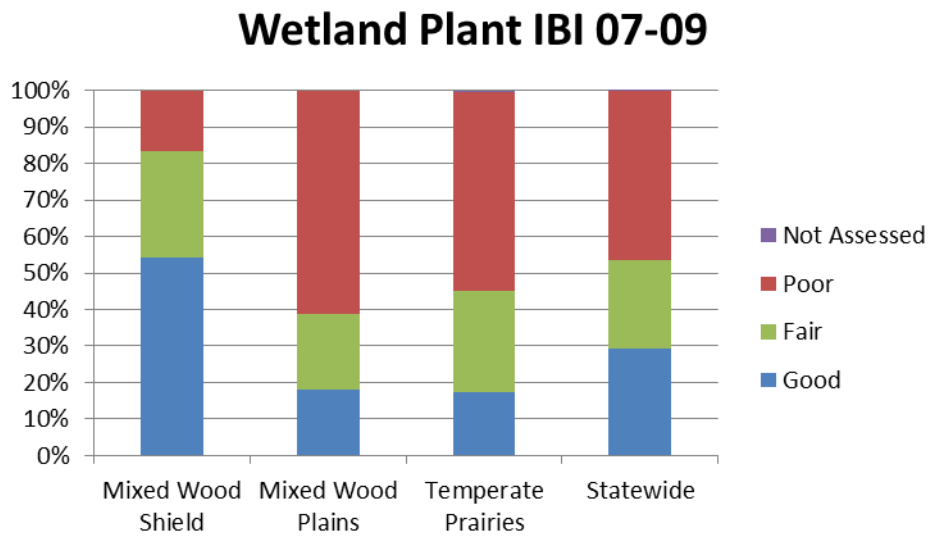
<u>Every ten years (Intensive Watershed Monitoring report out; trend analysis of load monitoring data):</u>

To be developed ~2018 after completion of first 10-year IWM cycle

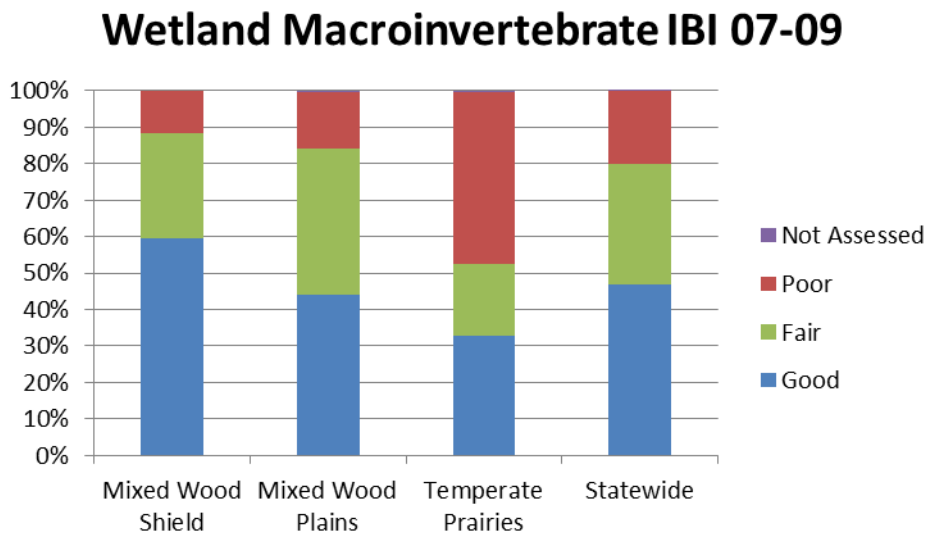
EDWOM 2c) Changes in wetlands over time in biology (plants, invertebrates)

Every 5 years (State Probabilistic Wetland Condition Assessment survey data)

Plant IBI - marsh wetlands, statewide and by major ecoregion. Results from 2007-2009



Invertebrate IBI - marsh wetlands, statewide and by major ecoregion. Results from 2007-2009



Associated Terms and Phrases

Citizen Lake Monitoring Programs (CLMP): Program supported by the MPCA where citizen volunteers collect water transparency data weekly during the open-water season on a lake site of their choice. The CLMP has been operating since 1973. CLMP transparency data are the only data we have for many lakes.

Index of biological integrity (IBI): A measure of biological health based on a community assemblage such as fish, invertebrates or algae. The MPCA uses IBIs to gauge the biological health of streams and wetlands.

Intensive watershed monitoring (IWM): A ten-year rotational cycle wherein an average of 8 of Minnesota's 81 major (8-digit hydrologic unit code) watersheds are intensively monitored each year. The outlet of each major watershed is monitored for physical and chemical parameters monthly on a continual basis for baseflow and more frequently during "events", such as snowmelt and storms (termed 'load monitoring'). During intensive watershed monitoring, additional focus is placed on monitoring the outlets of subwatersheds (12 -digit hydrologic unit code) for biota (fish and invertebrates) and physical habitat, and to sample for chemical parameters ten times. One-time biological, physical and chemical sampling is also conducted at the outlet of the 14 -digit hydrologic unit code watersheds. During intensive watershed monitoring, all lakes $\geq$500 acres and at least 25% of lakes 100-499 acres are monitored for physical and chemical parameters (biological assessment tool is currently under development).

Load monitoring: Flow and chemistry monitoring conducted at the mouth (or outlet) of each major (8-digit hydrologic unit code scale) watershed. Monitoring is conducted at least monthly, and then more frequently during events (i.e., snowmelt or rain events). The objective is to capture the entire hydrograph, and to determine the pollutant load carried by a stream or river. Watershed loads are also used to assess trends in the stream water quality of a watershed over time, and to see how data from a given year compare to the long-term record for a watershed. Load monitoring also enables comparisons of relative contributions of pollutants from one major watershed to another.

Major watershed: 8-digit hydrologic unit code (HUC) watersheds in Minnesota; there are 81 in Minnesota.

Minnesota Stream Habitat Assessment (MSHA): The name of the MPCA's habitat assessment methodology.

National Aquatic Resource Surveys: Surveys of the nation's aquatic resources that are financially supported and coordinated by the U.S. Environmental Protection Agency. Often referred to as probability-based (or probabilistic) studies, these surveys provide nationally consistent and scientifically-defensible assessments of our nation's waters and can be used to track changes in condition over time. Each survey uses standardized field and lab methods and is designed to yield unbiased estimates of the condition of the whole water resource being studied. Each year, the U.S. EPA focuses on a different resource (i.e., rivers/ streams, lakes, wetlands, and coastal waters). The surveys are intended to be repeated every five years. MPCA has chosen to add to the NARS survey for lakes; for stream and

wetland the enhancement is completely separate from the draw for the NARS study and uses Minnesota specific monitoring protocols and does not incorporate the NARS data in our analysis.

National Lakes Assessment (NLA): The National Aquatic Resource Survey for lakes. Surveys were completed in 2007 and 2012 and reporting is underway.

Pollutant flow weighted mean concentration (FWMC): The volumetric average pollutant concentration measured at the monitoring site. The FWMC and is computed by dividing watershed load by total flow volume. Flow-weighted mean concentrations allow for direct comparison of water quality between watersheds.

Pollutant load: The mass of a pollutant passing a stream location over a defined period of time (i.e. lb/yr).

Pollutant yield: Yield is the pollutant load per unit area measured at the monitoring station. This statistic represents watershed load normalized for watershed area (i.e. kg/acre/yr).

Probabilistic study: A study where sampling sites are selected randomly, so the resulting data are unbiased and can be used to generalize conditions for a given region.

Surface Water Pesticide of Concern: A pesticide determined by the MDA Commissioner to have increasing frequency of detection, or elevated concentrations, in Minnesota's surface waters. The determination signals MDA interest in developing voluntary Best Management Practices (BMPs) for applicators to use when applying the pesticide.

State Probabilistic Flowing waters survey: MPCA's sampling will occur in 2015 for this probabilistic survey for fish, invertebrates and associated physical and chemical parameters.

State Probabilistic Wetlands Condition Assessment: The first state wetlands condition assessment patterned after the EPA NARS study was conducted in 2011.

Trend: Statistically significant improvement, no change or decline in a water quality parameter (chemistry, biology as measured by an index of biotic integrity (IBI), or physical characteristics).

Target

Impaired lakes or streams: Decreasing trend for chemical parameters, increasing IBI and transparency trend.

Unimpaired lakes or streams: Decreasing or stable (no change) trend for chemistry, increasing or stable IBI and transparency.

Wetlands: No net loss of wetland quality (increasing or stable IBI).

Baseline

Baseline varies depending on the parameter and site.

Citizen Monitoring Lake Program: Citizen Lake Monitoring Program - began in 1973 at the U of MN, transferred to the MPCA in 1978.

Intensive Watershed Monitoring: The baseline year is 2006, when pilot studies began for biology in streams. All of the MPCA's condition monitoring activities were fully aligned in 2009. For a given watershed, the baseline year is the year it was monitored in the original 10-year cycle (2006-2017).

Load monitoring: 2008, the year the network began operation, though not all watersheds went on-line that year.

Probabilistic studies: The EPA began funding randomized studies in 2006 for streams. The first national lake study occurred in 2007. The first wetland study took take place in 2011.

Geographical Coverage

Both statewide and watershed scales for Citizen Lake Monitoring Program, load monitoring and Intensive Watershed Monitoring data. Statewide and ecoregion scales for national study data.

Data and Methodology

Methodology for Measure Calculation

EDWOM 2a) Changes in lakes over time

Annually

Citizen Lake/Stream Monitoring Program (lakes and streams monitored by citizen volunteers)

Key parameter: transparency

Scale: Statewide

Method: Transparency trends are calculated for each lake/stream monitored through the MPCA's Citizen Lake/Stream Monitoring Program using a seasonal Kendall test. The MPCA uses the statistical program R for all of its analyses on citizen monitoring data. Only sites for which a significant statistical test result (i.e., those with sufficient data for trend analysis) is obtained will be reported in this measure. Statewide maps are created from this information, and statewide summary statistics (% of sites in this network with increasing, declining or no trend in water clarity) are manually computed. Steps to develop the annual trend maps are described in EDWOM2 procedures_Lakes and Streams.docx and stored on the MPCA's server in this folder: X:\Agency_Files\Water\Condition Monitoring\Measures\Lakes & Streams\EDWOM2_Changes over time.

Every five years

National Lake Assessment (federally funded probabilistic lake study conducted by MPCA)

Key parameters: TP, chlorophyll-a, Secchi transparency, pesticides

Scale: Statewide/ecoregion

a. Method: National Lake Assessment data are queried from the National Lakes Assessment Database (permanently stored at EPA: http://water.epa.gov/type/lakes/NLA_data.cfm. Directions for downloading data are on the site.). The database is filtered for Minnesota data and data for Secchi (m), Chl-a (ug/L), TP (ug/L), Pesticide date is analyzed at the MDA Laboratory, and stored within MDA's EQuIS database.

   The MDA provided pesticide analysis for the 2007 and 2012 national lake assessments. Due to the large number of samples and individual pesticide analytes evaluated (126 pesticide analytes in 2012), individual lake results are not be presented. Statewide detection frequencies for all pesticides detected both years are presented.

   Detection frequencies provide a snapshot as to whether the presence of the pesticides of greatest concern in lakes statewide is increasing or decreasing between survey years. Maximum concentrations are also presented to provide a sense of magnitude for the worst case samples. Because pesticide concentrations in lakes tend to be low, standards and benchmarks for the parent pesticide compounds are not presented in the graphic as they are typically off of the Y-axis scale. Applicable water quality reference values are presented below the maximum graphic for pesticide parent compounds.

Every ten years

Intensive Watershed Monitoring (compare results of revisits to target sites (lakes ≥500 acres) within a given watershed from visits that occurred ten years prior)

Key parameters: TP, chlorophyll-a, Secchi transparency.

Scale: Statewide and by watershed

Method: TBD. We will monitor and assess all lakes ≥500 acres within each watershed on a 10-year rotational basis. Once we have worked through the 10-year watershed cycle and are beginning a second round (2018-2027), we will be able to compare assessment results for these lakes from the first cycle to the second. While this comparison will not provide a statistical trend, it will reveal changes in assessment status after a 10-year period of time.

EDWOM 2b) Changes in streams over time

Annual

Watershed Pollutant Load Monitoring Network (stream outlets of major watersheds monitored by MPCA and local partners) – Annual tracking of loads.

Key parameters: total suspended solids (TSS), total phosphorus (TP), nitrite-nitrate (NO_2+NO_3)

Scale: Statewide and by watershed

Methods: The Watershed Pollutant Load Monitoring Network (WPLMN) is designed to measure and compare regional differences and long-term trends in water quality among Minnesota's

major rivers (8 digit HUC and major river mainstem scale). Extensive water quality sampling occur year round at all 79 sites within WPLM network. Thirty to thirty-five mid-stream grab samples are collected annually at each site with sampling frequency greatest during periods of moderate to high flow. Annual water quality and daily average discharge data are coupled in the "Flux32" pollutant load model (U.S. Army Corp of Engineers and the Minnesota Pollution Control Agency) to compute annual pollutant loads. Site specific annual pollutant loads, flow weighted mean concentrations and other relevant data are warehoused in an MS Access database titled "SLS" on the MPCA server: X:\Agency_Files\Water\Condition Monitoring\Rivers & Streams\Major Watershed Load Monitoring\SLS stored.

SLS load reports are exported and used to create statewide maps of average annual pollutant loads, yields, and flow weighted mean concentrations by watershed or drainage area for the period of record (area above major river mainstem sites). The data are on located on the MPCA server at: X:\Agency_Files\Water\GIS\projects\LoadMonitoring\Maps.

MDA Annual Pesticide Reporting Streams and Rivers (watersheds monitored by MDA and other cooperators) – Annual tracking of detection frequency and concentrations statistics.

Key parameters: acetochlor, atrazine, chlorpyrifos and metolahclor

Scale: Statewide

Methods: Annually, MDA completes statewide surface water monitoring for pesticides utilizing a tiered approach that intensifies sampling efforts at locations that have exhibited elevated pesticide concentrations. MDA monitoring focuses on the agricultural and urban areas of the State where pesticide usage tends to be greatest. Approximately 600-800 pesticide samples are collected annually from river and stream locations each year. Each sample can be analyzed for up to 130 different pesticide compounds. The graphics present the three pesticides identified as "Surface Water Pesticides of Concern": acetochlor, atrazine, and chlorpyrifos. Metolachlor is also presented due to its high detection frequency. Annual detection frequencies and concentrations are presented by combining data for all statewide Tier 1, Tier 2, and Tier 3 locations representing the agricultural areas of Minnesota. Sample collection locations are also presented.

Concentration trend graphics with the median, 75th and 90th percentile statistics are also presented for the same chemicals. The relevant surface water aquatic life standards for the individual chemicals are presented in the graphic title. Due to limited detections, all individual chlorpyrifos detections are plotted by year.

Every five years

State Flowing Waters survey (federally funded probabilistic stream study conducted by MPCA) -

Key parameters: TSS, TP, NO_2+NO_3, index of biotic integrity (fish, invertebrates), physical habitat (MN Stream Habitat Assessment)

Scale: Statewide/ecoregion

Method: Since 1996 the MPCA has been collecting data to characterize the condition of Minnesota's rivers and streams using a random survey in conjunction the environmental protection agency's (EPA) environmental monitoring and assessment program (EMAP). The random survey reduces bias that can be created when sites are targeted and allows the results to be extrapolated from a relatively small number of sites to the larger population of rivers and streams in the State. From 1996 to 2005 the MPCA used a rotating basin design, completing each major basin (4 digit HUC) once during that time period. Results reported here use the data from each basin over that 10 year time span. In 2010 the MPCA aligned its random survey work with the National Flowing Water survey but elected to enhance the sampling effort by selecting 150 sites statewide with approximately 50 sites in each Level 2 Omernik ecoregion. Consequently, future reports on stream condition will use the results of this newer survey design.

All data associated with the random surveys is housed in the MPCA biological monitoring database. Standard EMAP procedures are followed to determine whether or not candidate sites are considered target or non-target. The data is analyzed using the R Gui statistical program. The SPsurvey package that is maintained by EPA was used to create condition estimates for each metric. R and its packages update periodically; the most updated version, R Gui 2.13.1 was used for this project.

Graphs were created by transferring the R output into Excel to create bar charts that describe the survey results statewide and within each of the three, level 2 ecoregions. Criteria used to derive the good/fair/poor ratings for nutrients were based on the draft TSS and nutrient standards for rivers. Biological thresholds were based on the statewide IBI criteria developed for each of the 9 fish and invertebrate stream classes (guidance currently in development). Habitat thresholds were derived by examining the distribution of least disturbed sites in a statewide dataset.

Further details regarding the survey design, analysis, and derivation of the criteria can be found at X:\Agency_Files\Water\Condition Monitoring\Measures\Biological Monitoring on the MPCA's server under EDWOM2_ Biological Monitoring procedures_2011.docx.

<u>Every ten years</u>

Load monitoring (stream outlets of major watersheds monitored by MPCA and local partners) – Statistically-based trend analyses will be conducted every ten years, at a minimum.

Key parameters: total suspended solids (TSS), total phosphorus (TP), nitrite-nitrate (NO_2+NO_3)

Scale: Statewide and by watershed

Method: TBD. Adequate data sets for purpose will not be available until 2017. Statistically based trend models to be considered include Seasonal Kendall and WQ Trend. Results will be incorporated into the long term average flow weighted mean concentration watershed maps as an insert within each watershed showing trend direction.

Intensive Watershed Monitoring (compare results of revisits to target sites (outlets of 12-digit hydrologic unit code subwatersheds) within a given watershed from visits that occurred ten years prior)

Key parameters: TSS, TP, NO_2+NO_3, index of biotic integrity (fish, invertebrates), and physical habitat (MN Stream Habitat Assessment) for streams.

Scale: Statewide and by watershed

Method: TBD. We will monitor and assess all stream sites at the outlets of subwatersheds (12-digit hydrologic unit code) within each watershed on a 10-year rotational basis. Once we have worked through the 10-year watershed cycle and are beginning a second round (2018-2027), we will be able to compare assessment results for stream sites from the first cycle to the second. While this comparison will not provide a statistical trend, it will reveal changes in assessment status after a 10-year period of time.

EDWOM 2c) Changes in wetlands over time

Every five years

State Wetlands Condition Assessment (federally funded probabilistic wetland study conducted by MPCA)

Key parameters: plants and macroinvertebrates

Scale: Statewide/ecoregion

Method: The IBI data used to generate these estimates of condition resides in the Wetland Biological Monitoring database (wetbioDa.mdb) or in the individual .txt data files used by the analysis software. These files are located in the 'Original Data' folders for each of the ecoregion analyses (X:\Old_P_Fo\WQPRJ\DBF\WETLANDS\WETLANDS\SpecialProjects\MonitoringStrat\Quality Survey\Results) and contain the category 1 (natural) and category 2 (man-made) assignments for each of the survey sites. Both IBIs were compared to regional reference conditions approximated by a set of least-disturbed reference sites within each of the three ecoregions. Analyses were conducted in the statistical package R using the spsurvey library developed by the Environmental Monitoring and Analysis Program (EMAP) Design Team (see: http://www.epa.gov/nheerl/arm/analysispages/software.htm). The data files and results are located in the 'Statewide' folder set up in the Results directory (see address above). The results of each ecoregion's analysis are located in the 'Results' directory (see above) under the 'Analyses' folder set up for each ecoregion in the Biological\Category\Categorical Estimates.csv spreadsheet file. The graphics displaying the results from each ecoregion were generated by

exporting the output of the R/spsurvey statistical package (i.e., Categorical Estimates.csv) into an Excel spreadsheet. Detailed procedures can be found on the MPCA's server under X:\Agency_Files\Water\Condition Monitoring\Measures\Biological Monitoring\EDWOM2_Wetland procedures_2013.docx.

Data Source

EDWOM 2a): Citizen monitoring data, intensive watershed monitoring chemistry data, state add-on for the national survey for lakes and pesticide data for lakes are located in the MPCA's EQuIS water quality database; lake chemistry data from national surveys is stored in the EPA's databases.

EDWOM2b): Load monitoring, intensive watershed monitoring, and pesticide chemistry data for streams are located in the MPCA's EQuIS water quality database; flow data for load monitoring is stored in Hydstra, and biological and physical habitat data from intensive watershed monitoring and probabilistic surveys are stored in the MPCA Biological Monitoring Unit program databases.

EDWOM 2c): Wetland data are stored in the MPCA Biological Monitoring Unit program databases.

Data Collection Period

EDWOM 2a): Citizen Lake Monitoring Program sites are sampled annually May to September.

National Lake Assessment surveys: Data are collected every 5 years, starting in 2007, with the index period of June to September.

Intensive watershed monitoring: Watershed lake chemistry data are collected annually from May to September, with each major watershed intensively sampled for a two year period every 10 years.

EDWOM 2b): Load monitoring sites are sampled annually during open water.

State Probabilistic flowing water surveys: Data are collected every 5 years, starting in 2010; index period June to August.

Intensive watershed monitoring: Watershed stream biological, chemical and physical habitat data are collected annually with an index period of May to September, with each major watershed intensively sampled for a two year period every 10 years.

EDWOM 2c): State Probabilistic Wetland Condition Assessment surveys: Data are collected during summer months over two seasons every 5 years, starting in 2011-2012.

Data Collection Frequency

EDWOM 2a): Citizen monitoring: Transparency data are collected through volunteer efforts. Volunteers are encouraged to collect weekly data from May-September, but actual sampling frequency is variable. Data are submitted to EQuIS through the MPCA each fall/winter.

National Lake Assessment survey: Occurs every five years on a rotating schedule. Surveys have been completed in 2007 and 2012. Approximately fifty sites are selected randomly

for each survey for national and statewide estimates, and an additional 100 sites are added to this to allow for ecoregional trend analysis. Sites are sampled once during the survey in between June and September. A certain number of sites are selected for revisits for quality assurance purposes for each survey.

Intensive watershed monitoring: Data are collected by MPCA staff and local partners. Each of Minnesota's 81 major watersheds will be intensively monitoring from 2008-2017, with eight watersheds monitored on average each year. Lakes are sampled monthly from May-September for two years.

EDWOM 2b): Load monitoring: Data are collected by MPCA staff and local partners monthly for baseline information, and during events (snowmelt and rain events) for pollutant loading. Each site is sampled between 25-35 times annually.

Stream monitoring: The MPCA sampled 30-50 sites for each of Minnesota's 11 major basins from 1996-2005. The sites were sampled from June-September using MPCA sampling methods. Fish, invertebrate, habitat, and nutrients were sampled at each of the sites with 10% duplication to ensure method consistency. The fish and invertebrate index of biological integrity (IBI) results were calculated using an index developed in 2010. Good and poor ratings were developed using the IBI index thresholds for impairment and the current water quality standards. These results were used to establish the baseline results in this measure.

Random stream surveys are completed every 5th year starting in 2010. Approximately 150 sites are selected randomly for each survey for state and ecoregional trend analysis. Monitoring is conducted June-September. A certain number of sites are selected for revisits for quality assurance purposes for each survey.

Intensive watershed monitoring: Each of Minnesota's 81 major watersheds will be intensively monitoring from 2008-2017, with eight watersheds monitored on average each year. Biological data are collected by MPCA staff. Streams are generally sampled for fish/habitat in the May-July, and invertebrates sampled in the July-September timeframe. Streams are sampled for chemistry by MPCA staff or local contractors three times monthly May-September for the first year, and then twice per month June-September the second year.

EDWOM 2c): Wetland Condition Assessment: The MPCA established a rotating 3-year random survey of marsh type wetlands in 2007. Plants and invertebrates were sampling at 50 sites per major ecoregion for a total of 150 sites. These results were compared to MPCA IBIs and thresholds based off of reference sites to determine good and poor sites.

A State Probabilistic Wetland Condition Assessment Survey occurs every five years on a rotating schedule, with the first wetland survey occurring in 2011. Approximately fifty sites are selected randomly for each survey for national and statewide estimates, and an additional 100 sites are added to this to allow for ecoregional trend analysis. Monitoring occurs June-September, for aquatic plants, algae, water chemistry (if wet) and soils. One hundred depressional wetlands will be sampled again in 2012, departing from the 3-year rotation, so that the work could coincide with the national surveys. The depressional survey results were the basis of the current baseline measure. This baseline will be increased to all wetland types when the 2011-12 results are completed.

Supporting Data Set

The data sets supporting the graphics shown in this measure are large and unwieldy. In addition, substantial summarization and analyses were necessary to generate the graphics. Requests for additional information regarding the various graphics can be addressed by the contacts shown at the end of this document.

Caveats and Limitations

The only data sets included in this measure from which we can analyze true trends at this time are the Citizen Lake Monitoring Program data. Data from the National surveys are randomized so the results are unbiased, but they are not considered to be trends. The load monitoring network began operation in 2008 and sufficient data to run a trend analysis is not yet available, so the annual load monitoring maps simply display information from the most recent year. A statistical trend analysis of the load monitoring data is expected to be done ~2017-18. National probabilistic surveys of lakes, streams and wetlands, funded and coordinated by USEPA, are conducted every five years and show general statewide and ecoregional water quality and biology conditions. Lastly, the Intensive Watershed Monitoring Schedule is a rotational cycle where each major watershed is monitored every ten years, and these data will provide an opportunity (starting ~2020) to compare lake and stream assessment results from the first cycle to the second.

Most of the monitoring networks mentioned in this measure (load, intensive watershed, probabilistic studies) result in the collection data above and beyond the key parameters chosen to represent this measure. As programs develop, the key parameters for this measure may change to incorporate other parameters.

Data on pesticides in surface water is considered messy data. The data is censored, contains multiple detection limits, missing values, and unquantifiable detections. The data over time is typically non-linear, contains multiple peaks, and has inconsistent variability over time making analysis of results quite difficult. As a result of the messy data, graphical representations of the data will frequently display trends long before statistical analysis is capable of confirming a trend is present.

Future Improvements

The intensive watershed monitoring and load monitoring networks are all new. As the monitoring activities solidify, aspects of the measure may change accordingly. At a minimum, this measure will be modified to clarify the Methodology for Measure Calculation as those methods are developed and refined.

Financial Considerations

Contributing Agencies and Funding Sources

MPCA – Clean Water Fund and General Fund; USEPA for National Aquatic Surveys

Substantial funding for surface water pesticide work comes from non-clean water funds. This also includes limited funds from the EPA.

Communication Strategy

Target Audience
Local, state and federal agencies, legislators, and the general public.

Associated Messages
This measure conveys information about the trending condition of water quality in the state. Once Clean Water Funded activities have been ongoing for many years (>10 years), the water quality trend information will also convey information as to whether or not restoration and protection planning activities are succeeding.

Outreach Format
TBD.

Other Measure Connections
EDWOM2 touches on many of the other surface water-focused measures because it reflects the overall trends in water quality in lakes and streams.

Measure Points of Contact

Agency Information
EDWOM 2a):

Lake chemistry, Citizen Monitoring Programs: Pam Anderson, MPCA, Water Quality Monitoring Unit supervisor, pam.anderson@state.mn.us

Pesticide monitoring: Bill VanRyswyk, MDA, Pesticide Monitoring Unit supervisor, bill.vanryswyk@state.mn.us

EDWOM 2b):

Pollutant load monitoring: Lee Ganske, MPCA, Groundwater and Load Monitoring Unit supervisor, lee.ganske@state.mn.us

Pesticide monitoring: Bill VanRyswyk, MDA, Pesticide Monitoring Unit supervisor, bill.vanryswyk@state.mn.us

Stream biological monitoring (fish, invertebrate), stream chemistry monitoring: Scott Niemela, MPCA, North Biological Monitoring Unit supervisor, scott.niemela@state.mn.us

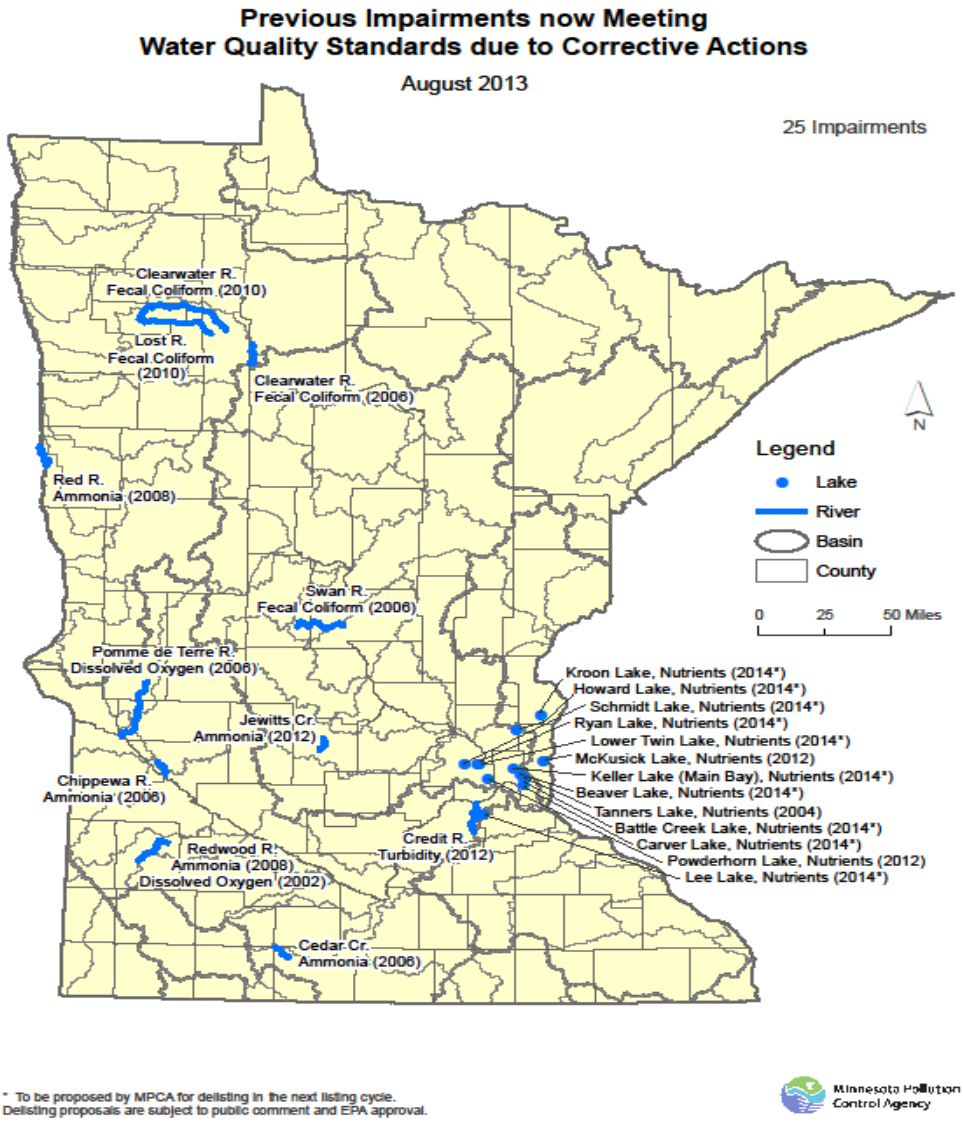
EDWOM 2c):

Wetland biological monitoring (plants, invertebrates): Dan Helwig, MPCA, South Biological Monitoring Unit supervisor, dan.helwig@state.mn.us

Number of previous impairments now meeting water-quality standards due to management actions

Measure Background

Visual Depiction



Measure Description

The measure will identify waters restored due to a management action (best management practice installation, wastewater upgrade, etc.) taken to fix a pollution problem, rather than a delisting that's due to better monitoring data or other reasons unrelated to actual restoration activities.

Associated Terms and Phrases

- Water quality standards identify allowable concentrations (per Minnesota regulations) of specific pollutants in water, established to protect its beneficial uses such as recreation, aquatic life, drinking water, fish consumption and others.
- A lake or stream is considered impaired if monitoring data reveals that it is not meeting a water quality standard. Each state updates a list of these impaired waters is updated every two years.
- Minnesota's 2012 Impaired Waters List contains 2171 impairments that require TMDL studies; 511 of those impairments are proposed new listings. The Inventory of all impaired waters now totals 3,638, which includes impairments in need of TMDLs, those with completed TMDLs that have not yet been restored, and impairments due to natural sources.
- The proposed new listings are dominated by impaired biological communities (44 percent of new listings) and bacteria impairments (23 percent of new listings). Also new to the 2012 TMDL List is the first-ever listing of chlorpyrifos, a broad-spectrum insecticide used on agricultural food and non-food crops, and greenhouse and turf applications.
- The 2012 list is the first developed under a refined approach to assessment that focuses on comprehensive assessment of water quality within major watersheds. MPCA has developed a 10-year schedule for monitoring and assessing each of Minnesota's 81 major watersheds.

Target

Ultimately, the goal is for all impaired waters in Minnesota to be restored. However, achieving this goal is unlikely due to lack of adequate economic resources, extremely degraded water quality in some cases, and other constraints.

Baseline

The baseline year for this measure is 2002, which is the year that the first water body was removed from the impaired waters list ("delisted") due to a management action that resulted in it again meeting water quality standards.

Geographical Coverage

This measure is statewide.

Data and Methodology

Methodology for Measure Calculation

The MPCA recommends "Delistings" (i.e., removal from the impaired waters list) to the U.S. EPA through the impaired waters list approval process. Delistings are determined according to the MPCA's assessment and delisting methodology.

Data Source

The data for the measure is maintained (see below) by the MPCA's Environmental Outcomes Division's Delisting Committee through its delisting review process.

Data Collection Period

1998 to present.

Data Collection Methodology and Frequency

Water quality monitoring data is assessed by the MPCA every two years and then documented in two places:

Supporting Data Set

As of 9-26-13:

1. Data and decisions reached are documented in a spreadsheet maintained by the MPCA's Delisting Committee
2. Summary data listed below is also located in a spreadsheet maintained by the MPCA's regional division.

Reach	Pollutant or stressor	Year listed	Year de-listed	Comments
Howard Lake	Excess nutrients	2006	2014*	Action in watershed: restoration project which included fish barriers and treatment to eliminate rough fish.
Kroon Lake	Excess nutrients	2008	2014*	Action in watershed: feedlot retired conversion of land use, stormwater BMPs in place.
Lee Lake	Excess nutrients	2002	2014*	Action in watershed: stormwater BMPs in place, half of runoff to the lake receives some form of treatment. TMDL approved 9/30/11
Lower Twin	Excess nutrients	2002	2014*	.Action in watershed: Restoration activities underway. TMDL and implementation plan approved 11/9/07 and 11/13/07.
Ryan	Excess nutrients	2002	2014*	Action in watershed: restoration activities underway per TMDL Implementation Plan. TMDL approved 11/9/07.
Schmidt	Excess nutrients	2002	2014*	Action in watershed: restoration activities underway per TMDL Implementation Plan. TMDL approved 09/25/09.
Keller Lake (main bay)	Excess nutrients	2002	2014*	Action in watershed: improved stormwater treatment.
Beaver Lake	Excess nutrients	2002	2014*	Action in watershed: implementation of stormwater treatment.

Reach	Pollutant or stressor	Year listed	Year de-listed	Comments
Battle Creek Lake	Excess nutrients	2002	2014*	Action in watershed: implementation of stormwater treatment in watershed.
Carver Lake	Excess nutrients	2008	2014*	Action in watershed: improved stormwater treatment.
Jewitts Creek, Headwaters (Lk Ripley) to N Fk Crow R	Ammonia (un-ionized)	1994	2012	Action in watershed: construction of upgraded wastewater treatment facility for Litchfield.
Credit River, Headwaters to Minnesota R	Turbidity	2002	2012	Action in watershed: construction erosion control programs, various projects including bank and channel stabilization, and rain gardens.
Powderhorn Lake	Excess nutrients	2002	2012	Application of in-lake management techniques resulted in improved water quality
McKusick Lake	Excess nutrients	2006	2012	Action in watershed: various watershed district projects to reduce runoff to the lake
Lost River, Anderson Lk to Hill R	Fecal Coliform	2002	2010	Action in watershed: construction of wastewater treatment facility for Oklee and implementation of BMPs by landowners.
Clearwater River, Ruffy Bk to Lost R	Fecal Coliform	2002	2010	Action in watershed: Implementation of BMPs by landowners and altered drainage practices by wild rice farmers.
Powderhorn Lake	Excess nutrients	2002	2010	Move to Category 4B Impaired, but TMDL not required as WQS expected to be met in near future. Application of in-lake management techniques resulted in improved water quality
Redwood River, T111 R42W S33 west line to Threemile Cr	Ammonia (un-ionized)	1992	2008	Action in watershed: upgrade of Marshall wastewater treatment facility (1994)
Red River of the North, Fargo/Moorhead Dam A to Sheyenne R (ND)	Ammonia (un-ionized)	1992	2008	Actions in watershed: improvements to Fargo (1995) and Moorhead (2003) wastewater treatment facilities.
Swan River, Headwaters (Big Swan Lk, 77-0023) to Mississippi R	Fecal coliform	1994	2006	Action in watershed: feedlot upgrade, feedlot inspections, BMPs.

Reach	Pollutant or stressor	Year listed	Year de-listed	Comments
Pomme de Terre River, Muddy Cr to Minnesota R (Marsh Lk Dam)	Low Oxygen	1994	2006	Action in watershed: removal of dam at Appleton
Chippewa River, Watson Sag Diversion to Minnesota R	Ammonia (un-ionized)	1994	2006	Action in watershed: upgrade of Montevideo wastewater facility (1994)
Cedar Creek, T104 R33W S6 west line to Cedar Lk	Ammonia (un-ionized)	1994	2006	Action in watershed: Individual Sewage Treatment System (ISTS) upgrades and feedlot inspections and manure management plans
Clearwater River, Trout stream portion	Fecal coliform	2002	2006	Action in watershed: upgrade of Bagley wastewater treatment facility and feedlot management practices.
Tanners Lake	Excess nutrients	2002	2004	Action in watershed: improvements to sedimentation ponds and facility built to treat stormwater with alum
Redwood River, Below trout stream portion to Threemile Cr	Low Oxygen	1992	2002	Action in watershed: upgrade of Marshall wastewater treatment facility (1994)

** To be proposed by MPCA for delisting in the next listing cycle.

Delisting proposals are subject to public comment and EPA approval.

Caveats and Limitations

Implementation actions may be funded from a variety of state, local or federal sources so it is difficult to attribute a restoration to a single funding source such as the Clean Water Fund.

Future Improvements

No future improvements are anticipated at this time.

Financial Considerations

Contributing Agencies and Funding Sources

Not applicable

Communication Strategy

Target Audience
All audiences

Associated Messages
This measure is important to convey because it is the achievement of one of our most important environmental goals – the restoration of impaired waters due to implementation activities often led by local government and supported by local, state and federal funding.

Outreach Format
This measure will be included on the MPCA web page and linked to other state sites.

Other Measure Connections
Depending on the cause of the impairment and the activities required for restoration, other measure connections will vary widely. In general, measures related to monitoring, funding and point/nonpoint source implementation activities will be most relevant.

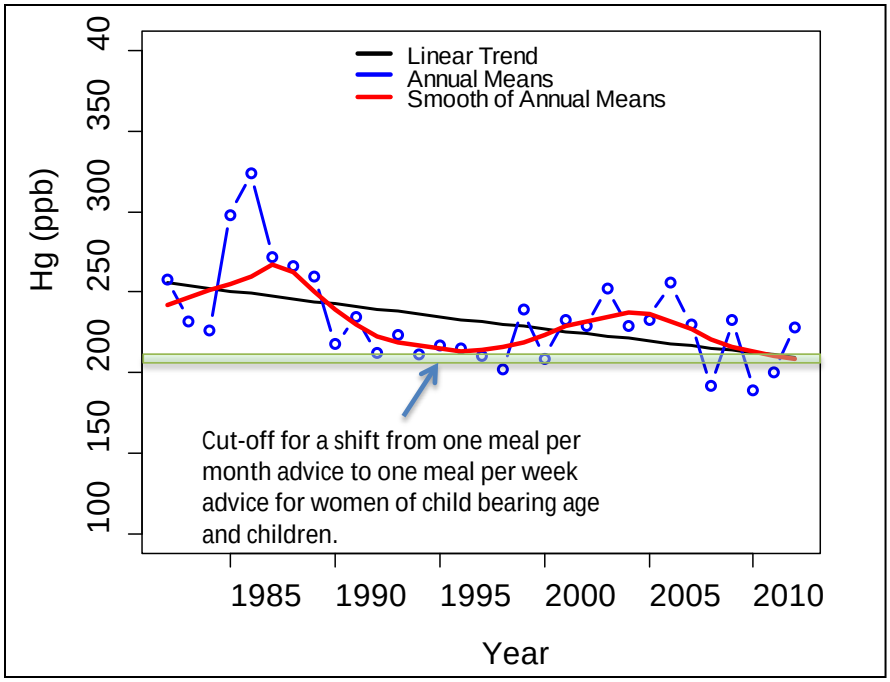
Measure Points of Contact

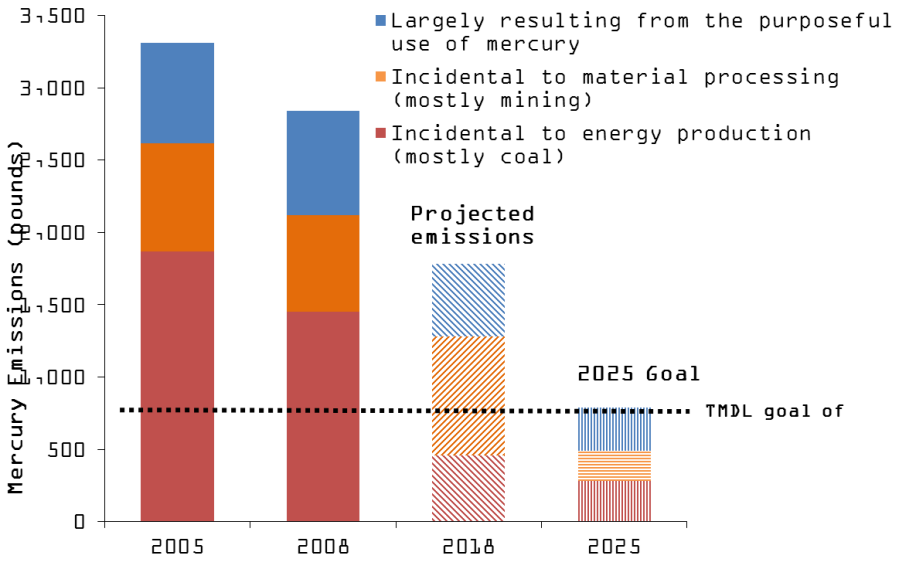
Agency Information
Denise Leezer, Minnesota Pollution Control Agency
(651) 757-2523
Denise.Leezer@state.mn.us

Trends of mercury in fish and Minnesota mercury emissions

Measure Background

Visual Depiction





Measure Description

Many Minnesota lakes and rivers contain mercury. Mercury bioaccumulates in aquatic food chains and may pose a risk to humans, as well as wildlife, that eat fish from those waters. Because air pollution is the primary source of mercury, reducing mercury in fish likely requires large reductions in mercury emissions from sources in Minnesota and throughout the world. To evaluate if Minnesota waters are getting cleaner, we can track Minnesota mercury emission levels over time through periodic emissions inventories and measure how fish mercury levels respond. Because of the large variation in mercury concentrations from year to year within and among lakes/rivers, long-term trends of mercury in fish are necessary to see if pollution control efforts are sufficient.

Associated Terms and Phrases

Bioaccumulates: Increased concentration of a substance in an organism with time. Bioaccumulation will occur in an organism when the rate of the substance intake is faster than the rate at which the organism is able to eliminate it. The concept of bioaccumulation is often used in reference to the concentrating of toxic substances such as pesticides, heavy metals, or certain other industrial chemicals in living organisms where bioaccumulation increases the risk of toxicity for organisms at the top of food chains.

Food chains: A relationship between the organisms in a particular ecological community whereby organisms at each trophic level (i.e., each step in the food chain) are consumed by organisms of a higher trophic level.

Mercury Emissions: The primary source of mercury pollution is from atmospheric deposition. Human sources contributed 60-70% of the atmospheric mercury and the other third is from natural sources. Energy production—primarily burning of coal—contributes about 50% of the human-sourced mercury.

The other 50% is from volatilization of mercury in products, mining operations, and other manufacturing operations that release mercury during the processing of raw materials. Mercury emitted into the atmosphere can become a global pollutant, which is why mercury deposition and fish mercury concentrations have not declined despite large reductions in North American mercury emissions from human sources.

Methylmercury: Organically bound form of mercury – as opposed to ionic or reduced free-metal state. The Minnesota fish contaminants program tests for total mercury, which includes methyl, ionic, and free-metal forms. In practice, this is nearly the same as testing specifically for methyl mercury, as over 90% of mercury contained in fish muscle tissue has been shown to be in the methyl mercury form.

Statewide Mercury TMDL: When a waterway is impaired (i.e., exceeding a water quality standard) a total maximum daily load (TMDL) is prepared, which identifies the pollutant sources and the load reduction required to meet the water quality standard. Because the primary source of mercury to waterways in Minnesota is atmospheric deposition, which is fairly uniform throughout the state, a statewide TMDL was prepared for mercury. The EPA approved the TMDL in 2007 which sets mercury reduction targets that Minnesota is currently working to achieve.

Target

The mercury emissions target for Minnesota, established in the Statewide Mercury TMDL, is 789 pounds of mercury per year. The Statewide Mercury TMDL Plan sets out strategies and a timeline to achieve this goal by 2025.

The target for mercury in fish concentrations is for all fish to have mercury concentrations below 0.2 parts per million, which is the state water quality standard for mercury in fish. Mercury in fish is expected to decrease as mercury deposition is decreased, although the lag time between source reduction and reductions in the fish is unknown. Because Minnesota receives 90% of its mercury pollution from outside the state, achieving a decline will likely require reducing pollution from both in-state and out-of-state sources. Other factors, such as the presence of wetlands, land-use practices, and climate, also influence the amount of mercury pollution that is converted to methylmercury and accumulates in aquatic food chains. As more is learned about how these factors alter how much mercury accumulates (bioaccumulates) in fish, the target for mercury in fish concentrations may need to be revised.

Baseline

The Minnesota mercury emissions inventory uses 2005 as the baseline year; the mercury in fish trend analysis uses 1982 as the baseline year. The reduction goals in the Statewide Mercury TMDL used 1990 as a baseline year.

Geographical Coverage

Minnesota has adopted a statewide strategy to address mercury pollution, outlined in the Statewide Mercury TMDL; Minnesota emissions inventory data and fish mercury levels are reported on a statewide basis to match the framework of the strategy.

Data and Methodology

Methodology for Measure Calculation

The trends of mercury in fish rely on northern pike and walleye as the indicator fish species. Because mercury concentrations increase with the age and size of a fish, the two species are standardized to specific total length (55 cm for northern pike and 40 cm for walleye). Consequently, each lake or river with one or both of these species will have a standardized length fish mercury concentration assigned to it and that value is used in the trend analysis. The length standardization methodology is described in a 2009 paper authored by B. A. Monson, *Trend Reversal of Mercury Concentrations in Piscivorous Fish from Minnesota Lakes: 1982-2006*, published in Environmental Science & Technology, vol. 43, pp. 1750-1755. In addition, average mercury concentrations in the fish increase with latitude (i.e., from south to north) and most of the lakes sampled in the 1980s were in the northern region of the state; therefore, the annual means of standardized length fish-mercury concentrations were also corrected for latitude and represent the mean latitude in the state.

Data Source

The DNR, Division of Ecological and Water Resources, maintains the primary fish contaminant database (ALLFISHM1.mdb). The Minnesota Department of Agriculture (MDA) currently provides the fish mercury analytical services and maintains the associated analytical and quality assurance records.

Mercury emissions in Minnesota are inventoried at least every five years by the MPCA. The emissions estimates for each source are either measured directly or calculated. As measurement technology improves, more of the emissions are being measured rather than calculated.

Data Collection Period

Fish contaminant data have been collected from 1967 to the present year. Data were collected in all years, although the number of samples varied from year to year.

Minnesota's mercury emissions have been estimated every five years since 1990.

Data Collection Methodology and Frequency

The DNR, Division of Ecological and Water Resources, maintains a methods document that outlines the procedures used to collect, store, and process fish for mercury tissue analysis.

The data for mercury emissions is either measured directly or calculated. Direct measurements are increasingly done by the emissions sources, such as coal-fired power plants. Emission calculations follow a procedure developed by the U.S. EPA. The calculations are essentially the mercury concentration per unit of production multiplied by the total production volume.

Supporting Data Set

The fish-mercury trend for 1982-2012 is based on 2774 standardized length-fish mercury concentrations from 1107 lakes. The tabular data is available on request from Bruce Monson, MPCA.

The mercury emissions inventory is available at http://www.pca.state.mn.us/index.php/view-document.html?gid=292.

Caveats and Limitations

Caveats and limitations associated with the sample collection and sample processing are outlined in the methods document maintained by the DNR, Division of Ecological and Water Resources.

The standardized length fish mercury concentration is based on the available northern pike and walleye collected from each lake. The relationship between mercury concentration and fish length can vary from year to year within a lake, as well as among lakes and rivers. Consequently, each standardized mercury concentration has some uncertainty (i.e., confidence interval) associated with it, but that uncertainty is not explicitly included in the trend analysis; assumptions are made that the uncertainty fits within a normal distribution.

For the mercury emissions inventory, there is uncertainty in measured values and in the calculated emissions. The confidence in the calculations is qualitatively assessed based on the quality of the information available to make the calculations. For example, there is high confidence in the mercury emissions from coal-fired power plants, but very low confidence in the mercury emissions from solid waste collection and processing.

Future Improvements

As mentioned above, more mercury emissions are being measured, which will improve the confidence in those estimates. Calculations of standardized length fish mercury concentrations are not expected to change; however, new statistical methods may be applied to the trend analysis if they provide improved inference about the changes in mercury concentrations.

Financial Considerations

Contributing Agencies and Funding Sources

Not applicable

Communication Strategy

Target Audience

In addition to businesses and organizations in Minnesota whose air emissions of mercury are covered by the Statewide Mercury TMDL Plan, Minnesota residents and visitors who consume fish caught from Minnesota waters and individuals interested in the health of Minnesota's fish-eating wildlife will be particularly interested in this measure.

Associated Messages

The measure directly links efforts to reduce the release of an air pollutant, mercury, and a specific environmental outcome, reducing mercury in fish. It helps show whether a specific pollution-reduction effort is having the desired environmental affect. In addition, because Minnesota receives 90% of its mercury pollution from outside of the state, the measure also shows the extent to which in-state reductions in mercury air emissions are sufficient.

Outreach Format

In addition to help conveying success in meeting Clean Water goals, this measure will complement MPCA's current effort to provide information to those businesses with air emissions permits for mercury or businesses whose air emissions of mercury may be regulated in the future, as well as organizations/individuals interested in air emissions permitting.

Other Measure Connections

Not applicable

Measure Points of Contact

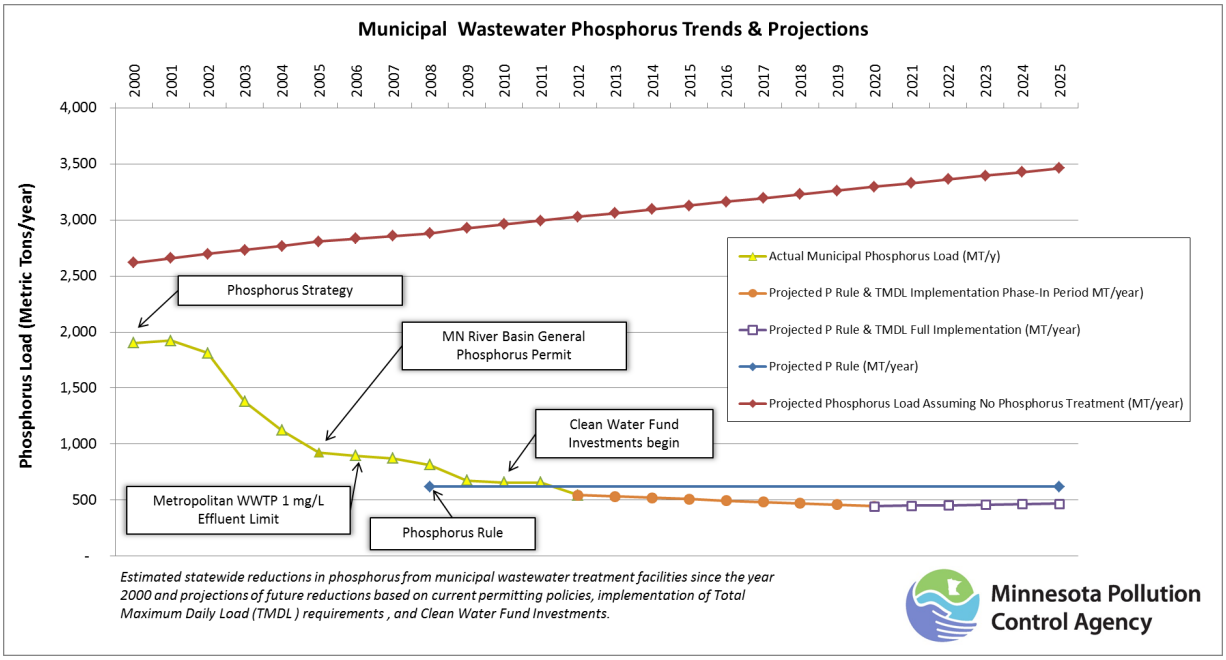
- David Wright, Minnesota Department of Natural Resources, David.I.Wright@state.mn.us
- Paul Hoff, Minnesota Pollution Control Agency, paul.hoff@state.mn.us
- Frank Kohlasch, Minnesota Pollution Control Agency, frank.kohlasch@state.mn.us

Changes over time in municipal wastewater phosphorus discharges

Measure Background

Visual Depiction

This graph represents statewide municipal wastewater treatment facility phosphorus reductions since the year 2000, projects future reductions based on the implementation of current permitting policies, and contrasts them to anticipated increases in phosphorus loading that would have resulted from the perpetuation of previous permitting policies.



Estimated statewide reductions in phosphorus from municipal wastewater treatment facilities since the year 2000 and projections of future reductions based on current permitting policies, implementation of Total Maximum Daily Load (TMDL) requirements , and Clean Water Fund Investments.

Measure Description

The measurements are statewide municipal wastewater treatment facility phosphorus trends and projections assuming a 1% per year population growth rate.

- The **red line** displays the estimated phosphorus loading if no reductions had been made and effluent phosphorus concentrations remained at 4 mg/L. The projected increase in loading assumes a linear relation between population growth and water usage.
- The **yellow line** represents DMR data reported for since the year 2000.
- The **blue line** represents the statewide phosphorus load if the permitted reductions associated with the lake phosphorus rule were expanded to include all municipal facilities (based on 2010-12 average flow).
- The **orange line** represents a phase-in period for the full implementation of phosphorus reductions required by existing water quality standards.
- The **purple line** represents the loading expected with the full implementation of the P rule and incorporates a potential 1% annual increase in loading as facilities increase flow to meet future demands.

- Actual wastewater loads are based on discharge monitoring report data. TMDL implementation, future river eutrophication standards and operational margins of safety are expected to reduce future phosphorus loads beyond projected values.

Associated Terms and Phrases

The Phosphorus Strategy was a permitting approach adopted by the MPCA in 2000. It established policies to assign 1 mg/L effluent phosphorus permit limits for municipal wastewater treatment facilities that had the potential to discharge annual phosphorus loads in excess of 1,800 lbs/year to specific watersheds and waterbodies. Municipal wastewater treatment facilities that were not assigned effluent phosphorus limits were required to monitor influent and effluent phosphorus and develop phosphorus management plans.

The Minnesota River Basin General Phosphorus permit was issued in 2005 to implement the wasteload allocations established by the Lower Minnesota River Dissolved Oxygen TMDL. It established baseline load and pollutant load reduction requirements for the 39 largest continuously discharging municipal and industrial wastewater dischargers in the 8 major watersheds of the Minnesota River basin.

The Metropolitan WWTP is the largest wastewater treatment facility in Minnesota with an average annual design flow or 251 mgd.

The "phosphorus rule" refers to Minnesota Rules Chapter 7053.0255. It codifies the phosphorus strategy but extends its requirements to all Minnesota watersheds.

Target

The Projected P Rule (MT/year) target of 619 MT/year is estimated as a result of applying the categorical performance goals developed for the draft Lake Pepin TMDL to all municipal wastewater treatment facilities.

Baseline

Baseline year: 2000

Baseline load: 1,902 metric tons/year

Geographical Coverage

Statewide

Data and Methodology

Methodology for Measure Calculation

The projections are based on a **1 % per year population** growth estimate.

All municipal ("city") populations are used to calculate municipal flow. All rural ("township") populations are assumed to be outside municipal service boundaries.

92% of the flow and load are assumed to be from cities with populations ≥ 2000.

TMDL implementation, future river eutrophication standards and operational margins of safety push actual future loads below the projections.

The year 2000 discrepancy between "Actual Municipal Phosphorus Load" and "Projected Phosphorus Load Assuming Non Phosphorus Treatment" reflects pre-2000 implementation of phosphorus effluent limits.

Data Source

WQ Delta database discharge monitoring report data

State demographic center population estimates

Data Collection Period

2000 - 2012

Data Collection Methodology and Frequency

Actual Municipal Phosphorus Load data (yellow line) will be updated annually from discharge monitoring report data.

Supporting Data Set

	Domestic								*Original Graph from 'PhosGraph_DOMvsIND.xlsx' in Old Folder		
	Flow (MG/y)	Conc. (mg/L)	TP Load (MT/y)	Project TP Load @ 2000 Conc (MT/y)	No of Permits		No. of Permits with P Limits				
2000	178,106	3.42	2,305	2,305	511		80				
2005	210,756	2.49	1,985	2,727	552		100				
2009	160,932	2.41	1,471	2,082	573		119				

Average Municipla Wastewater Flow/Capita = 0.0406 MG/capita/year
Average Municipla Wastewater Flow/Capita = 111 gal/capita/day

										Municipal		
Year	City Population	Projected Average Municipal Wastewater Flow (MG/y)	Projected Phosphorus Load Assuming No Phosphorus Treatment (MT/year)	Actual Municipal Wastewater Flow (MG/y)	Estimated Municipal Phosphorus Load (MT/year)	Actual Municipal Phosphorus Load (MT/y)	Actual Industrial Phosphorus Load (MT/y)	Actual Total Phosphorus Load (MT/y)	Projected P Rule & TMDL Implementation Phase-In Period MT/year)	Projected P Rule & TMDL Full Implementation (MT/year)	Projected P Rule (MT/year)
2000	4,257,328	172,848	2,617	179,658	2,305	1,902	214	2,116			
2001	4,324,100	175,558	2,658	199,191		1,923	196	2,119			
2002	4,387,230	178,122	2,697	203,696		1,813	177	1,990			
2003	4,444,786	180,458	2,732	173,074		1,379	163	1,542			
2004	4,500,777	182,732	2,767	183,658		1,123	162	1,285			
2005	4,567,652	185,447	2,808	171,294	926	926	187	1,114			
2006	4,607,356	187,059	2,832	169,915		896	182	1,079			
2007	4,648,222	188,718	2,857	170,913		873	185	1,058			
2008	4,686,816	190,285	2,881	167,767		817	184	1,000			619
2009	4,762,705	193,366	2,928	158,624		676	186	862			
2010	4,816,929	195,567	2,961	171,025		657	194	851			
2011	4,871,153	197,769	2,994	180,379		659	180	839			
2012	4,925,377	199,970	3,028	151,049		546	152	698	546		
2013	4,979,601	202,172	3,061						534		
2014	5,033,825	204,373	3,094						521		
2015	5,088,048	206,575	3,128						509		
2016	5,142,272	208,776	3,161						497		
2017	5,196,496	210,978	3,194						484		
2018	5,250,720	213,179	3,228						472		
2019	5,304,944	215,381	3,261						460		
2020	5,359,168	217,582	3,294						447	447	
2021	5,413,392	219,784	3,328							452	
2022	5,467,616	221,985	3,361							456	
2023	5,521,840	224,187	3,394							461	
2024	5,576,064	226,388	3,428							465	
2025	5,630,288	228,590	3,461							470	619

Caveats and Limitations

The projections are based on a **1 % per year loading increase** estimate.

All municipal ("city") populations are used to calculate municipal flow. All rural ("township") populations are assumed to be outside municipal service boundaries.

92% of the flow and load are assumed to be from cities with populations ≥ 2000.

TMDL implementation, river eutrophication standards and operational margins of safety push actual future loads below the projections.

Projected P Rule & TMDL Implementation Phase-In Period assumes a 10-year period (from 2010) to achieve full implementation.

The year 2000 discrepancy between "Actual Municipal Phosphorus Load" and "Projected Phosphorus Load Assuming Non Phosphorus Treatment" reflects pre-2000 implementation of phosphorus effluent limits.

These represent only municipal wastewater treatment facility phosphorus loads. Industrial loads are excluded because Clean Water Legacy Funds are not available for industrial wastewater improvements.

Future Improvements

TBD

Financial Considerations

Contributing Agencies and Funding Sources

None.

Communication Strategy

Target Audience

Concerned citizens, Clean Water Council

Associated Messages

None at this time.

Outreach Format

TBD.

Other Measure Connections

Related to the measure "Number of municipal point source construction projects implemented with Clean Water Funding and estimated pollutant load reductions."

Measure Points of Contact

Agency Information

Marco Graziani (marco.graziani@state.mn.us), 651-757-2398

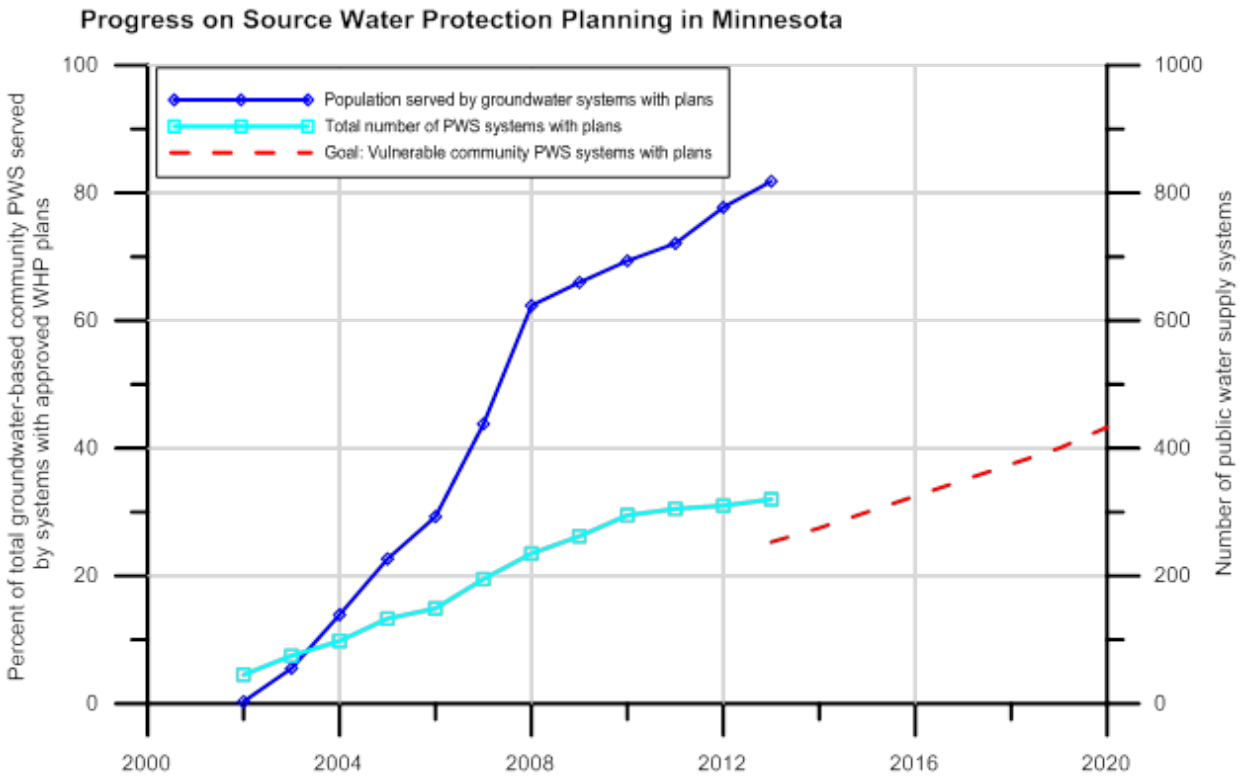
Casey Scott (casey.scott@state.mn.us), 507-206-2652

Drinking and Groundwater Measures

Number of community water supplies assisted with developing source water protection plans.

Measure Background

Visual Depiction



Measure Description

Source water protection planning and implementation activities help public water supply systems (PWS) protect the source used for drinking water supplies. Such efforts are organized around identifying and managing risks associated with the range of potential sources of contamination present in the source area for a PWS.

Source water protection in Minnesota is mandatory for groundwater-based systems and is voluntary for surface water-based systems. Such efforts are scaled depending on the technical, financial, and managerial capacity of the PWS system. Other considerations include the size (i.e., population served) of the system, the vulnerability (physical setting) of its sources, and the type of source (i.e., groundwater or surface water). The most rigorous and involved planning efforts are generally applied towards municipalities that rely on sources in vulnerable settings.

All PWS systems must manage potential sources of contamination in close proximity to the wells used for drinking water supply. For example over 1800 Inner Wellhead Management Zone (IWMZ) Inventories were conducted on new or existing PWS wells in FY 2013. IWMZ inventories have been completed for virtually all PWS wells statewide. These efforts primarily target acute public health threats.

Of all the PWS systems, community systems serve the most people and do so over long time periods. Community PWS systems also must do the following:

1. Identify the area that supplies water to the PWS well or wells;
2. Assess the vulnerability of that area; and
3. Develop land and water resource management strategies for protecting the source of drinking water.

Additional source water protection activities used for community PWS systemscan also address concerns surrounding chronic public threats.

MDH staff will be targeting engaging all vulnerable community systems in source water protection activities by 2020. Emphasizing vulnerable systems represents a shift in emphasis for the program that is inherently risk-based and achievable. Vulnerable community PWS are those for which there are few or no barriers preventing contamination at the land surface from migrating to the drinking water source. Out of the total number of about 320 approved plans at the end of FY 2013, 253 are for vulnerable communities. There are about 433 such systems operating as of late 2013. Our goal is to engage each one of these systems in source water protection activities by 2020.

Additional efforts are underway to assist other types of PWS systems (i.e., low vulnerability communities and non-transient, non-community systems) to develop source water protection approaches that are effective and protective while at the same time commensurate with technical, managerial, and financial capacity of their systems. Developing procedures and approaches that work well for non-municipal communities and non-transient, non-community systems will likely require changes to the state wellhead protection rule (Minnesota Rules Parts 4720.5100 to 4720.5590).Rule and other structural and programmatic changes, as well as plan development and implementation activities, will require ongoing attention by MDH staff beyond 2020.

Communities develop source water protection plans for water supplies as legally required in Minnesota (Minnesota Rules Parts 4720.5100 to 4720.5590, and assistance is available from several partners. The Minnesota Department of Health (MDH) is the primary agency responsible for source water protection; MDH staff review and approve source water protection plans. However, the Minnesota Department of Agriculture (MDA), the Minnesota Department of Natural Resources (DNR), Minnesota Pollution Control Agency (MPCA), Metropolitan Council, Board of Soil and Water Resources, federal agencies, overlapping watershed districts and local governments all provide vital information and management tools.

Associated Terms and Phrases

Drinking water supply management area (DWSMA): The area delineated using identifiable land marks that reflects the scientifically calculated wellhead protection area boundaries as closely as possible (Minnesota Rules, part 4720.5100, subpart 13).

Drinking water supply management area vulnerability: An assessment of the likelihood that the drinking water aquifer within the DWSMA is subject to impacts from land and water uses within the wellhead protection area. It is based upon criteria that are specified under Minnesota Rules, part 4720.5210.

Inner wellhead management zone (IWMZ): The land that is within 200 feet of a public water supply well (Minnesota Rules, part 4720.5100, subpart 19). The public water supplier must manage the IWMZ to help protect it from sources of pathogen or chemical contamination that may cause an acute health effect.

Source water protection: Source water protection prevents contaminants from entering a public water supply at levels that could negatively impact human health. Source water protection activities have many benefits:

- Human health is protected;
- Costs are reduced; the cost of pollution prevention is less than the cost of remediation;
- Risk is reduced; property owners are less likely to become responsible parties to contaminating a source of public drinking water;
- Sustainable water supplies are ensured for future generations' health and economic needs.

Surface water intake protection: A method of preventing contamination of surface water (rivers, lakes, or mine pits) used to supply drinking water by managing potential contamination sources. The development of surface water intake protection plans is voluntary in Minnesota. However, plans seeking the endorsement of the State must follow the guidance provided by MDH.

Wellhead protection: A method of preventing contamination of either wells or the aquifer supplying wells using effective management of potential sources of contamination in all or a portion of the well's recharge area. Wellhead protection is a legal requirement that was adopted by the state in December 1997. Procedures and time frames for wellhead planning are described in Minnesota Rules Parts 4720.5100 to 4720.5590, and apply to community and noncommunity public water supply systems that rely on groundwater for their source of drinking water.

Well vulnerability: An assessment of the likelihood that a well is at risk to human-caused contamination, either due to its construction or indicated by criteria that are specified under Minnesota Rules, part 4720.5550, subpart 2.

Target

All vulnerable community public water suppliers that use groundwater will be engaged in wellhead protection efforts by 2020.

Baseline

Data from 2001 through June 30, 2009 provides a context for this measure.

Geographical Coverage
Statewide

Data and Methodology

Methodology for Measure Calculation
For this report, data from the MDH Source Water Protection Tracker database was used to provide the number of new communities entering the wellhead protection program, technical assistance provided by the four planners supported by the Clean Water Fund, and new wellhead protection plans that were approved.

Data Source
Source Water Protection Tracker and Minnesota Drinking Water Information System, two databases that are maintained by the Minnesota Department of Health.

Data Collection Period
1998 to 2013

Data Collection Methodology and Frequency
Data documenting the satisfaction of rule requirements are continually entered by Minnesota Department of Health and Minnesota Rural Water staff and assistance is provided to public water suppliers and the general public.

Supporting Data Set
Currently there are 919 community public water supplies with groundwater as a source. Of these approximately 315 have approved plans and 215 are in the process of developing a first plan or amending an existing plan. Vulnerable community PWS systems represent 253 of the approved plans; as of late 2013 there are about 433 total vulnerable community systems in Minnesota.

[Public water suppliers with source water protection plan approvals in FY12 and 13:]

FY 2012

	Detroit Lakes	Pine River
Alden	Dexter	Princeton
Bovey	Edgerton	Rum River Elementary School
Braham	Glenville	Saint Bonifacius
Brainerd	Granite Falls	Scandia Elementary School
Browerville	Lafayette	Shakopee
Browns Valley	Light of Christ Lutheran/Headstart	Utica
Buhl	Mountain Iron	Winthrop
Chandler	Mountain Lake	

FY 2013

Altura	Chanhassen	Goodhue	Lake Wilson	Roscoe
Annandale	Cobden	Hancock	Lakeland Municipal Water	Rosemount
Ashby	Cuyuna	Iron Junction	Litchfield	St. John's Lutheran School
Battle Lake	Delavan	Ironton	Maple Grove	Sunray Water Company, LLC
Baxter	Edina	Kandiyohi	Milaca	Vermillion
Bertha	Elk River	Kellogg	Northfield	Viking Industries
Brownsdale	Empire Township	Kinney	Randolph	White Bear Lake
Camp Ripley	First District Association	Lake Lillian	Rockville	White Bear Township

Communities that entered the wellhead protection program in FY 2012 and 2013:

FY 2012:

Adrian	Eitzen	LeSueur	Rock County Rural Water System
Barnum	Ellsworth	Lincoln-Pipestone Rural Water System	Shafer
Belgrade	Frazee	Lino Lakes	Sleepy Eye
Bird Island	GNP Company	Lowry	Spring Grove
Bloomington	Granada	Medford	Stacy
Brandon	Harris	Melrose	Trimont
Breitung	Hayfield	Moorhead	Truman
Brooten	Hoffman	Moose Lake	Viking
Carlton	Hokah	Oakdale	Waconia
Cloquet	Houston	Oklee	Waite Park
Cold Spring	Hugo	Pease	Walker
Cromwell	Inver Grove Heights	Pequot Lakes	Willmar
Dodge Center	Kasson	Preston	Winona
Eagan	Kensington	Red Wing	Winton
Eden Prairie	LaCrescent	Remer	Wrenshall

FY 2013:

Adams	Cottage Grove	Cottage Grove	Perham
Albert Lea	Crosby	Crosby	Randall
Amboy	Donnelly	Donnelly	Sacred Heart
Barnesville	Elbow Lake	Elbow Lake	Saint Francis
Battle Lake Mobile Home Park	Elysian	Elysian	Saint John's University
Becker	Fairfax	Fairfax	Saint Paul Park
Belle Plaine	Fergus Falls	Fergus Falls	South Saint Paul
Big Lake	Fertile	Fertile	Vernon Center

Blue Earth	Foley	Foley	Waseca
Buffalo Lake	Franklin	Franklin	Windom
Cannon Falls	Garfield	Garfield	Woodbury
Champlin	Good Thunder	Good Thunder	
Claremont	Hammond	Hammond	
Cleveland	Iona	Iona	

Caveats and Limitations

Community public water supply systems include municipal and non-municipal systems. Forty-one of the community systems rely on surface water and are not regulated by the wellhead protection rule. The remainder of the State's approximately 7000 public water supply systems are non-community systems, which include both transient and non-transient public water supply systems. All of these must manage an inner wellhead management zone that consists of an area defined by a 200 ft radius around a public water supply well. This measure does not include Minnesota residents that rely on private wells or surface water supplies. Also, wellhead protection plans are required to be amended every 10 years, a process that consumes program resources at a level comparable to developing a first generation plan. This recurring work load limits the number of new community PWS that can be brought into the wellhead protection program (assuming stable staffing).

Future Improvements

Plans are underway to modify the Source Water Protection Tracker database to improve MDH's ability to manage plan development and implementation activities. In addition, the state rule that governs wellhead protection planning needs to be updated 1) to allow greater MDH flexibility in deploying staff and resources and 2) to fix a number of administrative and procedural requirements that currently make the process cumbersome and difficult for certain types of public water supply systems without providing commensurate public health protection.

Financial Considerations

Contributing Agencies and Funding Sources

U.S. Environmental Protection Agency provides baseline funding.

Clean Water, Land, and Legacy Amendment appropriation ($890,000 in 2012 and $940,000 in 2013). This supports part of the planning and technical assistance activities for wellhead protection and allows more public water supplies to be brought into the planning process than would otherwise be possible using established funding.

Communication Strategy

Target Audience

City and county governments, watershed districts and management organizations, land use planning and zoning staff, water planning staff, environmental non-governmental organizations, the legislature, state agency partners and the general public.

Associated Messages

Associated messages:

1. Source water protection activities help to prevent contaminants from entering a public water supply at levels that could negatively affect human health;
2. The goal is to engage all vulnerable community public water supply systems in wellhead protection planning efforts by 2020; and
3. As of the end of FY 2013, over 80 percent of the population served by groundwater-based public water supply systems is protected by wellhead protection planning efforts.

Outreach Format

TBD

Other Measure Connections

Groundwater and surface water are each used for drinking water supply purposes in Minnesota, and thus other measures that concern water quantity and quality are related to this measure.

Measure Points of Contact

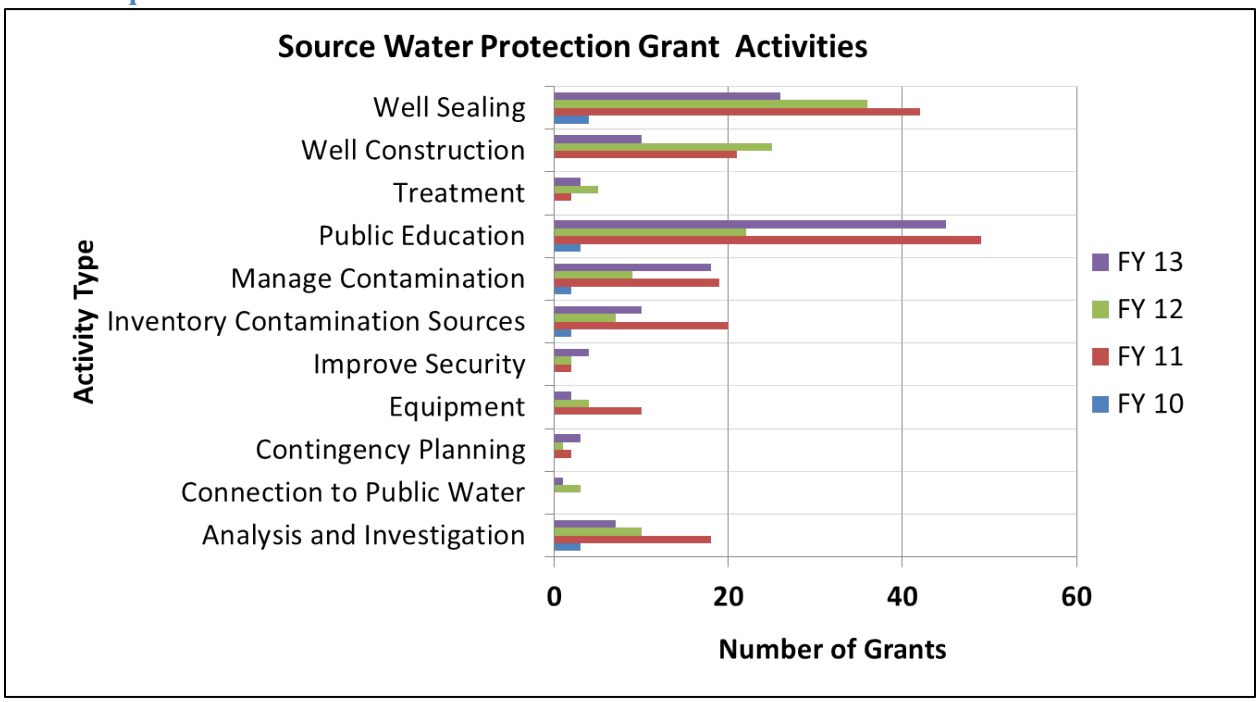
Lead Agency Information

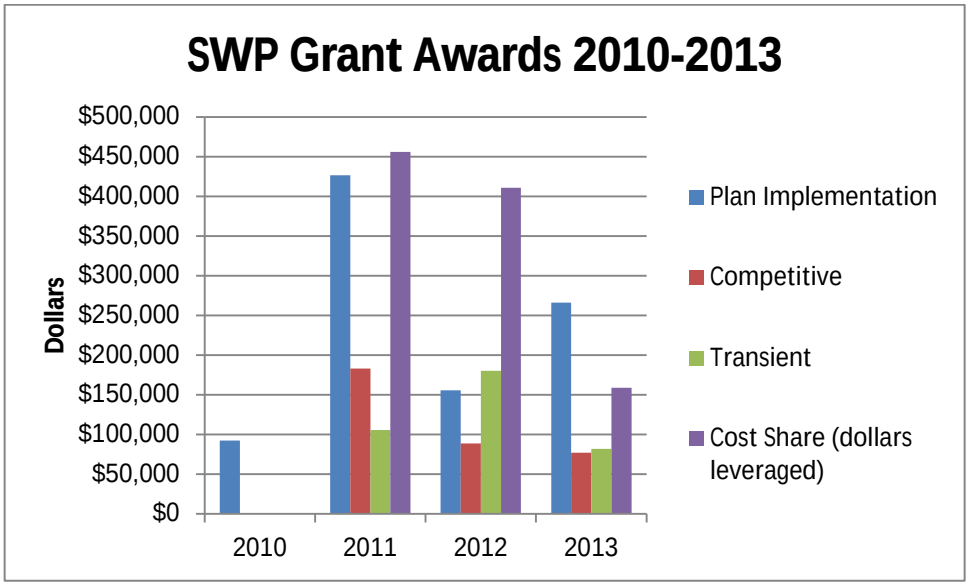
Stephen W. Robertson, Minnesota Department of Health, steve.robertson@state.mn.us

Number of grants awarded for source water protection

Measure Background

Visual Depiction





Measure Description

Source Water Protection (SWP) Grants are used to encourage implementation of source water protection activities. These include measures designed to protect or manage source water that are

identified in wellhead protection plans (groundwater), intake protection plans (surface water), and other documentation. Prior to the availability of funding through the Clean Water Fund, no resources were available to assist in implementation of source water protection measures in Minnesota. SWP Grant funding has been used to support activities within Drinking Water Supply Management Areas (DWSMAs) that are specifically tied to safeguarding drinking water supplies. Examples include 1) sealing old, abandoned wells, 2) supporting efforts to limit nitrogen losses on agricultural fields, 3) inventorying potential sources of contamination, and 4) conducting public education and outreach.

SWP grants are only issued to public water supply wells. Three different kinds of grants have been established:

1. SWP Implementation Grants are used to fund measures that are specifically identified in certain kinds of qualifying plans (e.g., wellhead protection plans, intake protection plans, etc.). No cost share is required;
2. SWP Competitive Grants are used to fund measures that are germane to source water protection goals and objectives for systems that do not have a source water protection plan in place. A 50-50 cost share is required for these grants;
3. SWP Transient Grants are used to support source water protection measures for transient public water supply systems. As a class, transient PWS systems face different obstacles and challenges than the larger PWS systems. A 50-50 cost share is required for these grants.

Each SWP Grant type is open for applications twice per year.

Associated Terms and Phrases

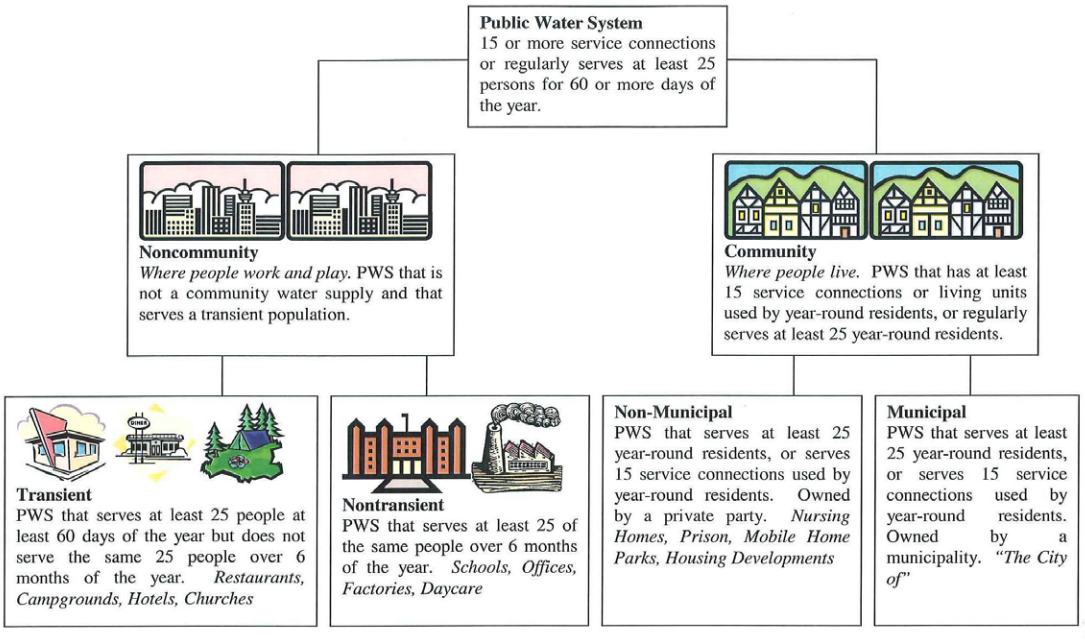
Drinking water supply management area (DWSMA): The area delineated using identifiable land marks that reflects the scientifically calculated wellhead protection area boundaries as closely as possible (Minnesota Rules, part 4720.5100, subpart 13).

Drinking water supply management area vulnerability: An assessment of the likelihood that the drinking water aquifer within the DWSMA is subject to impacts from land and water uses within the wellhead protection area. It is based upon criteria that are specified under Minnesota Rules, part 4720.5210.

Inner wellhead management zone (IWMZ): The land that is within 200 feet of a public water supply well (Minnesota Rules, part 4720.5100, subpart 19). The public water supplier must manage the IWMZ to help protect it from sources of pathogen or chemical contamination that may cause an acute health effect.

Public Water Supply systems: Refer to the chart, below, for definitions of the various types of public water supply systems.

Figure 2.1 Water System Categories And Definitions



Source water protection: Source water protection prevents contaminants from entering a public water supply at levels that could negatively impact human health. Source water protection activities have many benefits:

- Human health is protected;
- Costs are reduced; the cost of pollution prevention is less than the cost of remediation;
- Risk is reduced; property owners are less likely to become responsible parties to contaminating a source of public drinking water;
- Sustainable water supplies are ensured for future generations' health and economic needs.

Surface water intake protection: A method of preventing contamination of surface water (rivers or lakes) used to supply drinking water by managing potential contamination sources. The development of surface water intake protection plans is voluntary in Minnesota. However, plans seeking the endorsement of the State must follow the guidance provided by MDH.

Wellhead protection: A method of preventing contamination of either wells or the aquifer supplying wells using effective management of potential sources of contamination in all or a portion of the well's recharge area. Wellhead protection is a legal requirement that was adopted by the state in December 1997. Procedures and time frames for wellhead planning are described in Minnesota Rules Parts 4720.5100 to 4720.5590, and apply to community and noncommunity public water supply systems that rely on groundwater for their source of drinking water.

Well vulnerability: An assessment of the likelihood that a well is at risk to human-caused contamination, either due to its construction or indicated by criteria that are specified under Minnesota Rules, part 4720.5550, subpart 2.

Target

Individual PWS systems are expected to implement 75 percent or more of the measures in their Source Water Protection Plan. The ongoing availability of SWP Grants removes financial obstacles that interfere with implementation efforts. The target therefore is to increase the reach of the SWP Grants program – that is, to involve more public water supply systems in as broad a range of implementation efforts as possible.

Baseline

No funds were available for SWP Grants or other implementation efforts prior to Clean Water Fund appropriations for FY 2010.

Geographical Coverage

Statewide.

Data and Methodology

Methodology for Measure Calculation

The SWP Grants Database is used to track the number and dollar amount of SWP grants awarded by year in Minnesota.

Data Source

Source Water Protection Tracker and Minnesota SWP Grants database, two databases that are maintained by the Minnesota Department of Health.

Data Collection Period

State fiscal years 2010 - 2013.

Data Collection Methodology and Frequency

MDH staff and others enter and track SWP grants information on an ongoing basis, with final accounting occurring at the end of each fiscal year. Minnesota Department of Health and Minnesota Rural Water staff track the degree to which they assist PWS systems with all implementation activities, not just the ones for which PWS systems receive funding. These measures and other data pertaining to Source Water Protection are routinely entered into MDH databases.

Supporting Data Set

As of the end of FY 2013, there are 919 community public water supplies with groundwater as a source. Of these approximately 315 have approved plans and 215 are in the process of developing a first plan or amending an existing plan. Three surface water-based systems have intake protection plans endorsed by MDH. Only systems with approved plans are eligible for SWP Implementation Grants. SWP Competitive Grants and SWP Transient Grants are used to support source water protection activities that may or may not be formalized in a plan.

Caveats and Limitations

Access to certain grant types is limited to those with approved plans, but not all eligible PWS systems have an appropriate plan. Structural, programmatic and financial constraints limit the capability of MDH staff to develop plans for all eligible systems. Addressing these bottlenecks is a focus within the SWP program at MDH. Also, implementation of source water protection measures is an expectation for PWS systems that requires skills and abilities unfamiliar to their staff. Many lack the technical and administrative expertise or experience to do so without assistance. MDH staffing is insufficient to fully support the implementation activities of all PWS systems.

Future Improvements

Plans are underway to modify the Source Water Protection Tracker database to improve MDH's ability (and the ability of the public water supply systems) to manage plan development and implementation activities. It may be possible to structure these improvements not only to update the manner in which MDH staff manage its work, but also to provide assistance to PWS staff in their implementation efforts.

Financial Considerations

Contributing Agencies and Funding Sources

U.S. Environmental Protection Agency provides baseline funding for MDH's Source Water Protection program.

Clean Water, Land, and Legacy Amendment appropriation ($525,000 in 2012 and $475,000 in 2013). This funding supports the SWP Grants program.

Communication Strategy

Target Audience

The target audience for source water protection implementation includes, but is not limited to, public water supply systems, other governmental and non-governmental partners, and the general public.

Associated Messages

1. Source water protection activities help to prevent contaminants from entering a public water supply at levels that could negatively affect human health;
2. The goal is to engage all community public water supplies in wellhead protection planning efforts by 2020; and
3. SWP Grants not only enable implementation activities, but also leverage resources from other funding sources.

Other Measure Connections

Number of public water supply systems assisted with developing and implementing source water protection plans (FY 2012/2013).

Outreach Format

Regular announcements of grant opportunities through MDH web site and email broadcasts to PWS systems, MDH staff, and program partners.

Measure Points of Contact

Agency Information

Stephen W. Robertson, steve.robertson@state.mn.us

Number of local government partners participating in Clean Water Fund supported groundwater nitrate-nitrogen monitoring and reduction activities

Measure Background

Nitrate is a water soluble molecule that is made up of nitrogen and oxygen. It is naturally occurring in the environment; however at elevated levels it can have negative effects on human health. Nitrate is one of most common contaminants in Minnesota's groundwater and may exceed the drinking water standard in vulnerable or sensitive aquifers. There is significant local variability in nitrate monitoring results; some areas of the state have shown little change while other areas have shown increasing nitrate trends. The most vulnerable areas of the state are the Central Sands region of central Minnesota and the Karst region located in southeast Minnesota.

Groundwater funding from Minnesota's Clean Water Fund is being used for activities that help identify potential sources of nitrate contamination and evaluate and implement practices to reduce nitrate in groundwater. The Minnesota Department of Agriculture (MDA) leads many projects and activities to protect groundwater in regions of the state most vulnerable or sensitive to contamination. There are several MDA activities currently underway (number of local partners in parentheses*):

- Rosholt Farm: A public-private partnership to improve nitrogen fertilizer efficiency and protect groundwater (2)
- Dakota County: Validating nitrogen recommendations and water quality impacts under irrigated agriculture(1)
- Irrigators Workshops and Adaptive Management Program in Central Minnesota (5)
- Central Sands Private Drinking Water Well Monitoring Network (14)
- Township scale Private Drinking Water Well Monitoring Networks (2 **)
- Manure testing, soil testing and aerial imagery (2)
- Research projects focusing on nitrate reduction activities (1)

* The total number of partnerships recorded is lower than the sum of the numbers in the parentheses because we do not double count counties that are participating in more than one project.
** This number will increase as the NFMP is implemented in additional townships.

MDA also works on statewide efforts to better understand nitrogen fertilizer use and to promote proper nitrogen management. Additionally, MDA works with local partner on hosting free nitrate testing clinics and is in the process of implementing the recently revised Nitrogen Fertilizer Management Plan. All activities reported in this measure are supported by the Clean Water Fund, in the category of Groundwater and Drinking water Protection. Many Clean Water funded projects (listed above) started in 2010-2011 and will continue until 2015 or later. New projects will depend upon results from existing projects as well as future CWF appropriations.

In 2013, the MDA completed a revision of the Nitrogen Fertilizer Management Plan (NFMP). The NFMP is the state's blueprint for prevention or minimization of the impacts of nitrogen fertilizer on

groundwater. The Plan includes both voluntary components, with an emphasis on Nitrogen Best Management Practices (BMPs), and provisions for the development of nitrogen fertilizer use restriction if the implementation of BMPs is proven to be ineffective.

The intent of the Nitrogen Fertilizer Management Plan is to prevent, evaluate and mitigate nonpoint source pollution from nitrogen fertilizer in groundwater. The Plan includes components promoting prevention and developing appropriate responses to the detection of nitrogen fertilizer in groundwater. The strategies in the NFMP are based on voluntary BMPs and are intended to engage local communities in protecting groundwater from nitrate contamination.

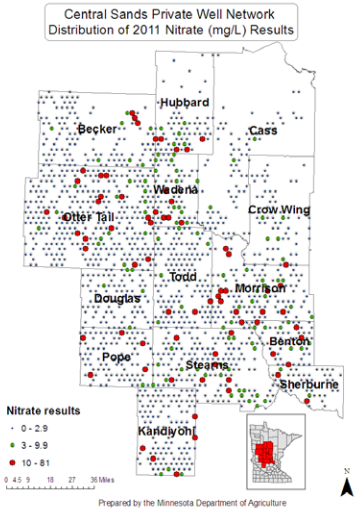
MDA will conduct private drinking water well sampling in vulnerable areas, generally using the township as the primary geographic boundary in order to evaluate current nitrate conditions. These efforts will be conducted on a cooperative basis with the assistance of local government units and other agencies that can provide field support for the area. Based on the results of one round of sampling, MDA will determine the appropriate mitigation response. Enhanced monitoring on the township scale is a key component of the revised NFMP. Township scale monitoring will begin in 2014; the long term goal will be to survey every vulnerable township at least once every ten years in synch with the Minnesota Pollution Control Agency's 10 year watershed monitoring cycle.

The Plan was originally written in 1990 and was recently revised to reflect current activities, interagency water protection planning and implementation work, and to better align it with current water resource conditions and program resources. The revisions were based primarily on input from the NFMP Advisory Committee with consideration for past NFMP implementation experience, Nebraska's Central Platte Natural Resources District phased approach to groundwater management, MDA's Pesticide Management Plan, increased knowledge about occurrences of elevated nitrate in groundwater, and advances in agricultural technology and management practices.

Visual Depiction

Visual depictions will vary depending on the specific activity or project being explained.

For example, the following map will be used to display results from the Central Sands Private Well Monitoring Network.



Tables, graphs and charts will be used to present results for the projects. Other visuals may include: pictures of local partners (in the field and hosting events) and short "success stories" written for newsletters or sent out as postcards.

Measure Description

This measure counts the number of local government partners participating in Clean Water funded nitrate monitoring and reduction activities. In general, local partners include Soil and Water Conservation Districts (SWCDs) and Watershed Districts.

Associated Terms and Phrases

Central Sands: A region in central Minnesota that is characterized by course-textured sandy soils, often referred to as glacial outwash. There are 14 counties located in this region.

Nitrate: Nitrate (NO_3^-) is a water soluble molecule that is made up of nitrogen and oxygen. It is naturally occurring in the environment and can be taken up and used by plants. Nitrate is a negatively charged ion and does not adhere to soil particles. As a result, it can be leached and easily lost from the soil profile. One significant source of nitrate in the environment is agricultural fertilizer.

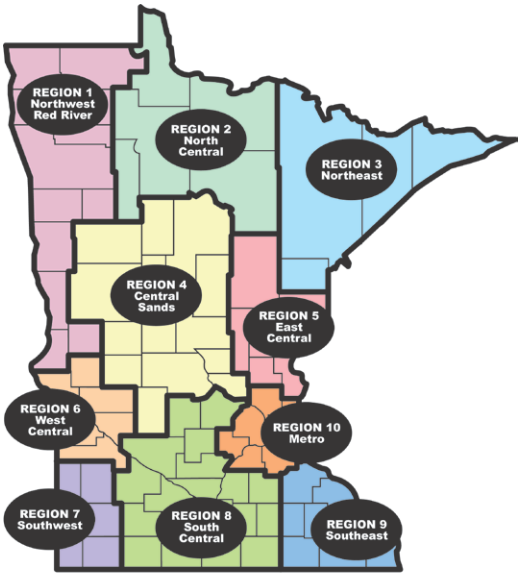
Nitrate Testing Clinics: "Walk-in" style clinic that offers free water testing. The goal is to increase awareness about nitrate in drinking water and to educate private well owners that it is a personal responsibility to test well water.

Target

MDA's goal is to continue to develop effective partnerships with counties. There is no specific numeric target for this measure.

Township scale Private Drinking Water Well Monitoring Networks: According to the recently revised Nitrogen Fertilizer Management Plan, MDA plans to analyze water samples from approximately 70,000 private wells, in about 275 vulnerable townships, between 2014 and 2020. In townships with elevated nitrate concentrations, the MDA will work with communities to design and initiate private well monitoring networks. This is a voluntary program and the actual number of partnerships will depend on interest and ability of individual or groups of townships.

Nitrate Clinics: MDA's goal is to support counties that would like to host a clinic and ensure that all counties that have a chronic problem with nitrate are hosting annual clinics. MDA provides nitrate testing equipment and technical support to counties.



Baseline

The baseline year for this measure is 2010. This year marked the beginning of Clean Water funding and the first year of each of the nitrate monitoring and reduction activities.

Geographical Coverage

Many of these projects are targeted in areas of the state most vulnerable to groundwater contamination (Region 4 and Region 9 on the map). Dakota County is located in Region 10. Nitrate clinics and township monitoring networks are located in many areas of the state.

Data and Methodology

Methodology for Measure Calculation

Data for this measure will be collected from the contract and work plan for each individual project. The number of local partners will be calculated according to the number of partners identified in the formal contract (i.e. Joint Powers Agreement) and each partner that has a formal role in executing work described in the approved work plan.

Data Source

The MDA is the lead agency for this measure. All information is stored in contracts and work plans maintained by all staff and supervisors involved in the projects. MDA's Finance and Budget Division also retains all original contract information.

Data Collection Period

Data collection begins on the date a contract is executed. Data collection began July 1, 2009 and will continue for 25 year duration of the Clean Water Fund.

Data Collection Methodology and Frequency

Data will be collected at the time when contracts are executed and whenever any modifications are made to work plans. Updates will occur annually.

Supporting Data Set

There is no formal data set for this measure. Rather, MDA staff count the number of local partners participating in nitrate monitoring and reduction activities (supported by the Groundwater and Drinking Water appropriation in the Clean Water Fund).

Caveats and Limitations

This measure only accounts for formal partnerships with local government units. It does not account for partnerships with local co-ops, the University of Minnesota or other non-government units.

This measure records partnership supported by the Groundwater and Drinking Water appropriation in the Clean Water Fund. It does not account for partnerships on projects in other appropriation categories such as Implementation or Monitoring/Assessment.

Future Improvements

None identified at this time

Financial Considerations

Contributing Agencies and Funding Sources

Minnesota Department of Agriculture is the only agency contributing data. Clean Water funding supports the partnerships identified in this measure.

Communication Strategy

Target Audience

State agencies, local government units, agricultural co-ops, farmers, researcher and the general public.

Associated Messages

State agencies work closely with local governments (LGUs) on all nitrate monitoring and reduction activities. Working with local government helps ensure that Clean Water funds are spent on priority projects that are relevant and important to community members. LGU's add value by providing expertise and knowledge of local issues.

Outreach Format

Newsletters, web pages, factsheets, Power Point presentations and reports are used to communicate information about nitrate monitoring and reduction projects.

- Quarterly updates are written for each project
- One page factsheets are available for each project
- Updates to web pages are made biannually or whenever significant activities occur
- Project staff prepare presentations for meetings and annual field days

Other Measure Connections

This measure is related to the following additional measures:

- Changes over time in pesticides, nitrate and other key water quality parameters in groundwater
- Total dollars awarded in grants and contracts to non-state agency partners

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Measure Points of Contact

Agency Information

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Number of New Health-Based Guidance Values for Contaminants of Emerging Concern

Measure Background

Visual Depiction

Illustration of the molecular structure of compounds and pictures of consumer products or pharmaceuticals.

Measure Description

Active research combined with our increasing ability to measure minute amounts of chemicals in water raises concerns about people's exposure to very low levels of chemicals over a long period of time, especially during vulnerable periods like fetal development. This measure tracks the number of contaminants of emerging concern for which the Minnesota Department of Health (MDH) has conducted toxicity and exposure evaluations resulting in health-based guidance for drinking water.

Associated Terms and Phrases

Contaminant of Emerging Concern: A substance that has been released to, found in, or has the potential to enter Minnesota waters (groundwater and surface water), characterized by:

- a perceived or real threat to public health;
- no Minnesota drinking water health-based guidance currently exists or existing guidance needs to be updated to reflect new toxicity or occurrence information;
- insufficient or limited toxicological information or toxicity information that is evolving or being re-evaluated; or,
- significant new source, pathway, or detection limit information.

Health Based Values (HBV): Concentrations of chemicals in drinking water at which no adverse health effects would be expected among the general population, including sensitive populations such as pregnant women and infants.

Health Risk Limits (HRLs): HBVs which are promulgated through a formal rulemaking process authorized in the 1989 Groundwater Protection Act (GWPA). Per the GWPA, MDH's authority to promulgate HRLs is limited to chemicals that have been detected in groundwater in Minnesota.

Risk Assessment Advice (RAA): May be based on more limited toxicity data than HBVs or HRLs, or may use new risk assessment methods that are not included in the HRL rules. RAA may include a numerical value or may be qualitative in nature.

Target

Develop health-based guidance for ten contaminants every biennium. Guidance was developed for the following substances in the FY10-11 biennium:

1. acetaminophen,
2. 6-acetyl-1,1,2,4,4,7-hexamethyltetraline (AHTN or Tonalide),
3. carbamazepine,
4. N,N-diethyl-meta-toluamide (DEET),
5. 1,4-dioxane,
6. metribuzin degradates,
7. pyraclostrobin,
8. tris(2-chloroethyl) phosphate (TCEP),
9. 1,2,3-trichloropropane (1,2,3-TCP), and
10. triclosan.

Guidance was developed for the following substances in the FY12-13 biennium:

11. bisphenol A (BPA),
12. butyl benzyl phthalate (BBP),
13. dibutyl phthalate (DBP),
14. microcystin
15. propyl paraben,
16. skatol,
17. sulfamethazine,
18. sulfamethoxazole,
19. triclocarban,
20. tris(1,3-dichloroisopropyl)phosphate (TDCPP).

Additionally, 20 contaminants are proposed to be screened each biennium. The following substances were screened in the FY10-11 biennium:

1. BPA,
2. BBP,
3. cadmium,
4. decabromodiphenyl ether (decaBDE),
5. DBP,
6. di(2-ethylhexyl)phthalate (DEHP),
7. formaldehyde,
8. hexabromocyclododecane (HBCD),

9. lead,
10. propyl paraben,
11. skatol,
12. sulfamethoxazole, and
13. triclocarban.

The following substances were screened in the FY12-13 biennium:

14. bupropion,
15. chlorpyrifos,
16. chlorpyrifos oxon,
17. colloidal silver,
18. copper sulfate,
19. 2,4-dichlorophenoxyacetic acid (2-4 D),
20. diquat,
21. endothall,
22. estrone,
23. 17 alpha-ethinylestradiol,
24. fluoxetine,
25. fluoridone,
26. glyphosate,
27. imazapyr,
28. nanosilver,
29. nonylphenol,
30. nonylphenol mono-ethoxylate (NP1EO),
31. nonylphenol di-ethoxylate (NP2EO),
32. octylphenol,
33. perfluorohexane sulfonate (PFHxS),
34. sulfamethazine,
35. thiamethoxam,
36. triclopyr,
37. trimethoprim,
38. TDCPP, and
39. venlafaxine.

Baseline

While historically MDH only developed guidance for contaminants found in groundwater and when there was no state standard, Clean Water funding allows MDH to provide guidance that will help regulatory agencies prevent harmful levels of emerging contaminants in Minnesota drinking water, including surface water and groundwater, and provide a human health context for research and monitoring efforts. Beginning in 2009, funding from the Clean Water amendment added staff and resources to support this expanded effort.

Geographical Coverage
This activity is relevant to the entire state.

Data and Methodology

Methodology for Measure Calculation
Health risk assessment methodology used to develop guidance is consistent with the methodology promulgated as part of the HRL rule (Minnesota Administrative Rules, Parts 4717.7810 through 4717.7900).

Data Source
Information on the process used and contaminants assessed is available in periodic reports for the public authored by the Health Risk Assessment Unit's Contaminants of Emerging Concern staff. This information includes quarterly reports, an interim biennial report, and a final biennial report. Numerous data sources are used to develop health based guidance, depending on the availability of applicable toxicological studies. Sources of data for each chemical are listed in toxicity summaries and information sheets intended for the public and posted on MDH web pages.

Data Collection Period
July 2009-June 2013

Data Collection Methodology and Frequency
MDH relies on occurrence information from ongoing groundwater and surface water monitoring conducted by the Minnesota Pollution Control Agency (MPCA) and Minnesota Department of Agriculture (MDA). Contaminants evaluated through the program include those nominated by the MPCA and MDA who need guidance information to compare to the results of their monitoring and regulatory efforts. MDH has also used monitoring data that is available from various research projects that were conducted by the United States Geological Survey (USGS), American Water Works Association (AWWA), and academic institutions. Toxicological studies are available from various data sources.

Supporting Data Set
The toxicological data used by MDH is described in toxicological summary sheets Available for each contaminant assessed. The occurrence data accessed by MDH is provided in public information sheets. Information sheet development is a collaborative effort with MPCA and MDA. Both types of information are posted online as links on the water guidance table (www.health.state.mn.us/divs/eh/risk/guidance/gw/table.html).

Caveats and Limitations
Currently, MDH has restricted its use of funding for research on contaminants of emerging concern to evaluating health based guidance for contaminants that have the potential to impact drinking water. For some contaminants, the route of exposure of greatest concern may be something other than drinking water such as use of a consumer product that contains the chemical. Additionally, for some contaminants of emerging concern there may not be sufficient published and peer reviewed toxicological data available to develop numeric health-based guidance. In these instances, it is anticipated that qualitative guidance will be provided as applicable and available.

Future Improvements

The work of the program continues to evolve and improve. Two task groups and an advisory forum have been convened and have provided advise and input on the work of the program. The task groups are temporary in nature but public forums have been and will continue to be held annually. Additionally, some work of the program is conducted by contracted research and grants.

Financial Considerations

Contributing Agencies and Funding Sources

This effort is entirely supported by Clean Water amendment funding, with some in-kind contributions of staff supported by the state general fund. Such in-kind enhancement is particularly necessary to ensure that the CEC program work is conducted in a manner consistent with other water quality guidance and rule making work of the department.

Communication Strategy

Target Audience

Audiences include the legislature, the public, and environmental and health professionals (state, local and federal agencies, academic institutions, nonprofit organizations, private industry, general practitioners, and public health nurses).

Associated Messages

The exposure and toxicity information generated from this measure can be used to inform consumer activity as well as the environmental regulation and monitoring activities of government entities and academic institutions. The human health-based guidance and risk assessment advice for drinking water provided through this measure clarifies the potential risk from exposure to contaminants of emerging concern.

Outreach Format

Information regarding this measure is communicated via a program website, factsheets (including contaminant specific factsheets), quarterly reports, biannual reports, an email list serve, an advisory forum, interagency communications, and presentations at conferences and other events.

Other Measure Connections

This measure does not specifically link to other measure but is an integral component of ambient water, source water, and drinking water protection efforts. Monitoring activities conducted by MPCA include contaminants of emerging concern.

Measure Points of Contact

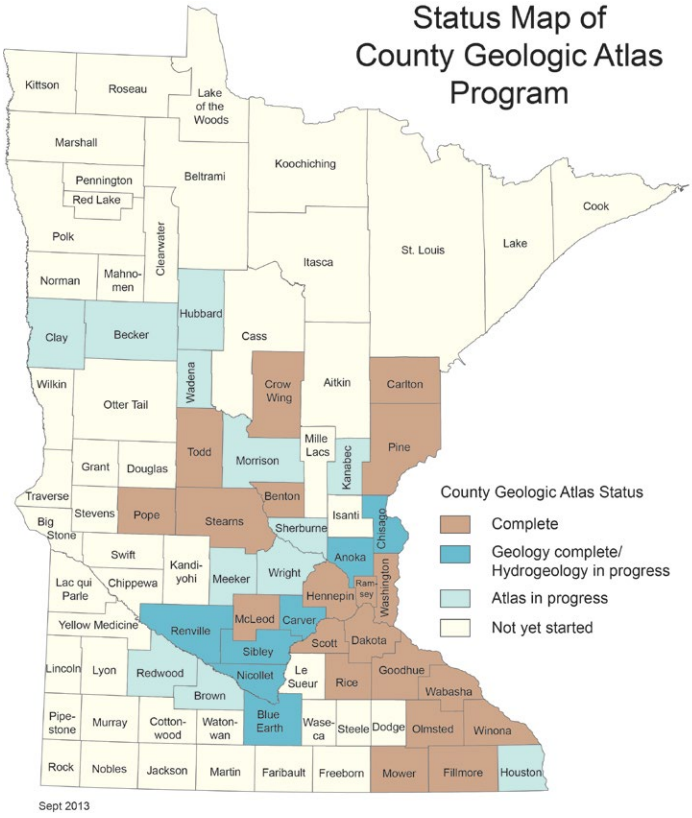
Agency Information

Michele Ross, michele.ross@state.mn.us, 651.201.4927

Number of counties completing a county geologic atlas for groundwater sustainability

Measure Background

Visual Depiction



This measure can be depicted as a statewide map for a specific point in time, as shown above for September 2013, or as a time series plot that shows the amount of work accomplished (e.g., the number of counties with a completed atlas, the percent of the state's land area with a completed atlas, or the percent of the state's population living in a county with a completed atlas).

As of summer 2013 (see above figure), 20 atlases are completed and another 19 are underway. Taken together, county geologic atlas work is completed or has commenced in just over one-third of the state and covers about 80 percent of the state's population.

The table below shows how the number of counties where geologic atlas work is completed has changed since 2009, the baseline year.

Fiscal Year	Counties with a completed Geologic Atlas	Percent of the state with a completed Geologic Atlas
FY09	16	13.7
FY10	17	14.9
FY11	18	15.9
FY12	19	16.4
FY13	20	17.0

Measure Description

Groundwater resources in Minnesota are critical for meeting drinking water, industrial, and agricultural needs, and the needs of groundwater-dependent ecological communities. Groundwater and surface water resources are linked, forming a large, inter-connected, system. Nevertheless, our knowledge of groundwater resources in many parts of Minnesota is limited. Our ability to fully utilize groundwater resources to support Minnesota's economies and communities, while insuring long-term resource sustainability and avoiding adverse impacts on ground-water dependent ecological communities, is limited by the lack of detailed geologic or groundwater information.

This measure tracks the extent to which this critical data assessment process has been completed for the state. Individual counties self-select for completing a county geologic atlas by making a commitment to provide in-kind services such as locating wells from Minnesota Department of Health well records. Counties may also provide a cash match.

Associated Terms and Phrases

Groundwater: All water beneath the land surface.

County geologic atlas: A comprehensive report of a county's geology and groundwater resources.

Groundwater sustainability: Groundwater use that prevents degradation, avoids unacceptable consequences, does not compromise future use, and does no harm to ecosystems.

Target

The long-term goal is to complete a County Geologic Atlas for every county in Minnesota. The current target for achieving that goal is to complete one or two atlases per fiscal year.

Baseline

2009 was selected as the baseline year because it represents when the Minnesota Legislature (2009) first appropriated Clean Water Legacy funds to help develop County Geologic Atlases. At that time, sixteen county geologic atlases were completed (representing 13.7 percent of the state and 58.1 percent of the population) and thirteen atlases were in progress (representing 10.2 percent of the state and 16.1 percent of the population).

Geographical Coverage

The measure is statewide although the work is done at the county scale because it is designed to inform water-use decisions being made by local communities that use counties as political boundaries. Groundwater resources follow neither county boundaries nor the watershed boundaries used for organizing surface water-use decisions.

Data and Methodology

Methodology for Measure Calculation

The percent area of the state with county geological atlas a completed or in progress is assessed annually. The proportion of the state's population living in a county with a completed geologic atlas is also tracked.

Data Source

DNR's Division of Ecologic and Water Resources tracks this activity

Data Collection Period

The period of interest are fiscal years beginning in FY10 and continuing.

Data Collection Methodology and Frequency

The measure is the calculated percent area of all counties with completed county geologic atlases compared to the area of the state.

Supporting Data Set

COUNTY	POP2010	AREA	Year Completed Parts A+B
Anoka*	330844	446	underway
Becker			underway
Benton	38451	413	2012
Blue Earth	64013	766	underway
Brown	25893	618	underway
Carlton	35386	875	2011
Carver	91042	376	underway
Chisago*	53887	442	underway
Clay*	58999	1053	underway
Crow Wing	62500	1157	2007
Dakota	398552	586	1990
Fillmore	20866	862	1996
Goodhue	46183	780	2003
Hennepin	1152425	606	1989
Houston	19027	569	underway
Hubbard			underway
Kananbec	16239	533	underway
McLeod	36651	506	2013
Meeker	23300	645	underway
Morrison	33198	1153	underway
Mower	39163	712	2002
Nicollet	32727	467	underway
Olmsted	144248	654	1988
Pine	29750	1435	2004
Pope*	10995	717	2006
Ramsey	508640	170	1992
Redwood*	16059	882	underway

COUNTY	POP2010	AREA	Year Completed Parts A+B
Renville*	15730	987	underway
Rice	64142	516	1997
Scott	129928	369	1982
Sherburne*	88499	451	underway
Sibley	15226	600	underway
Stearns*	150642	1390	1998
Todd*	24895	979	2010
Wabasha	21676	550	2005
Wadena			underway
Washington	238136	423	1990
Winona	51461	642	1984
Wright	124700	714	underway
state area*		84371	
*no Lake Sup.area			

Caveats and Limitations

The current program plan is to complete a county geologic atlas for all 81 of the state's counties.

Future Improvements

None planned at this time.

Financial Considerations

Contributing Agencies and Funding Sources

County geologic atlases are a cooperative effort between the Minnesota Geological Survey (MGS) and the Minnesota Department of Natural Resources (DNR). The MGS completes Part A (geology) which is followed by DNR completing Part B (groundwater). Funding for the work comes from multiple sources and has varied over time. The new Clean Water Legacy funding is allowing the effort to be accelerated and more detailed data to be collected.

Measure Points of Contact

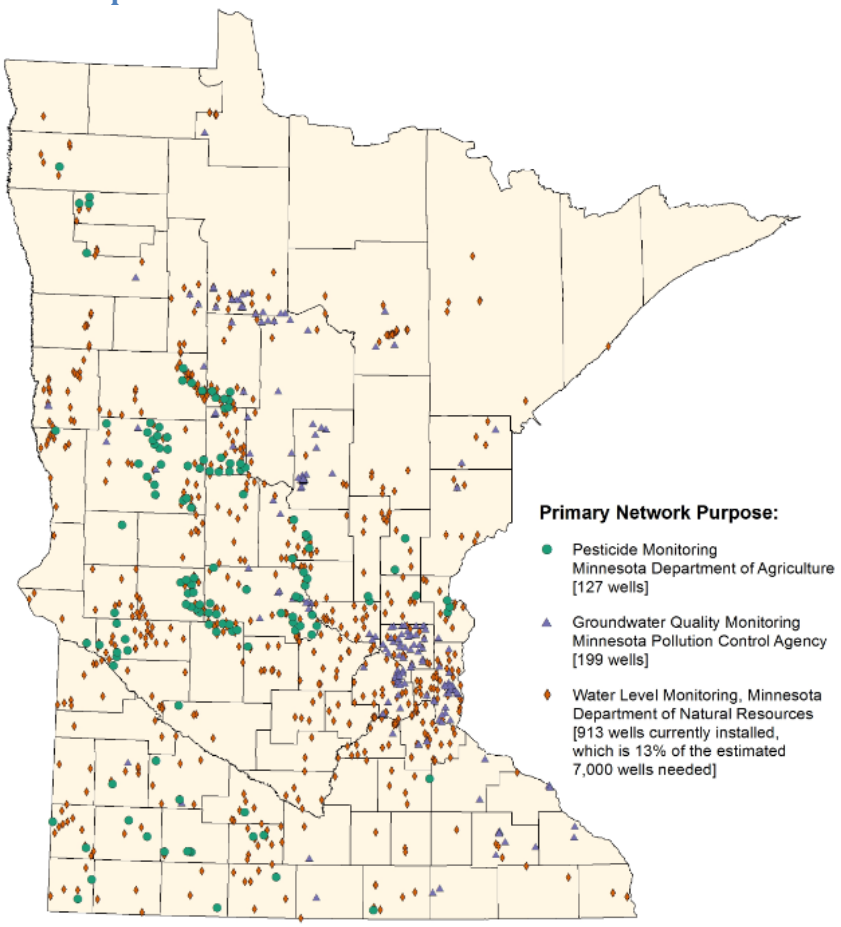
Agency Information

Point of Contact: Jan Falteisek, P.G., Supervisor, County Geologic Atlas Program
jan.falteisek@state.mn.us,
http://www.dnr.state.mn.us/waters/groundwater_section/mapping/index.html

Number of long-term groundwater monitoring network wells in Minnesota

Measure Background

Visual Depiction



Minnesota groundwater monitoring network wells as of July 2013.

Measure Description

This measure represents the current distribution of wells used by state agencies to monitor long-term trends in water quality and aquifer levels. 1,239 wells are currently used to monitor long-term groundwater conditions. Going forward, this measure will illustrate how gaps in groundwater information are filled.

Well installation, water quality sampling and water level measurement are coordinated between state agencies and wells are used for multiple purposes whenever feasible. Other monitoring wells exist, but they are used for short-term, contamination identification or remediation activities.

This measure illustrates how Clean Water Fund investments accelerate efforts to fill gaps in our understanding of aquifer conditions across the state and improve local capacity to improve private and public drinking water supply infrastructure development. While Minnesota's groundwater monitoring network is still inadequate for understanding groundwater conditions in portions of the state, it is improving.

Associated Terms and Phrases

Aquifer: Rock or sediment that is saturated with water able to transmit economic quantities of water to wells and surface waters.

Groundwater: Water stored in the pore spaces of rocks and unconsolidated deposits found in the saturated zone of an aquifer.

Monitoring network: Set of monitoring wells, managed by multiple state agencies, used to repeatedly measure groundwater quantity and quality over the long-term.

Monitoring well: In this measure, the term 'monitoring well' refers to any well which is actively used to collect information about groundwater parameters such as chemistry, contamination, temperature, water level, etc. over the long term. Different agencies use a variety of terms for monitoring wells, and each term may have a different programmatic or legal definition. Wells used for short-term, contamination identification or remediation activities are not considered to be monitoring wells for the purpose of this measure.

Ob Well: An abbreviated version of "observation well", commonly used by the MN Department of Natural Resources when referring to wells in their groundwater level monitoring network. The term may also be used by other agencies when referring to any groundwater monitoring well.

Observation Well: Another term for "monitoring well". It is used by all agencies and particularly by the MN Department of Natural Resources when referring to wells in their groundwater level monitoring network.

Target

Minnesota Department of Natural Resources (DNR) currently monitors aquifer levels in 913 wells, which is 13% of the estimated 7,000 wells needed.

Minnesota Pollution Control Agency (MPCA) currently monitors water quality in 210 wells. The system is being expanded to result in a completed network of about 270 wells.

The Minnesota Department of Agriculture (MDA) manages a long-term monitoring network of 127 wells. This network is being expanded to target an additional 280 townships with vulnerable groundwater and row crop agriculture over the next six years, as part of the Nitrogen Fertilizer Management Plan. In these townships, MDA will partner with private well owners to monitor approximately 70,000 wells.

The current statewide groundwater monitoring network includes 1,239 wells.

The ultimate goal is a network of approximately 7,400 state-owned and managed long-term groundwater monitoring wells and over 70,000 private well monitoring partnerships.

Baseline

The baseline year for reporting the number of new monitoring wells installed is 2013. This year will serve as the baseline data set for future monitoring.

Geographical Coverage

The measure is statewide.

Data and Methodology

Methodology for Measure Calculation

Minnesota Department of Health (MDH) generated a map of agency's long-term monitoring wells using data provided and maintained by the MPCA, the MDA and the DNR. For this map project, these data were reviewed to identify active wells currently used for long-term monitoring of groundwater conditions. Map updates will require data from each of these agencies.

The MDH dataset was refined using additional data provided by the MDA. Two new wells that are not in the MDH dataset were provided in an Esri GIS shapefile by MDA on July 2, 2013.

The MDH dataset was further refined to eliminate all inactive DNR groundwater observation wells. This was a necessary step, as the MDH database site includes all wells that have ever been part of the DNR observation well program. Many wells are not currently in use and should not be displayed on the map. To avoid displaying inactive wells, a smaller dataset including only currently active DNR wells was used. This dataset was provided as an Esri GISshapefile by DNR on July 9, 2013.

The completed database was used to calculate the total number of wells in the statewide long-term groundwater monitoring network and the number of wells in each agency's network.

Data Source

MDH periodically compiles state agency groundwater monitoring well GIS data, which is available upon request. The dataset does not have a formal name but is referred to by the map title "Minnesota Groundwater Monitoring Network Wells as of July 2013". This dataset should be considered raw data that may not include the refinements described above in the "Methodology" section.

The respective agencies should be contact for information about more current data.

Data Collection Period

Through July 9, 2013.

Data Collection Methodology and Frequency

Data is added to the MDH state agency groundwater monitoring well GIS data set on an ad hoc basis as new wells are installed or as updated information about existing wells is provided by partner agencies.

Supporting Data Sets

MDA monitoring well information, managed by Brennon Schaefer, Hydrologist 2, Pesticide & Fertilizer Management Division, is stored in the Minnesota Pollution Control Agency's EQUIS database. Annual monitoring reports are produced by MDA and posted on their website.

DNR water-level data are stored in an observation-well database maintained by the Ecological and Water Resources Division and provided on their website. Over the coming year, these data will be migrated to the State Cooperative Water Data System (Hydstra) and a new web interface will be developed. Old data is still available from the current site at http://climate.umn.edu/ground_water_level/.

MPCA provides public access to a wide variety of data on environmental conditions through Environmental Data Access. MPCA collects a variety of data on groundwater quality, which is available online at http://www.pca.state.mn.us/index.php/data/groundwater.html.

Caveats and Limitations

Other monitoring wells exist, but they are used for short-term, contamination or remediation activities.

Future Improvements

In this future, the groundwater level observation well network may include MPCA wells where contamination investigation is ongoing and where water level information is collected.

Financial Considerations

Contributing Agencies and Funding Sources

The DNR groundwater-level monitoring program is funded by a mix of Clean Water Fund, bonding, and the General Fund. Observation-well construction costs have been supported by designated bonding funds. Clean Water Fund money also supports planning and maintenance of the observation-well network and program coordination.

The MPCA's long-term groundwater monitoring well network is supported by Clean Water Legacy funds.

The MDA's monitoring network is designed specifically for pesticides and is funded using dedicated fees on pesticides.

Communication Strategy

Target Audience

The target audience for these groundwater observation well distribution results includes, but is not limited to, community public water systems, consulting engineers, academia, policy makers, and the general public.

Associated Messages

While Minnesota's groundwater monitoring network is still inadequate for understanding groundwater conditions in portions of the state, it is improving.

Public and private well owners should regularly review local groundwater information and use the data as a tool to assess the need for future well maintenance or water treatment. For example, if the data collected at a nearby groundwater level observation well shows a long-term drop in water level, the pump may eventually need to be lowered or the well drilled deeper.

Other Measure Connections

The results of this measure may be examined in conjunction with other measures documenting surface water and groundwater quality and quantity. For example, changes in overall trend in Minnesota's aquifer levels or groundwater quality may be impacted by a change in the number and distribution of the state's monitoring well network.

Outreach Format

Information regarding groundwater levels is provided on the Minnesota Department of Natural Resources website: http://www.dnr.state.mn.us/waters/groundwater_section/obwell/index.html

Information regarding groundwater quality is provided on the Minnesota Pollution Control Agency website: http://www.pca.state.mn.us/index.php/water/water-types-and-programs/groundwater/groundwater-monitoring-and-assessment/index.html

Information regarding groundwater quality monitoring is provided on the Minnesota Department of Agriculture website: http://www.mda.state.mn.us/protecting/cleanwaterfund/~/link.aspx?_id=23D8B64273814B09B4FBD954DAA29396&_z=z

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Measure Points of Contact

Agency Information

Ed Schneider, MDH, ed.schneider@state.mn.us

Number of Unused Groundwater Wells Sealed

Measure Background

Visual Depiction
Picture or graphic of a well or a cross section showing how an open well can allow contaminants to reach groundwater, or a graph of cumulative wells sealed.

Measure Description
This measure tracks the number of unused wells and borings sealed. Unused wells, sometimes called "abandoned" wells, can pose a serious threat to groundwater quality by providing a pathway for contaminants to travel deep into groundwater, bypassing the natural protection usually provided by layers of clay, silt, and other geologic materials. This can threaten water quality in city water wells, wells that serve local business, or private wells that serve individual homes. Sealing unused wells helps protect groundwater and drinking water sources from contaminants.

Associated Terms and Phrases

Sealing: Sealing means the process of preparing a well or boring to be filled with grout and the process of filling a well or boring with grout. In Minnesota wells must be sealed by a licensed well contractor. Before sealing the well, the contractor will remove any pumping equipment that may still be in place and remove any debris or other obstructions from the well. The well is then sealed by pumping a grout mixture into the well.

Well: Well means an excavation that is drilled, cored, bored, washed, driven, dug, jetted, or otherwise constructed if the excavation is intended for the location, diversion, artificial recharge, or acquisition of groundwater. Wells include monitoring wells, drive point wells, and dewatering wells.

Target
To seal all unused wells.

Baseline
The number of wells sealed before Clean Water Fund dollars became available for well sealing grants.

Geographical Coverage
Statewide

Data and Methodology

Methodology for Measure Calculation
The total number of wells sealed each year as reported to the Health Department will be compared to the number of wells reported sealed through the Clean Water Funded grants.

Data Source
Total wells sealed is information collected by the Health Department through submittal of well sealing records and recorded in the County Well Index. The number of private wells sealed with Clean Water funds will be reported to BWSR who will pass this along to MDH. Number of public water supply wells sealed will be reported directly to MDH.

Data Collection Period
July 1, 2011 to June 30, 2013

Data Collection Methodology and Frequency
A well sealing form is submitted to the MDH for each well sealed in the state. In addition, a requirement of the Clean Water Fund well sealing grants is to report the number and type of wells sealed with those funds. These two sources of information will be compared on an annual basis.

Supporting Data Set
NA

Caveats and Limitations
NA

Future Improvements
NA

Financial Considerations

Contributing Agencies and Funding Sources
NA

Communication Strategy

Target Audience
NA

Associated Messages
NA

Outreach Format
TBD

Other Measure Connections

Measure Points of Contact

Agency Information

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Manager, Well Management Section

Environmental Health Division

Minnesota Department of Health

Chris.elvrum@state.mn.us

Changes over time in pesticides, nitrate-nitrogen and other key water quality parameters in groundwater

Measure Background

Reporting on this measure will be the responsibility of both the Minnesota Department of Agriculture (MDA) and the Minnesota Pollution Control Agency (MPCA). Each agency has a unique groundwater monitoring program, which is designed for a specific purpose and to meet specific objectives. The agencies also have a monitoring agreement to coordinate monitoring activities. Whenever possible, data will be colligated between the two programs. However, there will be many instances when MDA and MPCA data will be reported separately.

In general, the MDA's pesticide monitoring program analyzes samples for pesticides that are widely used and/or pose the greatest risk to groundwater or surface water. The MDA follows a pesticide selection process which prioritizes the specific compounds to be tested. Common compounds include pesticides applied in agricultural settings and those applied to lawns and gardens. The MDA's water quality monitoring program is designed specifically to evaluate pesticides; however, analysis of nutrients is also conducted. The MDA has also initiated an extensive program for monitoring nitrate concentration trends in private drinking water wells. For this measure, the MDA will begin reporting on pesticide trends in fall of 2011 and nitrate trends in the fall of 2012.

The MPCA manages a network of groundwater monitoring wells that measure ambient (or background) conditions for non-agricultural parameters, and is focused on two aquifers that are vulnerable to anthropogenic contamination—the sand and gravel and Prairie du Chien-Jordan aquifers. Some wells in the MPCA's network are monitored to discern the effect of urban land use on groundwater quality and comprise an early warning network. The early warning network was designed using a random stratified statistical approach to determine the effects of land use (sewered residential, residential areas on subsurface sewage treatment systems, commercial/industrial, and undeveloped) and the composition of the sand and gravel aquifers (these aquifers vary in composition depending upon which glacial advance deposited the sediments) on groundwater quality. The MPCA portion of this measure will report on the changes in nitrates, chloride, volatile organic compounds, and contaminants of emerging concern in vulnerable aquifers. Reporting ambient groundwater trends for nitrates, chloride, volatile organic compounds and emerging contaminants will begin in 2014.

There are some important differences between the monitoring programs at the MDA and MPCA. The MPCA's network deliberately focuses on urban and undeveloped parts of the State since their role is to provide information on non-agricultural chemicals. The MDA program is designed to evaluate the impact to groundwater from the normal use of pesticides and fertilizer, with an emphasis on the impacts from agricultural crops such as corn in areas vulnerable to groundwater contamination. The MDA has been collecting groundwater monitoring data, primarily for pesticides, for this purpose since 1987. The MDA currently has groundwater quality trend data extending over 20 years, which is exceedingly rare,

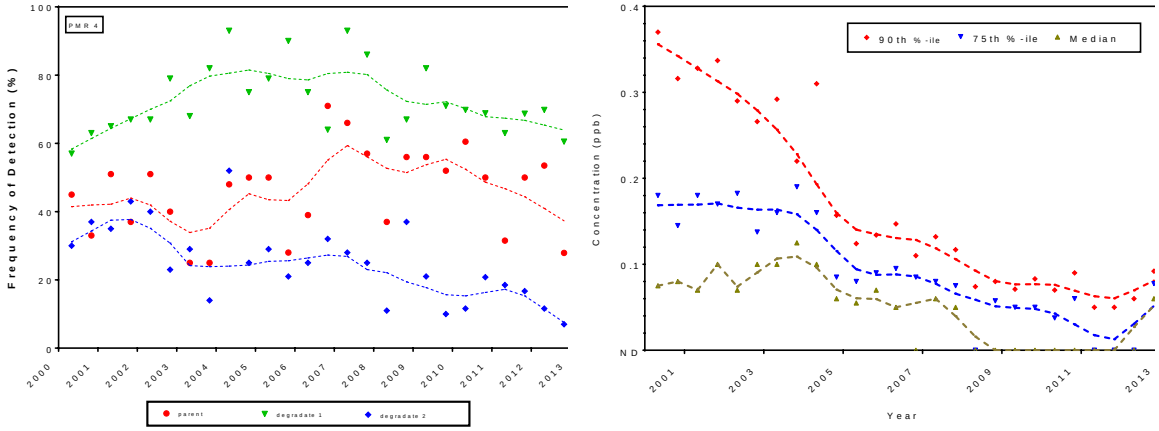
and publishes an annual report which summarizes this data. This data is important for evaluating the long term effects of agricultural practices on groundwater quality.

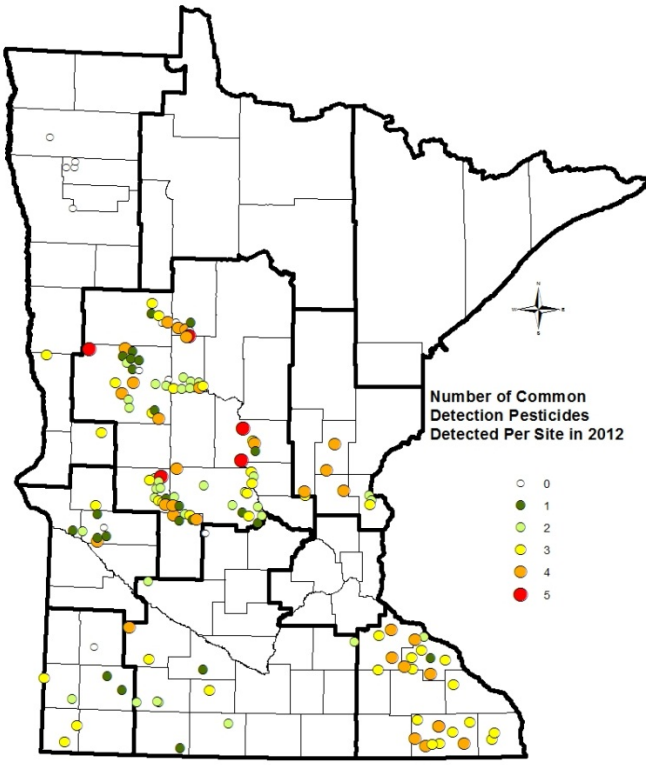
Due to the large amount of data that is available and the many water quality parameters that could be reported on, it is possible that sub-measures may eventually be developed. Possible sub-measures are: 1) Trends in the concentration and detection of common detection pesticides in groundwater), 2) Trends in concentration of nitrate-nitrogen in groundwater, and 3) Changes in chloride, volatile organic compounds, and emerging contaminants of vulnerable aquifers.

Visual Depiction

Example graphics for common detection pesticides in groundwater over time.

Each pesticide that is in Common Detection will have similar graphs and tables prepared for the analysis of trends over time.



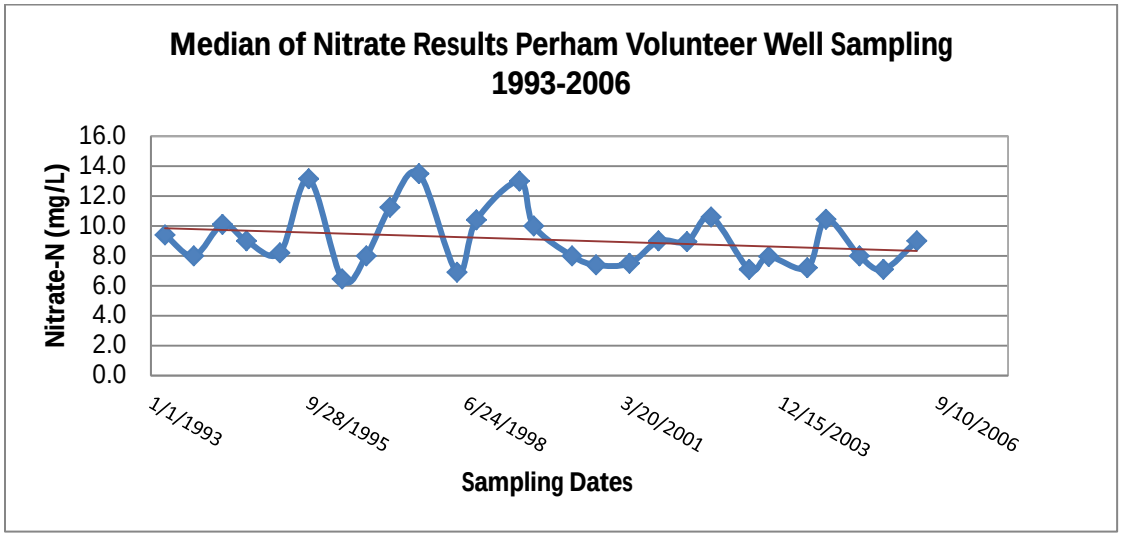


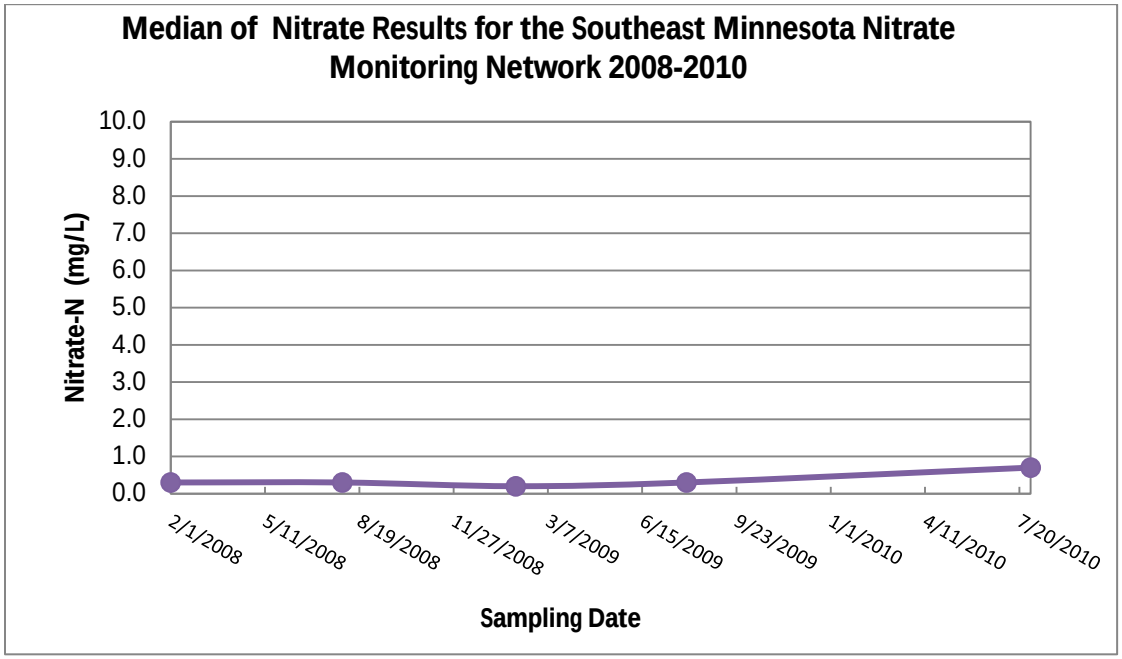
An example of results of trend analysis of a pesticide in groundwater.

Parameter	M-K stat	Kendall Tau	Slope estimate
Parent Median	76	0.33	0
Parent 75th %-ile	-110	-0.48	-0.001
Parent 90th %-ile	-137	-0.59	-0.003
Parent Detection Frequency	72	0.31	1.55
Degradate 1 Median	-134	-0.58	-0.002
Degradate 1 75th %-ile	-162	-0.70	-0.004
Degradate 1 90th %-ile	-183	-0.79	-0.007
Degradate 1 Detection Frequency	48	0.21	0.75

Degradate 2 Median	-5	-0.02	0
Degradate 2 75th %-ile	-73	-0.32	0
Degradate 2 90th %-ile	-130	-0.56	-0.009
Degradate 2 Detection Frequency	-99	-0.43	-1.84

An example graph for nitrate concentrations in groundwater over time.





Note: SE MN volunteers with no or extremely low nitrate concentrations in their well water tended to drop out of this program, which likely resulted in the higher nitrate concentrations in 2010.

Measure Description

Pesticides

This measure consists of graphics and tables displaying pesticide concentration and detection over time. Coupled with trend calculations the graphics provide a rapid determination of tendency in groundwater monitoring results for pesticides. This measure is intended for pesticides that have been detected frequently enough to be designated as commonly detected in Minnesota groundwater. As of February 2011 acetochlor, alachlor, atrazine, metolachlor and metribuzin have been placed in Common Detection in Minnesota groundwater. Specific pesticides in Common Detection status may change over time.

The pesticide portion of this measure does not evaluate the condition of drinking water but only the shallowest groundwater at the edges of fields in highly sensitive geological areas.

Nitrates

This measure consists of graphics and tables displaying nitrate concentrations over time. This measure will include nitrate data from multiple networks. This includes data collected statewide as part of MDA's water quality monitoring program and also data from more intensive sampling in areas where private well networks are established.

Background on Private Well Networks

- The current Central Sands private well monitoring network began nitrate sampling in spring of 2011. The initial sampling set the stage for a long-term monitoring network (502 homeowner participants). The private well network is designed to complement the MDA monitoring well data. The MDA monitoring wells sample at the most vulnerable parts of the aquifer on the edge of fields. The Central Sands private well monitoring project emphasizes sampling groundwater that people are drinking.
- The Southeast Minnesota volunteer monitoring network has completed five rounds of sampling since 2008. Approximately 400 to 500 wells are sampled each round (sampling event).
- As outlined in the Nitrogen Fertilizer Management Plan (2013), MDA will conduct private drinking water well sampling in vulnerable areas with significant row crop agriculture, generally using the township as the primary geographic boundary in order to evaluate current nitrate conditions. These efforts will be conducted on a cooperative basis with the assistance of local government units and other agencies. Based on the results of one round of sampling, MDA will determine the appropriate mitigation response. Township scale monitoring will began in 2013; the long term goal will be to survey every vulnerable township at least once every 10 years in synch with the Minnesota Pollution Control Agency's 10 year watershed monitoring cycle. MDA plans to analyze water samples from approximately 70,000 private wells, in about 275 vulnerable townships, between 2013 and 2020. It is important to note that this approach is bias to the most sensitive areas of the state and data collected will only be used to make conclusions about nitrate trends in drinking water in the townships sampled.

Chloride, Volatile Organic Compounds and Emerging contaminants

This measure consists of graphics and statistics displaying trends in chloride concentrations, VOCs, and contaminants of emerging concern detections over time.

Associated Terms and Phrases

Common detection: As defined in Minnesota Statutes Section 103H and further described within the Minnesota Pesticide Management Plan.

Contaminant of Emerging Concern: Any synthetic, naturally-occurring chemical or microorganism that is not commonly monitored in the environment but has the potential to enter the environment and cause known or suspected adverse ecological and/or human-health effects. In some cases, the release of emerging contaminants has occurred for a long time but may not have been detected until new laboratory methods were developed.

Groundwater quality: The chemical condition of water beneath the ground surface regardless of the use of the water. This measure does not refer to, or necessarily reflect, the general condition of drinking water in the state or any sub-state region.

Pesticides in groundwater: Pesticides that are present in groundwater as a result of routine application and not some unusual or unique circumstance.

Pesticide Monitoring Region (PMR): An area of the state that contains similar land and water features and similar types of pesticide use practices. By dividing the state into regions, the MDA can provide information about the effects of pesticides in each unique area of the state. A map of the 10 PMRs is located in the "Geographical Coverage" section of this measure.

Private Well Monitoring Network: A group of private well owners that agree to collect well water samples and submit them for nitrate analysis. The monitoring network is statistically designed for an unbiased sample collection. The **Central Sands Private Well Monitoring Network** is distributed across 14 counties in central Minnesota. Selection of individual wells was random, and results from this program can be used to make conclusions about nitrate trends in drinking water across the region.

Trend: A change, either an increase or decrease, in the frequency of detection or concentration of pesticides, nitrates or other water quality parameters in groundwater.

Volatile organic compounds: Organic chemicals that have a low boiling point and evaporate readily.

Target

Groundwater is not assessed as impaired/unimpaired as is surface water since there currently are no water quality standards for this media. The purpose of the health-based guidance set by the Minnesota Department of Health for groundwater is to protect human health from contaminants in drinking water. The target is decreasing detection frequencies and/or concentrations of common detection pesticides, nitrate, chloride, and VOCs. For example, subsequent targets may be to decrease common detection pesticide concentration and frequency of detection over time or stabilize and decrease nitrate concentration trends. Subsequent actions and targets will be based on the trends found by these analyses.

Baseline

Pesticides

The baseline year for MDA's groundwater reporting is 2000 for Pesticide Monitoring Region (PMR) 4, 2000 for PMR 9, 2006 for PMRs 1, 6, 7 and 2007 for PMR 5.

Nitrates

Central Sands Private Well Monitoring Network: baseline nitrate data collection began in spring 2011 in this region.

Township-scale Private Well Monitoring: private well monitoring began in fall 2013 and the initial sampling will continue for a period of approximately six years. The first round of sampling will provide a snapshot of nitrate conditions in each township. In the case elevated nitrate concentrations are detected, the township can choose to work with the MDA and establish a volunteer monitoring network (similar in design to the Central Sands monitoring network). After six years, one time monitoring data should be available for the most vulnerable or sensitive townships in the state. The goal is to develop baseline information and to develop long-term trends in the most sensitive areas of the state.

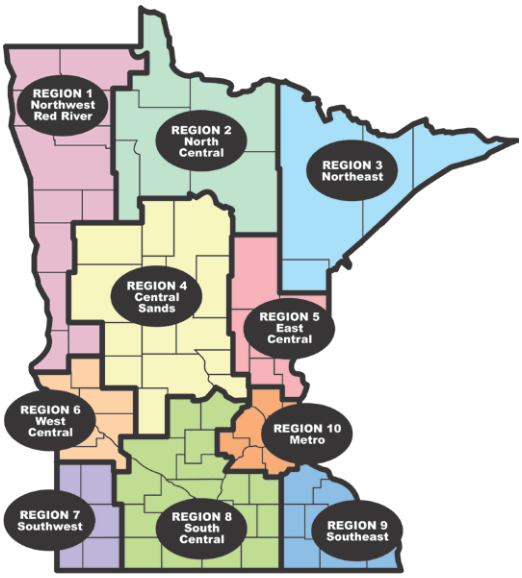
The baseline for MPCA's ambient nitrate groundwater reporting is 2004, when the network was started. That network is currently being redesigned and will not be fully in place until 2014. The available 2004-2014 data will yield limited baseline information.

Chloride, Volatile Organic Compounds and Emerging contaminants

The baseline for MPCA's ambient groundwater reporting is 2004, when the network was started. That network is currently being redesigned and will not be fully in place until 2014. The available 2004-2014 data will yield limited baseline information.

Geographical Coverage

The MDA has established 10 Pesticide Monitoring Regions to provide a framework for conducting groundwater and surface water monitoring. The MDA's water quality monitoring efforts are statewide.



The MPCA's ambient groundwater network also is on a statewide scale.

The general geographic coverage for nitrates would be both statewide and focused on MDA's Pesticide Monitoring Regions. Local implementation projects will be based on the county or township scale. The Central Sands project includes 14 counties and is considered a regional network. Township-scale monitoring is on a smaller geographic scale.

Data and Methodology

Data Collection Methodology

Pesticides

Annual production of graphs of common detection pesticide median, 75th percentile and 90th percentile concentrations over time will be generated. Graphs will be accompanied by a table of the results of calculations of general monotonic trend for each summary statistic. Trends will be calculated by use of the Mann-Kendall test or other appropriate statistical method. Magnitude of any trends present will be estimated using the Thiel-Sen method. Statistical methods may change in response to newly developed techniques or new applications of previously existing methods.

Nitrates

Trends in nitrate concentration (both MDA and MPCA) will be calculated by use of non-parametric tests or other appropriate statistical methods. For the MPCA's nitrate data, Mann-Kendall or Regional Kendall test are the most appropriate to use to determine concentration trends.

MDA monitoring unit sample collection: MDA staff collects samples two to four times annually.

Central Sands Private Well Network: Volunteers will initially collect samples at least annually; however the frequency is yet to be determined.

Southeast Minnesota Volunteer Nitrate Monitoring Network: Volunteers will collect the samples at least annually.

Township-scale Private Well Networks: MDA plans to analyze water samples from approximately 70,000 private wells, in about 275 vulnerable townships, between 2013 and 2020.

Chloride, Volatile Organic Compounds and Endocrine Disruption Compounds

The key parameters to be tracked by MPCA will be calculated by non-parametric statistics, the Mann-Kendall or Regional Kendall test are the most appropriate to use to determine chloride concentration trends. Logistic regression is likely the most appropriate statistical test to use to determine whether the detections of VOCs or contaminants of emerging concern have changed over time.

Data Source

MDA's results are generated by the MDA analytical laboratory on groundwater samples and are maintained in a joint MPCA/MDA database, called EQuIS.

Most MPCA ambient groundwater data are generated by the Minnesota Department of Health (MDH) Environmental Laboratory. Contaminant of emerging concern data are generated by the US Geological Survey (USGS) laboratory, and PFC data are generated by AXYS laboratory. The data generated by the MDH laboratory are maintained in the joint MPCA/MDA database, called EQuIS. The data generated by the USGS and AXYS laboratory are expected to be migrated to EQuIS in 2013.

Private Well monitoring networks

Currently there is two full years of data for the Central Sands private well monitoring network. The first round of sampling began in spring 2011.

Data Collection Period

Pesticides

The MDA's pesticide monitoring began January 2000 and is intended to be maintained in perpetuity.

Nitrates

The MDA groundwater monitoring program has been sampling nitrates since 1986 in edge of field conditions, which do not reflect general drinking water conditions. This is intended to continue in perpetuity.

Central Sands Private Well Monitoring Project: Began in March 2010 and will continue for at least a period of 20 years.

Southeast Minnesota Volunteer Nitrate Monitoring Network: Began in 2008 and there is no set end date.

Township-scale Private Well Monitoring Networks: Began in 2013 and should continue at least for a period of 20 years. The goal is to develop long-term trends in the most vulnerable townships in the state. It is important to note that this approach is bias to the most sensitive areas of the state and data collected will only be used to make conclusions about nitrate trends in drinking water in the townships sampled.

The MPCA's groundwater monitoring network began in 2004 and is intended to be maintained in perpetuity.

Chloride, Volatile Organic Compounds and Endocrine Disruption Compounds

The MPCA's groundwater monitoring network began in 2004 and is intended to be maintained in perpetuity.

Data Collection Frequency

MDA's samples are collected two to four times annually from specifically designed and installed monitoring wells, naturally occurring springs and private drinking water wells. Sampling frequency depends on site location and hydrogeologic conditions.

The MPCA's groundwater monitoring wells are sampled annually.

Supporting Data Set

Pesticides

As of January 2011 MDA's groundwater pesticide data set consists of nearly 200,000 records of analyses conducted on approximately 2,500 groundwater samples.

Nitrates

The MDA has been monitoring well nitrate results starting in 1986. From 1986 to 1999, DNR and USGS observation wells were used for the monitoring program. These monitoring wells are edge of field conditions and do not reflect general drinking water conditions. A newly designed monitoring well network in the Central Sands region was completed and sampling commenced by early 2011. The Centrals Sands network was used as a model to develop the approach to township-scale private well monitoring networks that began in 2013. Please note that regional and township data sets are different.

Nitrate Clinics: From 1993-2006 MDA and its local partners held walk-in style nitrate clinics. These clinics were funded in part with Legislative Commission on Minnesota Resources (1997-1999), EPA 319 (1997-2000) and the MDA Fertilizer Account. These clinics were mainly designed as a public education tool and were not scientifically or statistically designed.

The MPCA presents no supporting data, as we have not yet begun to report on this measure.

Caveats and Limitations

Pesticides

Data on pesticides in groundwater is considered messy data. The data is censored, contains multiple detection limits, missing values, and unquantifiable detections. The data over time is typically non-linear, contains multiple peaks, and has inconsistent variability over time making analysis of results quite difficult. As a result of the messy data, graphical representations of the data will frequently display trends long before statistical analysis is capable of confirming a trend is present.

Nitrates

The data collected with the monitoring wells was designed to monitor pesticides at the most vulnerable parts of the aquifers, on the edge of fields. However, nitrate has been sampled along with the pesticide data.

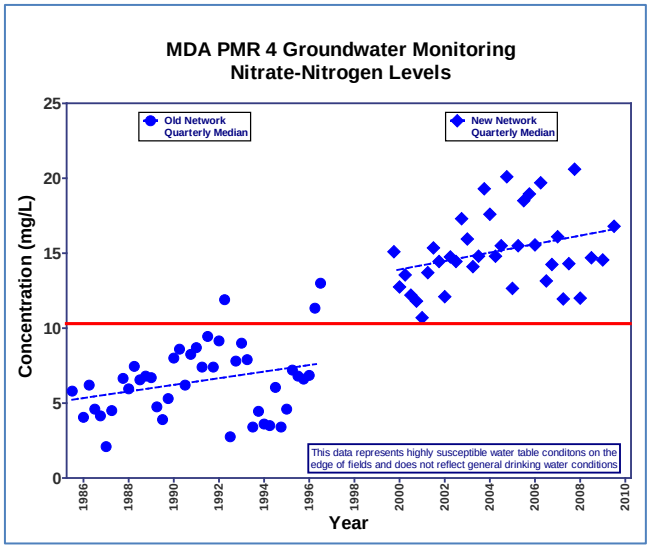
The Central Sands private well monitoring network have been designed to sample the groundwater that people are drinking and may not be representative of all groundwater resources in the area. The same applies to the township-scale monitoring network. The nitrate clinics were not statistically or scientifically designed and were used for educational purposes only. The nitrate clinic data may be a high estimate; it is not representative of all private well drinking water.

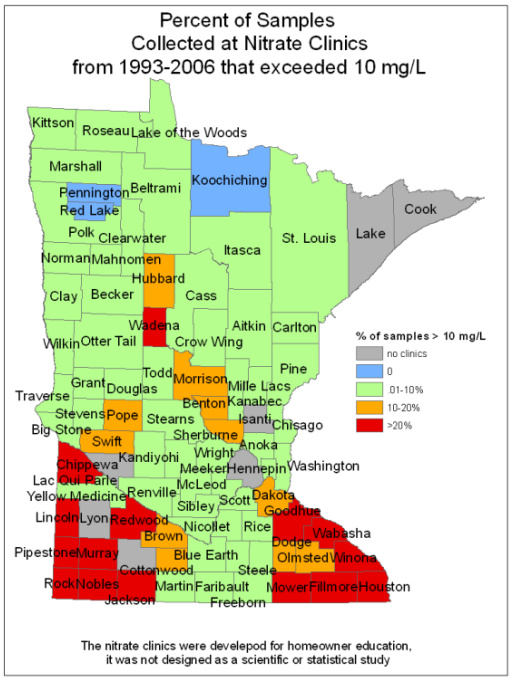
Chloride, Volatile Organic Compounds and Endocrine Disruption Compounds

The suite of VOCs and contaminants of emerging concern analyzed in the groundwater is censored at a variety of method reporting limits. These data will need to be re-censored at a common reporting limit to most accurately describe the most-frequently detected chemicals in the groundwater. Emerging contaminant concentrations below the method reporting limit are reported by the laboratory since the qualitative identification is done using mass spectrometry. These concentrations and those with matrix interferences or not meeting quality-assurance criteria are qualified. The emerging contaminants data often is affected by contamination from the laboratory and field. These data must be reviewed prior to analysis to ensure the reported concentrations are not an artifact of field or laboratory contamination.

Future Improvements

Laboratory capacity and capability is always the limiting factor in groundwater characterization regarding pesticide impacts. Analysis for pesticides in water is very expensive, collection of the samples is time consuming and analysis of the data is quite difficult. Measures to improve laboratory capacity and capability are continuously being sought and are normally very expensive, sometimes prohibitively so. The design and operation of the monitoring network(s) are continuously reviewed for improvements in efficiency, scientific and technical validity, and for newly emerging methods or insights from other organizations conducting similar work in other locations. The entire state cannot be comprehensively monitored at one time resulting in the need to stage various aspects of a complete monitoring system. Staging of program components is typically done as funding becomes available and may be short-term or one-time in nature and is used to begin, refine or extend a program element. Short term funding





generally has very limited usefulness for trend monitoring in groundwater as trends are usually not evident for 5 years or more.

Develop more private well networks throughout the state in order to develop long-term trends.

Financial Considerations

Contributing Agencies and Funding Sources

Substantial funding for groundwater pesticide work comes from non-clean water funds. This also includes limited funds from the EPA.

Funding for water quality monitoring has come through the MDA, MDH, and MPCA.

MDA is the lead agency in the Central Sands Private Well monitoring project and funded by the Clean Water Fund. It is also a local implementation project and partners with the 14 counties of the Central Sands region.

Measure Points of Contact

Agency Information

Minnesota Department of Agriculture:

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Margaret Wagner, Environmental Outreach Coordinator, Pesticide and Fertilizer Management Division, margaret.wagner@state.mn.us

Minnesota Pollution Control Agency:

Paul Hoff, Environmental Reporting and Special Studies Unit supervisor, paul.hoff@state.mn.us.

Example summary table of time series pesticide groundwater monitoring information.

	Median (µg/L)							75th Percentile (µg/L)							90th Percentile (µg/L)							Maximum (µg/L)						
PMR 1	**05**	**06**	**07**	**08**	**09**	**10-1**	**10-2**	**05**	**06**	**07**	**08**	**09**	**10-1**	**10-2**	**05**	**06**	**07**	**08**	**09**	**10-1**	**10-2**	**05**	**06**	**07**	**08**	**09**	**10-1**	**10-2**
Metolachlor	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.17	0.0710	0.0710	nd	nd	nd	nd	0.21	0.0800	0.0800
Metolachlor ESA	nd	-	nd	nd	nd	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	-	nd	1.75	1.74	0.2406	0.2406	nd	-	nd	2.19	2.18	1.020	1.020
Metolachlor OXA	nd	-	nd	nd	nd	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	-	nd	0.32	0.98	0.0613	0.0430	nd	-	nd	0.40	1.23	0.4300	0.4300
PMR 4																												
Metolachlor	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	P	nd	nd	P	P	1.87	0.76	0.24	0.75	1.79	0.3700	0.3700
Metolachlor ESA	0.23	0.20	0.22	0.19	0.15	0.1720	0.1720	1.13	1.24	1.72	1.14	1.27	1.465	1.465	2.68	3.33	4.10	2.39	2.98	4.903	4.903	10.20	12.70	34.20	12.30	20.70	24.30	24.30
Metolachlor OXA	nd	nd	nd	nd	nd	nd	nd	0.11	0.12	0.19	0.11	0.18	0.1667	0.1635	0.66	0.64	0.64	0.49	0.71	1.082	1.082	6.75	4.90	8.03	5.41	13.00	12.60	12.60
PMR 5																												
Metolachlor	-	-	nd	nd	nd	nd	nd	-	-	nd	nd	nd	nd	nd	-	-	nd	nd	P	nd	nd	-	-	nd	nd	P	P	P
Metolachlor ESA	-	-	0.60	0.29	0.54	0.3320	0.3320	-	-	1.85	2.71	1.80	1.172	1.172	-	-	4.63	3.61	4.82	3.272	3.272	-	-	4.66	4.00	4.89	5.140	5.140
Metolachlor OXA	-	-	nd	nd	0.09	0.0284	nd	-	-	0.37	0.49	0.17	0.0490	nd	-	-	1.89	2.98	2.15	0.5950	0.5950	-	-	2.86	4.15	3.47	3.810	3.810
PMR 6																												
Metolachlor	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Metolachlor ESA	nd	-	nd	nd	0.07	0.0536	nd	0.75	-	0.05	0.16	0.30	0.1900	0.1900	0.76	-	0.49	0.38	0.75	0.4436	0.4436	0.76	-	0.67	0.47	0.81	0.5300	0.5300
Metolachlor OXA	nd	-	nd	nd	nd	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	-	nd	nd	nd	0.0258	nd
PMR 7																												
Metolachlor	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	P	nd	nd	P	P	nd	nd	P	nd	nd	P	P
Metolachlor ESA	1.09	-	0.12	0.08	0.09	0.1075	0.1075	1.21	-	0.65	0.39	0.56	0.3900	0.3900	1.23	-	1.08	0.62	0.89	0.8717	0.8717	1.23	-	1.16	0.65	0.94	0.9320	0.9320
Metolachlor OXA	0.05	-	nd	nd	nd	nd	nd	0.13	-	nd	nd	nd	0.0103	nd	0.15	-	0.07	nd	nd	0.0515	nd	0.15	-	0.09	nd	nd	0.0538	nd
PMR 8																												
Metolachlor	-	nd	nd	nd	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	-	P	nd	nd	nd	nd	nd	nd	P	nd	nd	nd	P	P
Metolachlor ESA	-	-	nd	nd	0.22	0.2580	0.2580	-	-	nd	0.25	0.53	0.4597	0.4597	-	-	nd	0.51	0.97	0.6508	0.6508	0.12	nd	nd	0.89	1.43	1.760	1.760
Metolachlor OXA	-	-	0.07	nd	nd	nd	nd	-	-	0.59	nd	nd	nd	nd	-	-	2.00	0.02	0.02	0.0380	nd	nd	nd	2.69	0.07	0.07	0.0414	nd
PMR 9																												
Metolachlor	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	P	P	P	P	P	P	P	P	0.17	0.0360	0.0360	P	0.58	P	0.12	5.00	4.250	4.250
Metolachlor ESA	0.13	0.24	0.27	0.53	0.52	0.4050	0.4050	0.26	0.84	0.81	1.21	0.79	0.8660	0.8660	0.36	1.48	1.26	1.70	1.48	1.680	1.680	0.43	3.13	2.60	2.70	3.63	4.550	4.550
Metolachlor OXA	nd	nd	nd	nd	nd	0.0153	nd	nd	nd	nd	0.07	nd	0.0441	nd	nd	0.11	nd	0.14	0.15	0.2015	0.2015	nd	0.61	0.16	0.22	0.59	1.570	1.570
Urban																												
Metolachlor	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Metolachlor ESA	nd	nd	nd	nd	nd	0.0112	nd	nd	nd	nd	nd	nd	0.0222	nd	nd	0.11	0.61	0.40	0.26	0.1470	0.1470	nd	1.59	8.49	9.71	0.76	0.1470	0.1470
Metolachlor OXA	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.0054	nd	nd	nd	nd	nd	nd	0.0235	nd	0.07	nd	0.65	5.43	nd	0.0356	nd

Changes over time in source water quality used for community water supplies

Measure Background

Visual Depiction

No specific visualization; measure will include a map of Minnesota depicting selected parameters and a picture of a water tower with a city logo.

Measure Description

The Minnesota Department of Health (MDH) is collecting general water chemistry samples from community public water systems from July 1, 2010 through September 30, 2013, and will be publishing an electronic summary of the water quality data (similar to the MDH Public Water Supply Data hardcopy books published in 1989). Systems can use their individual results to develop a more in-depth understanding of the water quality from their unique aquifers and well depths, to assess and maintain water quality at entry points and within the distribution system, and to use as baseline data in evaluating potential contamination events. It is recommended that systems continue to regularly monitor for the water quality parameters reported by MDH.

Associated Terms and Phrases

Ammonia Nitrogen: Ammonia in water can decrease the efficiency of disinfection treatment. Oxidation of ammonia will result in the formation of nitrite.

Arsenic: Arsenic is a semi-metal element in the periodic table. It is odorless and tasteless. It enters drinking water supplies from natural deposits in the earth or from agricultural and industrial practices. The EPA MCL for arsenic is 10 µg/l.

Barium and Strontium: Barium and strontium are minerals that naturally occur in water. They can be used as indicators of a waters source (aquifer).

Bromide and Chloride: The ratio of bromide to chloride in water can be an indicator of potential effects of surface activities on ground water. Absolute values of these two compounds are not as significant as the ratio between the two minerals. Bromide and chloride can also be used to determine a water's source (aquifer).

Calcium and Magnesium: Calcium and Magnesium are indicators of waters hardness. Knowing a water's hardness will help in optimizing the water treatment process.

Carbonate and Bicarbonate Alkalinity: Alkalinity is the measure of the ability of the water to neutralize acid. This can be useful in assessing and optimizing corrosion control treatment.

Community Public Water Supply System: Community public water supplies serve at least 25 persons or 15 service connections year-round, which includes municipalities, manufactured mobile home parks, etc. These systems are required to provide a safe and adequate supply of water under the federal Safe Drinking Water Act (SDWA). Currently there are almost 1,000 community water supply systems in Minnesota.

Conductivity: Conductivity measures waters ability to conduct electrical current. Conductivity can be an indicator of water quality and can also help in assessing TDS.

Dissolved Oxygen (DO): High dissolved oxygen concentrations can increase the corrosion process within the distribution system. This can lead to contaminants such as lead and copper being introduced into the water supply and also reduce the lifetime of distribution piping and household plumbing materials.

Entry point: The place where the source water (from a well or surface water) comes into the water treatment plant or water supply system. The term is used to describe where the water sample is collected. Sample results from the entry point provide a picture of the source water. When samples are collected at various points in the treatment process or at the end the water quality is impacted by the various treatment processes.

Fluoride: Fluoride can occur naturally in an aquifer's geology and is commonly added to drinking water to promote dental health of the consumers. The USEPA secondary standard for fluoride is 2 mg/L.

Heterotrophic Plate Count (HPC): HPC is an analytic method used to measure the variety of bacteria that are common in water. Heterotrophic bacteria occur in drinking water even after disinfection. Values greater than 500 CFU/mL may indicate poor microbiological quality. HPC greater than 10,000 CFU/mL can mask total coliform counts.

Iron and Manganese: Iron and Manganese are metals that are commonly found in water. They are considered secondary contaminants. The USEPA secondary standard for iron and manganese are 0.3 mg/L and 0.05 mg/L respectively.

Metals Scan: The MDH Public Health Lab will do a metals scan that will analyze for 67 different trace metals. The results are not accurate enough to indicate well-by-well or metal-by-metal water quality, but are expected to help broadly characterize chemistry in different hydrogeologic settings across Minnesota.

Nitrite: Nitrites are nitrogen-oxygen chemical units which combine with various organic and inorganic compounds. The USEPA MCL for nitrite is 1 mg/L.

Oxidation Reduction Potential (ORP): Oxidation Reduction Potential, also known as Redox, is the activity or strength of oxidizers and reducers in relation to their concentration. ORP is also affected by pH.

pH: pH is a measure of how acidic or alkaline water is. pH is important in assessing water quality and the speciation of compounds in water. pH can also be an indicator of the corrosiveness of water and plays a key role in assessing corrosion control treatments.

Potassium and Sodium: Potassium and sodium can be naturally occurring in water or the result of chemicals being added to the water during the treatment process. Although potassium and sodium may cause some health effects in susceptible individuals, potassium and sodium intake from drinking-water is well below the level at which adverse health effects may occur.

Sulfate: Sulfate is considered a secondary contaminant by the USEPA. The USEPA secondary standard for sulfate is 250 mg/L at which taste and odor issues can occur.

Temperature: Temperature can affect water chemistry and water quality.

Total Dissolved Solids (TDS): Total dissolved solids are the compounds in water that cannot be removed through conventional filtration. TDS are made up of compounds which dissociate in water to form ions. TDS is considered by USEPA to be a secondary contaminant with a secondary standard of 500 µg/L where taste and laxative properties can occur.

Total Organic Carbon (TOC): Total Organic Carbon is the measure of all organic carbon molecules in water. TOC can react with disinfectants to produce disinfection byproducts in the distribution system.

Total Phosphorus: Total phosphorus is the total measure of phosphorus in water. Phosphorus is often added to drinking water in the form of phosphates to sequester iron and manganese and also as a corrosion control method.

Target

MDH intends to conduct sampling at all of Minnesota's community public water systems (approximately 1,000 systems).

Baseline

Similar parameters were included in the MDH Public Water Supply Data hardcopy books published in 1989. These data, along with the results from this period of sampling (2011-2013), will serve as the baseline data set for future monitoring.

Geographical Coverage

The measure is statewide.

Data and Methodology

Methodology for Measure Calculation

Water quality analysis is being done in the field and at the MDH Public Health Laboratory.

Data Source

The data is held in the Minnesota Drinking Water Information System (MNDWIS) in the MDH Drinking Water Protection Section.

Data Collection Period

Samples are being collected in 2011-2013.

Data Collection Methodology and Frequency

Each community public water supply system's drinking water source(s), water system entry point(s), and water distribution system is sampled by MDH. The MDH provides results for:

- Ammonia Nitrogen
- Total Phosphorus
- Total Organic Carbon
- Total Alkalinity
- Carbonate Alkalinity
- Bicarbonate Alkalinity
- Dissolved Oxygen
- Conductivity
- Total Dissolved Solids
- Oxidation Reduction Potential
- Temperature
- pH

MDH is providing additional results from drinking water sources:

- Arsenic
- Barium
- Bromide and Chloride
- Calcium
- Iron
- Potassium
- Sodium
- Sulfate
- Nitrite
- Magnesium
- Manganese
- Strontium

If water treatment involves more than chemical addition, MDH will also provide results at water system entry points for:

- Calcium
- Iron
- Magnesium
- Manganese
- Nitrate+Nitrite
- Nitrite

Supporting Data Set

The complete data set will be available in 2014.

Caveats and Limitations

Water quality at the source, entry point, and distribution system is variable, and that variability will not captured by the results of the MDH's 2011-2013 study. Additionally, community public water systems are not randomly distributed across the state; the results of this study will not necessarily represent an unbiased snapshot of the state's source water quality.

Future Improvements

It is proposed to conduct rounds of general water chemistry sampling at ten year intervals.

Financial Considerations

Contributing Agencies and Funding Sources

Total general water chemistry sampling costs for 2010 through 2013 is approximately $1 million. Although this measure helps us evaluate the impact of activities supported by the Clean Water Fund, this study is supported by service connection fees and not Clean Water Fund dollars.

Communication Strategy

Target Audience

The target audience for these water quality results includes, but is not limited to, community public water systems, consulting engineers, academia, and the general public.

Associated Messages

MDH recommends systems regularly monitor for the above-listed water quality parameters, and use the data as a tool to assess and maintain water quality throughout the water system. Results will be used as a starting point for evaluating systems needs related to source, treatment, distribution, and storage.

Other Measure Connections

Community public water supply systems in Minnesota rely on both surface water and groundwater sources. The results of this measure may be examined in conjunction with other measures documenting surface water and groundwater quality.

Outreach Format

Information from the study will be provided on the MDH website.

Measure Points of Contact

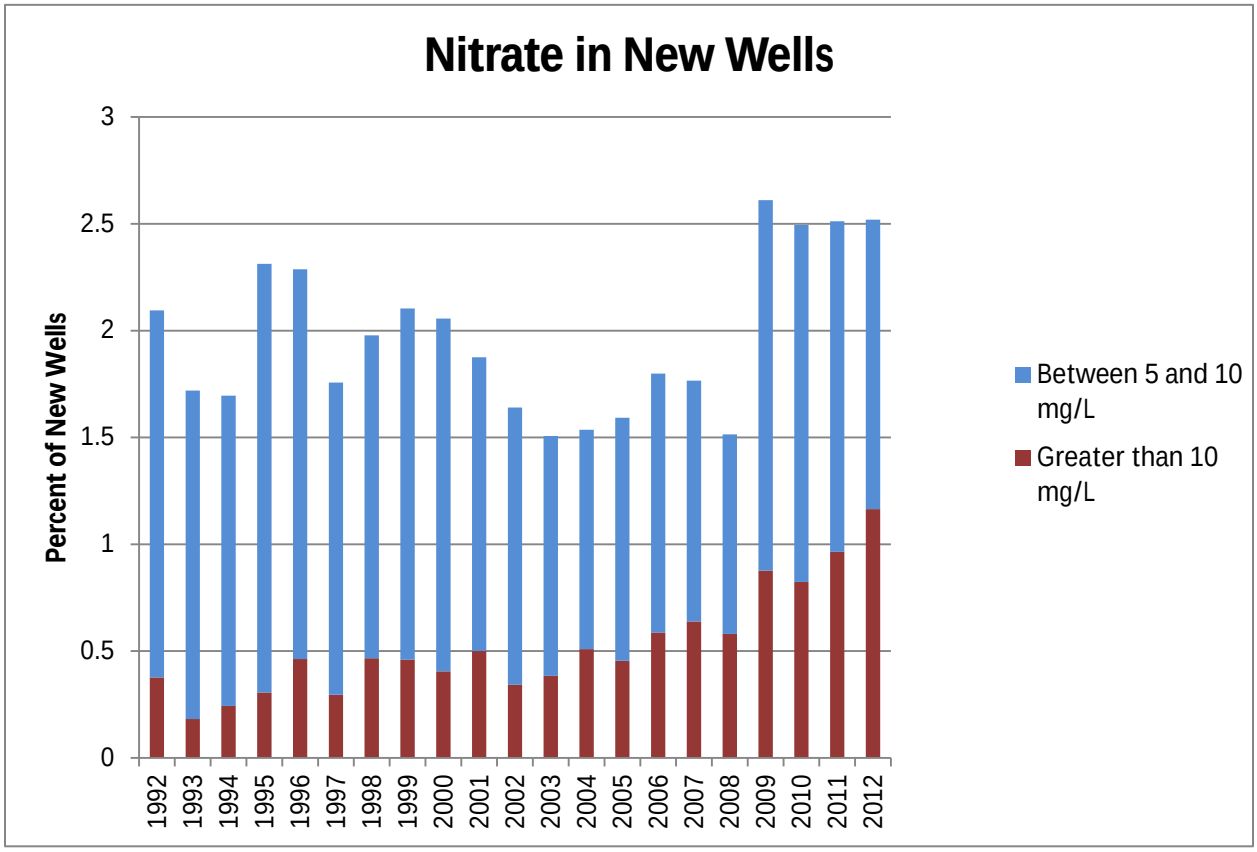
Agency Information

Karla Peterson, Community Public Water Supply Unit Supervisor, Drinking Water Protection Section, Minnesota Department of Health, karla.peterson@state.mn.us

Percent of newly constructed drinking water supply wells with elevated nitrate concentrations.

Measure Background

Visual Depiction



Measure Description

This measure tracks the percentage of newly constructed drinking water supply wells with elevated nitrate concentrations. Natural levels of nitrate are typically quite low. Elevated nitrate concentrations in drinking water wells are associated with sources such as fertilizers, animal wastes or human sewage. Minnesota statute and rules governing the location and construction of wells (Minnesota Statute 103I and Minnesota Rules 4725) are intended to avoid elevated nitrate in groundwater. In addition, activities to manage nitrate sources can result in a reduction of nitrate input into groundwater. Therefore, this is a measure of both the effectiveness of the well code and nitrate management activities.

Associated Terms and Phrases

Nitrate: A compound of nitrogen and oxygen (NO_3) found in nature and in many food items in the human diet.

Methemoglobinemia: A blood disorder found in infants aged less than 6 months of age caused by elevated nitrate contamination in groundwater resulting in decreased oxygen carrying capacity of hemoglobin in babies which can cause death.

Drinking water supply well: A well that provides water used for a potable (drinking, cooking, bathing, washing, etc.) supply. This includes both public and private water supply wells.

Target

A downward trend in the percent of wells with nitrate exceeding the drinking water standard is the target.

Baseline

The historical percentage of wells exceeding the drinking water standard (10 ppm) will serve as the baseline.

Geographical Coverage

Statewide

Data and Methodology

Methodology for Measure Calculation

The number of new wells with nitrate above the drinking water standard will be compared to the total number of new wells constructed each year as reported to the Minnesota Department of Health (MDH).

Data Source

Every new drinking water supply well in the state is required to be sampled for nitrate prior to putting the well into service. The results of the analysis are required to be submitted to MDH and to the well owner. This information is entered into MDH's "Wells" database which is managed by the MDH Well Management Section.

Data Collection Period

1992 to present.

Data Collection Methodology and Frequency

After construction of the well a sample is collected and submitted to an MDH certified laboratory for analysis. There is no requirement for follow up sampling. Sample results are required to be submitted to the Health Department. The analysis will be conducted annually for the calendar year.

Supporting Data Set

Percent of New Wells With Elevated Nitrate		
Year	Greater than 10 mg/L	Between 5 and 10 mg/L
1992	0.38	1.72
1993	0.18	1.54
1994	0.24	1.45
1995	0.31	2.01
1996	0.46	1.82
1997	0.30	1.46
1998	0.47	1.51
1999	0.46	1.64
2000	0.40	1.65
2001	0.50	1.38
2002	0.34	1.30
2003	0.38	1.12
2004	0.51	1.03
2005	0.45	1.14
2006	0.59	1.21
2007	0.64	1.13
2008	0.58	0.93
2009	0.88	1.73
2010	0.82	1.67
2011	0.96	1.55
2012	1.16	1.35

Caveats and Limitations

Well construction is not uniformly distributed across the state. Nitrate concentrations can vary spatially and temporally depending on geology, land use, groundwater flow etc. The number of wells constructed varies from year to year.

Future Improvements

No improvements planned at this time.

Financial Considerations

Contributing Agencies and Funding Sources

The Well Management Section is funded nearly exclusively through fees on the construction and sealing of wells and borings. The funding for this measure will come from these fees. The cost for construction of wells and analysis of nitrate is the responsibility of the well owner.

Communication Strategy

Target Audience

TBD

Associated Messages

TBD

Outreach Format

TBD

Other Measure Connections

TBD

Measure Points of Contact

Agency Information

Chris Elvrum, Manager, Well Management, Environmental Health, Minnesota Department of Health

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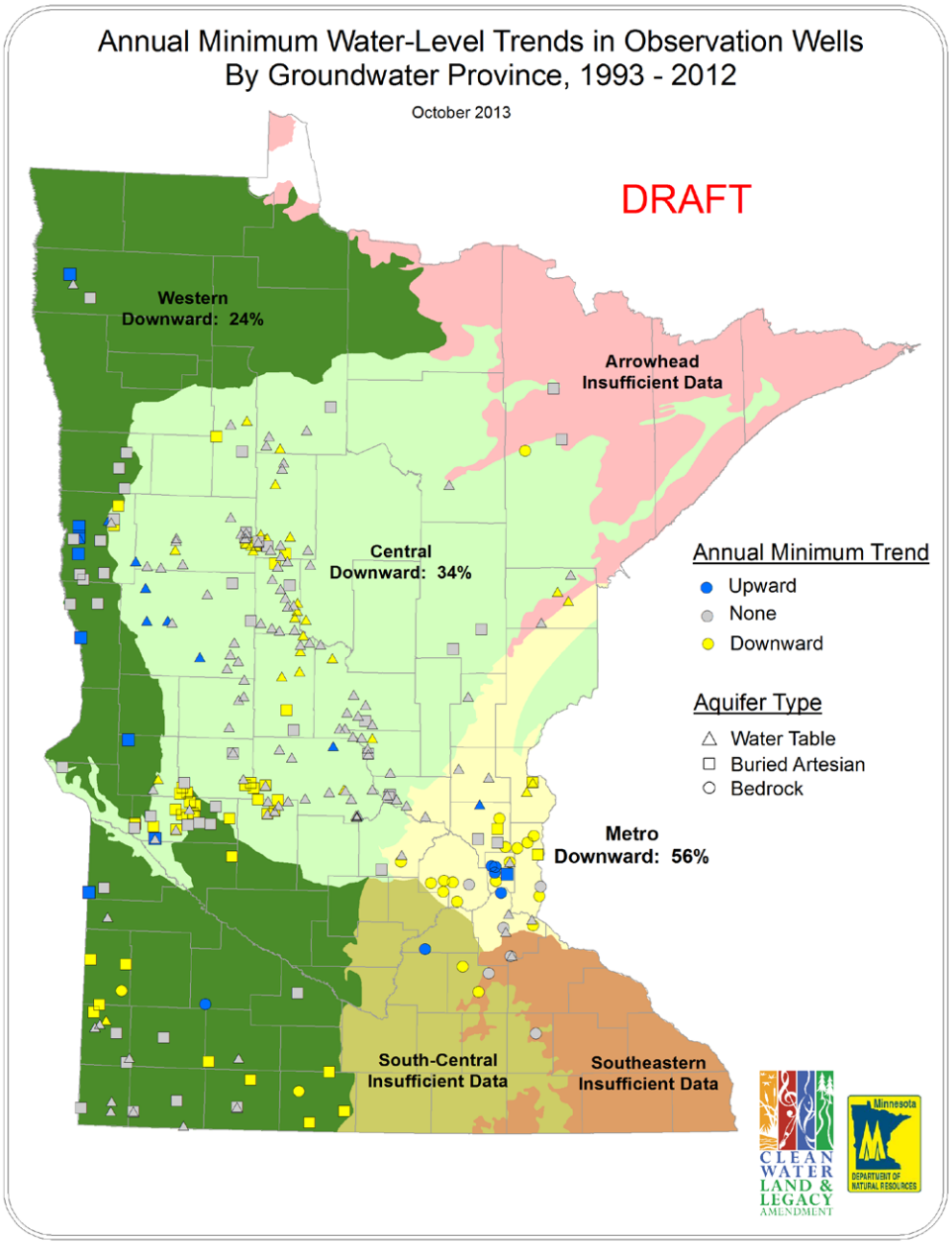
Changes over time in groundwater levels

Measure Background

Visual Depiction



Measure Description

Minnesota Department of Natural Resources (DNR) manages a statewide network of water-level observation wells. Data from these wells are used to determine long-term trends, interpret impacts of pumping and climate, plan for water conservation, and otherwise manage the water resource. Soil and

Water Conservation Districts under contract with DNR measure the wells and report the readings to DNR. Monthly measurements are typically made from April through November for these wells. DNR has installed automatic data recorders in some observation wells. A set of indicator wells having at least 20 years of measurement records, distributed geographically across the state and in major aquifers used for water supplies, are tracked in monthly Hydrologic Conditions Reports. These indicator observation wells can be used to illustrate trends in groundwater levels around the state relative to the long-term records.

Associated Terms and Phrases

Aquifer Type: There are many aquifers with varying characteristics in Minnesota. Aquifers measured by observation wells are sorted into three categories. Water-table aquifers are typically shallow, contain the water table, and are generally well connected to the land surface. Buried Artesian aquifers are composed of unconsolidated sediments (i.e. sand and gravel) overlain by lower permeability sediments such as glacial till or lake clay that slow or restrict the vertical movement of groundwater. Bedrock aquifers include all aquifers composed of consolidated rocks.

Groundwater Provinces: Six regions of the state divided by the types and properties of aquifers in each province that affect the potential availability of groundwater, as defined by DNR. Minnesota Department of Health occasionally subdivides the Western and Central provinces into multiple provinces.

Indicator Well: Well used to evaluate aquifer level trend statistics for this measure. To qualify as an indicator well, it must have a minimum of nineteen (19) years of record with relatively few missing data, be geographically distributed across the state, and represent one of the major aquifers of the state. The number of aquifers with trend information is currently inadequate to meet the needs of the state, and the number will be increased in part with support from Clean Water Fund. As groundwater level monitoring wells are added and trends are determined, they will be added to this set of indicator wells.

Observation Well: A well or environmental borehole used for the purpose of measuring groundwater levels. May be referred to as an 'ob well' or 'monitoring well'.

Trend: Groundwater level trends for each groundwater province were determined by calculating the percentage of downward trends in that province, determined for each indicator well in the province. In each groundwater province, the trend was defined as upward, downward, none, or insufficient data. For each indicator well, the Mann-Kendall test for monotonic trend was performed on the annual minimum of measurements for each year in the period of record. A trend was declared significant if the probability of obtaining the test statistic under no actual trend (p-value) was less than or equal to 0.05. The linear slope was calculated using the non-parametric Kendall-Theil robust line[1].

Target

Specific targets for groundwater levels are not defined. A range of groundwater levels are expected due to climatic variations and levels are specific to each location. A downward trend in groundwater levels by itself does not necessarily indicate unsustainable groundwater use. Water levels measured in observation wells can be combined with local information on climate, hydrogeology, land use, and water use to assess groundwater availability changes and sustainability.

Baseline

The baseline for comparing groundwater levels is the twenty year period 1993-2012.

Geographical Coverage
The measure is statewide.

Data and Methodology

Methodology for Measure Calculation
The Minnesota Department of Natural Resources observation well network has 296 wells with over nineteen (19) years of data, and they were selected for trend testing. The bulk of the wells had over twenty (20) years of data, but some wells did have up to two (2) years of missing data. This includes wells that had slow slug tests; although the data from these were deemed usable.

The Mann-Kendall test for monotonic trend (e.g. Helsel and Hirsch[1]) was performed on the annual minimum of measurements for each year in the period of record. A trend was declared significant if the probability of obtaining the test statistic under no actual trend (p-value) was less than or equal to 0.05. For sufficiently long data sets, a p-value meeting this significance criterion may result even for a very low slope of the trend. Therefore, only data sets meeting the significance test and having a linear slope greater than or equal to 0.05 feet/year (1 foot per 20 years) were regarded as having a significant trend. The linear slope was calculated using the non-parametric Kendall-Theil robust line[1].

The period of record for indicator wells varies from 19 to 63 years. Data from the period 1993 through 2012 were used in the analysis. Annual minima were not calculated for years with few measurements or partial records that likely did not include a measurement close in value to the April through November minimum. Periods preceding a data gap greater than two years were excluded from the trend analysis.

Because the significance test value is only correct if individual measurements are independent (not serially correlated), the records initially showing a trend were adjusted to remove serial correlation that is common in groundwater-level data. The trend-free pre-whitening procedure of Yue et al.[2] was used to make these adjustments to verify the significance of the trends.

Data Source
Water-level data are stored in an observation-well database maintained by the Minnesota Department of Natural Resources Ecological and Water Resources Division and provided on their website. Over the coming year, these data will be migrated to the State Cooperative Water Data System (Hydstra) and a new web interface will be developed. Old data is still available from the current site at http://climate.umn.edu/ground_water_level/.

Data Collection Period
Groundwater level data from 1993 to 2012 are used to calculate this measure.

Data Collection Methodology and Frequency
Data are collected at groundwater observation wells on a monthly or more frequent basis from April through November. Measurements are made at some wells during the other months of the year.

[1] Helsel, D.R. and Hirsch, R.M. (2002) *Statistical Methods in Water Resources*, Techniques of Water Resources Investigations of the United States Geological Survey: Book 4, Hydrologic Analysis and Interpretation, Chapter A3, 510 p.
[2] Yue, S., Pilon, P., Phinney, R., and Cavadias, G. (2002) The influence of autocorrelation on the ability to detect trend in hydrological series, *Hydrological Processes* 16, 1807-1829.

Methods used to collect data range from manual measurements using a steel tape to automated pressure sensors/data recorders with quarterly manual measurement verification.

Supporting Data Set
The data used to support this measure may be found online at http://climate.umn.edu/ground_water_level/.

Caveats and Limitations
This measure uses data from a limited number of observation wells around the state that are not generally representative of groundwater conditions at other locations. The method does not resolve the type of change in water-level over the analysis period, such as "step" changes over a shorter period of time versus longer-term or gradual changes. This measure also only considers annual minimum water levels without considering other aspects of seasonal groundwater-level fluctuations

Future Improvements
As the observation-well network is expanded and historical records at existing observation wells become longer, this measure will be reported for a larger number of measurement locations.

Financial Considerations

Contributing Agencies and Funding Sources
The Minnesota Department of Natural Resources groundwater-level monitoring program is funded by a mix of Clean Water Fund, bonding, and the General Fund. Observation-well construction costs have been supported by designated bonding funds. Clean Water Fund money also supports planning and maintenance of the observation-well network and program coordination.

Communication Strategy

Target Audience
The target audience for these groundwater-level conditions includes, but is not limited to, community public water systems, well drillers, community water-management planners, consulting engineers, academia, policy makers, and the general public.

Associated Messages
In addition to the application of observation-well data to DNR water resource management decisions, public and private well owners and their consultants use observation-well data to assess the need for well maintenance, in water-supply planning, and in assessing impacts of groundwater withdrawals to connected surface waters.

Other Measure Connections
The results of this measure may be examined in conjunction with other measures documenting climatic variations, land-use changes, and surface-water and groundwater quantity. Changes in relative groundwater levels may be correlated to changes in climate, groundwater use, and/or land use.

Outreach Format

Information regarding groundwater levels is provided on the Minnesota Department of Natural Resources website.

Measure Points of Contact

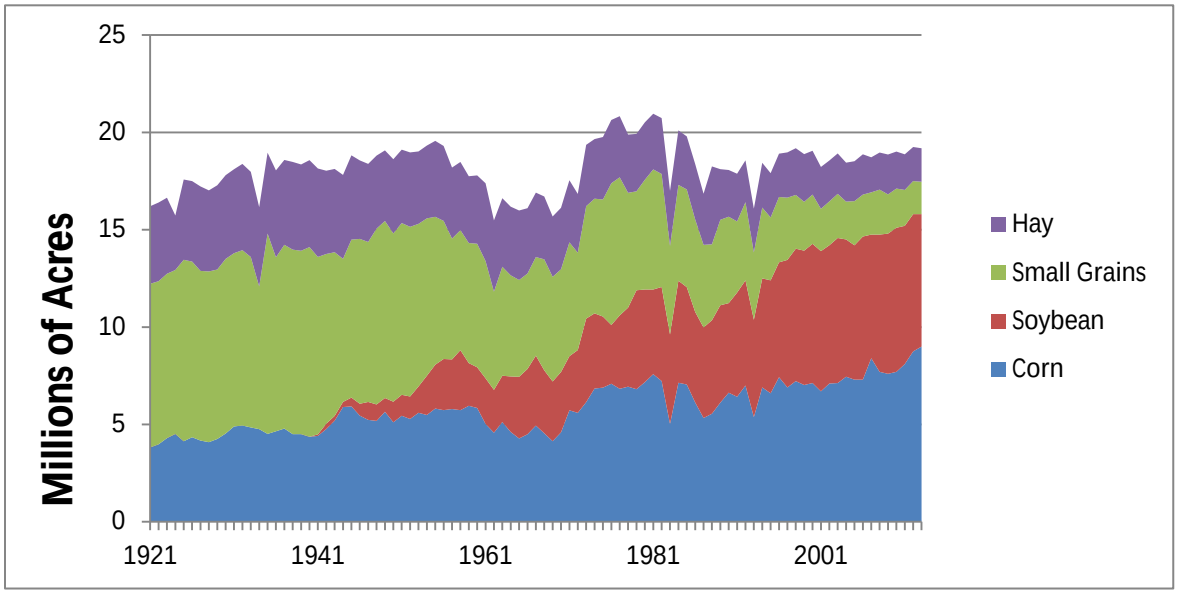
Agency Information

Greg Kruse, Water Monitoring and Surveys Unit Supervisor, Minnesota Department of Natural Resources Division of Ecological and Water Resources, greg.kruse@state.mn.us

External Drivers

Land-Use Changes – Agricultural Land Use

Measure Background



Measure Description

Agriculture is the second-largest industry in Minnesota, creating jobs, generating business and supporting other industries. Agricultural production may require the input of fertilizer or the removal/addition of water to increase food, fiber, feed and fuel production for consumption by humans and livestock. In addition, based on the type of crop produced and the management practices employed, there may be periods where agricultural lands are free or largely free of vegetation cover that normally reduces erosion potential. Finally, when livestock are produced, the volume of wastes produced and their concentration can increase substantially. For all these reasons, understanding major trends to agricultural land-use, both at the statewide and regional scales, is important for understanding what clean water restoration and protection strategies are being implemented and in evaluating their effectiveness.

Associated Terms and Phrases

None

Target

Minnesota has no targets for how agricultural lands are used. State and federal farm policies create incentives that may encourage certain types of agricultural land use, the adoption specific production practices, or to discontinuation of production and enrollment in land set-aside programs.

Baseline

There is no baseline associated with this measure, change over time on the land area devoted to specific types of crops are tracked.

Geographical Coverage

The approximately one-half of Minnesota devoted to agriculture production

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Data and Methodology

Methodology for Measure Calculation

The USDA's National Agricultural Statistics Service (NASS) conducts hundreds of surveys every year and prepares reports covering virtually every aspect of U.S. agriculture. Production and supplies of food and fiber, prices paid and received by farmers, farm labor and wages, farm finances, chemical use, and changes in the demographics of U.S. producers are only a few examples.

The NASS data shown were compiled by the Minnesota Department of Agriculture

Data Collection Period

The National Agriculture Statistics Services has been collecting data for the last 90 years. This measure tracks how major agricultural land-use activities have changed since 1950.

Data Collection Methodology and Frequency

The specific data set used in the 2014 Clean Water Fund Performance Report was compiled by the Minnesota Department of Agriculture for the use in the draft Nitrogen Fertilizer Management Plan that was released for public review in 2013.
The data was obtained from the National Agricultural Statistics Service (NASS), by doing a query of MN historic crop data. See http://quickstats.nass.usda.gov/ for more information.

For more detail regarding NASS procedures for gathering & compiling this data see http://www.nass.usda.gov/About_NASS/index.asp.

Other Measure Connections

Agriculture land use is one of three land-use changes being tracked to examine how external drivers may impact Minnesota's ability to achieve its Clean Water and Drinking Waters goals and is meant to be viewed in concert with measures in the population change and climate change categories. Tracking external drivers will also help Clean Water partners adapt their actions over time, enhancing water quality and drinking water outcomes

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Measure Point of Contact

Agency Information

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Land-Use Changes – Impervious Surface Coverage

Measure Background

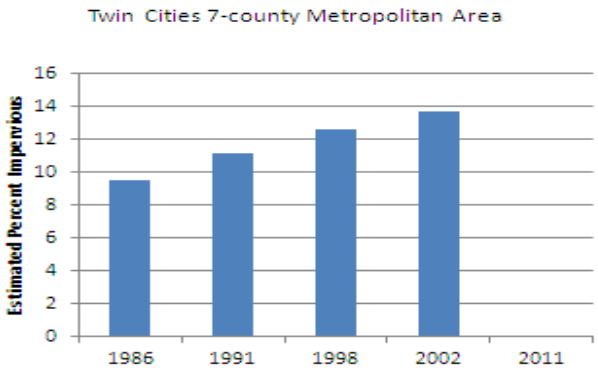

Fig. 3. Change in percent of land surface covered by impervious surfaces

Measure Description

Although on a statewide scale, the amount of impervious surface is a small fraction of the state's land area, it may be a large and highly significant percentage in locations dominated by urban, suburban, industrial, and/or transportation-related land uses. In addition, because rainfall or melting snow to not soak into these surfaces, they have a disproportionate potential to increase the amount of surface runoff and the speed with which that runoff reaches adjacent lakes, rivers, and wetlands. Increasing volume of water and its speed may increase the potential to move pollutants, increase the rate of erosion, and/or may minimize the effectiveness of various pollution prevention/mitigation measures.

Associated Terms and Phrases

Impervious surfaces: Impervious surfaces are mainly artificial structures—such as pavements (roads, sidewalks, driveways and parking lots) that are covered by impenetrable materials such as asphalt, concrete, brick, and stone--and rooftops. Soils compacted by urban development are also highly impervious (Wikipedia).

Target

Minnesota has not adopted limitations on the amount of impervious cover. Many BMPs are designed to mitigate the hydrologic and pollutant-carrying impacts associated with impervious surfaces. Stormwater rules and requirements seeks to minimize the impacts associated with impervious surfaces by identifying the types of BMPs that need to be implemented and/or settling specific water quality and quantity standards that need to be met.

Baseline

The methods of assigning and tracking changes in impervious surface coverage have changed. Instead of relying on standardized percent-impervious estimates for specific land-use activities, new techniques

have been developed that use remote-sensing satellites to develop impervious cover estimates (see http://land.umn.edu/methods/imperv_class.html). These new methods have allowed the development of impervious estimates that are specific to particular landscape and that can be updated periodically over time using standardize techniques. Baseline estimates are available in Minnesota from about 1990.

Geographical Coverage

The Twin Cities seven-county metropolitan area

Data and Methodology

Methodology for Measure Calculation

The University of Minnesota's website includes a factsheet that outlines the basic procedures used to impervious surface estimates from remote sensing data (http://land.umn.edu/documents/FS1.pdf). The document also references a number of other technical references:

> Arnold, C. L., and C. J. Gibbons. (1996). Impervious surface coverage: the emergence of a key environmental indicator. *Journal of the American Planning Association*, 62(2): 243-258. Monitoring using High-resolution Imagery. *Remote Sensing of Environment*. Stocker, J. (1998). Methods for measuring and estimating impervious surface coverage. *NEMO Technical Paper No. 3*, University of Connecticut, Haddam Cooperative Extension Center.

Data Source

The University of Minnesota's Remote Sensing and Geospatial Analysis Laboratory has been at the forefront of the development of the new satellite remote sensing methods.

Data Collection Period

Periodically starting in 1986

Data Collection Methodology and Frequency

The following reports published by the Metropolitan Council contain more thorough descriptions of data collection methodology and additional useful information about change in impervious cover in the Twin Cities Metropolitan Area for 1986, 1991, 1998, 2002, and 2007 (the 2007 data hasn't been summarized on the interactive maps, but it can be downloaded). Impervious surface coverage data for 2011 is currently being analyzed and will be added to the 2014 Clean Water Fund Performance Report when it is available.

The following page includes statistics about the changes between 1986-2002: http://land.umn.edu/methods/change.html

Use the following page to download all the data (including 2007): http://land.umn.edu/data/index.html

This page includes an interactive map that can be used to show the change and could be used to download high resolution printable versions of the maps: http://land.umn.edu/maps/impervious/landbrowse.php?year_imp=2002&type=county&county

Other Measure Connections

Impervious surface coverage is one of three land-use changes being tracked to examine how external drivers may impact Minnesota's ability to achieve its Clean Water and Drinking Waters goals and is meant to be viewed in concert with measures in the population change and climate change categories. Tracking external drivers will also help Clean Water partners adapt their actions over time, enhancing water quality and drinking water outcomes.

Measure Points of Contact

Agency Information

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Land-Use Changes – Wetland Cover

Measure Background

Visual Depiction

A graph showing estimated change in wetland cover statewide in Minnesota and/or by major landscape areas in comparison to the 2006 – 2008 baseline period will be included after the second, three-year, assessment interval (2012 – 2014) has been completed.

Measure Description

Wetlands are important landscape features that provide many benefits. From a water-quality/drinking water perspective wetlands are important because they provide water storage, holding back runoff and reducing the intensity of flood peaks, reduce the concentration of various pollutants in runoff water, and contribute to groundwater recharge. Because of these benefits, Minnesota adopted a "no net loss" of wetland policy in 1991 (M.S. 103A201) and initiated a monitoring program in 2006 to track changes in wetland quality and quantity over time; this measure focuses on changes in quantity. If a major loss in wetland abundance is observed, increases in runoff rates and pollution loads are likely to occur that may impact Minnesota's ability to achieve identified Clean Water goals. Likewise, there may be a reduction in infiltration to replenish aquifers that are important drinking water resources.

Associated Terms and Phrases

Wetlands: For the purpose of this measure, wetlands include the following land cover classes: 1) deepwater (lakes, reservoirs, rivers, and streams), 2) forested wetlands (forested swamps), 3) shrub swamp (woody shrub or small tree marshlands), 4) emergent wetlands (marshes, wet meadows, and bogs), 5) aquatic bed (wetlands with floating and submerged plants), 6) unconsolidated bottom (open water wetlands, shore beaches and bars), and 7) cultivated wetland (wetlands in agricultural fields).

Target

Minnesota has adopted a no net loss policy goal. In addition, in some watersheds, wetland restoration may be an important strategy to increase hydrologic storage, improve water quality, and/or enhance other natural resource goals. However, the purpose of this measure is to track overall change in wetland acreage and no specific target is listed.

Baseline

Major changes in the abundance of wetlands have occurred in Minnesota since the state was first settled by people of European descent; it has been estimated that approximately half of the state's wetlands have been lost and in many parts of southern Minnesota well over 90 percent of the original wetlands have been drained. However, for the purpose of this stressor measure, the baseline period is 2006 – 2008; the three-year period when Minnesota's Wetland Status and Trends Monitoring Program (WSTMP) conducted its initial statewide assessment.

Geographical Coverage

This measure uses data from 4990 randomly selected permanent plots to estimate statewide trends as well as trends within the Minnesota's major ecological regions (e.g., Laurentian Mixed Forest, Eastern

Broadleaf Forest, Prairie Parkland). Because of the high number and statewide coverage of the plots, the data could also be used to provide watershed and/or basin scale assessments as well.

Data and Methodology

Methodology for Measure Calculation

The data methods are described in detail in A, B, and C. In brief, changes in land cover are mapped for 4,990 randomly-selected, permanent plots located throughout Minnesota. All plots are one-square mile in area except for those that happen to fall on the state boundary, which are clipped to the boundary. Sampling occurs on a repeating three-year cycle: 250 plots are surveyed annually and the remaining 4,740 plots are divided equally into three sample panels with one panel surveyed each year of the sample cycle. Sample plot locations were selected using the generalized random tessellation stratified (GRTS) design (Stevens and Olsen 2004). The GRTS design was used to ensure adequate spatial distribution of sample plots. Land cover was mapped and classified for all plots for the initial, baseline sample cycle (T1, 2006 to 2008) using photo-interpretation and the data were stored in a GIS data layer. A GIS record, in the form of a polygon, was created for each photo-interpreted land cover feature. Special modifiers were added to the land cover attributes to indicate manmade (m) and artificially flooded features. Extensive field validation was used to measure the accuracy of the land cover classification (Kloiber 2010). The classification process correctly distinguishes between wetland and upland 94% of the time and correctly classifies the more detailed land cover types 89% of the time.

Land cover polygons from the baseline assessment (T1) were overlaid on aerial photography from the second sample cycle (T2, 2009 to 2011). Changes in wetland extent (gains, losses or change of type) were recorded by splitting land cover polygons as necessary to reflect changes and entering the updated land cover attribute in a second database field. Photo-interpreters also classified the cause of each change as either “direct” when there was direct visual evidence of the cause such as a new road or new drainage structure, or “indirect” when the cause of the change could not be ascertained from the imagery. The area and land cover change attributes for all polygons were imported into statistical software (JMP® version 10.0 - SAS Institute) for analysis. Features that did not change and non-target changes were excluded from further analysis. Non-target changes included changes between upland land uses and changes between upland and artificially flooded features. Features classified as artificially flooded typically serve an industrial or commercial purpose, have little natural wetland function, and usually do not meet the wetland definition. Examples include mine tailing discharge basins from active mining facilities and wastewater stabilization ponds. However, conversion of natural wetlands to a feature classified as artificially flooded was considered as a loss, and the reverse was regarded as a gain. Changes between wetland and deep-water habitats were treated as a change of wetland type rather than a wetland loss or gain. The acres of wetland gain, loss and change of type were tabulated for all sample plots. To extrapolate the results statewide, the area of the measured changes in each plot was first normalized by dividing by the plot size. We then calculated the mean of these normalized proportional changes and multiplied this by the area of the state. Since the program started in 2006, a key change in methods has involved the transition from aerial photographs to digital aerial images; the methods used to interpret and track changes in the images over time remains the same.

Data Source

The data for this measure are maintained by the agencies participating in the WSTMP effort; the wetland quantity database is maintained by the DNR.

Data Collection Period

The WSTMP began in 2006 and the first statewide assessment was completed in 2008; T1 (2006 – 2008) represents the baseline period. Data collection and analysis for the initial assessment interval (T2: 2009 – 2011) has been completed.

Data Collection Methodology and Frequency

The following three reports published by the DNR contain more thorough descriptions of data collection methodology:

- Status and Trends of Wetlands in Minnesota: Wetland Quantity Trends from 2006 to 2011
- Status and Trends of Wetlands in Minnesota: Wetland Quantity Baseline
- Technical Procedures for the Minnesota Wetland Status and Trends Monitoring Program

Supporting Data Set

Extrapolating the baseline assessment of wetland coverage to a statewide value generate an estimate of 10.62 million acres, a big number. Because the change in wetland acreage between assessment intervals is likely to be small in comparison to the statewide total, the data at for subsequent time periods are reported as gains or losses from 10.62 million acres.

Time Period	Statewide Gain/Loss from Baseline (Acres)
T1- Baseline (2006 – 2008)	----
T2 (2009 – 2011)	2080

Caveats and Limitations

See discussion section (p. 14) in the first the three DNR reports cited above, *Status and Trends of Wetlands in Minnesota: Wetland Quantity Trends from 2006 to 2011*, (2013), that discuss challenges of determining long-term changes in the status of various types of wetlands from a series of aerial photos.

Other Measure Connections

Wetland coverage is one of three land-use changes being tracked to examine how external drivers may impact Minnesota's ability to achieve its Clean Water and Drinking Waters goals and is meant to be viewed in concert with measures in the population change and climate change categories. Tracking external drivers will also help Clean Water partners adapt their actions over time, enhancing water quality and drinking water outcomes.

Measure Points of Contact

Agency Information

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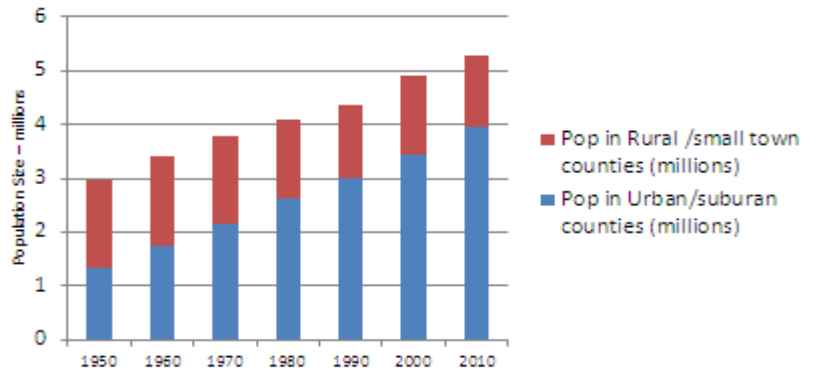
Demographic Changes – Population Size & Proportion Urban/Suburban

Measure Background

Visual Depiction



Change in Minnesota's population and urban/suburban vs. rural distribution since 1950

Measure Description

People are the cause of most of the water quality problems in Minnesota. As a result, as the population size of the state increases, the challenge associated with obtaining and maintaining good water quality in the state's lakes, rivers, and wetlands is likely to rise. In addition to population size, where people live, how they use the state's land and water resources, (see Land-use External Drivers above), and their expectations about resource protection/resource use will influence the success of Clean Water investments. Many aspects of how Minnesota's population is changing over time are tracked by the US Census Bureau. This measure reports on the following two demographic attributes: 1) population size and 2) urban/suburban vs. rural residents. The attributes are paired (see graph above) to reflect to how the state's population is growing and becoming more urban/suburban.

Associated Terms and Phrases

Demographics: Relating to the dynamic balance of a population especially with regard to density and capacity for expansion or decline of time

Urban vs. Rural: For many years the Census Bureau's official urban vs. rural definition was dichotomous: places of 2,500 or more residents were considered urban, and those with fewer were

considered rural. These historical data are looking at the unit of the incorporated place, and then basically counting up heads. However, the Census' more modern definition of Urban Areas/Urban Clusters/Rural applies both a resident-based definition (UAs=50,000 people or more, UCs=2,500-49,999, and Rural=less than 2,499) in addition to examining the density of development at the tract or block level, so it is a much refined method. Thus, for example, a defined "urban cluster" that is home to 30,000 residents in the Census count may only count 25,000 of them as living in the UC if some live in low-density areas (that are still part of the incorporated place). Here's a map showing Urbanized Areas and Urban Clusters.

Target

There is no target associated with this measure

Baseline

Information on the size of Minnesota's population was obtained from U.S. Census Bureau, Decennial Census and U.S. Census, American Community Survey data as compiled by Minnesota Compass (www.mncompass.org). Minnesota Compass has chosen to use 1950 of the baseline for the demographic data report on their site and that convention was followed. Using 1950 as a baseline with census data allows multiple data points prior to the present to be shown which helps identify trends that are occurring over time and identify whether population-related stressors may be increasing or decreasing in importance.

Information on the proportion of Minnesotan's living in urban counties was provided the by the State Demographer. The Demographer's office provided table showing the share of Minnesota's state population that lived in counties defined as part of a metropolitan statistical area (MSA) each decade from 1950 to 2010. This somewhat blunt unit measure for defining urban or rural is the county, and the counties comprising each MSA changed over time as population centers grow. By this definition, in 2010, 75% of MN residents lived in urban areas, while the remaining 25% lived in rural areas. While not the most accurate measure for defining the proportion of Minnesotan's that are urban vs. rural, it is helpful because of the long time trend.

A similar urban vs. rural split was used in a recent report from the U.S. Dept of Agriculture, "Rural America at a Glance 2012" <http://www.ers.usda.gov/media/965908/eb-21_single_pages.pdf.

Geographical Coverage

Statewide

Data and Methodology

Methodology for Measure Calculation

Data Source

U.S Census Bureau, Decennial Census http://factfinder2.census.gov/main.html and U.S. Census Bureau, Population Estimates http://www.census.gov/popest/ as compiled and report at www.mncompass.org/demographics/ or as compiled by the State Demographer's Office.

Data Collection Period

1950 to the present, in ten year increments, a pattern that reflects the frequency of the U.S. Census and the format of demographic data present by Minnesota Compass.

Data Collection Methodology and Frequency

See www.mncompass.org/demographics/ and other resources linked to that site; also see U.S. Dept of Agriculture, "Rural America at a Glance 2012" http://www.ers.usda.gov/media/965908/eb-21_single_pages.pdf.

Supporting Data Set

Year	Population Size (millions)	Population in Urban/Suburban Counties (millions)
1950	2.98	1.32
1960	3.41	1.75
1970	3.80	2.16
1980	4.08	2.64
1990	4.38	3.00
2000	4.92	3.46
2010	5.30	3.99

Caveats and Limitations

See www.mncompass.org/demographics/ for a discussion of the caveats and limitations associated with the data represented in this measure.

Other Measure Connections

Population size and proportion urban/suburban are two demographic changes being tracked to examine how external drivers may impact Minnesota's ability to achieve its Clean Water and Drinking Waters goals and is meant to be viewed in concert with measures in the land-use and climate change categories. Tracking external drivers will also help Clean Water partners adapt their actions over time, enhancing water quality and drinking water outcomes.

Measure Points of Contact

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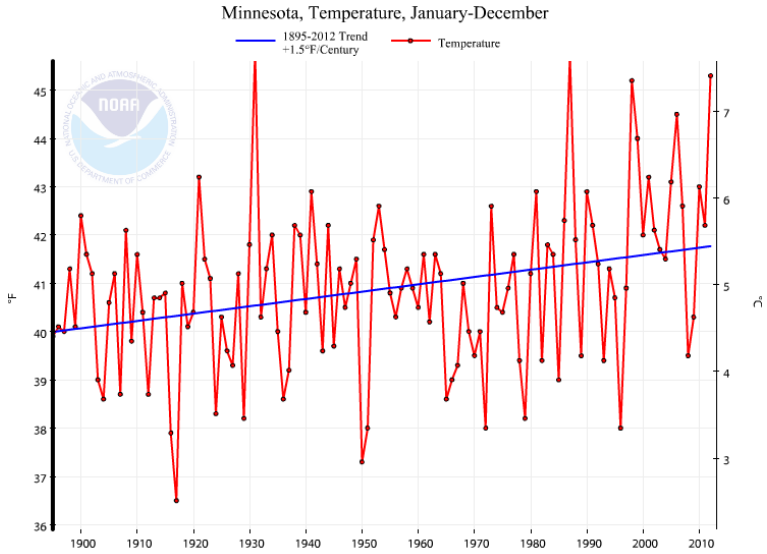
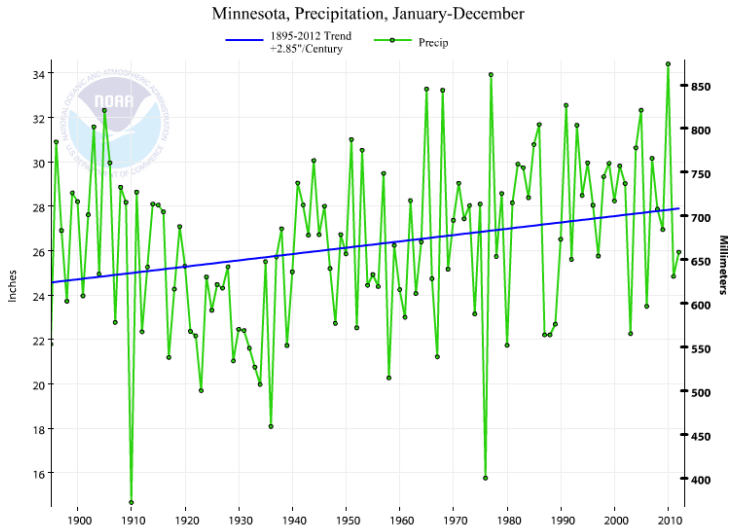
Climate Changes – Average Annual Temperature and Precipitation in Minnesota

Measure Background

Visual Depiction





Measure Description

Data collected from many sources is suggesting that the amount of variability associated with climate patterns in Minnesota as well as the movement of water through various parts of hydrologic cycle is increasing. Because these changes may impact Minnesota's ability to achieve its clean water goals,

understanding how climate and hydrologic variability is increasing, how those changes will alter how water and pollutants move between terrestrial and aquatic systems, and identifying adjustments that may be necessary to identified clean water protection and restoration strategies will be critical. This measure highlights one measure related to temperature, average annual temperature, and one measure related to precipitation, average annual precipitation, from among the multiple options available.

Associated Terms and Phrases

Climate patterns – A climate pattern is any recurring characteristic of the climate. Climate patterns can last tens of thousands of years, like the glacial and interglacial periods within ice ages, or repeat each year, like monsoons. A climate pattern may come in the form of a regular cycle, like the diurnal cycle or the seasonal cycle; a quasi-periodic event, like El Niño; or a highly irregular event, such as a volcanic winter. The regular cycles are generally well understood and may be removed by normalization. (Wikipedia)

Hydrologic cycle – The hydrologic cycle describes the continuous movement of water on, above and below the surface of the Earth. Although the balance of water on Earth remains fairly constant over time, individual water molecules can come and go, in and out of the atmosphere. The water moves from one reservoir to another, such as from river to ocean, or from the ocean to the atmosphere, by the physical processes of evaporation, condensation, precipitation, infiltration, runoff, and subsurface flow. In so doing, the water goes through different phases: liquid, solid (ice), and gas (vapor). Adapted from Wikipedia.

Target
There is no target associated with this measure

Baseline
There is no baseline associated with the long-term changes in average annual temperature and precipitation in MN.

Geographical Coverage
Statewide

Data and Methodology

Methodology for Measure Calculation

Data Source
The Minnesota Department of Natural Resources (MNDNR) State Climatology Office (http://www.dnr.state.mn.us/waters/groundwater_section/climatology/index.html) exists to gather, archive, manage, and disseminate historical climate data in order to address questions involving the impact of climate on Minnesota and its citizens.

In order to provide its services, the MNDNR State Climatology Office (SCO) requires an extensive historical climate data set. The SCO utilizes data managed locally, as well as data administered by national climate monitoring efforts.

National Weather Service Cooperative Observer Network

The National Weather Service (formerly the U.S. Weather Bureau) has maintained a large-scale, volunteer-based climate monitoring network in Minnesota since 1890. National Weather Service volunteers make daily measurements of maximum and minimum temperature, rainfall, snowfall, and snow depth. There are approximately 150 National Weather Service volunteers presently active in Minnesota. The data set is managed by the National Climate Data Center and their partner Regional Climate Centers. Historical time-trends of statewide and regional data can be viewed at http://www.ncdc.noaa.gov/cag. Access to daily data is accomplished via http://xmacis.rcc-acis.org.

MNGage

The MNGage data base features data collected by Minnesota's unique high spatial density precipitation monitoring program. The program was formed in the early 1970s to fill in geographic gaps between National Weather Service reporting locations. The program is made up of a "network of networks", utilizing the efforts of water-oriented state and local agencies to assemble daily precipitation data collected by approximately 1500 volunteer precipitation observers. Cooperating agencies include: Soil and Water Conservation Districts, Watershed Districts, DNR Forestry, and others. The cooperating agencies recruit volunteers, distribute monitoring equipment, distribute monitoring forms and instruction, and assure that the data are delivered to the SCO. In turn, the SCO provides cooperators with rain gauges, guidance regarding network management, value-added data analysis, and a variety of on-line tools which allow the agencies to enter, manage, and retrieve precipitation data. The precipitation data base managed by the SCO (see: http://climate.umn.edu/mngage).

CoCoRaHS

CoCoRaHS is an acronym for the Community Collaborative Rain, Hail and Snow Network. CoCoRaHS is a national, non-profit, community-based network of volunteers working together to measure and map precipitation. The program utilizes low-cost measurement tools, stresses training and education, and utilizes an interactive Web-site for data entry and retrieval. Volunteers report daily measurements of rainfall, snowfall, snow depth and hail. Over 2000 Minnesotans have participated in CoCoRaHS since its Minnesota debut in late 2009. The data set is managed by the CoCoRaHS organization and can be accessed at http://www.cocorahs.org.

Data Collection Period

The measures related to long-term changes in Minnesota's average annual temperature and precipitation cover the period 1895 – 2009.

Data Collection Methodology and Frequency

Details about the specific data collection methodologies and frequencies involved to tracking long-term average annual temperature and precipitation patterns for Minnesota are available by contacting the MN Department of Natural Resources State Climatology Office (http://www.dnr.state.mn.us/waters/groundwater_section/climatology/index.html).

Other Measure Connections

Average annual temperature and average annual precipitation are two climate changes being tracked to examine how external drivers may impact Minnesota's ability to achieve its Clean Water and Drinking Waters goals and is meant to be viewed in concert with measures in the land-use and demographic change categories. Tracking external drivers will also help Clean Water partners adapt their actions over time, enhancing water quality and drinking water outcomes.

Measure Points of Contact

Agency Information

MN Department of Natural Resources State Climatology Office (http://www.dnr.state.mn.us/waters/groundwater_section/climatology/index.html).